2 Herring (*Clupea harengus*) in Subarea 4 and divisions 3.a and 7.d, autumn spawners

The WG noted that the use of “age”, “winter rings”, “rings” and “ringers” still causes confusion outside the group (and sometimes even among WG members). The WG tries to avoid this by consequently using “rings”, “ringers”, “winter ringers” or “wr” instead of “age” throughout this section. However, if the word “age” is used it is qualified in brackets with one of the ring designations. It should be observed that, for autumn and winter spawning stocks, there is a difference of one year between “age” and “rings”, which is not the case for the spring spawners. Further elaboration on the rationale behind this, specific to the North Sea autumn spawners, Western Baltic spring spawners and the mixed stock catches, can be found in the 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.

2.1.1 ICES advice and management applicable to 2018 and 2019

Norway and the European Union had submitted a joint request to ICES to evaluate possible elements for long-term management strategies for several fish stocks, including North Sea autumn spawning herring.

These management strategy evaluations are in progress, but not finalized at the time of HAWG 2019. Results will become available in April 2019. There is currently no agreed EU-Norway management plan as the basis of advice. Until new agreed management strategies will become available, the MSY approach is used as the basis of ICES advice.

The final TAC adopted by the management bodies for 2018 was 610 257 tonnes for Area 4 and Division 7.d, where no more than 66 040 tonnes should be caught in Division 4.c and 7.d. For 2019, the total TAC has decreased by 35% to 398 198 tonnes (385 008 tonnes for the A-Fleet), including a TAC of 42 351 tonnes for Division 4.c and 7.d.

The by-catch TAC for the B-Fleet in the North Sea (and Division 2.a) was 9669 tonnes in 2018 and has increased by 36% to 13 190 tonnes for 2019. As North Sea autumn spawners are also caught in Division 3.a, regulations for the fleets operating in this area have to be taken into account for the management of the WBSS stock (see Section 3). Catches of spring spawning herring in the Thames estuary are in general low and not included in the TAC. For a definition of the different fleets harvesting North Sea herring see the Stock Annex and Section 2.7.2.

2.1.2 Catches in 2018

Total landings and estimated catches are given in the Table 2.1.1 for the North Sea and for each Division in tables 2.1.2 to 2.1.5. Total Working Group (WG) catches per statistical rectangle and quarter are shown in figures 2.1.1 (a–d), the total for the year in Figure 2.1.1(e). Each nation provided most of their catch data (either official landings or Working Group catch) by statistical rectangle. The catch figures in tables 2.1.1–2.1.5 are mostly provided by WG members and may or may not reflect national catch statistics. These figures can therefore **not** be used for legal purposes.

The total WG catch of all herring caught in the North Sea amounted to 602 328 tonnes in 2018. Official catches by the human consumption fishery were 593 851 tonnes, corresponding to a slight undershoot of 1% of the TAC for the human consumption fishery (600 588 tonnes).

As in previous years, the vast majority of catches are taken in the 3rd quarter in Division 4.a(W).

In the southern North Sea and the eastern Channel, the total catch sums to 45 462 tonnes. The separate TAC for this area was 66 040 tonnes, so 31% of the TAC remains in Division 4.c and 7.d (but due to catch regulations, 50% of the TAC could have been taken in Division 4.b). The obtained catch continues to relieve the fishing pressure on the Downs stock component, as observed since 2012.

Information on by-catches in the industrial fishery is provided by Denmark. While the Norwegian by-catches are included in the A-fleet figure for Norway, catches taken in the small-meshed fishery by Denmark account to a separate EU quota (B-fleet).

Landings of herring taken as by-catch in the Danish small-meshed fishery were 8477 tonnes in 2018. The by-catch ceiling for the B-Fleet was 9669 tonnes. Since the introduction of yearly by-catch ceilings in 1996, these ceilings have only fully been taken in 2014 and 2016.

The total North Sea TAC and catch estimates for the years 2013 to 2018 are shown in the table below (adapted from Table 2.1.6).

