

7 Herring in Division 7.a North (Irish Sea)

The stock was benchmarked in 2017 and a state-space assessment model, SAM, was proposed as the assessment model for the stock (WKIRISH, 2017).

The WG notes 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 the report. 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 such as this one, there is a difference of one year between “age” and “rings”. Further elaboration on the rationale behind this, specific to each stock, can be found in the individual Stock Annexes. It is the responsibility of any user of age based data for any of these herring stocks to consult the relevant annex and if in doubt consult a relevant member of the Working Group.

7.1 The Fishery

7.1.1 Advice and management applicable to 2020 & 2021

ICES advised that when the MSY approach is applied, catches in 2020 should be no more than 8064 tonnes. ICES advised that when the MSY approach is applied, catches in 2021 should be no more than 7341 tonnes.

7.1.2 The fishery in 2020

The catches reported from each country for the period 1987 to 2020 are given in Table 7.1.1, and total catches from 1961 to 2020 in Figure 7.1.1. Reported international landings in 2020 for the Irish Sea amounted to 7927 t with UK vessels acquiring the majority of the quota through swaps with the Republic of Ireland. The majority of catches in 2020 were taken during the 3rd quarter, with landings also made in quarter 4.

As in previous years the 2020 7.a (N) herring fishery began in late August, with catches taken to the north-west of the Isle of Man, before moving to the Douglas Bank. The majority of catches were taken by a UK pair-trawlers and by midwater pelagic fishing vessels from Ireland. In previous years a ‘Mourne’ fishery, limited to boats under 40 ft usually in October and November, this fishery landed 33 t in 2020.

7.1.3 Regulations and their effects

Closed areas for herring fishing in the Irish Sea along the east coast of Ireland and within 12 nautical miles of the west coast of Britain were maintained throughout the year. The traditional gillnet fishery on the Mourne herring has a derogation to fish within the Irish closed box. The area to the east of the Isle of Man, encompassing the Douglas Bank spawning ground (described in ICES 2001, ACFM:10), was closed from 21 September to 15 November. Boats from the Republic of Ireland are not permitted to fish east of the Isle of Man.

The arrangement of closed areas in Division 7.a(N) prior to 1999 is discussed in detail in ICES (1996/ACFM:10) with a change to the closed area to the east of the Isle of Man being altered in 1999 (ICES 2001/ACFM:10). The closed areas consist of: all year juvenile closures along part of the east coast of Ireland, and the west coast of Scotland, England and Wales; spawning closures

along the east coast of the Isle of Man from 21 September to 15 November, and along the east coast of Ireland all year-round. In 2020 these restrictions were no longer in place due to the changes within the EU Technical Regulations (EU) 2019/1241, however, national licensing measures still restrict vessels from fishing in some areas and seasons.

7.1.4 Changes in fishing technology and fishing patterns

UK Northern Irish and Irish pelagic pair and single trawlers take the majority of catches during the 3rd and 4th quarters. A small local fishery continues to record landings on the traditional Mourne herring grounds during the 3rd or 4th quarter. This fishery resumed in 2006 and has seen increasing catches of herring since, peaking at ~171 t in 2009, there was less than 10 t landings attributed to this fishery in 2018, no catches in 2019 and 33 t in 2020. Recently there has been a marked increase in the landings made by Irish vessels comprising 19% of the landings in 2018, 21% in 2019 and 27% in 2020 compared to an average of 2% during 2015 - 2017.

7.2 Biological Composition of the Catch

7.2.1 Catch in numbers

Routine sampling of the main catch component was conducted in 2020. Sampling was carried out on landings at fish processing factories for both Irish, Northern Irish vessels and UK English vessels. There was no biological sampling of the main catch component (pair trawlers) in 2009 due to a failure to acquire samples from the landings. Catches in numbers-at-age are given in Table 7.6.3.1 for the years 1972 to 2020 and a graphical representation is given in Figure 7.2.1. The catch in numbers at length is given in Table 7.2.2 for 1995 to 2020, excluding 2009.

7.2.2 Quality of catch and biological data

The number of samples acquired from the main catch component was 26 in 2020, which are similar sampling levels than has been achieved in the past. The number of measurements also remained similar to past sampling levels. At sea observer data have been collected since 2010 (~15% of fishing trips sampled annually) with no discards observed. In 2020 at-sea observations were not carried out due to the Covid-19 'social distancing' requirements. Discarding is not thought to be a feature of this fishery. Details of sampling are given in Table 7.2.3.

As a result of quality issues identified with the ageing of herring in the Irish Sea, a larger scale otolith exchange was completed in 2015. The results indicated relatively good agreement between ages and a consistent issue with inexperienced readers that can be solved through further training.

The 2017 benchmark concluded to conduct future assessments only to include data back to 1980. Data extends back to 1961 and the entire data series was included in the assessment up to 2016, but there are well documented concerns over the quality of historic landings information, especially in the 1970s (see Stock Annex). Recent landings data, particularly since the introduction of buyers and sellers regulation in 2006, are considered to be of good quality.

7.3 Fishery Independent Information

7.3.1 Acoustic surveys AC(7.aN)

The information on the time-series of acoustic surveys in the Irish Sea is given in Table 7.3.1. The SSB estimates from the survey are calculated using the (annually varying) maturity ogives from the commercial catch data.

The acoustic survey in 2020 was carried out over the period 26 August–9 September. The survey conditions were good. A survey design of stratified, systematic transects was employed, as in previous years (Figure 7.3.1). Sprat and 0-group herring were distributed around the periphery of the Irish Sea (Figure 7.3.1). Highest abundance of 1+ herring targets in 2020 were observed on the western sides of the Isle of Man (Figure 7.3.1). Local areas of high abundance of herring were also observed on the known spawning banks toward the county Down coast. The survey followed the methods described in the ICES WGIPS International Pelagic Survey Manual. Sampling intensity was high during the 2020 survey with 34 successful trawls completed. The length frequencies generated from these trawls highlight the spatial heterogeneous nature of herring age groups in the Irish Sea (Figure 7.3.2).

The age-disaggregated acoustic estimates of the herring abundance, excluding 0-ring fish, are given in Table 7.3.2. Results of a microstructure analysis of 1-ringer+ fish (Figure 7.3.6–7) have not been updated since 2011. Winter hatched fish, of which the majority are thought to be of Celtic Sea origin, are present in the prespawning aggregations sampled in the Irish Sea during the acoustic survey. The presence of these winter hatched fish has implications for the estimates of 1-ringer+ biomass and SSB, as well as confounding traditional cohort type assessment methods. However, removal of winter hatched fish, leaving only fish of autumn spawning origin, does not change the perception of a significant increase in biomass estimates (Figures 7.3.6–7). The benchmark working group (ICES WKPELA 2012) investigated the mixing issue and its impact on the assessment. The benchmark group concluded that the data should be treated as for a mixed stock. Both the fishery and survey operate on this mixture and by using the data without adjustment for winter hatched fish, the assessment is conducted on the mixed stock. The recruitment data (1 winter rings) have the largest proportion of “alien” stock. The benchmark suggested that this is considered in the assessment model configuration and dealt with objectively within the model.

7.3.2 Spawning-stock biomass survey (7.aNSpawn)

A series of additional acoustic surveys has been conducted since 2007 by Northern Ireland, following the annual pelagic acoustic survey (conducted during the beginning of September). The enhanced survey programme was initiated to investigate the temporal and spatial variability of the population estimates from the routine acoustic survey. The purpose was to track the spawning migration entering into the Irish Sea via the North Channel on route to the main spawning grounds of the Douglas Bank. The survey only concentrates on the spawning grounds surrounding the Isle of Man and the Scottish coastal waters (Figure 7.3.4). Herring found in this area represents >75% of the SSB index generated from the routine survey. In 2020 the survey was conducted during the 5th to 8th of October. This is the latest the survey has been carried out a delay of around 5 days compared to previous year. The predominant maturity stage of herring sampled during the survey were spent compared to maturing and ripe fish in other years. The spawning biomass to be 47.9kt, this is a small increase from 2019 (44.3kt) and within the previously observed range (28.4 – 114.0kt).

The density historic distributions from the surveys highlight the temporal and spatial complexity of the herring distributions. Problems with timing of the survey are further exacerbated by the significant interannual variation in the migration patterns, evident from the changes in density distributions. The results confirm the high estimate of abundance observed during the routine annual acoustic survey estimates. The survey results support the high abundance of herring in the Irish Sea. Since 2012 this extended survey series has been reduced to one repeat survey in late September to coincide with the main spawning time. The primary aim to generate an SSB index constituted from herring on or around the Irish Sea spawning ground to eliminate some of the age and mixing issues.

The 2012 benchmark (ICES WKPELA 2012) also suggested that the survey series could be used to fine tune the main survey used as the tuning fleet in the assessment. The survey uses a stratified design similar to the AC(7.a.N). Survey methodology, data processing and subsequent analysis is exactly the same as for AC(7.a.N) and follows standard protocols for surveys coordinated by WGIPS. The survey was presented to WGIPS in 2017 prior to inclusion into the benchmark. The results of the survey are reported in the WGIPS 2018 report (ICES, 2018). The survey is included in the assessment as a SSB index. A comparison with the SSB estimates from this survey and the acoustic survey that is conducted earlier confirms the high abundance of herring in the Irish Sea, but with some clear year effect (Figure 7.3.5). This index is generated from a survey where the timing mostly coinciding with the spawners being present on the Douglas Bank. The survey has been conducted on a chartered commercial vessel since 2007, timing of the survey is directed by input from the commercial fishery reporting movements of fish onto the spawning grounds.

7.4 Mean weight, maturity and natural mortality-at-age

Biological sampling in 2020 was used to calculate mean weights-at-age in the catch (Table 7.6.3.2). The mean weights-at-age in the 3rd quarter catches (for the whole time-series 1980 to present) are used as estimates of stock weights at spawning time (Table 7.6.3.3). Mean weights-at-age have shown a general downward trend (Figure 7.4.1). This has also been observed in other stocks. It is recommended that potential drivers for this decline is investigated to explore potential large-scale ecosystem changes. No biological sampling information was available for 2009 and the weights at age for 2009 were replaced by averaging the weight at age observed in 2008 and 2010. The final agreed model from the 2012 benchmark used the natural mortality estimates from the North Sea (Table 7.6.3.4). These were again reviewed at the 2017 benchmark and although not considered ideal it is still the best available in the absence of specific Irish Sea derived natural mortality estimates. A variable maturity ogive is used based on the corresponding annual quarter 3 biological sampling from the catch (Table 7.6.3.5).

7.5 Recruitment

An estimate of total abundance of 0-ringers and 1-ringers is provided by the Northern Ireland acoustic survey, with trends also provided by the groundfish surveys. There is evidence that a proportion of these are of Celtic Sea origin (e.g. Brophy and Danilowicz, 2002). Further, the SAM assessment provides estimates of the recruitment of herring in which information from the catch and from all fishery independent indices is incorporated. The recruitment trends from the assessment are dealt with in Section 7.6.

7.6 Assessment

7.6.1 Data exploration and preliminary modelling

The stock was benchmarked in 2017. The assessment model did not change and was applied without change in 2021. At the benchmark the following changes were made to the input data and model setting:

- The input data series was shortened to include data only from 1980 onwards, to remove poor quality historic data. Mohn's rho was reduced from 13.3 to 9% under shortened time-series, which will improve the basis for advice;
- Minor changes have been made to the variance and parameter bindings, to improve the model fit (see Table 7.6.3.10);
- The random walk assumption on recruitment was removed. Recruitment patterns are now estimated from cohort back-tracking from older ages;
- Includes a new SSB survey index (derived from acoustic methods; see Section 7.3.2). The primary aim is to generate an SSB index constituting mainly herring on or around spawning ground to eliminate some of the age and mixing issues. The larval survey (also an indicator of SSB) was removed as it contributes little to the assessment model. In addition, the modelling framework did not allow from a technical perspective to include two SSB surveys;
- The SSB survey index was included in the assessment without estimating catchability, which effectively implies an assumed catchability of 1, with variance fixed at 0.4 (this corresponded to the observation variance value when catchability was freely estimated in a trial run).

The benchmark accepted the assessment and model settings, but requested further exploration of the sensitivity to catchability assumption for the SSB survey. This was completed post benchmark, however, the reviewers could not reach consensus and proposed that HAWG is best place to propose a final assessment model.

HAWG in 2017 had discussions on the final assessment model that could form the basis for the advice. This process is described in detail in Section 1.9 in the HAWG 2017 report. Despite ongoing concerns over the catchability assumption and the mixing issues from some members, the decision was made to use the SAM assessment settings agreed at the benchmark, together with the catchability assumptions discussed at HAWG, as the final model.

The primary issue with the current perception of stock status of Irish Sea herring is trying to reconcile the SAM model estimates of stock size (primarily driven by catch data) and the much higher estimate of stock size estimates from 9 years of repeat surveys that specifically focused on the spawning population within the Irish Sea. By design, acoustic surveys are aimed to produce an absolute estimate of stock biomass (with some uncertainty). This would result in a catchability of ~1. The previous assessment estimates catchability to be around ~2.5 for the acoustic survey. The benchmark also revealed very significant issues with the catch data, on which the previous assessment and advice is based on.

The concerns from the benchmark were satisfactorily addressed and did not highlight any major issues that could not be explained. In general, the assessment model fit improved in the proposed model where the SSB survey is included at the catchability set to 1. Given that the primary aim is to provide credible scientific advice, the best proposal on this trade-off scenario (neither of which are ideal), is to base the assessment and advice on a more balanced assessment model. HAWG did recognize that this is not an ideal scenario and further work needs to be done in the short term to improve the assessment (see Section 1.9, HAWG 2017)

Acoustic (AC(7.a.N)) 1–8+ winter rings) and the SSB indices are available for the assessment of Irish Sea herring. 2020 catch-at-age data are derived from the international landings. The SAM model fits the catch well, with the model being weighted towards the catch information. The residuals are relatively small (figures 7.6.1–17). The residuals in the numbers-at-age in the catch and acoustic survey generally appear to be independent of time, but there are still some patterns in later years. These patterns are somewhat expected and could be explained by annual changes in migration patterns, magnitude and extent of the mixed component and converging trends in the surveys in recent years. The year effect in the 2011 survey is also evident from these plots with consistent negative residuals at older (3+) ages (winter rings).

The acoustic survey fits reasonably well at all ages except for 1 winter rings. The model fit is poor for SSB survey index (Figure 7.6.17). This is expected considering the catchability assumption, but it also highlights the fact that the model can deviate from the $q=1$ fit and the realized catchability for the survey deviated from one.

Model fit is poor for 1 ringers in the catch and survey, which is the age with the highest occurrence of fish mixing from different hatching seasons. The modelled acoustic survey catchability parameter and the selectivity of the fishery by pentad are illustrated in figures 7.6.18–19. The variability of fishery selection reflects is thought to reflect variable migration patterns and the effect of the spawning closure.

A feature of the assessment model is the estimation of an observation variance parameter for each dataset (Figure 7.6.20). Overall, the catch data (2+ winter ring) are associated with low observation variances, where 1 ringers (from catch and survey) are perceived to be the noisiest data series. Figure 7.6.21 shows observation variance vs. uncertainty of the data sources used in the model. Although the majority of the data sources are associated with relatively high observation variances, none of the uncertainty estimates are particularly high. The CVs do not indicate a lack of convergence of the assessment model.

7.6.2 Final assessment

The final assessment was carried out by fitting the state-space model (SAM, in the FLR environment) using the settings and data inputs in accordance to the stock annex (as decided at the 2017 benchmark and HAWG 2017). The input data and model settings are shown in Tables 7.6.3.1–11, the SAM output is presented in Tables 7.6.3.13–21, the stock summary in Table 7.6.3.12 and Figure 7.6.22, model fit and parameter estimates in Table 7.6.3.22, and negative log-likelihood for the model fit in Table 7.6.3.23.

Diagnostics and selectivity parameters for this run are presented in Figure 7.6.1–19. The stock parameters are estimated well by the model, as indicated by the relatively low uncertainty associated with the stock parameter (Figure 7.6.23), except for the most recent estimates.

The retrospective pattern shows a very similar perception in SSB, F and recruitment for the years 2016–18 (Figure 7.6.24). The retrospective bias from the model is low.

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figure 7.6.25. The stock was benchmarked in 2017, with updates made to the model configurations and input data sources (including a new SSB survey). The new perception of the stock provides biomass estimates more in between the acoustic survey and catch estimates. Recruitment assumptions in the assessment were changed, which resulted in higher interannual variability.

7.6.3 State of the stock

Trends from the final assessment indicate an increase in SSB and recruitment since the mid-2000s, with a stabilizing trend in the most recent years (although uncertain). The associated F has decreased significantly over the last 10 years to below F_{MSY} . Based on the most recent estimates the stock is being harvested sustainably at, or below, F_{MSY} .

7.7 Short-term projections

7.7.1 Deterministic short-term projections

A deterministic short-term forecast was conducted for Irish Sea herring with code in R software. Population abundances, F at age and input data were taken from the final SAM assessment, 1980–2020 (Table 7.7.1). Geometric mean recruitment of 1-ringers (2009–2018) replaced recruitment for 1-ringers in 2020 and is used as the intermediate year assumption. The forecast was based on catches (2021 advice = 7341 t) assuming full uptake of the ICES fishing opportunity advice. Fishing mortality, maturity-at-age, catch weights at age and stock weights were averaged over the most recent three years. Fishing mortality was not scaled to the last year, as the terminal estimate of F was not considered more informative.

The short-term catch option table is given in Table 7.7.2. SSB is expected to be well above MSY $B_{trigger}$ in 2021–2023, but is predicted to decrease if fishing at F_{MSY} . SSB with zero catch is forecast to increase (+10.2%). This is largely in response to maturation of the 2020 year class, which will contribute more than 32% of the SSB in 2022.

7.7.2 Yield per recruit

Not available, previous explorations are detailed in the stock annex.

7.8 Medium term projections

No medium term stock projections of stock size were conducted by the Working Group.

7.9 Reference points

MSY evaluations

New reference points were derived using the stock-recruit pairs generated by the 2017 assessment (WKIRISH3 and HAWG 2017). B_{lim} was set to the lowest SSB that generate above average recruitment, 8500 t. B_{pa} , 11 800 t calculated from B_{lim} with assessment error ($\sigma = 0.201$, based on the average CV from the terminal assessment year) MSY $B_{trigger}$ is set to B_{pa} as the stock has not been fished at or below F_{MSY} for more than five years. F_{MSY} median point estimates is 0.27 (0.266). The upper bound of the F_{MSY} range giving at least 95% of the maximum yield was estimated to 0.35(0.345) and the lower bound at 0.20(0.198). F_{lim} is estimated to be 0.40 (0.397) as F with 50% probability of $SSB < B_{lim}$ with F_{pa} was modified to F_{p05} as 0.309 calculated as the F that leads to $SSB \geq B_{lim}$ with 95% probability.

7.10 Quality of the assessment

The data used within the assessment, the assessment methods and settings were scrutinized during the 2017 benchmark (WKIRISH3 2017). The benchmark group performed sensitivity tests to

test model configurations and optimized the model fit to the data with the least amount of parameters estimated. The Working Group checked for convergence and judged that a good model fit was found. FLSAM will not run if convergence criteria are not achieved.

The stock is very well sampled and catch information is representative of the fishery (with the exception of 2009 when no samples were provided). The current assessment, being a time-series model, can estimate the missing catch numbers in 2009.

The main issues with the stock are stock mixing (at younger ages from fish of different spawning season origin) and the different trends in mortality observed in the survey and the commercial catches. The majority of this variation may arise from the inter-annual variation in herring migration patterns and their effect on the selectivity of both the fishery and acoustic survey, but is also affected by the effect the annual closure of the Douglas Bank spawning grounds has on the fishery patterns. There are some inconsistencies between observed and modelled landings. The magnitude of these differs between years, but is on average $\pm 12\%$ over the assessment period and mostly falls within the confidence limits of the estimate. The reason behind these needs further investigation, but might be due to conflicting mortality signals from the surveys and catches and the use of a constant M throughout the time-series.

The data are treated as for a mixed stock. Both the fishery and survey operate on this mixture and by using the data without adjustment for winter hatched fish, the assessment is conducted on the mixed stock. The mixing issue was considered in detail during the 2012 benchmark, but no further analysis was performed at the 2017 benchmark given that there was no new information presented. The noise in the data due to juvenile stock mixing resulted in increased estimates of F , catchability estimates >1 across the younger ages in the survey, or most likely a combination of these. Most of the mixing occurs at younger ages, and this is objectively, but only partially, corrected for in the model through a high catchability (3) estimated for the acoustic survey. Currently, the model doesn't have the structure to specifically deal with the emigration of small herring from other stocks.

The F_{bar} range 4–6 is considered representative of the mortality on the autumn spawning stock in the Irish Sea, excluding most the ages with significant mixed components.

The survey data quality is good, but the survey index is variable linked to the migration and biological characteristics of the stock and the need to assess similar stock components which the fishery exploits to ensure the sustainable exploitation of the Irish Sea spawning stock.

No major validations of the assumption underpinning the assessment model were found. The final assessment model is dominated by information from the catch, but with the noise being added to the survey information as age and year effects. The model does fit the catch data significantly better despite the significant quality issues with the catch data reported at the 2017 benchmark. This is not desirable. The new survey information adds more weight to the previously observed increase abundance trend observed from the main age-disaggregated acoustic survey. The 2017 assessment model attempted to provide a more balanced model, giving more weight to the SSB survey.

SAM down weights the 1 ring data and survey information in general. The uncertainty estimates of the model parameters, suggest the model is both appropriate for the available data and that the model describes these data reasonably well. Whilst, the trend in fishing mortality is estimated to be stable the historic comparison of the current assessment with previous assessments shows an annual upward revision of fishing mortality.

In 2020 the Spawning Stock Biomass survey was delayed (9 days compared to 2019) due to the impact of Covid-19 restrictions, this delay was considered to not have a negative effect on the quality of the assessment.

7.11 Management considerations

Given the historical landings from this stock and the knowledge that fishing pressure is light and mostly confined to one pair of UK vessels it can be assumed that fishing pressure and activity has not varied considerably in recent years. The catches have been close to TAC levels and the main fishing activity has not varied considerably as shown from landing data (Figure 7.1.1).

The current assessment and forecast indicate SSB to be the highest in the time-series and fishing mortalities below F_{MSY} . The Working Group supports the development of a long-term management plan for this stock. Such a plan should be further developed with stakeholders and forwarded to ICES for evaluation.

Characteristically of most herring stocks, the Irish Sea herring represents a mixture and management of this stock should be considered as part of a metapopulation. The consequence of this needs to be further evaluated for management and advice.

7.12 Ecosystem Considerations

No additional information presented (see Stock Annex).