Year	2013	2014	2015	2016	2017	2018
TAC HC ('000 t)	478	470	445	518	482	601
"Official" landings HC ('000 t) *	490	490	472	545	485	594
Working Group catch HC ('000 t)	490	493	474	545	485	594
Excess of landings over TAC HC ('000 t)	12	23	28	27	3	-7
By-catch ceiling ('000 t) **	14	13	16	13	11	10
Reported by-catches ('000 t) ***	8	14	8	15	7	8
Working Group catch North Sea ('000 t)	498	507	482	560	492	602

HC = human consumption fishery

*** Landings might be provided by WG members to HAWG before the official landings become available; they may then differ from the official catches and cannot be used for management purposes. Norwegian by-catches included in this figure.**

**** by-catch ceiling for EU industrial fleets only, Norwegian by-catches included in the HC figure.**

***** provided by Denmark only.**

2.1.3 Regulations and their effects

Following the apparent recovery of the NSAS herring, some regulatory measures were amended. A licence scheme introduced in 1997 by UK/Scotland to reduce misreporting between the North Sea and 6.aN was relaxed. The minimal amount of target species in the EU industrial fisheries in 3.a has been reduced to 50% (for sprat, blue whiting and Norway pout).

In 2019, half of the EU quota for Division 3.a can be taken in the North Sea (4); based on correspondence with the Pelagic RAC, HAWG notes that this transfer will be in the order of magnitude of 48%. Norway can take up to 50% of its quota for Division 3.a in the North Sea (4).

In the North Sea, Norway can take up to 50 000 tonnes of its quota in EU-waters in divisions 4.a and 4.b. 50 000 tonnes of the EU-quota can be taken within Norwegian waters south of 62°N.

Half of the EU quota for divisions 4.c and 7.d can be taken in Division 4.b. HAWG has no information to which extend these transfers were utilised.

In 2014, an agreed record between EU and Norway was applied, enabling an inter-annual quota flexibility of 10% of the TAC. Each party could transfer non-utilised quota of up to 10% of its quota into the next year, where it is added to the quota allocated to the party concerned in the following year (or borrow 10% of the TAC, to be subtracted the following year). This inter-annual flexibility has changed in 2015 so that 25% of the TAC can be transferred into the next year, while up to 10% can be borrowed.

HAWG has not applied this record to national catches, e.g. to what extent or which party may have used this annual quota flexibility.

Since 2015, a landing obligation is in place for pelagic fleets operating in the North Sea and the Baltic. All catches of (quota) regulated species have to be landed into port.

2.1.4 Changes in fishing technology and fishing patterns.

There have been no major changes to fishing technology of the fleets that target North Sea herring.

The fishery concentrated in the north-western part of the North Sea, around the Fladen Ground area (figures 2.1.1 a–e). The majority of catches is taken in Subdivision 4.aW, in the order of 60% of the total. In line with the TAC, catches in 2018 increased in all areas except Subdivision 4.aEast. Their proportion of the total North Sea catch was 12% in 2018. Catches in Division 4.b contributed 18% in 2018.

The utilisation of catches in divisions 4.c and 7.d has decreased since 2010. Since 2014, catches in the southern North Sea contributed less than 10% to the total catch, while they were in the range of 15% for the period before 2010. The TAC in this Division is not fully taken since 2012. Catches in Division 4.c were only 2188 tonnes in 2018.

As in former years, most of the catches in the B-Fleet are taken in Division 4.b (76%). The by-catch ceiling for this fleet has not fully been taken in 2018.

After a substantial decline in misreporting since 2009, misreporting is regarded as a minor problem in the herring fishery.

2.2 Biological composition of the catch

Biological information (numbers, weight, catch (SOP) at age and relative age composition) on the catch as obtained by sampling of commercial catches is given in tables 2.2.1–2.2.5. Data are given for the whole year and by quarter. Except in cases where the necessary data are missing, data are displayed separately by area for herring caught in the North Sea, for Western Baltic spring spawners (only in 4.aE), and for the total NSAS stock, including catches in Division 3.a.

Biological information on the NSAS caught in Division 3.a was obtained using splitting procedures described in Section 2.2 and in the Stock Annex.