Table 7.1.1 Herring in Division 7.a North (Irish Sea). Working Group catch estimates in tonnes by country, 1987–2020. The total catch does not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995
Ireland	1 200	2 579	1 430	1 699	80	406	0	0	0
UK	3 290	7 593	3 532	4 613	4 318	4 864	4 408	4 828	5 076
Unallocated	1 333	-	-	-	-	-	-	-	-
Total	5 823	10 172	4 962	6 312	4 398	5 270	4 408	4 828	5 076

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004
Ireland	100	0	0	0	0	862	286	0	749
UK	5 180	6 651	4 905	4 127	2 002	4 599	2 107	2 399	1 782
Unallocated	22	-	-	-	-	-	-	-	-
Total	5 302	6 651	4 905	4 127	2 002	5 461	2 393	2 399	2 531

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ireland	1 153	581	0	0	0	0	0	18	0
UK	3 234	3821	4 629	4895	4594	4894	5202	5675	4828
Unallocated	-	-	-	-	-	-	-	-	-
Total	4 387	4 402	4 629	4895	4594	4894	5202	5693	4828

Country	2014	2015	2016	2017	2018	2019	2020
Ireland	119	0	82	200	1299	1317	1957
UK	5089	4868	4245	3696	5504	5061	5969
Unallocated	-	22	-	-	-	-	-
Total	5208	4891	4327	3896	6804	6378	7927

Table 7.2.2 Herring in Division 7.a North (Irish Sea). Catch at length data 1995–2020. Numbers of fish in thousands. Table amended with 1990–1994 year-classes removed (see Annex 8).

Length (cm)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
14															-					-				16		
14.5															-					-				0	11	
15															-					15				31	50	11
15.5					10							16			-	93				14				54	74	
16	21	21	17		19	12	9				2				-	107	30		8	0		109		47	233	
16.5	55	51	94		53	49	27			13	1	44	33	1	-	487	165		84	14		174		176	401	106
17	139	127	281	26	97	67	53			25	39	140	69	3	-	764	356	89	202	213	16	261	86	431	883	428
17.5	148	200	525	30	82	97	105			84	117	211	286	11	-	1155	851	143	470	808	32	413	62	749	1170	1250
18	300	173	1022	123	145	115	229			102	291	586	852	34	-	1574	1406	301	533	1644	72	326	148	594	1532	1934
18.5	280	415	1066	206	135	134	240	36		114	521	726	2088	64	-	1405	841	533	555	3246	64	457	148	1097	1346	2913
19	310	554	1720	317	234	164	385	18		203	758	895	2979	85	-	866	1029	479	588	5357	136	522	234	841	1051	2832
19.5	305	652	1263	277	82	97	439	0	29	269	933	1246	3527	108	-	673	1026	493	680	5371	199	718	382	928	1331	1996
20	326	749	1366	427	218	109	523	0	73	368	943	984	3516	100	-	787	1062	298	1041	4025	271	826	1121	1608	1585	2438
20.5	404	867	1029	297	242	85	608	18	215	444	923	1443	2852	133	-	888	1502	511	1419	2905	279	1087	1343	1881	2263	2857

Length (cm)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
21	468	886	1510	522	449	115	1086	307	272	862	1256	1521	3451	192	-	1470	1874	643	2364	2608	439	1783	3154	3352	2716	3624
21.5	782	1258	1192	549	362	138	1201	433	290	1007	1380	1621	2929	217	-	1758	1396	1104	2963	2381	854	1762	3007	3838	3340	5419

Length (cm)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
22	1509	1530	2607	1354	1261	289	1748	1750	463	1495	1361	2748	3821	271	-	2363	2372	1586	3052	2906	1896	2588	4374	5232	4676	6 594
22.5	2541	2190	2482	1099	2305	418	1763	1949	600	2140	1448	3629	3503	229	-	3362	2778	2404	3599	2766	2028	2675	2711	6046	4289	7 828
23	4198	2362	3508	2493	4784	607	2670	2490	1158	2089	1035	4358	4196	322	-	4530	4100	3920	3432	2596	2470	2893	3475	7485	4476	7 872
23.5	4547	2917	3902	2041	4183	951	2254	1552	1380	2214	1256	2920	3697	264	-	5232	3394	6024	3039	1775	1977	3110	2625	6404	3745	7 378
24	4416	3649	4714	3695	4165	1436	3489	1029	1273	2054	1276	3679	3178	259	-	4559	4759	8849	3882	2161	2124	2849	2649	6912	4841	6 065
24.5	3391	4077	4138	2769	3397	1783	4098	758	1249	2269	1083	2431	2136	204	-	3616	3729	7777	3985	1879	1911	2523	2144	4992	5033	5 004
25	3100	4015	5031	2625	2620	2144	5566	776	1163	1749	1086	3438	1503	148	-	3083	3430	7020	3364	2282	2367	2414	2378	4462	3713	3 362
25.5	2358	3668	3971	2797	1817	1791	4785	1335	1211	1206	584	2198	952	114	-	2582	2662	5759	2693	2264	2319	2458	1824	2632	2079	3 102
26	2334	2480	3871	3115	1694	1349	3814	1570	1140	823	438	1714	643	78	-	1777	2343	4835	1934	1612	1962	1936	1331	1455	1401	1 945
26.5	1807	2177	2455	2641	1547	840	2243	1552	1573	587	203	605	330	42	-	950	1595	2664	1026	900	1016	1631	739	798	421	900

Length (cm)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	2010	2011	2012	2013	2014	2015	2016		2017	2018	2019	2020
27	1622	1949	1711	2992	1475	616	1489	776	1607	510	165	445	147	23	-	460	1083	1716	412	498	827	826	370		458	210	342
27.5	990	1267	1131	1747	867	479	644	433	1189	383	60	155	72	10	-	216	472	629	179	326	252	283	123		198	41	119
28	834	906	638	1235	276	212	496	162	726	198	45	104	33	12	-	9	248	231	85	256	141	65	37		104	52	29
28.5	123	564	440	170	169	58	179	108	569	51	18	9	26	1	-		53	159	28	156	48	65	12		0	11	80
29	248	210	280	111	61	42	10	36	163		12	46			-	9		108		57	16	22	25		16		
29.5	56	79	59	92		12	0	36	129				7		-			54		14	8		12		0		
30	40	32	8	84		6	9		43						-			17		0	8						

Table 7.2.3 Herring in Division 7.a North (Irish Sea). Sampling intensity of commercial landings in 2020.

Quarter	Country	Landings (t)	No. samples	No. fish measured	No. fish aged
1	Ireland	0	-	-	-
	UK (N. Ireland)	0	-	-	-
	UK (Isle of Man)	*	-	-	-
	UK (Scotland)	0	-	-	-
	UK (England & Wales)	0	-	-	-
2	Ireland	0	-	-	-
	UK (N. Ireland)	0	-	-	-
	UK (Isle of Man)	*	-	-	-
	UK (Scotland)	0	-	-	-
	UK (England & Wales)	0	-	-	-
3	Ireland	722	3	1225	150
	UK (N. Ireland)	5571	18	2181	826
	UK (Isle of Man)	*	-	-	-
	UK (Scotland)	0	-	-	-
	UK (England & Wales)	0	0	0	0
4	Ireland	1235	4	1060	200
	UK (N. Ireland)	398	1	143	50
	UK (Isle of Man)	*	-	-	-
	UK (Scotland)	0	-	-	-
	UK (England & Wales)	0	-	-	-

* no information, but catch is likely to be negligible

Table 7.3.1 Herring in Division 7.a North (Irish Sea). Summary of acoustic survey AC(7.aN) information for the period 1989–2020. Small clupeoids include sprat and 0-ring herring unless otherwise stated. CVs are approximate. Biomass in t. All surveys carried out at 38 kHz except December 1996, which was at 120 kHz.

Year	Area	Dates	herring bio- mass (1+rings)	CV	herring biomass (SSB)	CV	small clupeoids (biomass)	CV
1989	Douglas Bank	25/09– 26/09			18 000	-	-	-
1990	Douglas Bank	26/09– 27/09			26 600	-	-	-
1991	W. Irish Sea	26/07– 8/08	12 760	0.23			66 0001	0.20
1992	W. Irish Sea + IOM E. coast	20/07– 31/07	17 490	0.19			43 200	0.25
1994	Area 7.a(N)	28/08– 8/09	31 400	0.36	25 133	-	68 600	0.10
	Douglas Bank	22/09– 26/09			28 200	-	-	-
1995	Area 7.a(N)	11/09– 22/09	38 400	0.29	20 167	-	348 600	0.13
	Douglas Bank	10/10– 11/10		-	9 840	-	-	-
	Douglas Bank	23/10– 24/10			1 750	0.51	-	-
1996	Area 7.a(N)	2/09– 12/09	24 500	0.25	21 426	0.25	-2	-
1997	Area 7.a(N)- reduced	8/09– 12/09	20 100	0.28	10 702	0.35	46 600	0.20
1998	Area 7.a(N)	8/09– 14/09	14 500	0.20	9 157	0.18	228 000	0.11
1999	Area 7.a(N)	6/09– 17/09	31 600	0.59	21 040	0.75	272 200	0.10
2000	Area 7.a(N)	11/09– 21/09	40 200	0.26	33 144	0.32	234 700	0.11
2001	Area 7.a(N)	10/09– 18/09	35 400	0.40	13 647	0.42	299 700	0.08
2002	Area 7.a(N)	9/09– 20/09	41 400	0.56	25 102	0.83	413 900	0.09
2003	Area 7.a(N)	7/09– 20/09	49 500	0.22	24 390	0.24	265 900	0.10
2004	Area 7.a(N)	6/09– 10/09	34 437	0.41	21 593	0.41	281 000	0.07

Year	Area	Dates	herring bio- mass (1+rings)	CV	herring biomass (SSB)	CV	small clupeoids (biomass)	CV
		15/09– 16/09 28/09– 29/09						
2005	Area 7.a(N)	29/08– 14/09	36 866	0.37	31 445	0.42	141 900	0.10
2006	Area 7.a(N)	30/08– 9/09	33 136	0.24	16 332	0.22	143 200	0.09
2007	Area 7.a(N)	29/08– 13/09	120 878	0.53	51 819	0.42	204 700	0.09
2008	Area 7.a(N)	27/08– 14/09	106 921	0.22	77 172	0.23	252 300	0.12
2009	Area 7.a(N)	1/09– 13/09	95 989	0.39	71 180	0.47	175 000	0.08
2010	Area 7.a(N)	28/08– 11/09	131 849	0.22	99 877	0.22	107 400	0.10

Year	Area	Dates	herring bio- mass (1+rings)	CV	herring biomass (SSB)	CV	small clupeoids (biomass)	CV
2011	Area 7.a(N)	27/08–10/09 11–12/10	131 527	0.36	49 128	0.22	280 000	0.11
2012	Area 7.a(N)	29/08–12/09	79 051	0.18	56 759	0.22	171 190	0.11
2013	Area 7.a(N)	29/08–12/09	65 649	0.24	55 350	0.25	255 268	0.09
2014	Area 7.a(N)	27/08–14/09	79 826	0.30	56 629	0.33	393 024	0.10
2015	Area 7.a(N)	29/08–17/09	55 773	0.24	29 056	0.23	237 063	0.09
2016	Area 7.a(N)	31/08–15/09	102840	0.25	91332	0.28	240 926	0.10
2017	Area 7.a(N)	28/08–09/09	40974	0.21	36499	0.23	219 186	0.09
2018	Area 7.a(N)	29/08–13/09	54661	0.29	39997	0.31	196 600	0.13
2019	Area 7.a(N)	28/08–13/09	68078	0.09	39318	0.08	146 140	0.08
2020	Area 7.a(N)	26/08–09/09	59645	0.09	40076	0.09	110401	0.10

¹ sprat only

²Data can be made available for the IoM waters only

Table 7.3.2 Herring in Division 7.a North (Irish Sea). Age-disaggregated acoustic estimates (thousands) of herring abundance from the Northern Ireland surveys in September AC(7.aN). Ages in winter rings.

AGE (RINGS)	1	2	3	4	5	6	7	8+
1994	66.8	68.3	73.5	11.9	9.3	7.6	3.9	10.1
1995	319.1	82.3	11.9	29.2	4.6	3.5	4.9	6.9
1996	11.3	42.4	67.5	9	26.5	4.2	5.9	5.8
1997	134.1	50	14.8	11	7.8	4.6	0.6	1.9
1998	110.4	27.3	8.1	9.3	6.5	1.8	2.3	0.8
1999	157.8	77.7	34	5.1	10.3	13.5	1.6	6.3
2000	78.5	103.4	105.3	27.5	8.1	5.4	4.9	2.4
2001	387.6	93.4	10.1	17.5	7.7	1.4	0.6	2.2
2002	391	71.9	31.7	24.8	31.3	14.8	2.8	4.5
2003	349.2	220	32	4.7	3.9	4.1	1	0.9
2004	241	115.5	29.6	15.4	2.1	2.3	0.2	0.2
2005	94.3	109.9	97.1	17	8	0.8	0.6	5.8
2006	374.7	96.6	15.6	10.0	0.5	0.4	0.5	0.5
2007	1316.7	251.3	46.6	21.1	20.8	1.2	0.7	0.6
AGE (RINGS)	1	2	3	4	5	6	7	8+
2008	475.7	452.4	114.2	39.1	26.4	17.1	4.3	0.6
2009	371.2	182.6	177.8	92.7	32.5	15.1	13.9	6.9
2010	580.6	561.2	117.7	120.8	34.3	16.8	4.3	6.5
2011	1927.0	330.2	43.9	15.0	21.9	6.3	2.7	2.0
2012	369.1	191.9	161.0	51.4	21.6	19.3	12.1	3.1
2013	100.0	285.2	81.6	54.3	41.2	13.4	11.1	6.8
2014	299.7	193.3	127.3	29.7	43.1	17.3	7.8	12.5
2015	491.9	141.9	25.2	17.0	10.3	9.0	1.9	4.3
2016	131.5	449.3	257.2	110.2	32.2	18.3	8.2	7.0
2017	42.2	89.7	104.1	56.5	9.0	20.3	4.4	11.8
2018	237.9	120.7	63.3	110.9	29.6	7.6	7.9	5.1
2019	148.9	247.5	44.7	21.2	14.6	9.0	1.8	0.9

AGE (RINGS)	1	2	3	4	5	6	7	8+
2020	247.4	96.7	115.6	16.2	7.8	11.7	2.7	0.9

Table 7.6.3.1. Irish Sea Herring. Catch in number. Units: thousands

age/year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	5840	5050	5100	1305	1168	2429	4491	2225	2607	1156	2313	1999	12145
2	25760	15790	16030	12162	8424	10050	15266	12981	21250	6385	12835	9754	6885
3	19510	3200	5670	5598	7237	17336	7462	6146	13343	12039	5726	6743	6744
4	8520	2790	2150	2820	3841	13287	8550	2998	7159	4708	9697	2833	6690
5	1980	2300	330	445	2221	7206	4528	4180	4610	1876	3598	5068	3256
6	910	330	1110	484	380	2651	3198	2777	5084	1255	1661	1493	5122
7	360	290	140	255	229	667	1464	2328	3232	1559	1042	719	1036
8	230	240	380	59	479	724	877	1671	4213	1956	1615	815	392
year													
age/year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	646	1970	3204	5335	9551	3069	1810	1221	2713	179	694	3225	8692
2	14636	7002	21330	17529	21387	11879	16929	3743	11473	9021	4694	8833	13980
3	3008	12165	3391	9761	7562	3875	5936	5873	7151	1894	3345	5405	10555
4	3017	1826	5269	1160	7341	4450	1566	2065	13050	1866	2559	2161	3287
5	2903	2566	1199	3603	1641	6674	1477	558	3386	2395	882	623	1422
6	1606	2104	1154	780	2281	1030	1989	347	936	953	2945	213	415
7	2181	1278	926	961	840	2049	444	251	650	474	872	673	292
8	848	1991	1452	1364	1432	451	622	147	803	337	605	127	368

age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	5669	20290	8939	NA	9588	7454	2491	3889	27377	1654	2216	2112
2	15253	18291	18974	NA	17627	17598	9664	18916	9567	15414	19064	12844
3	8198	4980	7487	NA	6679	8984	12247	6836	7917	4840	5992	12419
4	6318	1655	2696	NA	6201	3982	7944	6631	1997	7376	4677	4407
5	1325	1062	2082	NA	3200	3671	3061	2901	1759	1613	2050	609
6	605	325	1761	NA	925	1751	3158	1472	964	4276	1421	1065
7	262	122	328	NA	370	690	1591	625	409	1678	896	487
8	246	111	216	NA	185	425	652	352	830	1112	759	623

age	2018	2019	2020
1	7991	12176	15260
2	22903	23112	29059
3	15657	11083	20869
4	12364	6776	4099
5	3240	6661	3355
6	538	1360	3200
7	391	182	777
8	50	194	209

Table 7.6.3.2. Irish Sea Herring. Weights-at-age in the catch. Units: kg

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.074	0.074	0.074	0.074	0.076	0.087	0.068	0.058	0.070	0.081	0.096	0.073
2	0.155	0.155	0.155	0.155	0.142	0.125	0.143	0.130	0.124	0.128	0.140	0.123
3	0.195	0.195	0.195	0.195	0.187	0.157	0.167	0.160	0.160	0.155	0.166	0.155
4	0.219	0.219	0.219	0.219	0.213	0.186	0.188	0.175	0.170	0.174	0.175	0.171
5	0.232	0.232	0.232	0.232	0.221	0.202	0.215	0.194	0.180	0.184	0.187	0.181
6	0.251	0.251	0.251	0.251	0.243	0.209	0.228	0.210	0.198	0.195	0.195	0.190
7	0.258	0.258	0.258	0.258	0.240	0.222	0.239	0.218	0.212	0.205	0.207	0.198
8	0.278	0.278	0.278	0.278	0.273	0.258	0.254	0.229	0.232	0.218	0.218	0.217

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.062	0.089	0.070	0.075	0.067	0.064	0.080	0.069	0.064	0.067	0.085	0.081
2	0.114	0.127	0.123	0.121	0.116	0.118	0.123	0.120	0.120	0.106	0.113	0.116
3	0.140	0.157	0.153	0.146	0.148	0.146	0.148	0.145	0.148	0.139	0.144	0.136
4	0.155	0.171	0.170	0.164	0.162	0.165	0.163	0.167	0.168	0.156	0.167	0.160
5	0.165	0.182	0.180	0.176	0.177	0.176	0.181	0.176	0.188	0.168	0.180	0.167
6	0.174	0.191	0.189	0.181	0.199	0.188	0.177	0.188	0.204	0.185	0.184	0.172
7	0.181	0.198	0.202	0.193	0.200	0.204	0.188	0.190	0.200	0.198	0.191	0.186
8	0.197	0.212	0.212	0.207	0.214	0.216	0.222	0.210	0.213	0.205	0.217	0.199

age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.073	0.067	0.064	0.067	0.071	0.0620	0.053	0.058	0.070	0.059	0.066	0.070
2	0.107	0.103	0.105	0.112	0.110	0.1080	0.106	0.106	0.120	0.100	0.110	0.106
3	0.130	0.136	0.131	0.135	0.135	0.1330	0.131	0.134	0.138	0.130	0.146	0.136
4	0.157	0.156	0.149	0.158	0.153	0.1490	0.145	0.152	0.152	0.142	0.177	0.148
5	0.165	0.166	0.164	0.173	0.156	0.1545	0.153	0.159	0.164	0.157	0.174	0.155
6	0.187	0.180	0.177	0.183	0.182	0.1730	0.164	0.175	0.174	0.165	0.176	0.157
7	0.200	0.191	0.184	0.199	0.196	0.1855	0.175	0.187	0.179	0.170	0.196	0.167
8	0.205	0.209	0.211	0.227	0.206	0.1890	0.172	0.196	0.191	0.180	0.198	0.171

age	2016	2017	2018	2019	2020
1	0.054	0.072	0.060	0.057	0.057
2	0.102	0.093	0.096	0.096	0.095
3	0.126	0.121	0.120	0.119	0.119
4	0.143	0.140	0.132	0.137	0.138
5	0.159	0.147	0.147	0.143	0.143
6	0.161	0.154	0.159	0.156	0.152
7	0.167	0.154	0.164	0.159	0.160
8	0.177	0.162	0.204	0.181	0.174

Table 7.6.3.3. Irish Sea Herring. Weights-at-age in the stock. Units: kg.

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.074	0.074	0.074	0.074	0.076	0.087	0.068	0.058	0.070	0.081	0.077	0.070
2	0.155	0.155	0.155	0.155	0.142	0.125	0.143	0.130	0.124	0.128	0.135	0.121
3	0.195	0.195	0.195	0.195	0.187	0.157	0.167	0.160	0.160	0.155	0.163	0.153
4	0.219	0.219	0.219	0.219	0.213	0.186	0.188	0.175	0.170	0.174	0.175	0.167
5	0.232	0.232	0.232	0.232	0.221	0.202	0.215	0.194	0.180	0.184	0.188	0.180
6	0.251	0.251	0.251	0.251	0.243	0.209	0.229	0.210	0.198	0.195	0.196	0.189
7	0.258	0.258	0.258	0.258	0.240	0.222	0.239	0.218	0.212	0.205	0.207	0.195
8	0.278	0.278	0.278	0.278	0.273	0.258	0.254	0.229	0.232	0.218	0.217	0.214

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.061	0.088	0.073	0.072	0.067	0.063	0.073	0.068	0.063	0.066	0.085	0.081
2	0.111	0.126	0.126	0.120	0.115	0.119	0.121	0.121	0.120	0.105	0.113	0.116
3	0.136	0.157	0.154	0.147	0.148	0.148	0.150	0.145	0.149	0.139	0.144	0.136
4	0.151	0.171	0.174	0.168	0.162	0.167	0.166	0.168	0.171	0.156	0.167	0.160
5	0.159	0.183	0.181	0.180	0.177	0.178	0.179	0.178	0.188	0.167	0.180	0.167
6	0.171	0.191	0.190	0.185	0.195	0.189	0.190	0.189	0.204	0.183	0.184	0.172
7	0.179	0.198	0.203	0.197	0.199	0.206	0.200	0.199	0.205	0.199	0.191	0.186
8	0.191	0.214	0.214	0.212	0.212	0.214	0.230	0.214	0.215	0.205	0.217	0.199

age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.067	0.067	0.064	0.073	0.071	0.0660	0.060	0.057	0.059	0.057	0.069	0.070
2	0.114	0.103	0.105	0.114	0.110	0.1140	0.118	0.109	0.109	0.100	0.112	0.106
3	0.144	0.136	0.131	0.137	0.135	0.1350	0.134	0.136	0.131	0.131	0.150	0.136
4	0.161	0.156	0.149	0.158	0.153	0.1500	0.147	0.155	0.149	0.142	0.178	0.148
5	0.170	0.166	0.164	0.174	0.156	0.1550	0.153	0.162	0.153	0.157	0.174	0.155
6	0.192	0.180	0.177	0.183	0.182	0.1740	0.165	0.177	0.162	0.167	0.176	0.157
7	0.202	0.191	0.184	0.199	0.196	0.1860	0.176	0.188	0.168	0.175	0.196	0.167
8	0.214	0.209	0.211	0.227	0.206	0.1895	0.173	0.197	0.190	0.180	0.202	0.171

[illegible]

age	2016	2017	2018	2019	2020
1	0.787	0.787	0.787	0.787	0.787
2	0.380	0.380	0.380	0.380	0.380
3	0.353	0.353	0.353	0.353	0.353
4	0.335	0.335	0.335	0.335	0.335
5	0.315	0.315	0.315	0.315	0.315
6	0.311	0.311	0.311	0.311	0.311
7	0.304	0.304	0.304	0.304	0.304
8	0.304	0.304	0.304	0.304	0.304

Table 7.6.3.5. Irish Sea Herring. Proportion mature. Units: NA.

[illegible]

age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.10	0.02	0.04	0.30	0.02	0.14	0.15	0.02	0.11	0.114	0.20	0.19	0.16	0.16	0.13
2	0.86	0.60	0.82	0.83	0.84	0.79	0.54	0.92	0.76	1.000	0.97	0.89	0.94	0.84	0.82
3	0.94	0.96	0.95	0.97	0.95	0.99	0.88	0.95	0.95	0.970	0.99	1.00	0.98	1.00	0.97
4	0.99	0.83	1.00	0.99	0.97	1.00	0.97	0.98	0.97	1.000	1.00	1.00	1.00	1.00	0.98
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.00	1.00

[illegible]

Table 7.6.3.6. Irish Sea Herring. Fraction of harvest before spawning. Units: NA

[illegible]

[illegible][illegible]

Table 7.6.3.7. Irish Sea Herring. Fraction of natural mortality before spawning. Units: NA

[illegible]

age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
5	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
6	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
7	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
8	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
5	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
6	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
7	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
8	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75

Table 7.6.3.8. Irish Sea Herring. Survey indices

AC(VIIaN) - Configuration

Irish Sea herring (Division VIIa) (run name: ICAMDC20) . Imported from VPA file.

min	max	plusgroup	minyear	maxyear	startf	endf
1.0	8.0	8.0	1994.0	2020.0	0.7	0.8

Index type : number

AC(VIIaN) - Index Values

Units : NA

year

age 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

1 66830 319116 11340 134146 110438 157756 78524 387559 390982 349216 241014

2 68290 82256 42372 49977 27312 77722 103439 93402 71935 220014 115529

3 73529 11935 67473 14812 8083 34017 105291 10194 31701 31984 29593

4 11860 29246 8954 10985 9266 5108 27543 17489 24804 4735 15398

5 9299 4574 26469 1751 6479 10260 8072 7704 31277 3921 2067

6 7550 3500 4171 4553 1778 13521 5432 1372 14830 4089 2299

7 3867 4887 5911 571 2254 1586 4899 626 2756 977 238

8 10118 6894 5815 1910 780 6289 2359 2263 4461 906 240

year

age 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

1 94330 374731 1316673 475675 371230 580602 1927032 369094 100023 299689

2 109938 96623 251276 452364 182643 561245 330180 191900 285238 193267

3 97111 15625 46570 114210 177813 117699 43855 160980 81601 127352

4 17023 9982 21101 39076 92741 120777 14978 51363 54347 29691

5 8029 530 20818 26370 32490 34325 21896 21643 41153 43057

6 810 369 1200 17063 15071 16759 6308 19285 13441 17342

7 607 478 718 4254 13940 4336 2715 12105 11132 7848

8 5804 469 556 599 6871 6453 1959 3128 6776 12481

year

age 2015 2016 2017 2018 2019 2020

1 491894 131512 42175 237857 148867 247356

2 141854 449316 89653 120683 247509 96674

3 25153 257152 104059 63334 44690 115553

4 17018 110196 56474 110874 21226 16269

5 10340 32232 9007 29555 14595 7807

6 8954 18312 20297 7645 8952 11744

7 1890 8157 4395 7926 1849 2763

8 4342 7042 11779 5053 882 977

VllaNSpawn - Configuration

FLT05: SSB acoustic (Catch: Unknown) (Effort: Unknown)

min max plusgroup minyear maxyear startf endf

NA NA NA 2007 2020 NA NA

Index type : biomass

VllaNSpawn - Index Values

Units : NA

	year
age	2007 2008 2009 2010 2011 2012 2013 2014
all	47582.61 41909.97 76786.97 91388.88 61907.54 52071.02 114044.2 28396.84

year

	year
age	2015 2016 2017 2018 2019 2020
all	60328.27 74275.73 41683.6 38973.8 44184.9 47933

TABLE 7.6.3.9 Irish Sea Herring. STOCK OBJECT CONFIGURATION

min	max	plusgroup	minyear	maxyear	minfbar	maxfbar
1	8	8	1980	2020	4	6

TABLE 7.6.3.10 Irish Sea Herring. sam CONFIGURATION SETTINGS

name :
desc :
range : min max plusgroup minyear maxyear minfbar maxfbar
range : 1 8 8 1980 2020 4 6
fleets : catch AC(VIIaN) VIIaNSpawn
fleets : 0 2 3
plus.group : TRUE
states : age
states : fleet 1 2 3 4 5 6 7 8
states : catch 1 2 3 4 5 6 7 7
states : AC(VIIaN) NA NA NA NA NA NA NA NA
states : VIIaNSpawn NA NA NA NA NA NA NA NA
logN.vars : 1 1 1 1 1 1 1 1
catchabilities : age
catchabilities : fleet 1 2 3 4 5 6 7 8
catchabilities : catch NA NA NA NA NA NA NA NA
catchabilities : AC(VIIaN) 1 2 3 4 4 4 4 4
catchabilities : VIIaNSpawn NA NA NA NA NA NA NA NA

```

power.law.exps :      age
power.law.exps : fleet    1 2 3 4 5 6 7 8
power.law.exps : catch    NA NA NA NA NA NA NA NA
power.law.exps : AC(VIIaN) NA NA NA NA NA NA NA NA
power.law.exps : VIIaNSpawn NA NA NA NA NA NA NA NA
f.vars      :      age
f.vars      : fleet    1 2 3 4 5 6 7 8
f.vars      : catch    1 1 2 2 2 3 4 4
f.vars      : AC(VIIaN) NA NA NA NA NA NA NA NA
f.vars      : VIIaNSpawn NA NA NA NA NA NA NA NA
obs.vars    :      age
obs.vars    : fleet    1 2 3 4 5 6 7 8
obs.vars    : catch    1 2 2 2 3 3 3 3
obs.vars    : AC(VIIaN) 4 5 5 5 5 6 6 6
obs.vars    : VIIaNSpawn NA NA NA NA NA NA NA NA
srr         : 0
cor.F       : FALSE
nohess      : FALSE
timeout     : 3600
sam.binary   : C:/Users/Matt Lundy/Documents/GIT_HUB/wg_HAWG/IrishSea/UpdateAssess-
ment/SAM/sam.exe

```

TABLE 7.6.3.11 Irish Sea Herring. FLR, R SOFTWARE VERSIONS

```

FLSAM.version      1.02
FLCore.version     2.6.6
R.version          R version 3.2.0 (2015-04-16)
platform           i386-w64-mingw32
run.date           2021-03-18 19:44:30

```

TABLE 7.6.3.12 Irish Sea Herring. STOCK SUMMARY

Year	Recruitment	Low	High	TSB	Low	High	SSB	Low	High	Fbar	Low	High	Landings	Landings
	Age 1					(Ages 4-6)				SOP				
							f	f	f	tonnes				
1980	177017	84186	372210	38638	26477	56385	15297	10178	22990	0.2957	0.2097	0.4171	10613	1.0308
1981	194853	93232	407239	36901	25280	53865	13747	9484	19927	0.2902	0.2084	0.4042	4377	1.0999
1982	207109	99115	432769	40135	27373	58847	13635	9339	19908	0.2844	0.2064	0.3918	4855	1.0166
1983	158103	73995	337812	40255	27905	58072	14451	9895	21103	0.2818	0.2068	0.3839	3933	1.0165
1984	121540	58108	254216	40015	29096	55031	15472	10985	21791	0.2840	0.2120	0.3805	4066	1.0392
1985	168552	80934	351023	45207	32655	62583	15782	11602	21468	0.2919	0.2224	0.3832	9187	0.9802
1986	208147	100078	432914	46817	34131	64217	18337	13505	24898	0.2956	0.2272	0.3846	7440	1.0238
1987	248699	118768	520777	44802	32390	61970	16528	11926	22906	0.2992	0.2311	0.3873	5823	0.9632
1988	111302	53555	231314	42362	31403	57144	19334	13661	27363	0.3053	0.2362	0.3947	10172	0.9505
1989	140505	67304	293320	38177	27850	52335	14439	10433	19984	0.3045	0.2359	0.3931	4949	0.9966
1990	127899	61902	264260	36644	27092	49563	13944	10188	19085	0.3056	0.2370	0.3940	6312	0.9872
1991	81634	39437	168983	28595	21639	37788	9703	7103	13254	0.3049	0.2368	0.3927	4398	0.9994
1992	257816	123920	536386	33323	22574	49190	10557	7734	14409	0.3076	0.2387	0.3964	5270	0.9890
1993	64602	32111	129969	30333	22359	41152	10540	7695	14436	0.3077	0.2380	0.3978	4409	0.9869
1994	160011	82523	310260	31288	22728	43072	12009	8763	16457	0.3093	0.2381	0.4019	4828	0.9757
1995	149194	75418	295138	31445	22586	43779	11802	8480	16426	0.3103	0.2373	0.4057	5076	1.0007
1996	95035	46564	193963	26476	19309	36305	9885	6976	14007	0.3127	0.2371	0.4124	5301	0.9999
1997	139525	70077	277797	26056	18354	36989	9491	6569	13713	0.3172	0.2372	0.4241	6651	0.9996
1998	170587	88221	329853	28226	19706	40431	10467	7458	14691	0.3181	0.2349	0.4307	4905	0.9951

1999 1.0001	84204	42988	164937	24125	17583	33101	9919	6896	14266	0.3118	0.2294	0.4238	4127
2000 0.9993	87641	44324	173288	21455	15698	29322	9540	6760	13462	0.3046	0.2231	0.4158	2002
2001 1.0004	125492	62209	253150	22720	15479	33348	7852	5315	11599	0.3058	0.2212	0.4228	5461
2002 0.9984	83283	41275	168046	20622	14564	29199	7913	5424	11545	0.2995	0.2151	0.4172	2393
2003 1.0010	145656	74038	286551	23389	15635	34987	6868	4812	9801	0.2944	0.2098	0.4133	2399
2004 0.9979	171271	85922	341397	26291	17733	38980	9779	6672	14332	0.2824	0.2004	0.3981	2531
2005 1.0062	190613	95233	381520	30212	20181	45230	12059	8107	17939	0.2730	0.1925	0.3872	4387
2006 1.0005	319656	162990	626907	38677	25409	58872	12947	8957	18714	0.2597	0.1811	0.3724	4402
2007 4629	592437	289728	1211418	70686	43750	114205	20550	14179	29782	0.2417	0.1633	0.3579	1.0012
2008 1.0008	298343	138847	641055	62944	42944	92259	26187	17807	38510	0.2317	0.1531	0.3507	4895
2009 NA	365858	172482	776036	65513	44040	97456	26450	17666	39602	0.2236	0.1447	0.3454	4594
2010 0.9989	416649	208638	832047	66370	45336	97163	27228	18325	40457	0.2158	0.1368	0.3403	4894
2011 1.0014	283226	134869	594775	58047	40246	83721	26796	18184	39485	0.2112	0.1327	0.3360	5202
2012 0.9999	289816	145970	575413	54339	37910	77888	24077	16097	36013	0.2082	0.1303	0.3326	5693
2013 0.9982	162105	81596	322053	44002	31007	62445	21448	14312	32143	0.2037	0.1258	0.3301	4828
2014 0.9405	357182	175928	725175	55882	37288	83748	22359	15215	32858	0.2001	0.1220	0.3282	5083
2015 1.0001	348363	176465	687708	55603	38242	80846	20511	14024	29997	0.2017	0.1247	0.3262	4891
2016 0.9999	192914	98456	377994	47005	33875	65222	21974	15030	32126	0.2006	0.1237	0.3252	4327
2017 0.9999	181498	90841	362629	43871	31412	61271	19853	13749	28665	0.1986	0.1214	0.3249	3896
2018 1.0031	399512	201047	793894	55105	37450	81084	19090	12831	28401	0.2003	0.1233	0.3253	6804
2019 1.0018	339422	153858	748789	55715	37674	82395	23981	16372	35126	0.2021	0.1248	0.3272	6377
2020 7927	470241	124991	1769131	65578	35265	121949	23435	15219	36087	0.2027	0.1246	0.3299	0.9848

TABLE 7.6.3.13 Irish Sea Herring. ESTIMATED FISHING MORTALITY

Units : f

year

age	1980	1981	1982	1983	1984	1985
1	0.02682825	0.02650293	0.02599113	0.02531647	0.02504202	0.02506958
2	0.30510479	0.28516138	0.26455662	0.24509730	0.23302722	0.23265468
3	0.29912313	0.28390943	0.27225940	0.26355321	0.26077430	0.26423934
4	0.31603573	0.31033591	0.30128458	0.29042788	0.28604676	0.28967375
5	0.27565643	0.26676157	0.25805049	0.25903295	0.26660157	0.27706587
6	0.29546645	0.29346409	0.29384584	0.29585080	0.29939246	0.30912795
7	0.25676346	0.21425251	0.19392186	0.11592637	0.20034788	0.34163922
8	0.25676346	0.21425251	0.19392186	0.11592637	0.20034788	0.34163922

year

age	1986	1987	1988	1989	1990	1991
1	0.02518769	0.02519021	0.02553513	0.02572994	0.02633912	0.02696003
2	0.23305053	0.23054712	0.23181863	0.23333035	0.24062875	0.24803138
3	0.26360592	0.26168861	0.26300033	0.26059182	0.26053971	0.26077430
4	0.28722195	0.28385265	0.28533253	0.28060705	0.27795390	0.27507816
5	0.28303067	0.28941316	0.29739323	0.29813765	0.30137498	0.30285534
6	0.31657345	0.32432798	0.33333743	0.33484083	0.33742905	0.33682223
7	0.40158342	0.47416970	0.65325351	0.54274808	0.52274056	0.41724571
8	0.40158342	0.47416970	0.65325351	0.54274808	0.52274056	0.41724571

year

age	1992	1993	1994	1995	1996	1997	1998
1	0.02743324	0.02738938	0.02770063	0.02827153	0.0287879	0.02869306	0.02786455
2	0.25738043	0.26572323	0.28147828	0.29614680	0.3078016	0.31092610	0.29243876
3	0.26365865	0.26535148	0.26893112	0.27155244	0.2721233	0.27274991	0.26874293
4	0.27631880	0.27419932	0.27411707	0.27538091	0.2786497	0.28736560	0.29170858
5	0.30740167	0.30999472	0.31376845	0.31584617	0.3186379	0.32287178	0.32203340
6	0.33905261	0.33891701	0.34010530	0.33959553	0.3407521	0.34133189	0.34051367
7	0.32200120	0.33753030	0.38902565	0.38946939	0.4897158	0.73256002	0.57156332
8	0.32200120	0.33753030	0.38902565	0.38946939	0.4897158	0.73256002	0.57156332

year

age	1999	2000	2001	2002	2003	2004
1	0.02709516	0.02626547	0.02559393	0.02483007	0.02513988	0.02613447
2	0.27245005	0.25306725	0.24706594	0.23137859	0.21429537	0.20576923

3 0.26153164 0.25367534 0.25246062 0.24229483 0.23742583 0.23442959
 4 0.28967375 0.28857508 0.29525969 0.29100932 0.28753807 0.27620830
 5 0.31117495 0.29987187 0.29730403 0.28768188 0.28085971 0.27179695
 6 0.33453961 0.32530242 0.32487980 0.31994698 0.31490005 0.29927272
 7 0.37306597 0.20412964 0.42163722 0.44003984 0.73286043 0.45797073
 8 0.37306597 0.20412964 0.42163722 0.44003984 0.73286043 0.45797073

year

age	2005	2006	2007	2008	2009	2010	2011
1	0.02714127	0.02766741	0.02824045	0.02848436	0.02847297	0.02846158	0.0283508
2	0.20219959	0.19429066	0.18222739	0.17197606	0.16806575	0.16376873	0.1613467
3	0.22836730	0.21969831	0.20690407	0.19732562	0.19251138	0.18753308	0.1847041
4	0.26585612	0.25024871	0.23066243	0.22027027	0.21483177	0.20965331	0.2086077
5	0.26268492	0.24954900	0.23103178	0.22126372	0.21246033	0.20417047	0.1973256
6	0.29034076	0.27923543	0.26350050	0.25359925	0.24341195	0.23354045	0.2276377
7	0.40810532	0.35686419	0.20894170	0.20835748	0.15902402	0.12115313	0.1635560
8	0.40810532	0.35686419	0.20894170	0.20835748	0.15902402	0.12115313	0.1635560

year

age	2012	2013	2014	2015	2016	2017	2018
1	0.02805467	0.02822633	0.02827436	0.02752667	0.0275735	0.02790359	0.02853568
2	0.16170202	0.16505113	0.16751205	0.16966998	0.1733574	0.18099244	0.18987297
3	0.18325072	0.18246444	0.18137293	0.18200884	0.1834157	0.19004393	0.19930878
4	0.20883726	0.20744273	0.20717322	0.21258784	0.2148533	0.21405977	0.21703427
5	0.19183877	0.18501840	0.17885140	0.17781706	0.1772135	0.17808399	0.18345241
6	0.22382294	0.21877751	0.21420967	0.21465998	0.2097162	0.20361995	0.20040800
7	0.17708950	0.10689588	0.12825946	0.20871199	0.1608312	0.12545602	0.06132302
8	0.17708950	0.10689588	0.12825946	0.20871199	0.1608312	0.12545602	0.06132302

year

age	2019	2020
1	0.02916751	0.0294577
2	0.19145548	0.1961060
3	0.20406841	0.2053786
4	0.21890882	0.2183404
5	0.18822824	0.1903673
6	0.19902994	0.1995082
7	0.07858299	0.0986576
8	0.07858299	0.0986576

TABLE 7.6.3.14 Irish Sea Herring. ESTIMATED POPULATION ABUNDANCE

Units : NA

year							
age	1980	1981	1982	1983	1984	1985	
1	177016.814	194852.862	207108.8957	158102.684	121540.157	168552.070	
2	59874.142	72911.379	82619.4166	88256.268	76956.838	58046.518	
3	38139.280	21192.444	34132.3195	41564.429	52575.210	58571.294	
4	27391.828	12692.925	9374.9826	18453.328	26317.779	38139.280	
5	5000.534	12235.539	4341.1736	4087.137	11988.462	20284.250	
6	3572.068	2081.200	6049.9180	2434.265	2469.078	8459.962	
7	1697.310	1830.419	988.8078	3172.579	1385.339	1699.858	
8	1113.207	1516.560	1858.8253	1275.253	3056.727	2870.955	
year							
age	1986	1987	1988	1989	1990	1991	1992
1	208147.033	248699.346	111301.721	140505.231	127899.490	81633.909	257815.631
2	76496.480	89859.265	119850.451	47619.613	68596.720	56669.986	34891.551
3	33894.228	39379.474	52156.287	69772.833	28595.367	39616.461	31319.619
4	35739.078	18568.094	22811.042	26160.345	43217.466	16898.836	24785.151
5	21200.923	20449.220	11720.562	10695.731	14235.584	25719.378	11182.440
6	12713.250	12088.381	12236.762	5779.081	5617.264	7348.122	16176.260
7	5009.543	7462.159	6771.650	5570.834	2916.385	2634.635	4015.833
8	2666.441	4349.865	6549.867	5108.188	4380.420	2887.366	2315.081
year							
age	1993	1994	1995	1996	1997	1998	1999
1	64601.958	160011.345	149193.589	95034.950	139525.129	170586.879	84204.193
2	101823.887	30946.030	81470.804	60779.023	45251.903	53103.600	79459.283
3	17469.294	56050.032	15100.755	46304.758	28566.786	17373.477	28282.542
4	16698.931	9596.944	29231.436	7758.932	25616.706	14537.692	8103.084
5	13489.947	9599.824	5278.515	16488.196	4640.605	14455.063	6717.693
6	6567.575	7465.891	5088.305	2945.400	8447.282	2768.054	7025.488
7	8859.982	3783.860	3783.860	2881.021	1484.747	4448.401	1442.164
8	3439.908	6975.086	5406.191	4433.746	3027.826	1404.870	2410.043
year							
age	2000	2001	2002	2003	2004	2005	
1	87640.632	125492.340	83283.023	145655.569	171270.5930	190612.9097	
2	34613.533	40619.357	48873.959	41481.383	70052.4832	73203.6089	

3 45981.757 19751.802 16527.815 22651.922 23932.6760 46723.3818
 4 15146.125 29643.555 9675.963 7960.125 11367.3444 12012.4633
 5 4370.357 8962.460 14272.644 4023.470 3331.9067 5455.6115
 6 2887.077 2673.116 4354.652 6685.525 1703.0908 1665.8654
 7 2885.923 1522.334 1478.968 1804.610 2463.4054 880.5089
 8 1579.715 2528.800 1710.088 1291.423 730.6248 1503.7240

year

age 2006 2007 2008 2009 2010 2011

1 319655.7773 592437.108 298343.265 365857.796 416649.242 283225.874
 2 80821.6375 140927.380 219695.989 119133.501 159691.642 172991.891
 3 35418.8697 40578.758 74682.420 120090.391 59100.815 75207.031
 4 23980.5892 17799.044 23063.349 46119.909 57814.796 28796.237
 5 4668.0654 12354.801 12056.992 14279.782 23837.136 28424.309
 6 2219.1955 2496.388 8155.926 7130.952 7624.332 12549.047
 7 854.3150 1021.268 1771.532 4536.450 3716.732 4258.618
 8 974.1838 822.049 1122.036 1909.124 3180.202 3674.234

year

age 2012 2013 2014 2015 2016 2017

1 289815.560 162105.073 357181.738 348362.889 192914.044 181498.016
 2 100307.927 137998.763 72911.379 134995.942 174905.306 93995.294
 3 94560.961 49761.656 69772.833 37797.566 71467.637 103156.239
 4 43608.179 47858.308 21978.061 35918.221 22742.712 37609.050
 5 17181.698 22225.599 23718.248 12237.986 18353.948 8459.116
 6 16383.008 9403.150 10662.626 14625.180 7630.434 9654.699
 7 7876.193 8550.970 4907.893 6135.213 7216.317 3852.972
 8 4427.100 6075.381 8590.395 7174.584 6527.635 6137.667

year

age 2018 2019 2020

1 399512.367 339422.187 470240.714
 2 97929.195 183872.893 149791.559
 3 63895.231 53369.783 114691.363
 4 66237.364 33996.063 26608.873
 5 21059.352 34337.729 18040.960
 6 4459.982 11202.587 19728.114
 7 5266.915 2416.076 6804.912
 8 3284.271 3679.382 3164.974