The tables are laid out as follows:

- Table 2.2.6: Total catches of NSAS (SOP figures), mean weights- and numbers-at-age by fleet
- Table 2.2.7: Data on catch numbers-at-age and SOP catches for the period 2003–2018 (herring caught in the North Sea)
- Table 2.2.8: WBSS taken in the North Sea (see below)
- Table 2.2.9: NSAS caught in Division 3.a
- Table 2.2.10: Total numbers of NSAS

- Table 2.2.11: Mean weights-at-age, separately for the different Divisions where NSAS are caught, for the period 2008–2018.

Note that SOP catch estimates may deviate in some instances slightly from the WG catch used for the assessment.

2.2.1 Catch in numbers-at-age

The total number of herring taken in the North Sea is 4.5 billion fish and the estimated overall number of NSAS caught in the North Sea and 3a amounts to 4.6 billion fish in 2018. The proportion of 0- and 1-ringers of herring taken in the North Sea is 31% of the total catch in numbers in 2018 (Table 2.2.5), compared to 18% in 2017. Most of these young herring are still taken in the B-Fleet in Division 4.b. Here, 0- and 1-ringers amount to 73% of the total catch in numbers.

The proportion of 3+ winterring herring is 65% of the total catch in numbers taken in the North Sea (compared to 80% in 2017). The 4 and 5 winterring herring contributed most to the catches in 2018, both in terms of numbers and in biomass.

Western Baltic (WBSS) and local Division 3.a spring-spawners are taken in the eastern North Sea during the summer feeding migration (see Stock Annex and Section 2.2.2). These catches are included in Table 2.1.1 and listed as WBSS. Table 2.2.8 specifies the estimated catch numbers of WBSS caught in the North Sea, which are transferred from the North Sea assessment to the assessment of Division 3.a/Western Baltic in 2003–2018. After splitting the herring caught in the North Sea and 3.a between stocks, the total catch of North Sea Autumn spawners amounts to 603 536 tonnes.

Area		Allocated	Unallocated	BMS	Total
4.a West		374 491			374 491
4.a East		74 580			74 580
4.b		107 795			107 795
4.c/7.d		45 462			45 462
	Total catch in the North Sea				602 328
	Autumn spawners caught in Division 3.a (SOP)				3 372
	Baltic spring spawners caught in the North Sea (SOP)				-2 164
	Total catch NSAS used for the assessment				603 536

2.2.2 Other Spring-spawning herring in the North Sea

Norwegian spring-spawners and local fjord-type spring spawning herring are taken in Division 4.a (East) close to the Norwegian coast under a separate TAC. These catches are not included in the Norwegian North Sea catch figures given in tables 2.1.1–2.1.6, but are listed separately in the respective catch tables. Along with the reduction in biomass of these spring-spawning herring in recent years, the catches have decreased in recent years and amount to 310 tonnes in 2018.

Blackwater herring are caught in the Thames estuary under a separate quota and included in the catch figure for England and Wales. In recent years, these catches have been relatively small and also in 2018 only 10 tonnes were caught.

In recent years no larger quantities of spring spawners were reported from routine sampling of commercial catch taken in the west.

2.2.3 Data revisions

No data revisions were applied in this year's assessment.

2.2.4 Quality of catch and biological data

Annual misreporting and non-allocation of catches were often substantial, but have reduced in the recent decade and are meanwhile regarded as a minor issue in the North Sea herring fishery. In 2018, no unallocated catches were reported. The **Working Group catch**, which include estimates of all fleets (and misreported or unallocated catches; see Section 1.5), is thus estimated to be the same as the official catch.

Since 2015, a landing obligation is in place for pelagic fleets operating in the North Sea and the Baltic. All catches have to be landed into port. Reported catches in the BMS category (below minimum landing size, including any fishes lost or damaged during processing procedures) were zero in 2018. Some countries stated these to be zero, and other countries have not reported any catches in this category. In accordance with the landing obligation, no discards were reported in the 2018 North Sea herring fishery. However, discards occurred in demersal fisheries not targeting on herring. These discards sum to 96 tonnes in 2018.

The sampling of commercial landings covers 83% of the total catch (2017: 84%).