TABLE 7.6.3.15 Irish Sea Herring. PREDICTED CATCH NUMBERS AT AGE

Units : NA
<0 x 0 matrix>

TABLE 7.6.3.16 Irish Sea Herring. CATCH AT AGE RESIDUALS

Units : NA
<0 x 0 matrix>

TABLE 7.6.3.18 Irish Sea Herring. PREDICTED INDEX AT AGE Fleet 1

Units : NA							
year							
age	1980	1981	1982	1983	1984	1985	
1	3248.9268	3533.9447	3685.5683	2740.1830	2085.0539	2892.9442	
2	13229.8378	15182.2157	16109.4285	16079.6536	13408.4448	10095.5499	
3	8383.9966	4450.2698	6905.9594	8179.0395	10249.5594	11544.5645	
4	6363.2212	2902.4486	2089.6670	3984.1928	5608.9566	8217.4893	
5	1040.9302	2474.6395	852.6678	805.5216	2423.5289	4241.3632	
6	791.3181	458.3807	1333.9904	539.8763	553.2943	1948.8408	
7	333.5824	306.0474	151.0287	300.3294	217.9662	427.8788	
8	218.7851	253.5802	283.9335	120.7232	480.9580	722.6319	
year							
age	1986	1987	1988	1989	1990	1991	1992
1	3590.7989	4291.450	1945.686	2475.877	2304.502	1505.1081	4837.9192
2	13322.2387	15507.360	20788.391	8304.227	12295.148	10435.2002	6641.4793
3	6667.6983	7698.494	10242.387	13586.881	5566.323	7724.3272	6163.9310
4	7642.1939	3930.099	4851.970	5482.300	8979.684	3479.8692	5124.7140
5	4516.4429	4441.334	2606.647	2383.893	3202.349	5808.9784	2559.2000
6	2989.1370	2901.868	3006.975	1425.531	1394.735	1821.7448	4032.7347
7	1443.2460	2458.729	2846.798	2039.520	1037.252	783.1702	961.0054
8	768.1999	1433.336	2753.560	1870.236	1558.096	858.3054	554.0805

year

age	1993	1994	1995	1996	1997	1998	1999
1	1210.6104	3032.249	2885.317	1870.8722	2736.2674	3251.6570	1561.5747
2	19924.1930	6373.984	17529.667	13529.5302	10157.6257	11305.3348	15905.4962
3	3457.2543	11221.311	3049.766	9372.9204	5790.8826	3476.8083	5527.8819
4	3428.9522	1970.199	6024.080	1615.8396	5482.3548	3150.9523	1745.6461
5	3109.5708	2235.947	1236.426	3891.4223	1107.7210	3442.8676	1553.5998
6	1636.8190	1866.275	1270.226	737.4365	2117.8358	692.6259	1731.9444
7	2207.2441	1061.842	1062.830	973.8819	677.1075	1694.0036	390.8446
8	857.0104	1957.513	1518.639	1498.7549	1381.1752	534.9589	653.2043

year

age	2000	2001	2002	2003	2004	2005	2006
1	1574.9204	2198.9165	1416.6355	2508.1231	3063.5511	3538.1526	6050.7046
2	6488.2621	7456.3403	8457.3401	6698.5744	10911.7994	11225.2390	11952.3119
3	8744.8479	3740.4081	3017.7295	4062.3220	4241.4056	8090.5339	5923.4244
4	3252.1773	6490.0791	2092.9294	1703.6870	2349.1762	2400.4944	4541.0793
5	978.9201	1992.7881	3083.4365	851.3216	684.9597	1088.4609	890.0966
6	694.8736	642.6434	1033.4417	1564.5132	381.5378	363.4094	467.8838
7	461.8915	456.3774	459.0412	823.3736	789.5080	257.0730	223.1044
8	252.8383	758.3007	530.8821	589.2733	234.1847	438.9695	254.3929

year

age	2007	2008	2010	2011	2012	2013	2014
1	11443.1892	5811.3025	8109.8123	5491.7377	5558.6469	3129.1604	6904.9236
2	19644.2509	29042.0483	20178.4403	21554.2868	12529.6110	17561.0735	9405.2187
3	6431.1587	11335.4470	8560.7236	10749.4514	13406.4337	7028.0179	9802.6692
4	3135.7699	3898.3942	9348.3955	4634.2980	7021.7658	7660.6338	3514.9128
5	2199.6642	2065.0093	3795.0012	4391.1657	2585.6702	3236.6043	3348.6079
6	500.4211	1580.9323	1373.1738	2208.5247	2840.2575	1597.3000	1776.6769
7	166.9276	288.9114	366.8085	556.3013	1107.2226	749.5402	511.1586
8	134.3529	182.8854	313.9331	479.9971	622.3359	532.5144	894.5761

year

age	2015	2016	2017	2018	2019	2020
1	6556.748	3637.8932	3464.7647	7791.3545	6767.0464	9467.7825
2	17617.535	23283.4945	13025.9656	14169.9669	26825.2799	22332.5381
3	5329.326	10147.9805	15126.9016	9780.8337	8351.6967	18057.0235
4	5881.752	3758.9314	6195.6332	11052.4787	5716.7172	4464.3102
5	1718.179	2568.9178	1189.2998	3042.1202	5078.4938	2696.0958

6 2441.603 1247.6537 1536.9266 699.7338 1746.3445 3082.0801
 7 1001.716 928.2954 393.0355 270.5833 157.7876 552.6694
 8 1171.629 839.6625 626.0561 168.7334 240.2308 257.0113

TABLE 7.6.3.19 Irish Sea Herring. INDEX AT AGE RESIDUALS Fleet 1

Units : NA

year							
age	1980	1981	1982	1983	1984	1985	1986
1	0.720021	0.4383130	0.3988190	-0.910845	-0.71153700	-0.21461600	0.27467000
2	1.687190	0.0993729	-0.0125103	-0.707031	-1.17686000	-0.01143810	0.34484300
3	2.138500	-0.8350760	-0.4993010	-0.960046	-0.88119000	1.02941000	0.28495800
4	0.739040	-0.1000550	0.0720620	-0.875049	-0.95868600	1.21668000	0.28421100
5	1.489680	-0.1695580	-2.1993000	-1.374840	-0.20218800	1.22799000	0.00592931
6	0.323754	-0.7613240	-0.4258560	-0.253117	-0.87047700	0.71289600	0.15649100
7	0.176572	-0.1247820	-0.1756830	-0.379068	0.11440000	1.02854000	0.03307230
8	0.115808	-0.1275190	0.6751880	-1.658750	-0.00945762	0.00437792	0.30688800
year							
age	1987	1988	1989	1990	1991	1992	1993
1	-0.806531	0.3592430	-0.935167	0.00451954	0.348439	1.1301500	-0.7711900
2	-0.450249	0.0556003	-0.665423	0.10880300	-0.170918	0.0911688	-0.7809950
3	-0.570250	0.6695940	-0.306256	0.07162010	-0.344012	0.2277310	-0.3524520
4	-0.685447	0.9848970	-0.385514	0.19458200	-0.520717	0.6748630	-0.3240760
5	-0.140503	1.3209700	-0.555087	0.26989900	-0.316157	0.5579080	-0.1592660
6	-0.101900	1.2167000	-0.295186	0.40478400	-0.461053	0.5539610	-0.0440359
7	-0.126589	0.2940150	-0.622452	0.01057790	-0.198061	0.1741010	-0.0277202
8	0.355450	0.9853080	0.103882	0.08309660	-0.119948	-0.8017380	-0.0244897
year							
age	1994	1995	1996	1997	1998	1999	2000
1	-0.5295340	0.1286400	1.2866400	1.5348700	-0.0709888	0.181272	-0.312534
2	0.2379230	0.4968340	0.6557360	1.8852100	0.1253200	0.157898	-1.392860
3	0.2044570	0.2685490	0.1027320	0.6756520	0.2745430	0.180361	-1.007960
4	-0.1924420	-0.3390900	-0.8391940	0.7391720	0.8740430	-0.274973	-1.150010
5	0.3189770	-0.0712024	-0.1784130	0.9105140	1.5335500	-0.117140	-1.302260
6	0.2777700	-0.2223300	0.1300010	0.1719590	0.9193640	0.320626	-1.608810
7	0.4292920	-0.3193050	-0.0308514	0.4994470	0.4407900	0.295435	-1.412970

8 0.0392923 -0.1039550 -0.2182640 0.0837246 -0.3955350 -0.113417 -1.256440

year

age 2001 2002 2003 2004 2005 2006 2007

1 0.257953 -2.5399800 -1.5775600 0.0630618 1.103580 -0.0800030 0.703221

2 1.091100 0.1633650 -0.9003930 -0.5351220 0.555686 0.6174130 -0.180729

3 1.640860 -1.1794400 -0.4919270 0.6138360 0.673252 0.8228370 -0.647500

4 1.768600 -0.2905990 1.0300700 -0.2114140 0.795803 0.8361480 -1.618120

5 1.228180 -0.5853770 0.0820156 -0.2196580 0.619280 0.9217180 -1.686990

6 0.871186 -0.1877470 1.4654600 -1.3505200 0.307562 0.5954410 -0.999994

7 0.819349 0.0743011 0.1329460 -0.3699050 0.295158 0.3723350 -0.726407

8 0.132706 -1.0528900 0.0610288 -1.4177200 -0.408574 -0.0777181 -0.442362

year

age 2008 2010 2011 2012 2013 2014 2015

1 0.5287280 0.2055910 0.375108 -0.985552 0.2669130 1.6913100 -1.691100

2 -1.0779100 -0.3422910 -0.513453 -0.657514 0.1881760 0.0431915 -0.338311

3 -1.0501800 -0.6284680 -0.454250 -0.229036 -0.0701307 -0.5409270 -0.243848

4 -0.9337840 -1.0393600 -0.384114 0.312444 -0.3654630 -1.4315100 0.573180

5 0.0189918 -0.3951030 -0.415024 0.390987 -0.2536300 -1.4915700 -0.146360

6 0.2499170 -0.9153520 -0.537823 0.245686 -0.1892700 -1.4165300 1.298270

7 0.2939810 0.0200694 0.498993 0.839858 -0.4209750 -0.5165800 1.195230

8 0.3855530 -1.2251800 -0.281947 0.107883 -0.9591140 -0.1735820 -0.121025

year

age 2016 2017 2018 2019 2020

1 -0.6086470 -0.6077990 0.0310711 0.721240 0.5860990

2 -0.5063300 -0.0356279 1.2157000 -0.377324 0.6665880

3 -1.3339700 -0.4994270 1.1912700 0.716418 0.3664430

4 0.5533000 -0.8625190 0.2839120 0.430405 -0.2161530

5 -0.5227800 -1.5506400 0.1460030 0.628441 0.5065750

6 0.3014010 -0.8498300 -0.6089610 -0.579292 0.0869925

7 -0.0820283 0.4966410 0.8528870 0.330749 0.7892950

8 -0.2339980 -0.0113425 -2.8179400 -0.495209 -0.4790810

TABLE 7.6.3.20 Irish Sea Herring. PREDICTED INDEX AT AGE Fleet 2

Units : NA

year							
age	1994	1995	1996	1997	1998	1999	2000
1	164078.459	152955.147	97372.587	142899.948	174905.306	86404.929	89922.188
2	45597.127	118657.919	87789.747	65186.000	77574.962	117865.568	52067.696
3	62280.272	16750.946	51364.369	31656.539	19311.190	31618.574	51694.155
4	9414.817	28644.021	7585.168	24891.957	14074.079	7856.920	14697.607
5	9279.751	5094.211	15879.433	4455.480	13887.438	6506.715	4268.510
6	7097.728	4838.693	2798.531	8021.735	2630.502	6707.489	2775.094
7	3486.139	3484.988	2461.509	1056.926	3573.604	1344.678	3054.619
8	6426.723	4979.526	3788.138	2155.957	1128.529	2247.334	1672.091
year							
age	2001	2002	2003	2004	2005	2006	
1	128862.342	85596.528	149671.7737	175799.6019	195438.2985	327813.4580	
2	61402.142	74719.770	64228.3512	109239.7186	114485.1043	127159.8201	
3	22225.599	18738.959	25781.1788	27285.2079	53524.7798	40839.2946	
4	28609.669	9372.545	7729.8907	11133.1230	11856.7191	23939.8569	
5	8771.824	14066.903	3986.1854	3323.2218	5478.6281	4734.7774	
6	2570.074	4202.858	6474.5863	1669.1503	1643.2151	2206.9572	
7	1368.458	1311.321	1284.1342	2153.4576	799.3589	805.8036	
8	2273.760	1516.545	919.0311	638.7672	1364.9731	918.8198	
year							
age	2007	2008	2009	2010	2011	2012	
1	607252.5220	305742.951	374857.038	427025.923	290308.666	296974.038	
2	223641.5889	351406.868	191070.930	256991.940	278841.835	161716.487	
3	47263.8022	87596.822	141350.797	69814.709	89071.972	112027.539	
4	18039.3363	23559.867	47277.983	59539.784	29670.246	44909.292	
5	12708.4194	12492.578	14893.498	25006.723	29998.420	18198.237	
6	2513.2198	8274.965	7289.061	7850.873	12977.210	16992.205	
7	1076.2951	1869.021	4967.391	4185.661	4644.969	8504.324	
8	866.2642	1183.120	2090.106	3582.263	4007.849	4780.020	
year							
age	2013	2014	2015	2016	2017	2018	
1	166142.312	365967.569	357074.599	197777.907	186111.270	409175.730	
2	221837.409	116984.883	216208.825	279372.138	149357.793	154476.923	

3	58988.630	82801.379	44850.948	84719.409	121637.428	74787.048
4	49340.474	22670.051	36908.605	23325.443	38595.849	67853.076
5	23666.125	25371.962	13099.247	19654.469	9052.262	22444.480
6	9790.424	11137.911	15270.987	7998.906	10166.365	4707.160
7	9732.344	5497.727	6467.662	7887.070	4324.795	6201.894
8	6914.459	9621.447	7564.715	7134.019	6888.854	3867.447

year

age 2019 2020

1	347597.333	481518.533
2	289873.529	235272.572
3	62286.501	133746.300
4	34773.122	27230.692
5	36464.702	19128.029
6	11833.503	20833.134
7	2807.950	7788.394
8	4275.131	3621.885

TABLE 7.6.3.21 Irish Sea Herring. INDEX AT AGE RESIDUALS Fleet 2

Units : NA

year

age 1994 1995 1996 1997 1998 1999 2000

1	-0.96179500	0.787502	-2.302470	-0.0677023	-0.492345	0.644638	-0.145133
2	0.64316300	-0.583373	-1.159950	-0.4230830	-1.662230	-0.663029	1.093010
3	0.26443700	-0.539761	0.434364	-1.2093300	-1.386760	0.116364	1.132740
4	0.36763800	0.033043	0.264163	-1.3024500	-0.665552	-0.685619	1.000050
5	0.00330341	-0.171509	0.813576	-1.4871100	-1.213990	0.725163	1.014500
6	0.08034650	-0.421253	0.519033	-0.7366300	-0.509439	0.911769	0.873530
7	0.13485700	0.439757	1.139400	-0.8008420	-0.599422	0.214679	0.614388
8	0.59028800	0.423109	0.557406	-0.1575430	-0.480424	1.338420	0.447631

year

age 2001 2002 2003 2004 2005 2006

1	1.17905000	1.6265700	0.9072310	0.3378820	-0.7800430	0.143216
2	0.66792100	-0.0604315	1.9604700	0.0891841	-0.0645537	-0.437248
3	-1.24106000	0.8371400	0.3433210	0.1293150	0.9484950	-1.529840
4	-0.78368400	1.5496500	-0.7804040	0.5164000	0.5758830	-1.392950

5	-0.20668400	1.2723400	-0.0262552	-0.7560710	0.6085800	-3.486820	
6	-0.81636200	1.6399400	-0.5977420	0.4164130	-0.9200280	-2.326270	
7	-1.01721000	0.9660310	-0.3555310	-2.8647100	-0.3580410	-0.679230	
8	-0.00617483	1.4032900	-0.0185744	-1.2731800	1.8825400	-0.874649	
year							
age	2007	2008	2009	2010	2011	2012	2013
1	0.8286870	0.473306	-0.0104153	0.3290130	2.026790	0.232846	-0.5433350
2	0.1855530	0.402089	-0.0718930	1.2436800	0.269147	0.272504	0.4002430
3	-0.0235159	0.422501	0.3654890	0.8317100	-1.128240	0.577323	0.5166580
4	0.2496200	0.805712	1.0729000	1.1261800	-1.088490	0.213857	0.1539340
5	0.7858870	1.189590	1.2420000	0.5043680	-0.501246	0.276038	0.8809550
6	-0.9614840	0.941239	0.9447700	0.9862740	-0.938242	0.164620	0.4121750
7	-0.5265070	1.069700	1.3420800	0.0459015	-0.698421	0.459177	0.1747620
8	-0.5767240	-0.885264	1.5478600	0.7654840	-0.931012	-0.551529	-0.0263036
year							
age	2014	2015	2016	2017	2018	2019	2020
1	-0.213979	0.343033	-0.4369420	-1.58958000	-0.580827	-0.908009	-0.713273
2	0.799368	-0.670999	0.7567040	-0.81273900	-0.393030	-0.251535	-1.416150
3	0.685502	-0.920878	1.7679800	-0.24849400	-0.264640	-0.528591	-0.232846
4	0.429549	-1.232720	2.4723700	0.60610100	0.781969	-0.785958	-0.820105
5	0.842082	-0.376639	0.7876290	-0.00798059	0.438288	-1.458020	-1.426910
6	0.575889	-0.694346	1.0772500	0.89924300	0.630766	-0.362946	-0.745526
7	0.462925	-1.600080	0.0437727	0.02094560	0.319032	-0.543416	-1.347870
8	0.338436	-0.722058	-0.0168883	0.69767400	0.347771	-2.052880	-1.704170

TABLE 7.6.3.22 Irish Sea Herring. PREDICTED INDEX AT AGE Fleet 3

Units : NA

year								
age	2007	2008	2009	2010	2011	2012	2013	2014
8	20549.05	26176.05	26452.34	27227.97	26787.75	24074.3	21447.64	22354.88
year								
age	2015	2016	2017	2018	2019	2020		
8	20509.63	21973.01	19852.4	19087.71	23971	23444.71		

TABLE 7.6.3.23 Irish Sea Herring. INDEX AT AGE RESIDUALS Fleet 3

Units : NA

year										
age	2007	2008	2009	2010	2011	2012	2013	2014	2015	
8	1.32761	0.744189	1.68499	1.91452	1.32451	1.21973	2.64204	0.378277	1.7059	
year										
age	2016	2017	2018	2019	2020					
8	1.92577	1.17286	1.12869	0.966921	1.13073					

TABLE 7.6.3.25 Irish Sea Herring. FIT PARAMETERS

	name	value	std.dev
1	logFpar	0.635940	0.219320
2	logFpar	0.883400	0.175340
3	logFpar	0.572090	0.183600
4	logFpar	0.437640	0.201290
5	logSdLogFsta	-2.151300	0.759090
6	logSdLogFsta	-2.398000	0.505740
7	logSdLogFsta	-2.430900	0.600500
8	logSdLogFsta	-0.725490	0.256910
9	logSdLogN	-1.245500	0.170700
10	logSdLogObs	-0.205260	0.144580
11	logSdLogObs	-0.929000	0.132910
12	logSdLogObs	-0.840200	0.111950
13	logSdLogObs	-0.068398	0.160250
14	logSdLogObs	-0.465170	0.081327
15	logSdLogObs	-0.261910	0.095760

TABLE 7.6.3.26 Irish Sea Herring. NEGATIVE LOG-LIKELIHOOD

571.675

Table 7.7.1. Herring in Division 7.a North (Irish Sea). Input data for short-term forecast.

2021								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	284958.8	0.787	0.093333	0.9	0.75	0.058	0.029054	0.058
2	207843.8	0.38	0.79	0.9	0.75	0.095667	0.192478	0.0956
3	84195.27	0.353	0.98	0.9	0.75	0.11933	0.202919	0.119
4	65619.05	0.335	1	0.9	0.75	0.135667	0.218094	0.135667
5	15300.79	0.315	1	0.9	0.75	0.144333	0.187349	0.144333
6	10883.82	0.311	1	0.9	0.75	0.155667	0.199649	0.155667
7	11840.63	0.304	1	0.9	0.75	0.161	0.079521	0.161
8	6665.277	0.304	1	0.9	0.75	0.186333	0.079521	0.186333
2022								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	284958.8	0.787	0.093333	0.9	0.75	0.058	0.029054	0.058
2	-	0.38	0.79	0.9	0.75	0.095667	0.192478	0.0956
3	-	0.353	0.98	0.9	0.75	0.11933	0.202919	0.119
4	-	0.335	1	0.9	0.75	0.135667	0.218094	0.135667
5	-	0.315	1	0.9	0.75	0.144333	0.187349	0.144333
6	-	0.311	1	0.9	0.75	0.155667	0.199649	0.155667
7	-	0.304	1	0.9	0.75	0.161	0.079521	0.161
8	-	0.304	1	0.9	0.75	0.186333	0.079521	0.186333
2023								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	284958.8	0.787	0.093333	0.9	0.75	0.058	0.029054	0.058
2	-	0.38	0.79	0.9	0.75	0.095667	0.192478	0.0956
3	-	0.353	0.98	0.9	0.75	0.11933	0.202919	0.119
4	-	0.335	1	0.9	0.75	0.135667	0.218094	0.135667
5	-	0.315	1	0.9	0.75	0.144333	0.187349	0.144333
6	-	0.311	1	0.9	0.75	0.155667	0.199649	0.155667
7	-	0.304	1	0.9	0.75	0.161	0.079521	0.161
8	-	0.304	1	0.9	0.75	0.186333	0.079521	0.186333

Table 7.7.2. Herring in Division 7.a North (Irish Sea). Management options table.