More important than a sufficient overall sampling level is an appropriate spread of sampling effort over the different metiers (here defined as each combination of fleet/nation/area and quarter). Of 103 different reported metiers, 33 were sampled in 2018. The recommended sampling level of more than 1 sample per 1000 tonnes catch has been met for only 14 metiers. With regards to age readings, 14 metiers appear to be sampled sufficiently (recommended level >25 fish aged per 1000 tonnes catch).

However, some of the metiers yielded very little catch. In 52 metiers the catch is below 1000 t. The total catch in these metiers sums to 9742 t, so the remaining 51 metiers represent 592 589 tonnes of the working group catch (98%). Of these 51 metiers 27 were sampled. Only 8 fulfil the recommended level of more than 1 sample per 1000 tonnes catch and of 25 age readings per 1000 tonnes catch.

According to the DCF regulations, some catches of UK (England and Wales) were landed into and sampled by other nations.

The WG recommends that all metiers with substantial catch should be sampled (including by-catches in the industrial fisheries), and that catches landed abroad should be sampled based on criteria provided above, and information on these samples should be made available to the national laboratories (see Section 1.5).

2.3 Fishery independent information

2.3.1 Acoustic Surveys in the North Sea (HERAS), West of Scotland 6.a (N) and the Malin Shelf area (MSHAS) in June–July 2018

Six surveys were carried out during late June and July covering most of the continental shelf in the North Sea, West of Scotland and the Malin Shelf. The survey methods and full results are given in the report of the Working Group for International Pelagic Surveys (WGIPS; ICES CM 2018/EOSG:14). The vessels, areas and dates of cruises are given in Table 2.3.1.1 and in Figure 2.3.1.1.

The global survey results provide spatial distributions of herring, abundance by number and biomass-at-age by strata and distributions of mean weight- and proportion mature-at-age.

The estimate of North Sea autumn spawning herring spawning stock biomass is higher than previous year at 2.3 million tonnes (2017: 1.9) due to an increase in the number of fish (2017: 11,621 mill. fish, 2018: 12,315) and an increase in weight-at-age for mature herring. The spawning stock is dominated by fish of age 4 and 5 wr, which is in accordance with the strongest year classes in the 2017 survey.

The time series of abundance of North Sea autumn spawning herring is given in Table 2.3.1.3.

The coverage per country is shown in Figure 2.3.1 and the spatial distribution of herring from the survey is shown in Figure 2.3.1.2. The distribution of adult herring in the North Sea is still concentrated in the areas east and north of Scotland. This year the distribution is slightly further north compared to the previous two years. Substantial aggregations of juvenile herring were encountered around the Dogger Bank area in addition to the usual distribution in the south eastern parts of the North Sea and in Kattegat.

The abundance of immature fish in the stock has increased from 18 434 million in 2017 to 20 290 million this year. This is mainly due to the high number of 1 wr fish this year and partly due to the exceptionally low maturity level of the 2 wr fish this year.

Maturity of 2 winter ringers was at an all-time low at 37%. Maturities for ages 3 and above were comparable to the long-term average, with 91% of 3 winter ringers and 98% or higher maturity for all ages 4 and above. 100% maturity was achieved by age 5.

2.3.2 International Herring Larvae Surveys in the North Sea (IHLS)

Four survey areas were covered within the framework of the International Herring Larval Surveys in the North Sea during the sampling period 2018/2019. They monitored the abundance and distribution of newly hatched herring larvae in the Orkney/Shetlands area, in the Buchan area and the central North Sea (CNS) in the second half of September and in the southern North Sea (SNS) in the second half of December 2018 (Figure 2.3.2.1).

The German survey contribution around the Orkneys started as scheduled, but after one day of sampling the research vessel had to face severe technical problems. There was no opportunity to conduct a safe journey any further, thus the survey had to be stopped after 28 plankton hauls. The vessel steamed back to Bremerhaven, where it is still in repair at the time of HAWG 2019. No charter vessel was available for the survey planned in early January 2019. As a consequence, the estimate for the Orkney/Shetland area is very low and biased due to the low area coverage, and no estimate for the Downs components is available in January 2019.

The survey contribution of The Netherlands in September 2018 was as planned and covered the Buchan and the central North Sea. The December survey in the Southern North Sea was conducted on-board a smaller vessel, which turned out to be more sensitive to weather conditions. Thus the area coverage is limited, and no information about larvae abundance in the western part of the sampling area (the main spawning ground) is available.

No survey was planned for the second half of January 2019. An additional MIK sampling will be undertaken instead in March/April in the German Bight and southern North Sea. This sampling should shade light on the foraging and recruitment of herring larvae originating from the Downs stock component.

During the most recent benchmark of the North Sea herring assessment (ICES, WKPELA 2018), it was decided to use the Larvae Abundance Index (LAI) as direct input into the assessment model and to resolve spatial stock dynamics inside the model. However, only the estimates from the Buchan and central North Sea were included in the assessment. The biased estimates of the Orkney/Shetlands and the southern North Sea were excluded and not used as data input to the assessment at HAWG 2019. Instead these larval abundances were estimated by the model.

Most of the survey areas have not been fully covered since the beginning of the 1990s, e.g. the first half of September in Orkney/Shetland and Buchan and CNS. It is very unlikely that survey effort will increase in the upcoming years. Thus the survey design will be revisited at the Working Group on Surveys of Ichthyoplankton in the North Sea (WGSINS) meetings, examining different and more efficient ways to make use of the current survey effort.

2.3.3 International Bottom Trawl Survey (IBTS-Q1)

The International Bottom Trawl Survey (IBTS) provides the time series for 1-ringer herring abundance index in the North Sea from GOV catches carried out during day-time. In addition, night time catches with a fine meshed 2 m ring trawl provide abundance estimates for large herring larvae in late development stage (0-ringers) of the autumn spawning stock components.

2.3.3.1 The 0-ringer abundance (IBTS0 survey)

The total abundance of 0-ringers in the survey area is used as a recruitment index for the stock. This year, 637 depth-integrated hauls were completed with the MIK-net. The coverage of the survey area was good with at least 2 hauls in most of ICES rectangles in the North Sea as well as in the Kattegat and Skagerrak.

Index values are calculated as described in detail in the Stock Annex.

Larvae were measured to standard length (SL). As in most years, the smallest larvae <10 mm were the most numerous but. Larger larvae >18 mm SL were rarer and were caught in lower densities than last year (Figure 2.3.3.1). The smallest larvae were chiefly caught in 7.d and in the Southern Bight. The large larvae appeared in moderate to high quantities only in the western part of the North Sea, in 3 rectangles of the Southern Bight and in the Skagerrak. In the eastern part of the North Sea, the potential nurseries, abundance of large herring larvae was very low, and virtually no larvae occurred in the German Bight. Instead sardine larvae were found in considerable numbers in the German Bight, which has not been shown before.

To exclude the newly hatched Downs larvae from the index, the rule has been applied to exclude larvae below 18 mm for the calculation of the MIK index. The results of the calculation can be found in Table 2.3.3.1.2. The 2019 index is 51.6.

2.3.3.2 The 1-ringer herring abundances (IBTS-1)

The 1-ringer recruitment estimate (IBTS-1 index) is based on GOV catches in the entire survey area. The time series for year classes 1995 to 2016 is shown in Table 2.3.3.2. The index from the 2019 survey is 1539 which is almost double that of 2018 but lower than the long-term average of the time series. Figure 2.3.3.3 illustrates the spatial distribution of 1-ringers as estimated by trawling in January/February 2017, 2018 and 2019. For the 2017 year class, the majority of the 1-ringers were distributed chiefly in the southern German Bight and in the Kattegat. The mean abundance in the southeastern North Sea was apparently lower and more dispersed than in 2018. Highest abundances, however, were observed in 3 rectangles in the Kattegat contributing the most to the higher index for this year. It appears noteworthy, that the trajectories for five recent 1-ringer abundances (year classes 2013–2017) correspond very well to the trajectories of their 5 respective 0-ringer indices (Figure 2.3.3.4).

2.4 Mean weights-at-age, maturity-at-age and natural mortality

2.4.1 Mean weights-at-age

Table 2.4.1.1 shows the historic mean weights-at-age (winter ringers, wr) in the North Sea stock during the 3rd quarter in divisions 4 and 3.a from the North Sea acoustic survey (HERAS) as well as the mean weights-at-age in the catch from 1996 to 2018 for comparison. The data for 2018 were sourced from Table 2.3.1.2. and Table 2.2.2. In the third quarter most fish are approaching their peak weights just prior to spawning.