Fbar (2021)	Catch (2021)	SSB (2021)	Fbar (2022)	Catch (2022)	SSB (2022)	SSB (2023)
0.209356	7341	27504.38	0	0	31606	34805
0.209356	7341	27504.38	0.1	3411	29100	29729
0.209356	7341	27504.38	0.2	6536	26804	25457
0.209356	7341	27504.38	0.3	9402	24699	21858
0.209356	7341	27504.38	0.4	12032	22770	18819
0.209356	7341	27504.38	0.5	14447	21000	16251
0.209356	7341	27504.38	0.6	16667	19378	14075
0.209356	7341	27504.38	0.7	18709	17889	12229
0.209356	7341	27504.38	0.8	20588	16524	10660
0.209356	7341	27504.38	0.9	22320	15271	9323
0.209356	7341	27504.38	1	23918	14121	8182
0.209356	7341	27504.38	1.1	25392	13065	7205
0.209356	7341	27504.38	1.2	26755	12096	6368
0.209356	7341	27504.38	1.3	28016	11205	5648
0.209356	7341	27504.38	1.4	29184	10387	5028
0.209356	7341	27504.38	1.5	30267	9635	4492
0.209356	7341	27504.38	1.6	31273	8944	4029
0.209356	7341	27504.38	1.7	32207	8309	3626
0.209356	7341	27504.38	1.8	33077	7724	3275
0.209356	7341	27504.38	1.9	33887	7187	2969
0.209356	7341	27504.38	2	34643	6692	2701

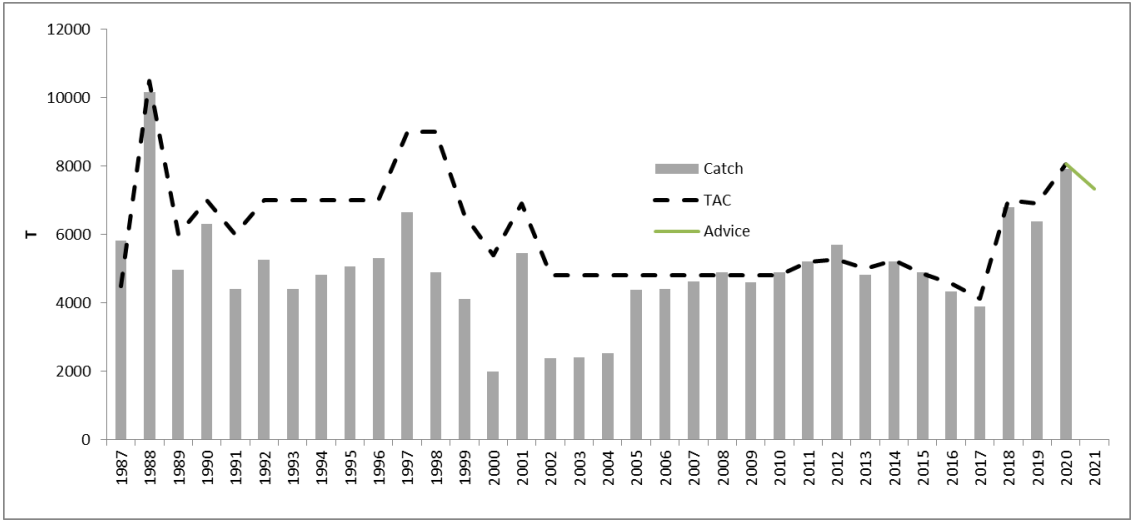


Figure 7.1.1 Herring in Division 7.a North (Irish Sea). Landings of herring from 7.a(N) from 1987 to 2020.

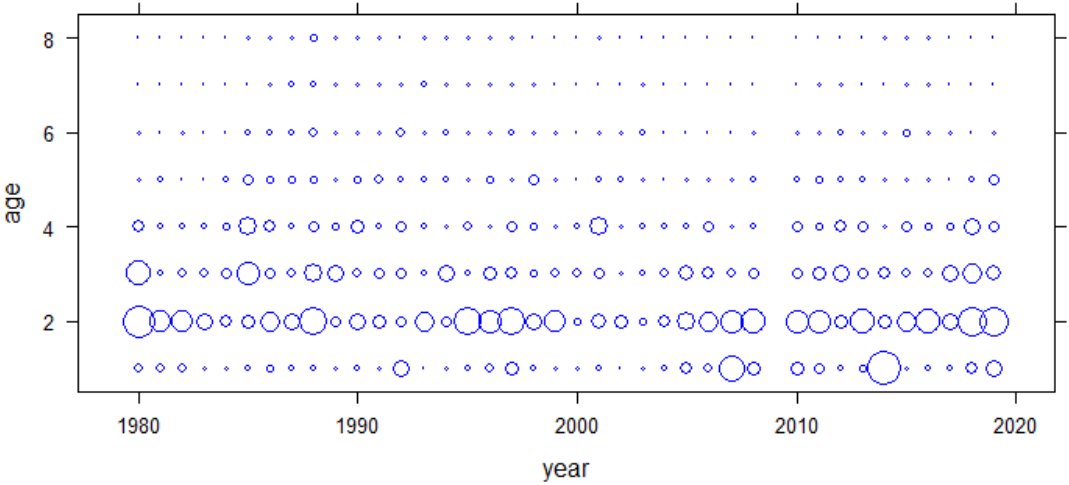


Figure 7.2.1 Herring in Division 7.a North (Irish Sea). Landings (catch-at-age) of herring from 7.a(N) from 1980 to 2020. No 2009 commercial samples.

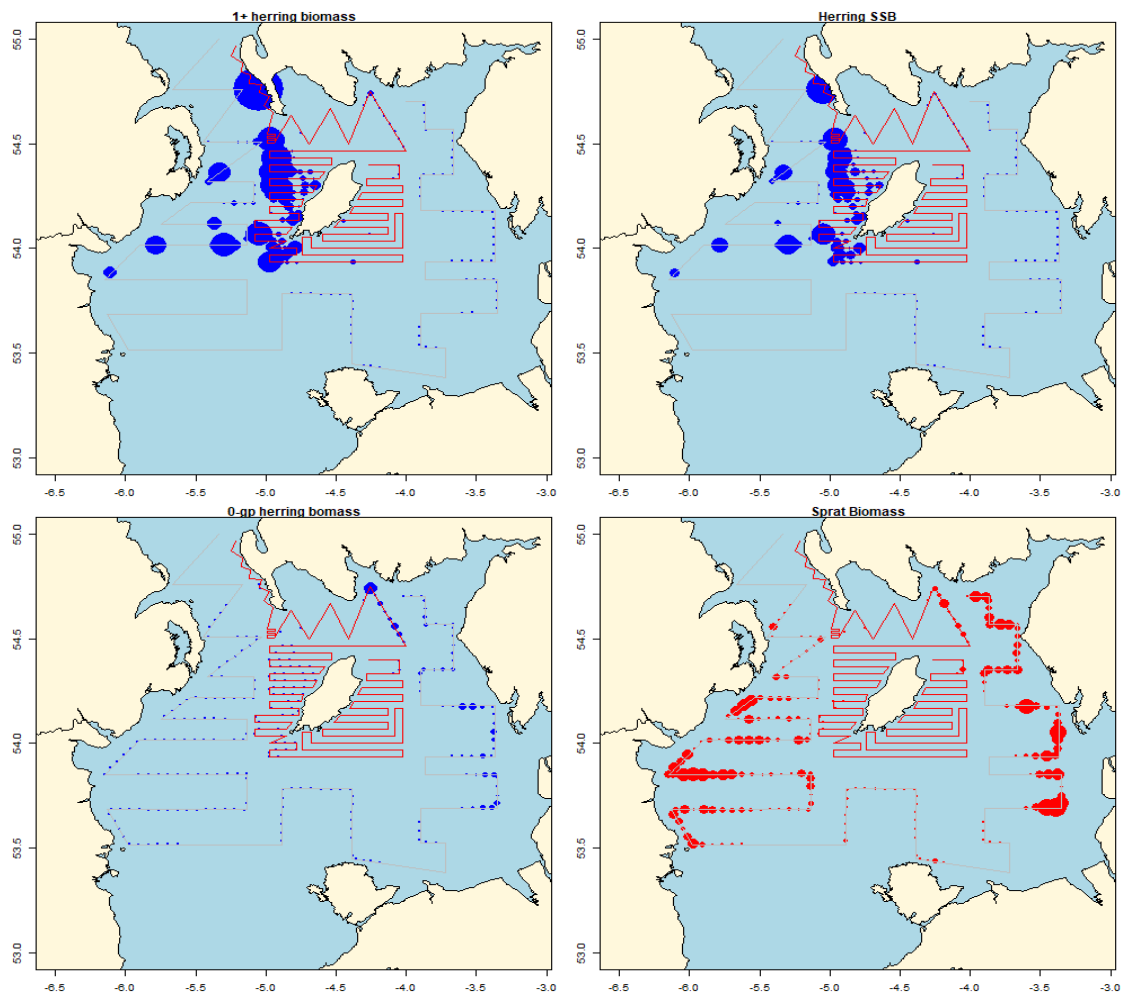


Figure 7.3.1 Herring in Division 7.a North (Irish Sea). Density distribution of 1-ring and older herring (top left panel) for the 2020 acoustic survey; SSB (top right panel); 0-ring herring (bottom left panel) and sprat biomass (bottom right panel). Note: size of ellipses is proportional to square root of the fish density (t n.mile⁻²) per 15-minute interval and the same scaling is used for all figures.

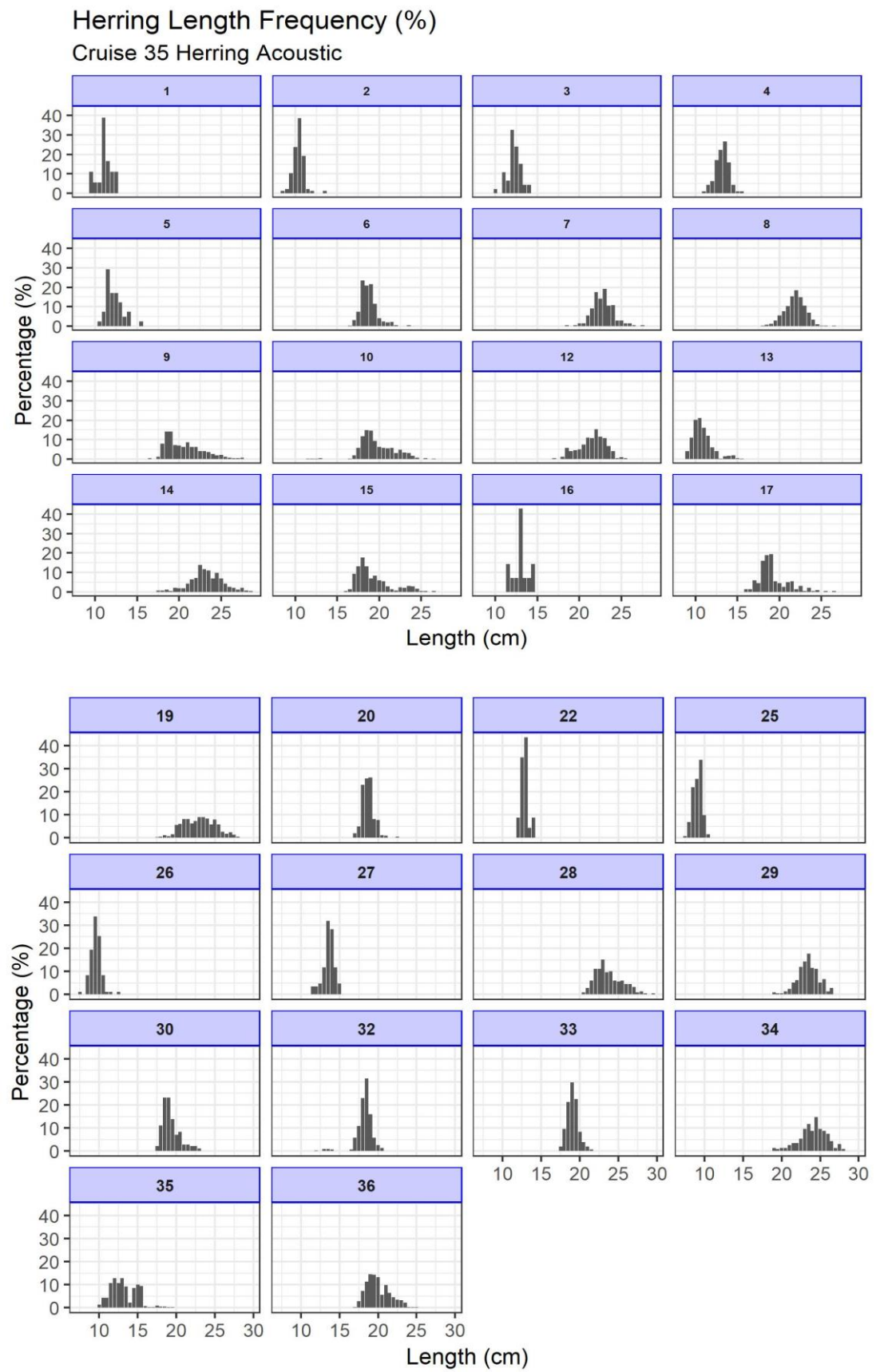


Figure 7.3.2 Herring in Division 7.a North (Irish Sea). Percentage length compositions of herring in each trawl sample in the September 2020 acoustic survey.

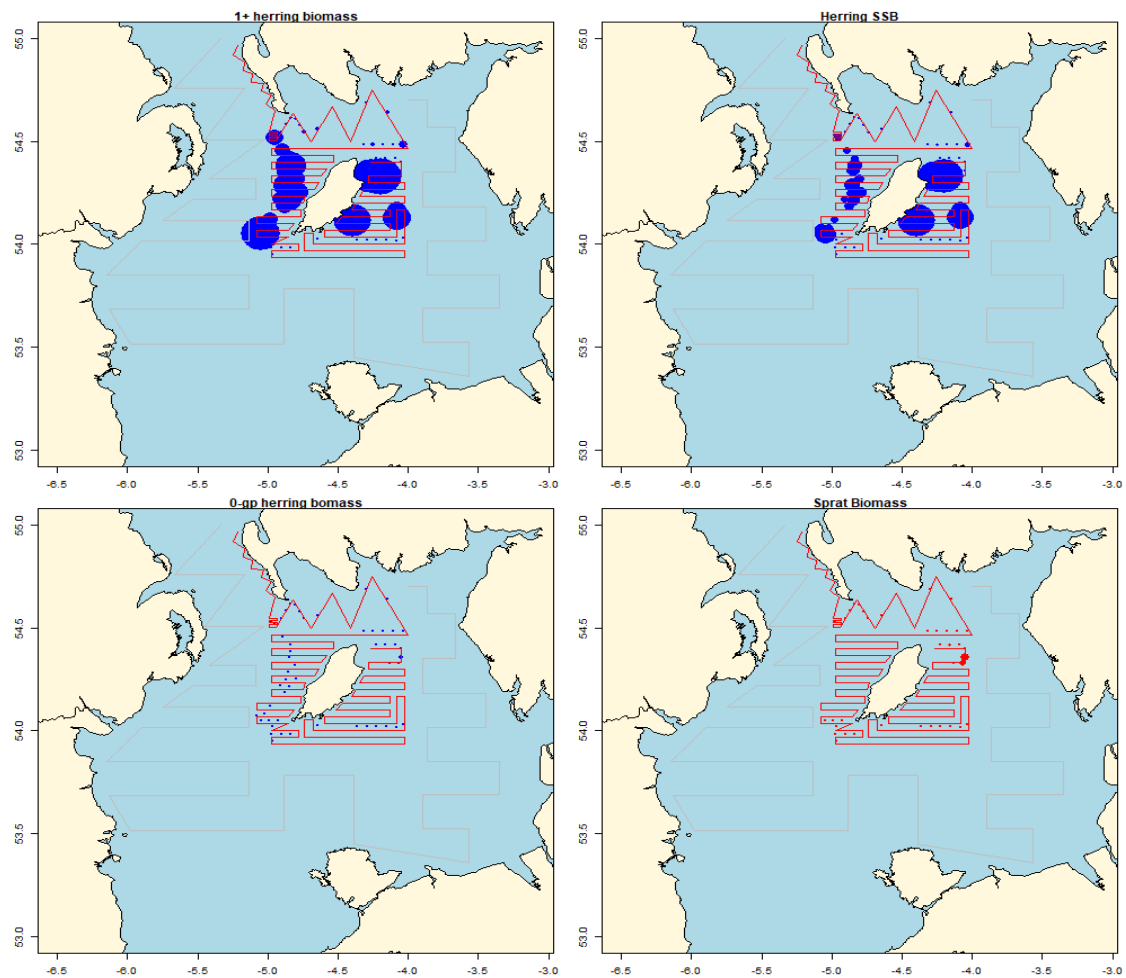


Figure 7.3.3 Herring in Division 7.a North (Irish Sea). Distribution plots for the 7.aNSpawn survey (2008–2020) (size of ellipses is proportional to square root of the fish density (t n.mile⁻²) per 15-minute interval).

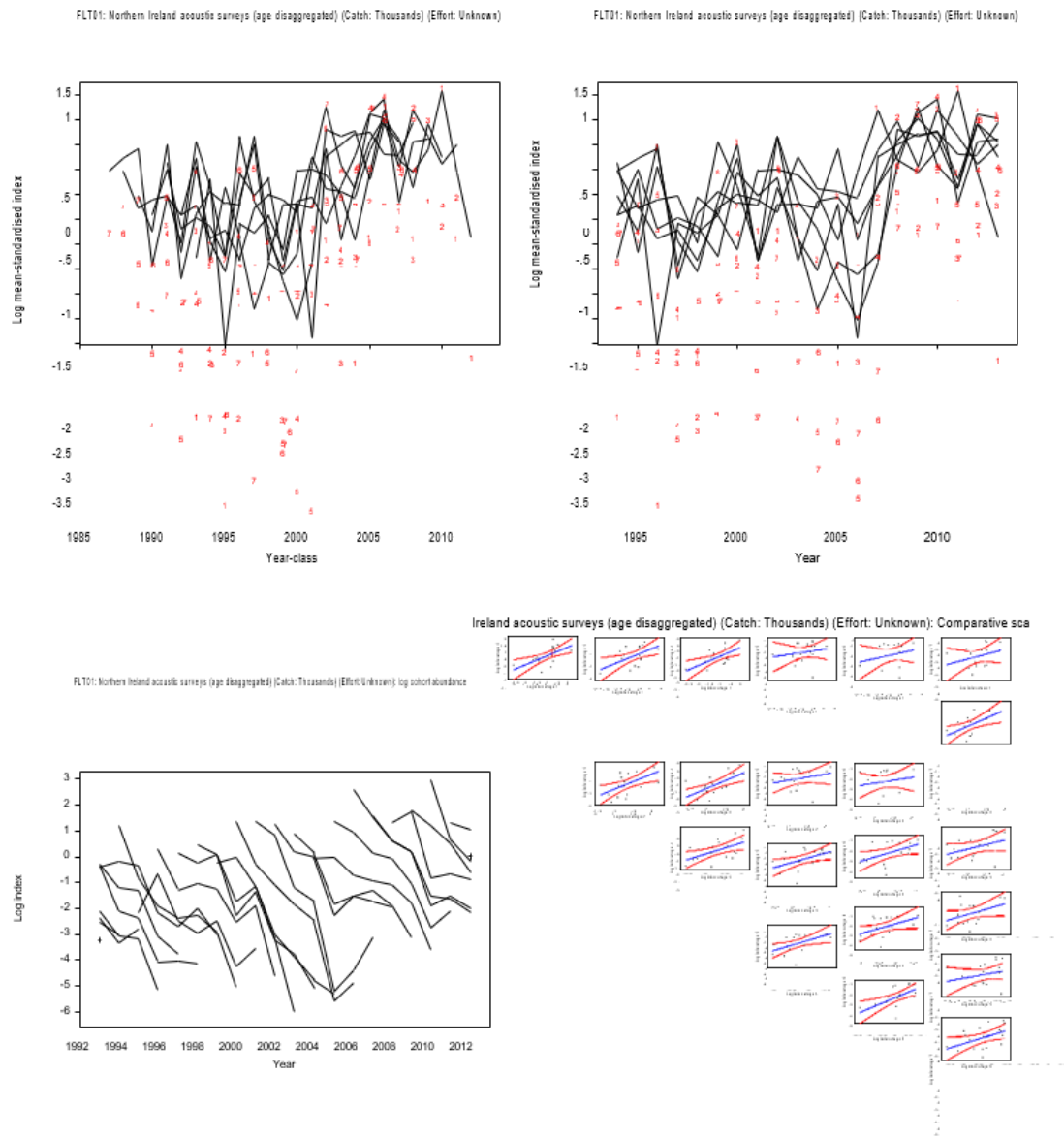


Figure 7.3.4 Herring in Division 7.a North (Irish Sea). Acoustic survey (AC(7.aN)) log mean-standardized indices by year and age class, scatterplots and catch curves.



Figure 7.3.5 Herring in Division 7.a North (Irish Sea). Comparison of SSB indices from the acoustic survey estimates of SSB (red line) and the later survey 7.aNSpawn (dotted line).

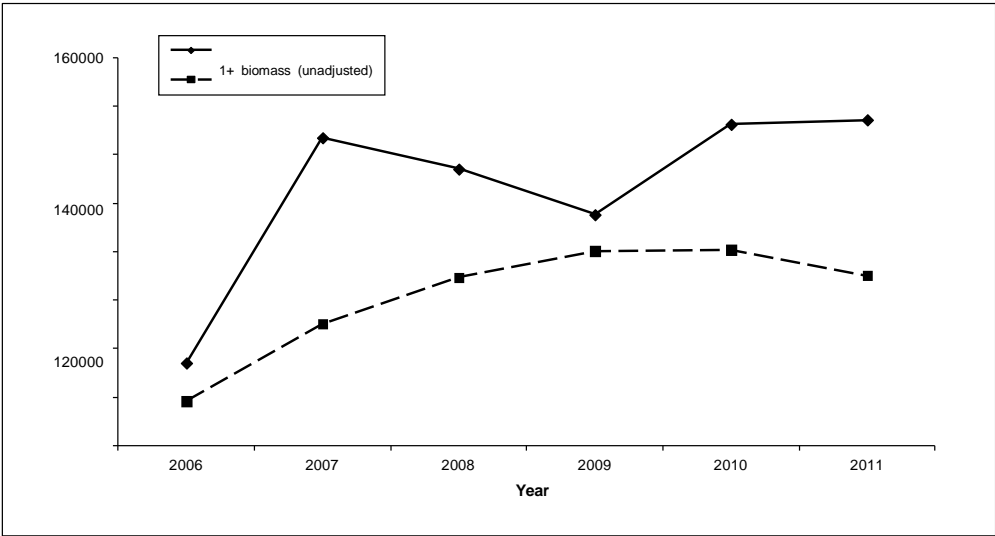


Figure 7.3.6 Herring in Division 7.a North (Irish Sea). Comparison of 1-ringer+ biomass estimates from acoustic survey with adjusted data (“winter spawners removed”) and unadjusted datasets.