The mean weights in the acoustic survey in 2018 were lighter for groups 1 to 4-wr and 7-wr compared to those in the catch (Table 2.4.1.1).

However, the general trend towards smaller mean weight at age observed in recent years in the acoustic survey and, but less pronounced, in the catch in the 3rd quarter (Figure 2.4.1.1), seems to be discontinued in 2018. Only 1, 2 and 3-wr in the acoustic survey had lower mean weight at age compared to 2017, while all other ages had higher mean weight. In the 3rd quarter catch, all aged were heavier expect of 1 and 3-wr.

The mean weight-at-age of the 9+ wr are almost the same weight than the 8-wr in the survey. The 2007 year class (part of the plus group) seems to have been growing slower throughout the years and was also the year class exhibiting greatly reduced maturity as 2-wr in 2010 and 3-wr in 2011.

2.4.2 Maturity ogive

The percentages at age of North Sea autumn spawning herring that were considered mature in 2018 were estimated from the North Sea acoustic survey (Table 2.4.2.1). The method and justification for the use of values derived from a single year's data was described fully in ICES (HAWG; ICES CM 1996/ACFM:10). While 5+ group herring were considered fully mature in the period prior to 2015, WGIPS reported maturity stage for all groups up to 7+ separately in the most recent years.

Maturity of 2 winter ringers was at an all-time low at 37%. Maturities for ages 3 and above were comparable to the long-term average, with 91% of 3 winter ringers and 98% or higher maturity for all ages 4 and above. 100% maturity was achieved by age 5.

2.4.3 Natural mortality

One of the improvements of the 2012 benchmark of the North Sea herring stock (ICES WKPELA, 2012) was the integration of fundamental links between the North Sea ecosystem and the NSAS stock dynamics.

From 2012 onwards, the assessment of NSAS includes variable estimates of natural mortality (M) at age derived directly from a multispecies stock assessment model, the SMS model, used in WGSAM (Lewy and Vinther 2004; ICES 2011). The input data to the assessment are the smoothed values of the raw SMS model annual *M* values, which are variable both at-age and over the time. Natural mortality in years outside the time-period covered by the model are filled and estimated for each age as a five year running mean in the forward direction and in the reverse direction for years prior. The M estimates are variable along the time period covered by the assessment and are the result of predator-prey overlap and diet composition. The trends in total M of NSAS are a result of the contribution of each of the predators to the predation mortality of the NSAS stock. The time series of M adopted at the benchmark in 2012 was from the 2011 key run of the SMS model covering the period 1963–2010 (ICES WGSAM, 2011). Since 2012, the M time series were updated following the latest key runs of the SMS model (ICES WGSAM, 2014; 2016).

During the 2018 benchmark (ICES WKPELA, 2018), it was decided to use the new M time series from the 2017 SMS model key run (ICES WGSAM, 2018). However, because of the substantial impact the absolute level of M has on the assessment, an age and year independent offset is applied. This offset is calculated using a likelihood profiling of the assessment model which allows one to find the M that best fits the input data to the assessment. The optimal offset obtained is of 0.11.

2.5 Recruitment

Information on the development in North Sea herring recruitment comes from the International Bottom Trawl Surveys, from which IBTS0 and the IBTS-1 indices are derived. 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 2.6.

2.5.1 Relationship between 0-ringer and 1-ringer recruitment indices

The estimation of 0-ringer abundance (IBTS0 index) predicts the year class strength one year before the strength is estimated from abundance of 1-ringers (IBTS-1 index). The relationship between year class estimates from the two indices is illustrated in Figure 2.5.1.1 and is described by the fitted linear regression.

The time series of 0- and 1-ringer abundance from the Q1 IBTS survey exists since the 1977 year class. For more than a decade until the mid-1990s, there has been very good agreement between the indices in their description of temporal trends in recruitment, with the 0-ringer index explaining more than 70 % of the variability of the respective 1-ringer abundance. It has to be borne in mind that the IBTS 0-ringer (or MIK) index only reflects recruitment in the autumn spawning components. Hence, once the contribution of the winter spawning Downs component to the total North Sea stock increased, the relationship between the two indices started to erode. This was particularly true in recent years (the 2009 and the 2006–2007 year classes), but also already for the 1995 year class, when the predicted levels of recruitment have deviated between the two indices.