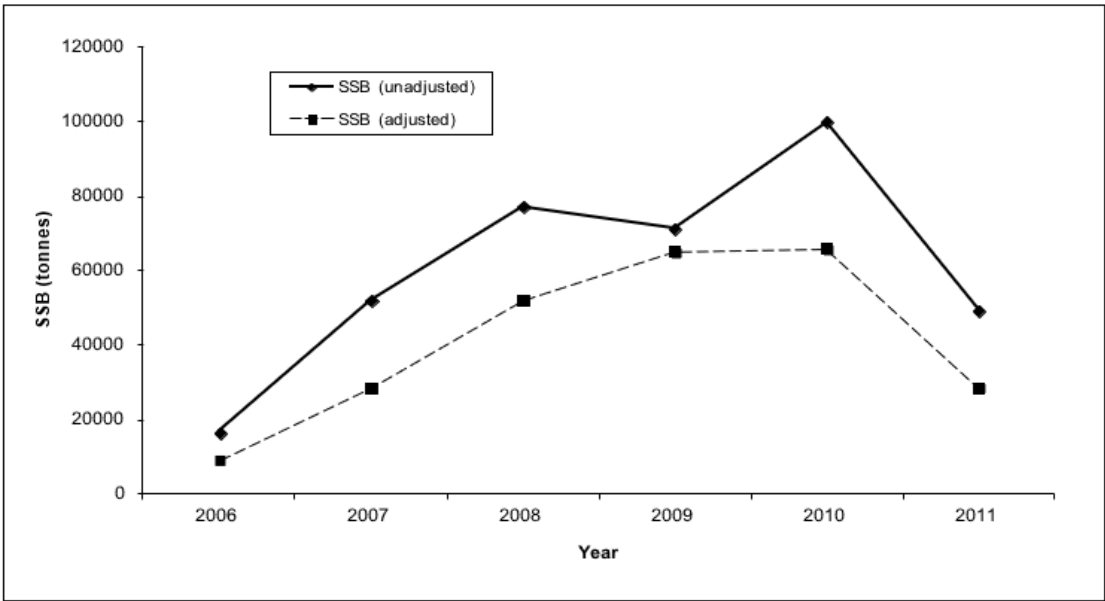


Figure 7.3.7 Herring in Division 7.a North (Irish Sea). Comparison of SSB biomass estimates from acoustic survey with adjusted data (“winter spawners removed”) and unadjusted datasets.

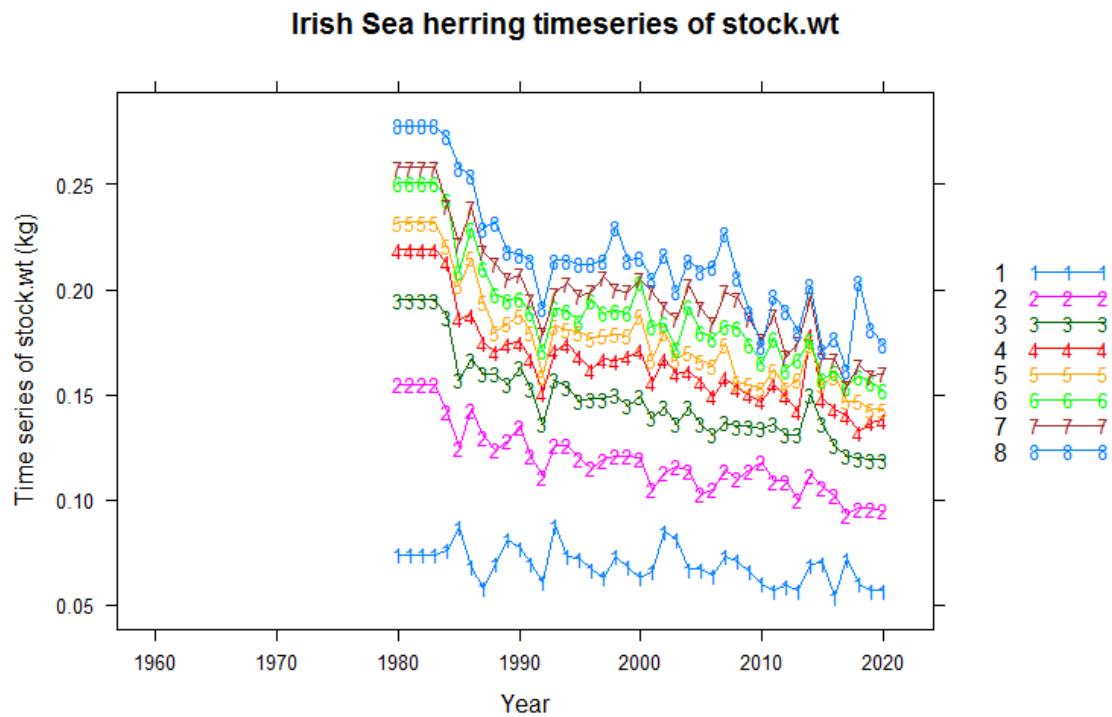


Figure 7.4.1 Herring in Division 7.a North (Irish Sea). Time-series of catch weights at age.

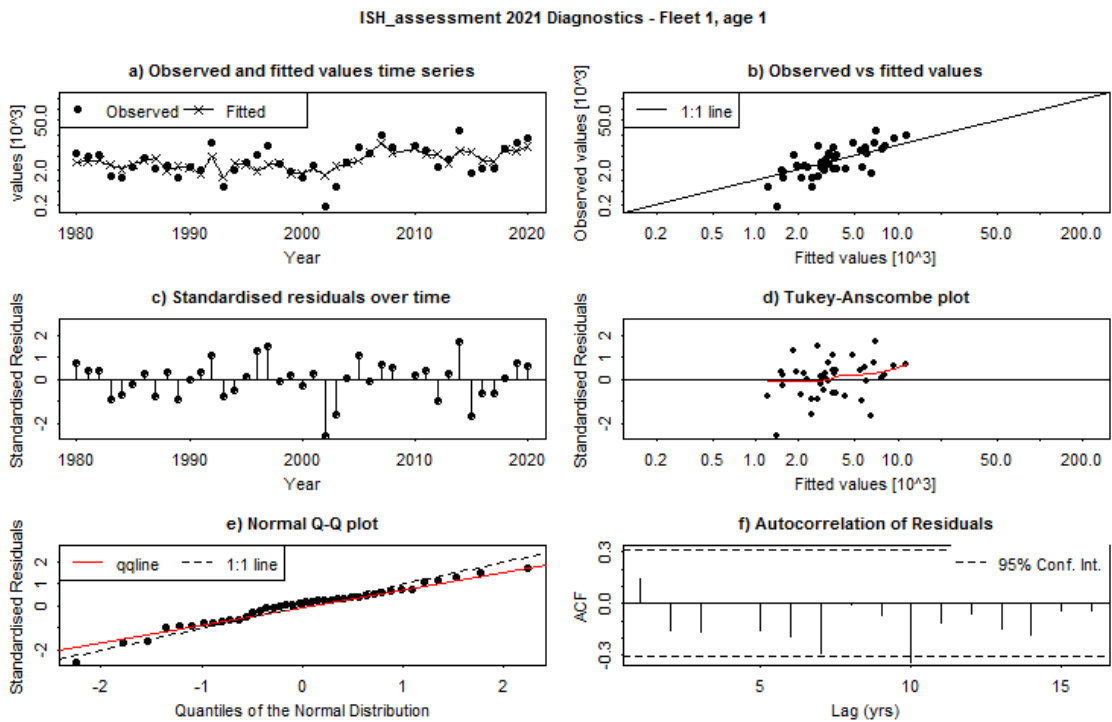


Figure 7.6.1 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age1.

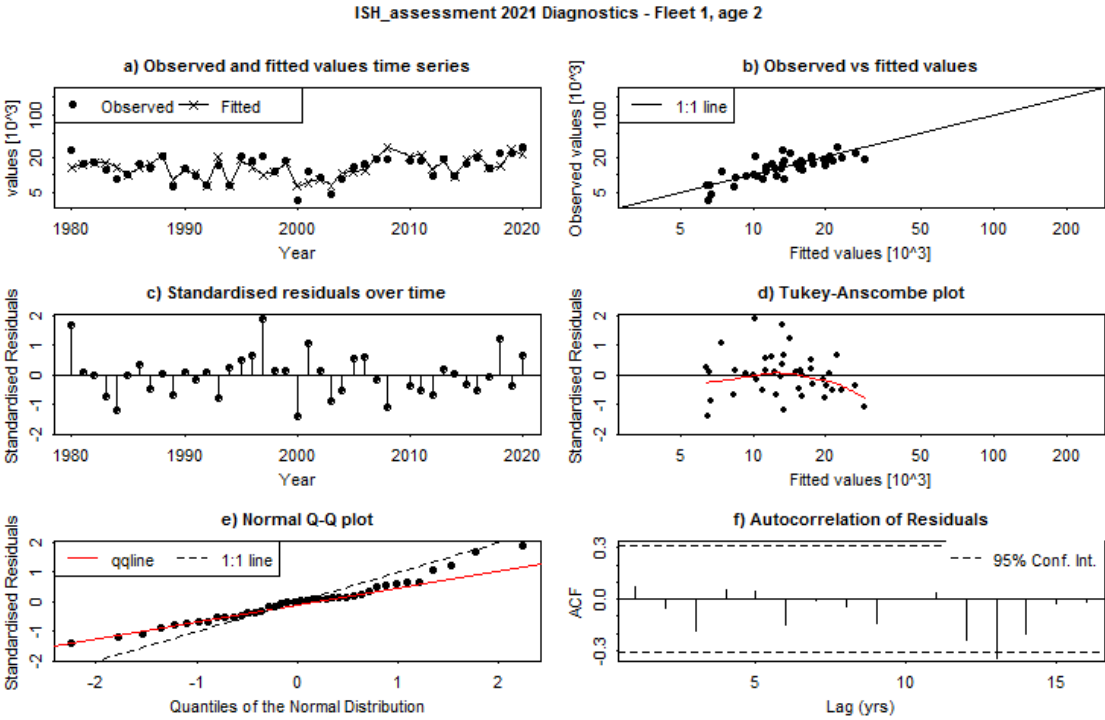


Figure 7.6.2 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age2.

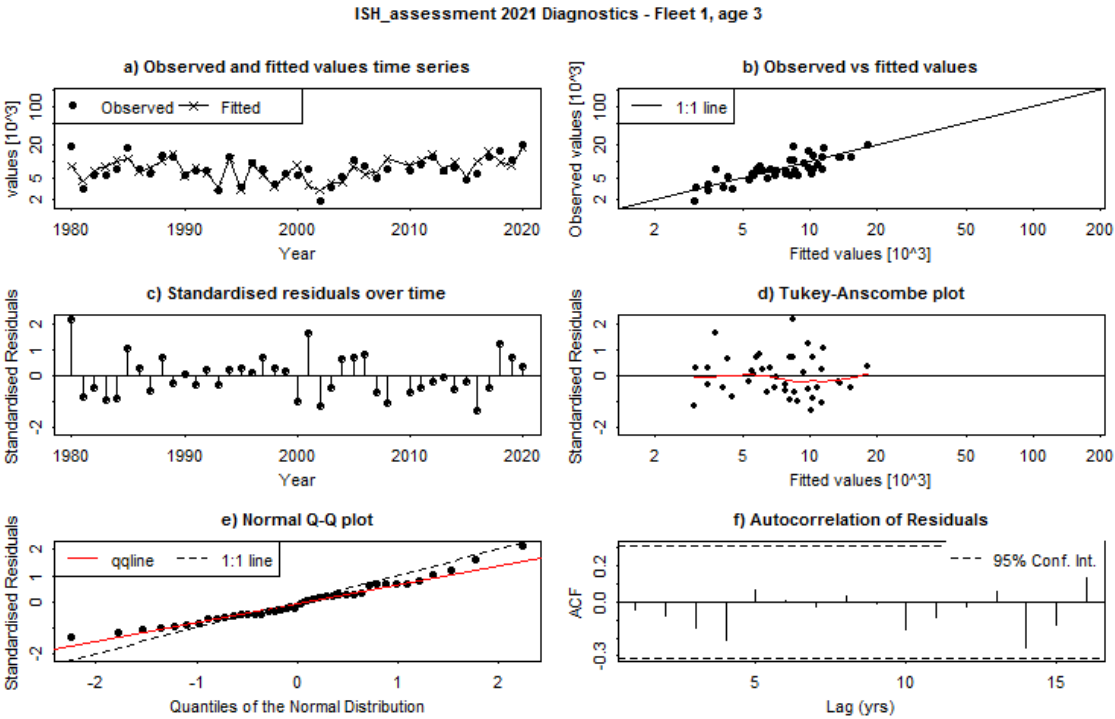


Figure 7.6.3 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age3.

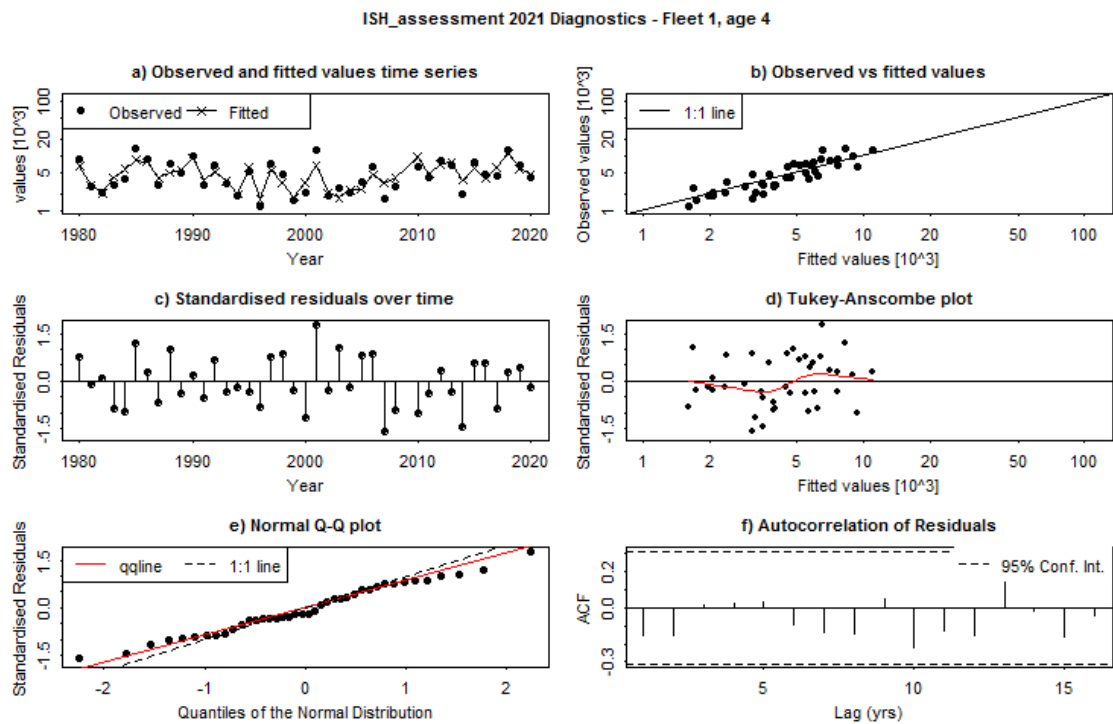


Figure 7.6.4 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age4.

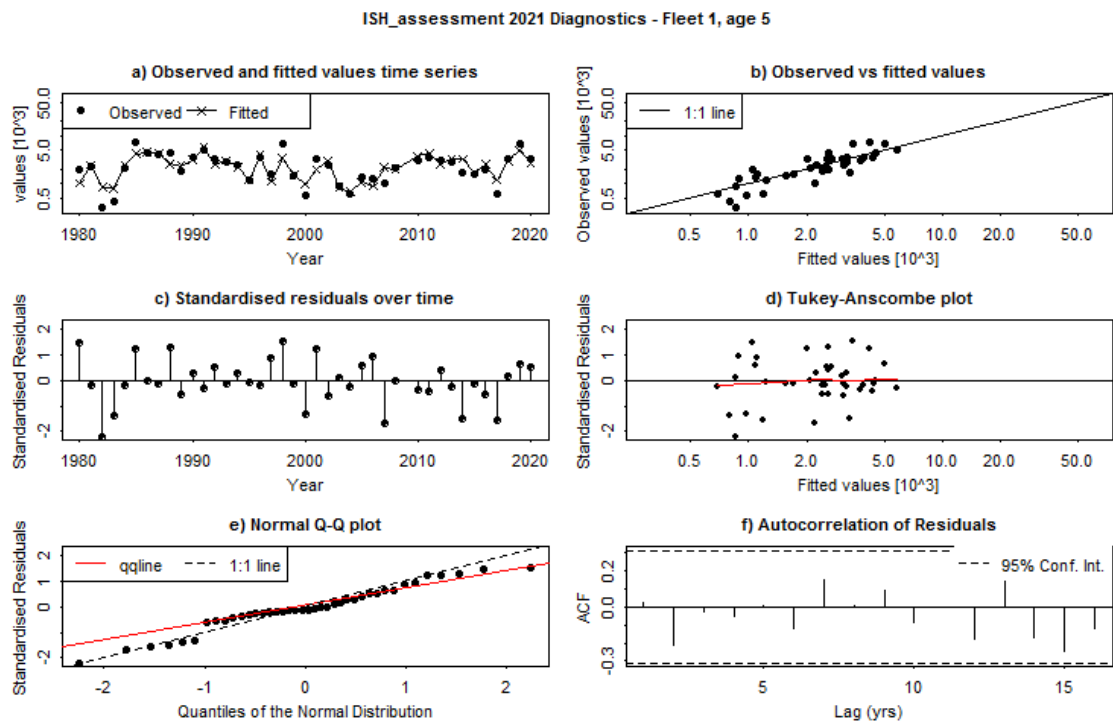


Figure 7.6.5 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age5.

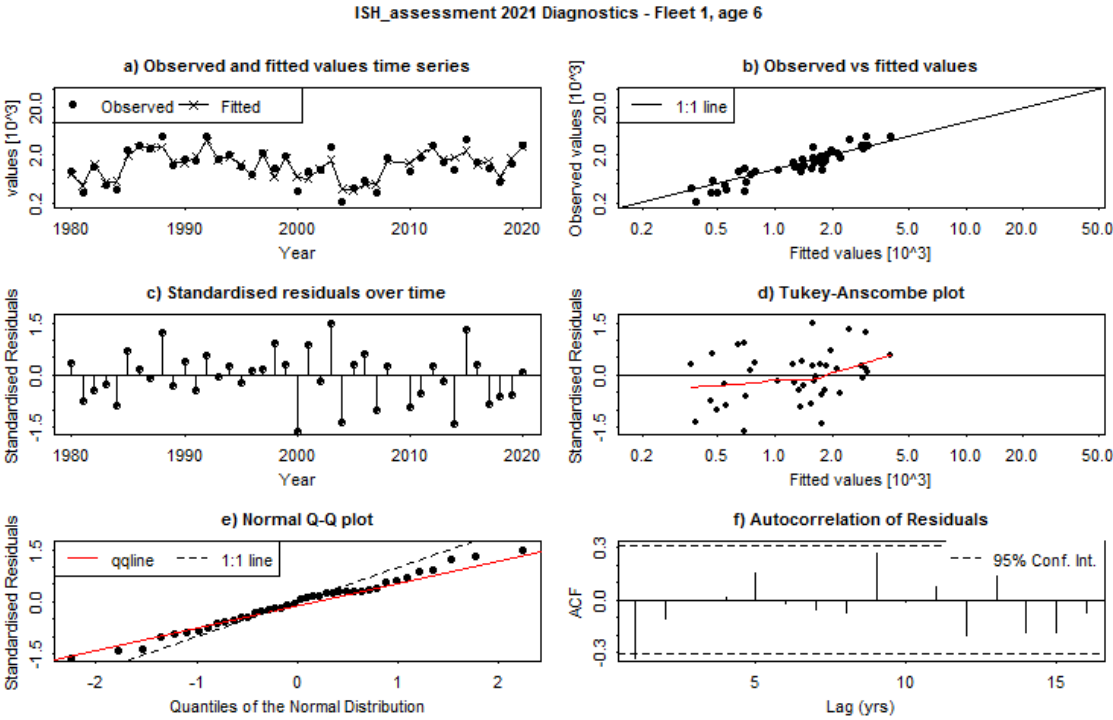


Figure 7.6.6 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age6.

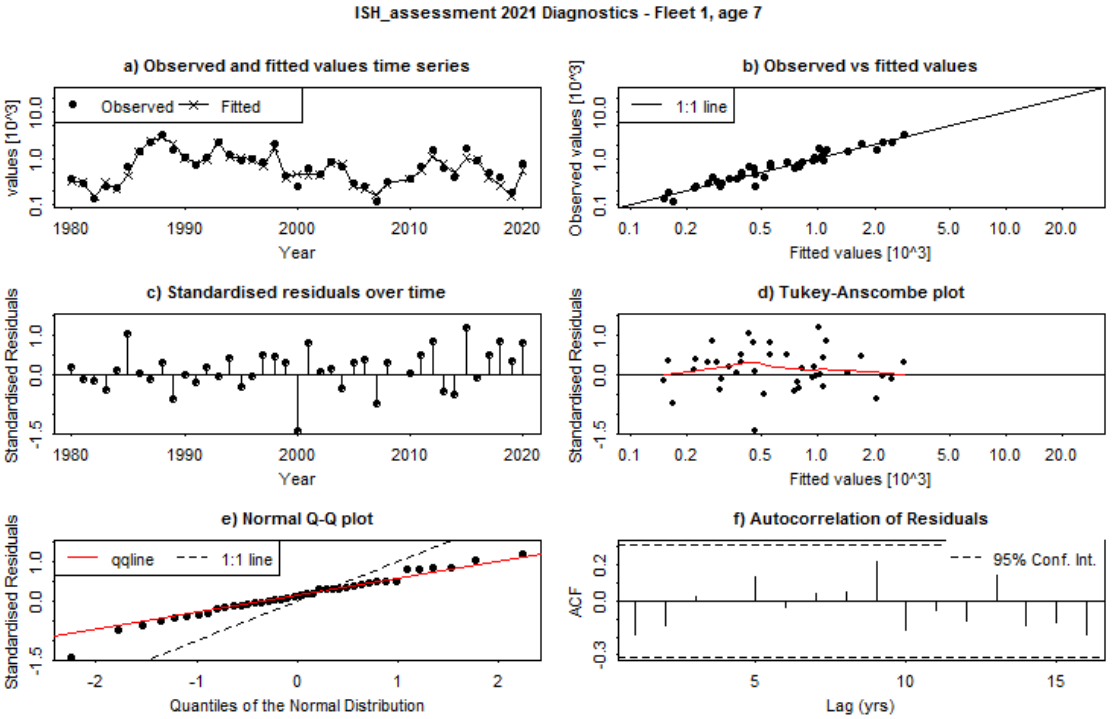


Figure 7.6.7 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age7.

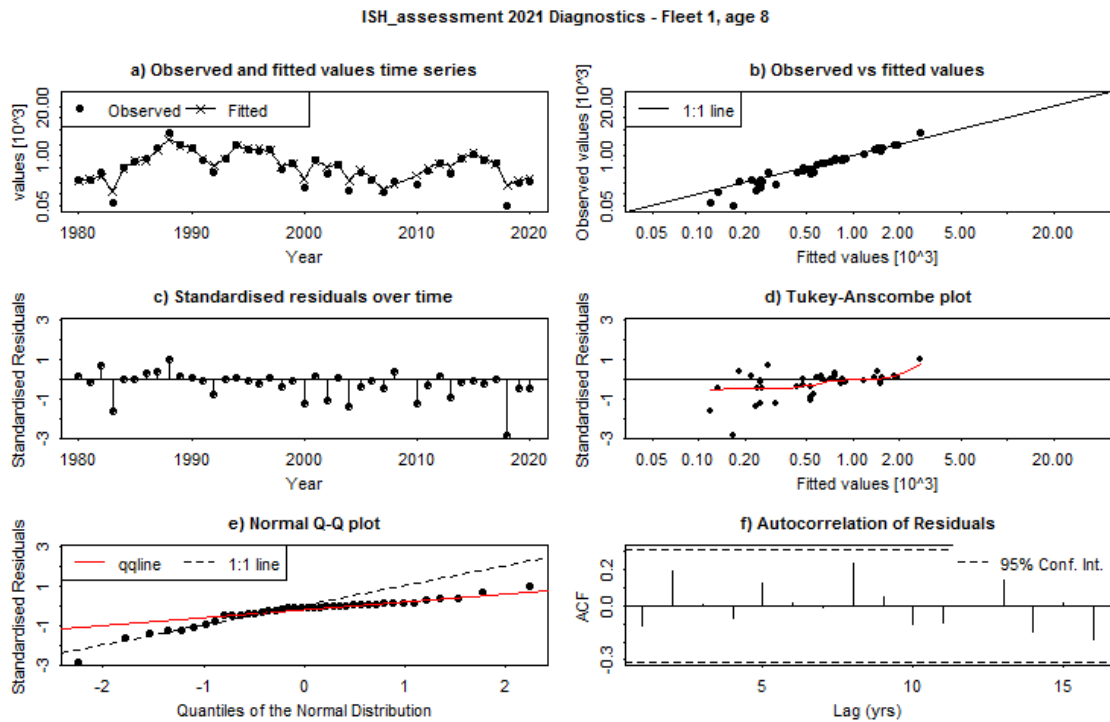


Figure 7.6.8 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the catch data at age8.

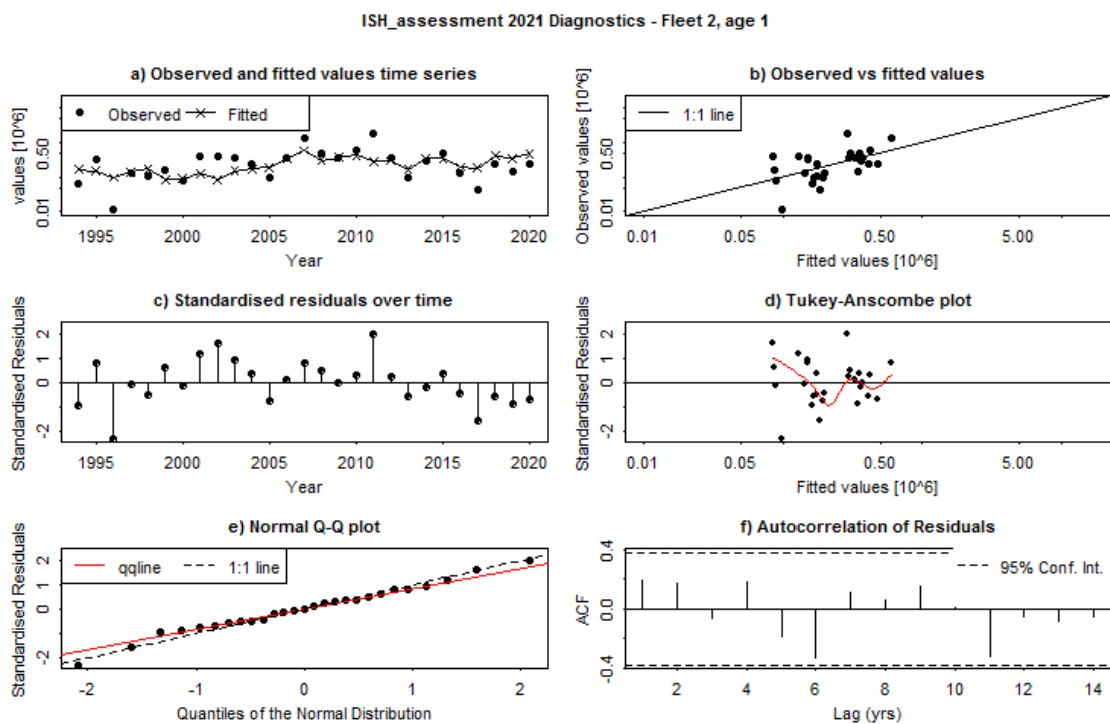


Figure 7.6.9 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age1.

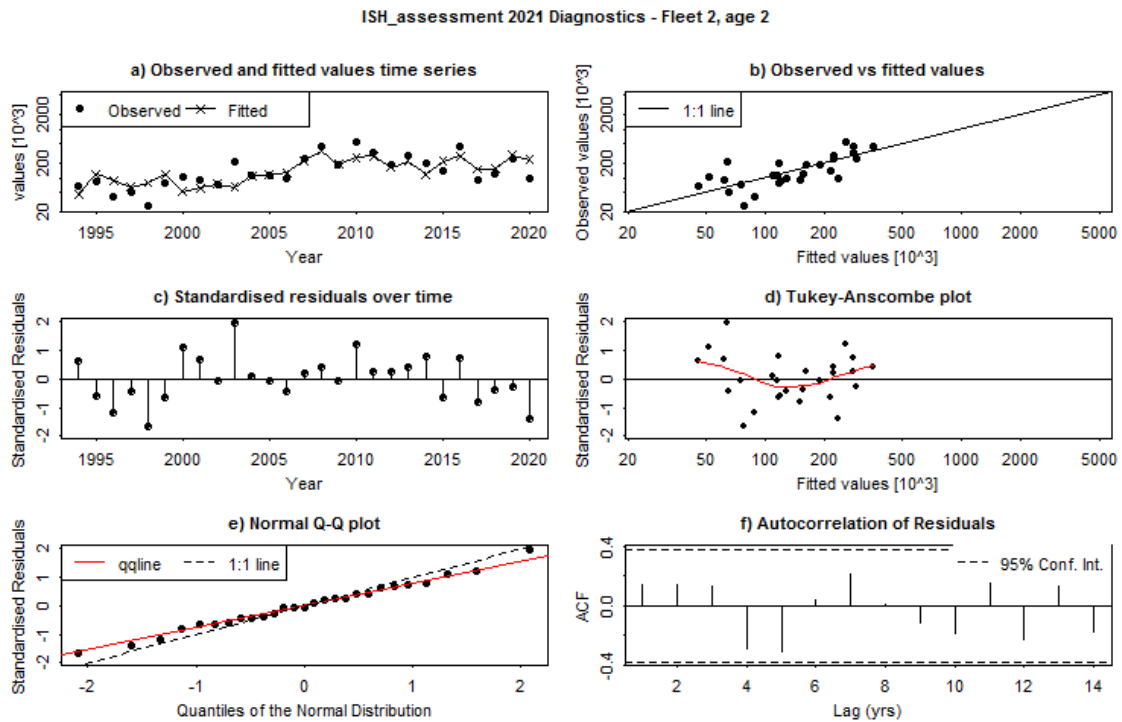


Figure 7.6.10 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age2.

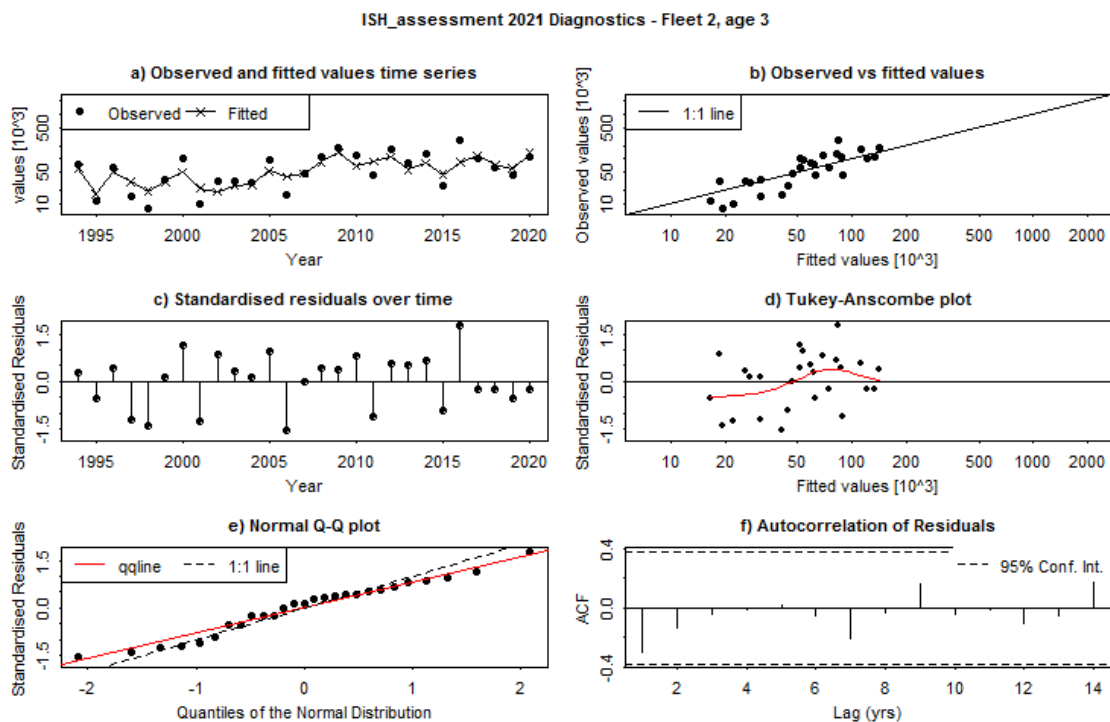


Figure 7.6.11 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age3.

ISH_assessment 2021 Diagnostics - Fleet 2, age 4

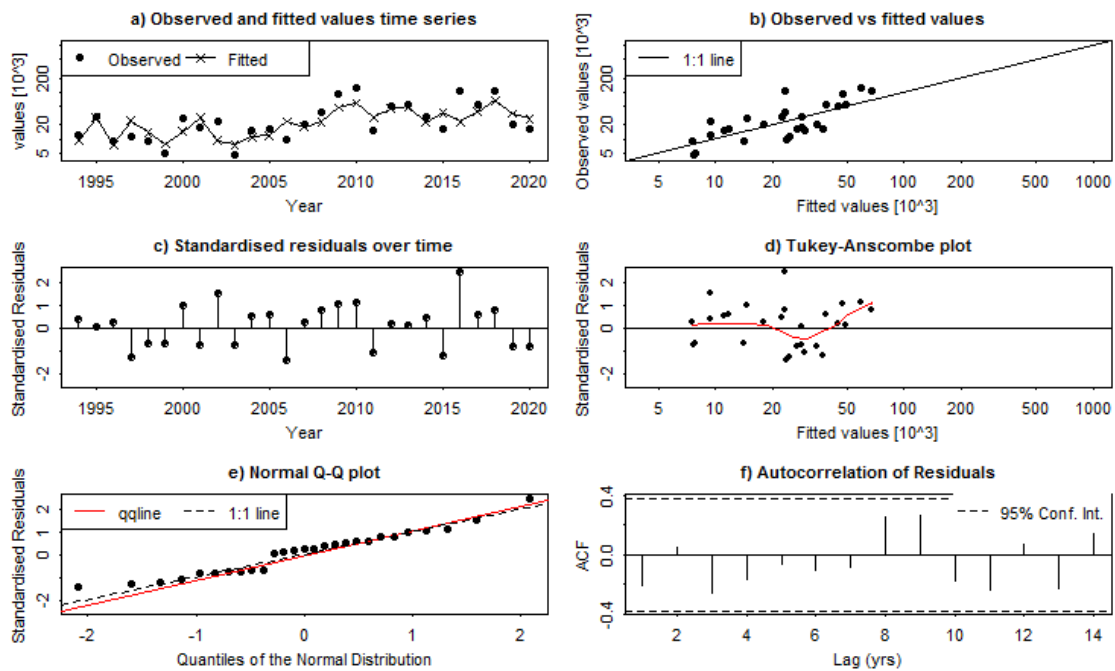


Figure 7.6.12 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age4.

ISH_assessment 2021 Diagnostics - Fleet 2, age 5

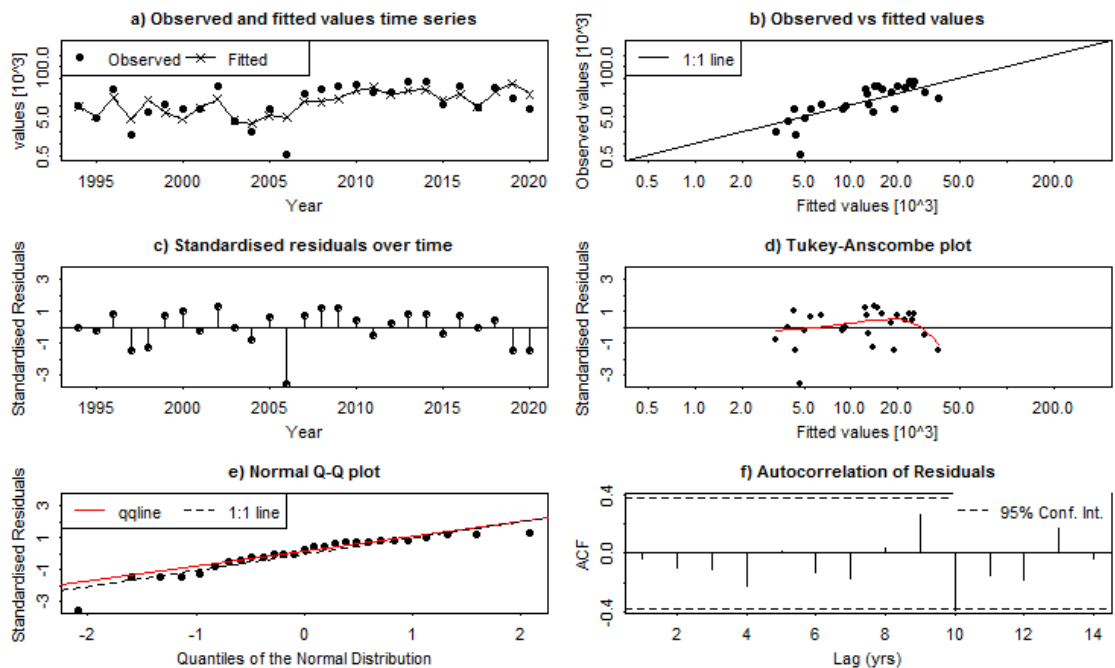


Figure 7.6.13 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age5.

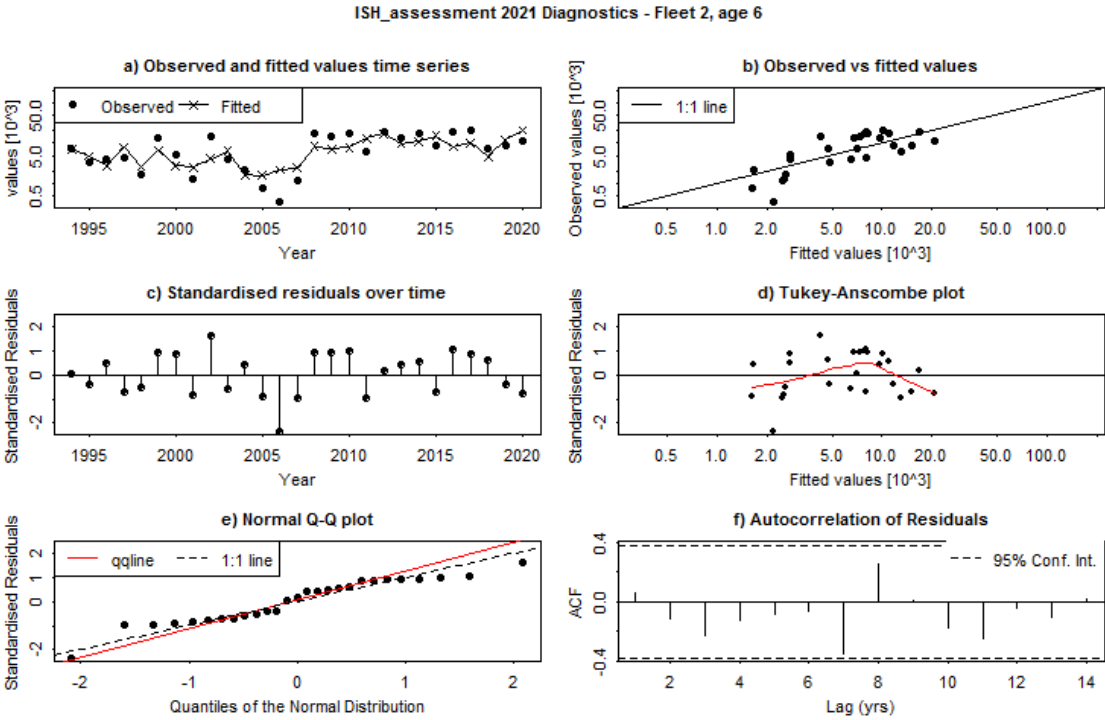


Figure 7.6.14 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age6.

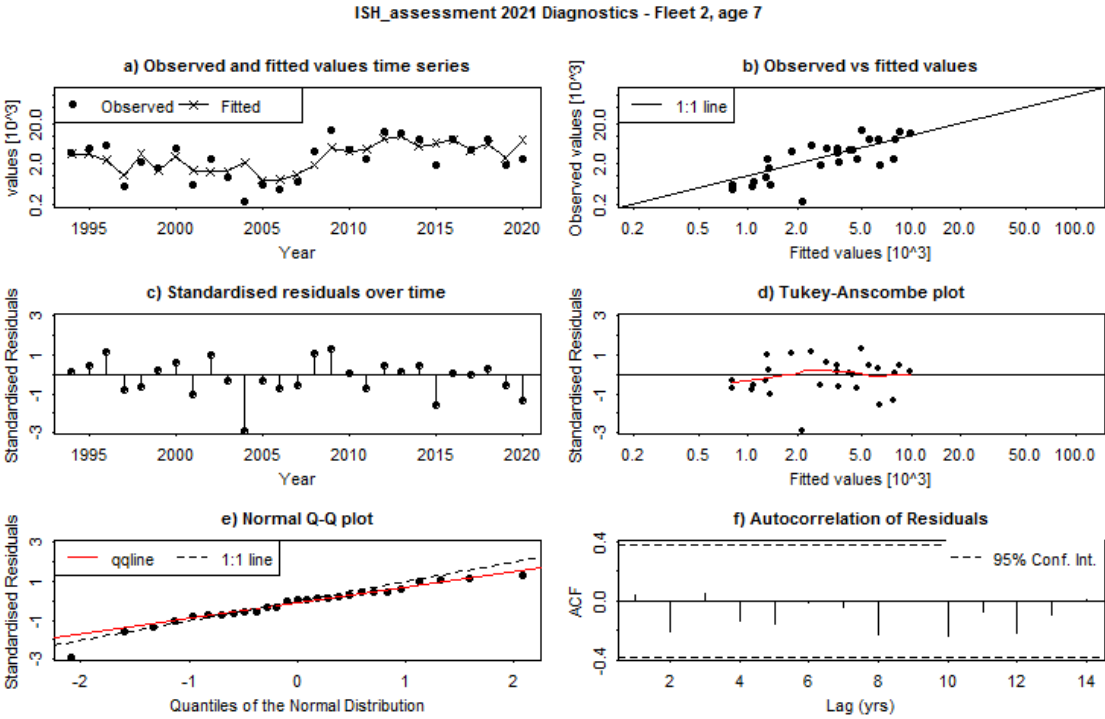


Figure 7.6.15 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age7.

ISH_assessment 2021 Diagnostics - Fleet 2, age 8

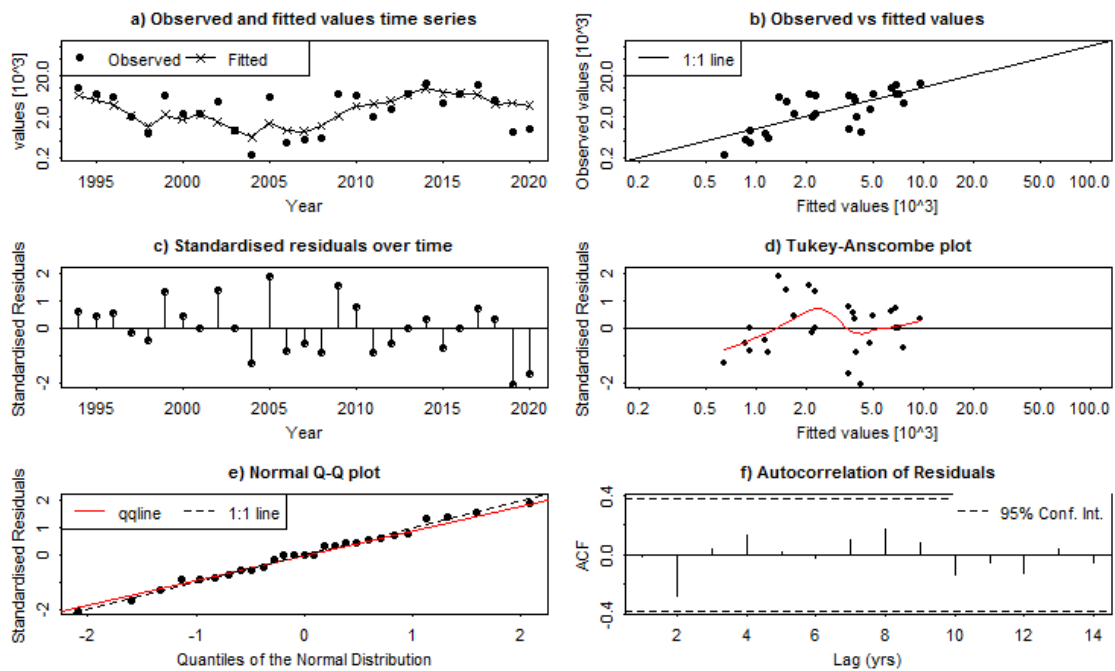


Figure 7.6.16 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to acoustic survey (AC(7.aN)) data at age8.

ISH_assessment 2021 Diagnostics - Fleet 3, age 8

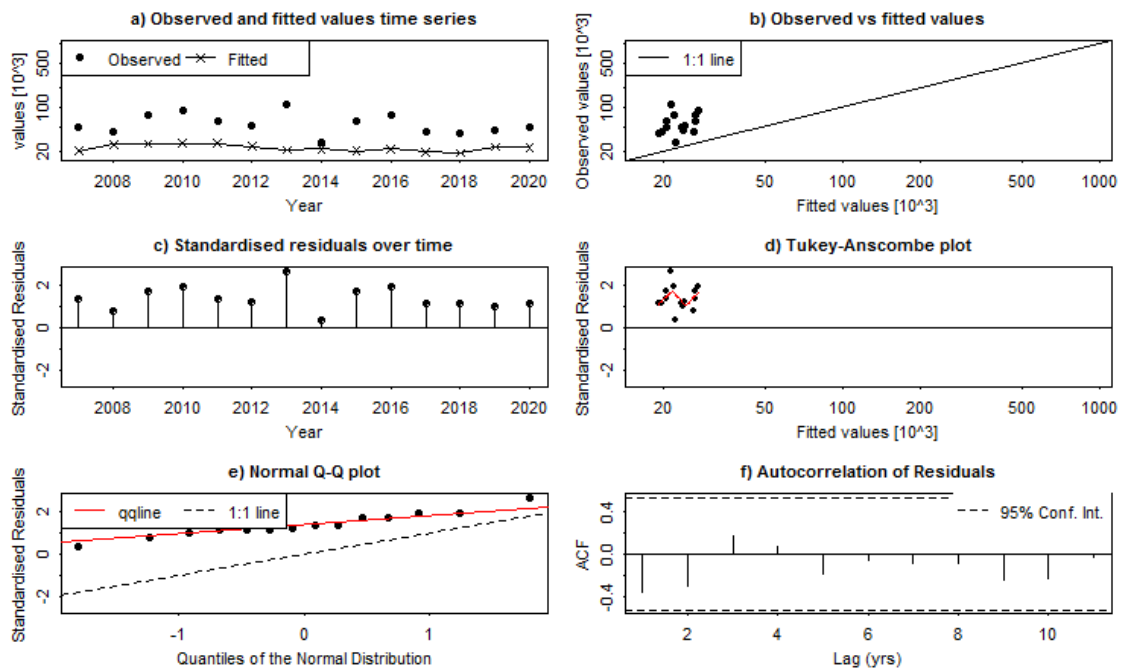


Figure 7.6.17 Herring in Division 7.a North (Irish Sea). FLSAM run output. Diagnostics of model fit to the SSB acoustic survey (SSB 7.aN)).

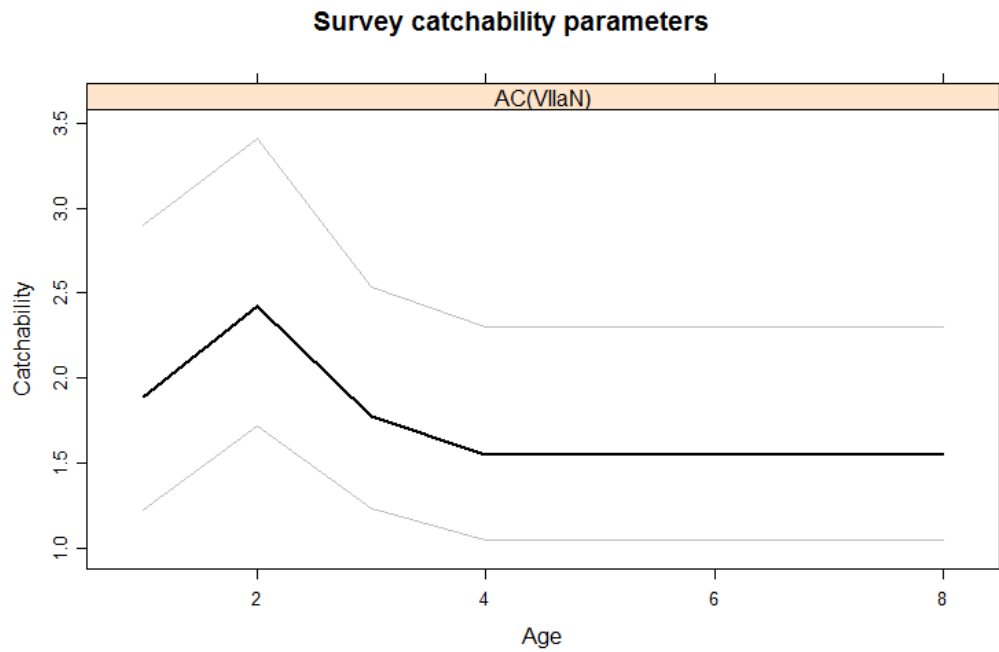


Figure 7.6.18 Herring in Division 7.a North (Irish Sea). FLSAM run output. Survey catchability parameter from the acoustic survey AC(7.aN).

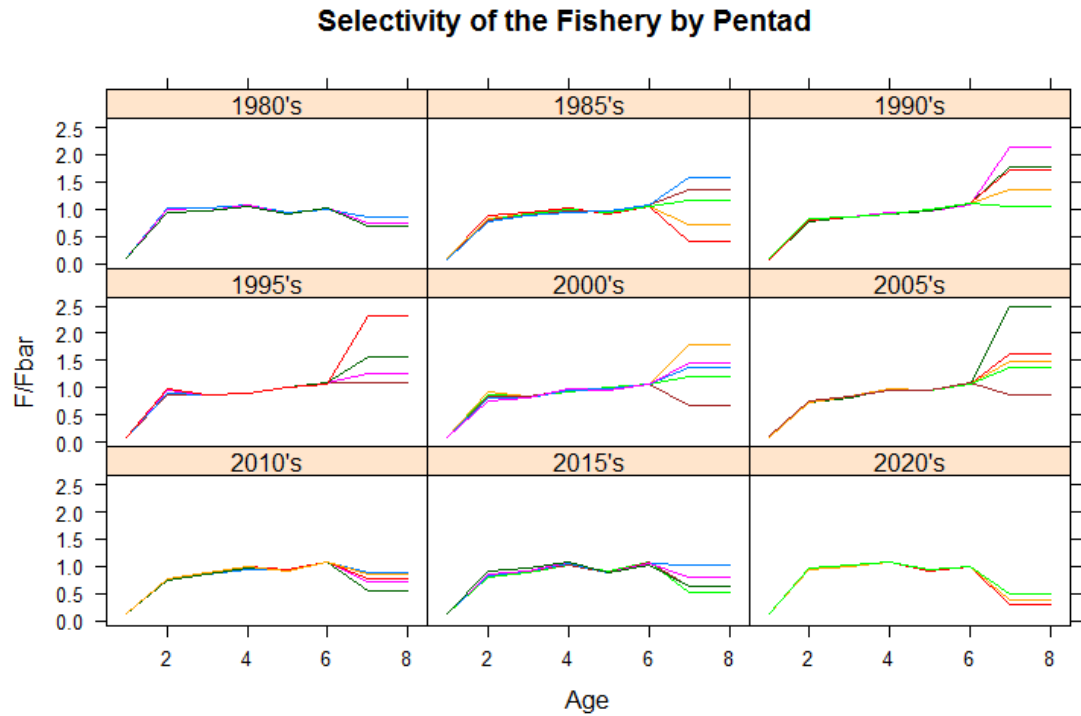


Figure 7.6.19 Herring in Division 7.a North (Irish Sea). FLSAM run output. Selectivity of the fishery by pentad.

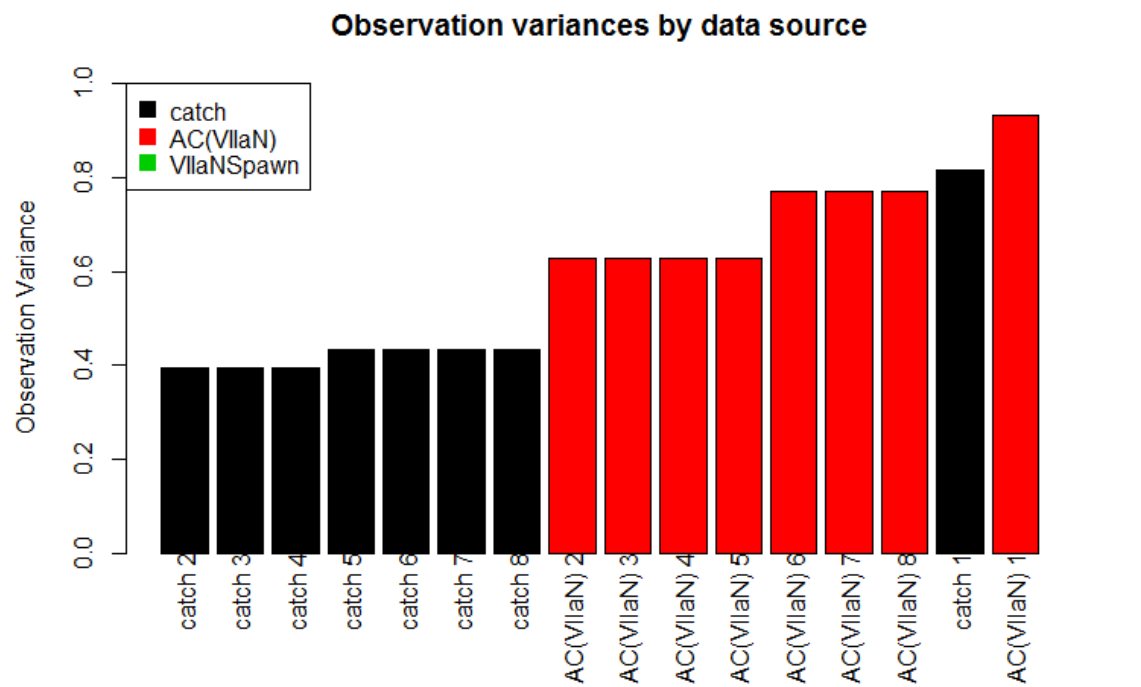


Figure 7.6.20 Herring in Division 7.a North (Irish Sea). Observation variances of all the data sources fitted in the FLSAM assessment model. The observation variance of 7.aNSpawn is fixed at 0.4

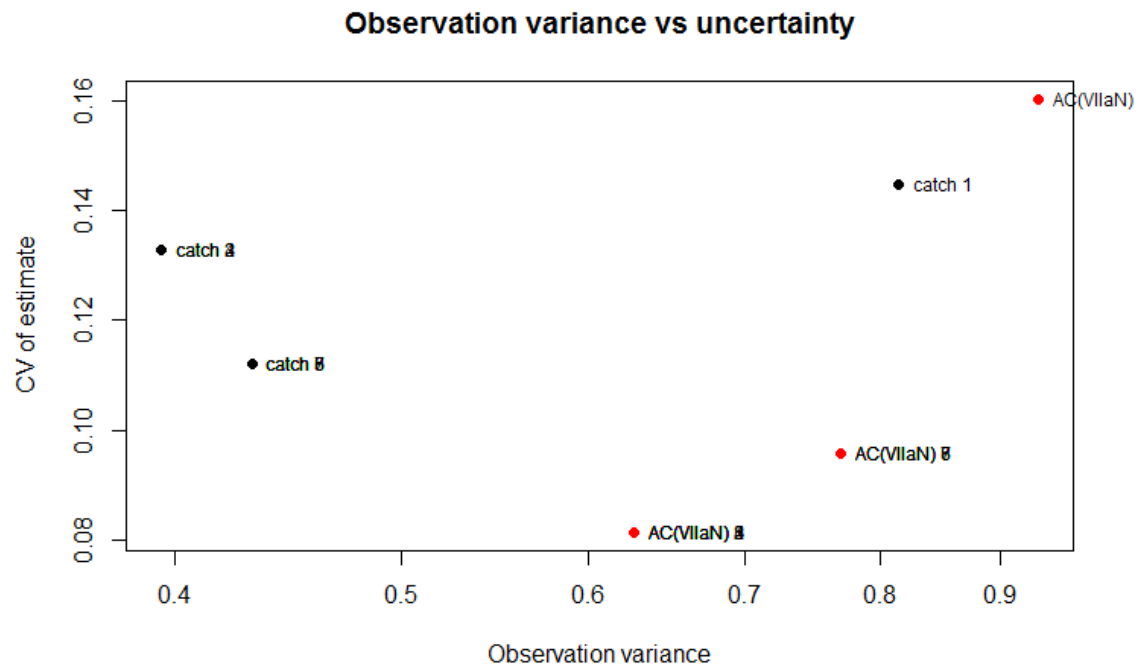


Figure 7.6.21 Herring in Division 7.a North (Irish Sea). Observation variances vs uncertainty of the data sources fitted in the FLSAM assessment model.

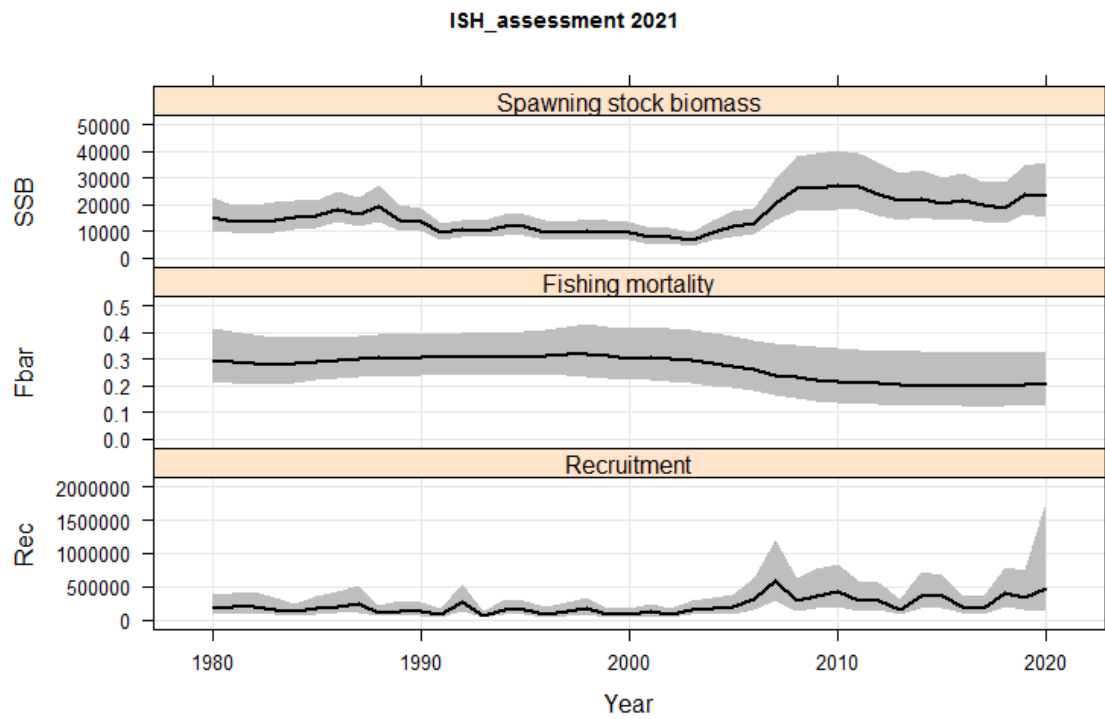


Figure 7.6.22 Herring in Division 7.a North (Irish Sea). Stock trends from the final FLSAM run, with 95% confidence intervals. Summary of estimates of spawning stock at spawning time, recruitment at 1-winter ring, mean F_{4-6} .

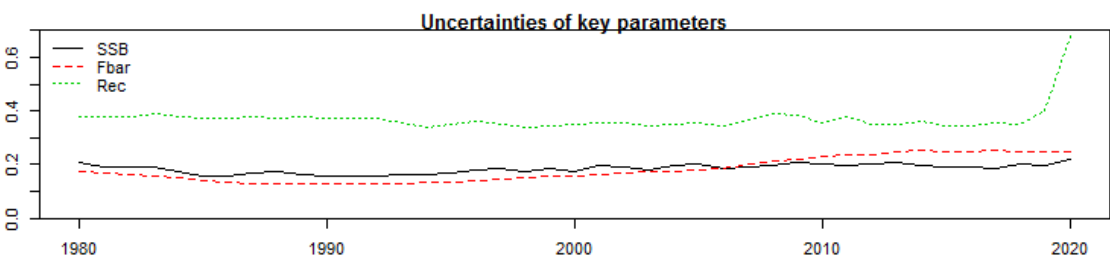


Figure 7.6.23 Herring in Division 7.a North (Irish Sea). Uncertainty of stock parameter estimates from the final FLSAM assessment. Rec = recruitment 1 winter ring.

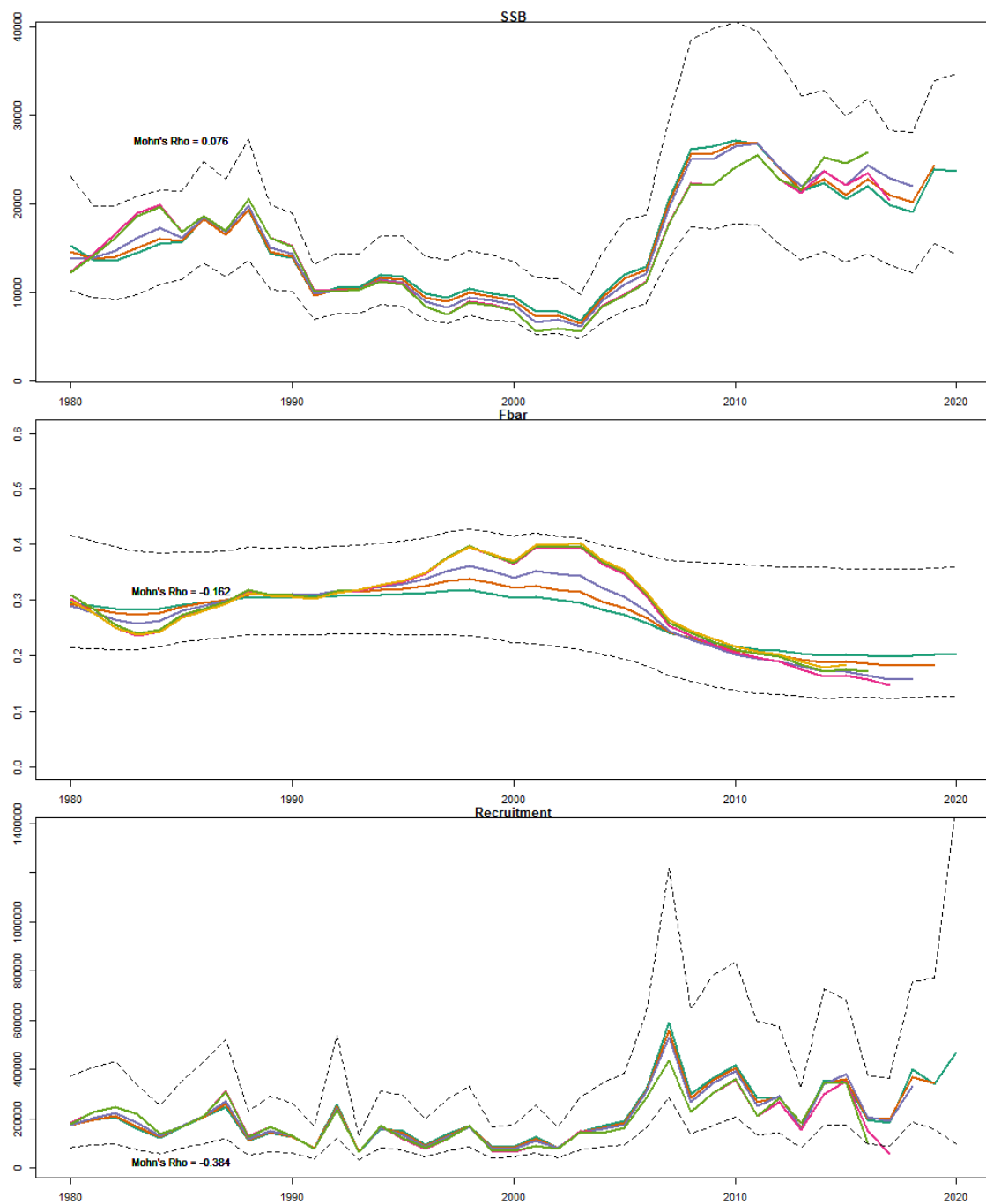


Figure 7.6.24 Herring in Division 7.a North (Irish Sea). Analytical retrospective patterns (2018 to 2013) of SSB, recruitment and mean F_{4-6} from the final FLSAM assessment. Confidence limits for the current year assessment are shown with dashed lines.

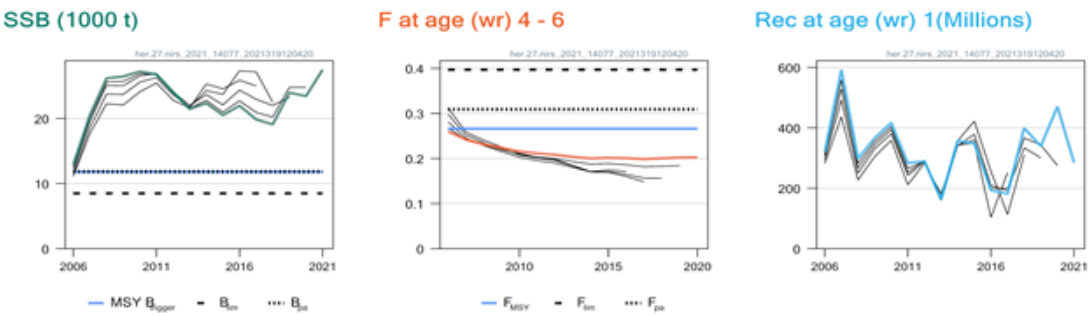


Figure 7.6.25 Herring in Division 7.a North (Irish Sea). Comparison of stock parameters between the 2021 assessment (red line) and previous assessments.