Since 2017, the MIK index time series is calculated with the new algorithm, which only dates back to 1992 and excludes larvae of Downs origin more rigorously. The correlation between 0- and 1-ringer indices utilizing the newly calculated MIK index time series is much weaker, explaining only 30% recruitment variability (Figure 2.5.1.1). However, starting with the 2013 year class there was once again good agreement between the trends of the two indices. In 2014, it was recorded as the largest 0-ringer abundance since 2002, and the strength of this year class was confirmed in 2015 with one of the largest 1-ringer abundances. This was the first strong year class observed since 2002. Since then, the IBTS 1-ringer index followed the ups and downs of the MIK 0-ringer index for the respective year class (Figure 2.5.1.1).

2.6 Assessment of North Sea herring

2.6.1 Data exploration and preliminary results

Thorough investigation of the assessment was undertaken during the last benchmark (2018). These are described in the WKPELA report (ICES WKPELA, 2018). The subsequent assessment methodology is described in the Stock Annex. In short, the changes to the assessment are as follows:

- Use of the new natural mortality from the last SMS key run (ICES WGSAM, 2018) together with a new strategy for using different SMS key runs and during interim years.
- Use of revised IBTS0 index.
- Standardization of IBTSQ1 and IBTSQ1 indices
- Introduction of IBTSQ3 age 2–5 index as a new data source
- Calculation of larvae index within the model as opposed to the SCAI model index.

The tool for the assessment of North Sea herring is FLSAM, an implementation of the State-space assessment model (www.stockassessment.org), embedded inside the FLR library (Kell *et al.*, 2007).

Acoustic (HERAS ages 1–8+), bottom trawl (IBTS-Q1 age 1, IBTS-Q3 age 2–5), IBTS0 and larval index (LAI) indices are available for the assessment of North Sea autumn spawning herring. The surveys and the years for which they are available are given in Table 2.6.1.1. The input data and the performance of the assessment have been scrutinised to check for potential problems.

The proportion mature of 2, 3 and 4-wr individuals are 37%, 91% and 98% respectively. The historical proportion mature at age are given in Table 2.6.3.5 and plotted in Figure 2.6.1.1. There is an overall decreasing trend for 2-wr individuals since 2012. The tracking of each cohort can be observed in Figure 2.6.1.2 and time series of natural mortality at age is shown in Figure 2.6.1.3.

The numbers at age over all ages in the acoustic survey can still be considered relatively high in the recent time period (see Figure 2.6.1.4). The internal consistency of the acoustic survey remains high, as it has been for a long period (see Figure 2.6.1.5).

The SAM model fits the catch and the surveys well and residuals are random and small for all ages (figures 2.6.1.6–2.6.1.41). A small block of positive residuals can be observed for age 7 catch data over the years 2000–2006, while at age 8 for catch data, a similar block of negative residuals can be observed (figures 2.6.1.12 and 2.6.1.13). This likely indicates a trade-off in model fit to either the age 7 or age 8+ catch information. There is a methodological need however to link age 7 and age 8+ together in the stock assessment model. The residuals are very small and are not considered an issue for the performance of the assessment. The fitting of the LAI index is poor due to the intrinsic noise to the larvae survey (figures 2.6.1.31–2.6.1.41). All other surveys fit well inside the model. Further visualisation of residuals for the catch data and the survey indices can be observed in figures 2.6.1.43–2.6.1.46.

A feature of the assessment model is the estimation of an observation variance parameter for each data set (see Figure 2.6.1.46). Overall, all data sources are associated with low observation variances. The catch at ages 1–5 stands out as the most precise data source while the LAI indices, IBTSQ3 age 0 and HERAS age 1 to be the noisiest data. The increase in observation variance from the SCAI index that was used in previous years is due to the change in methodology. Previously the observation variance was perceived as lower because of the pre-processing (e.g. smoothing) when modelling the SCAI index. The uncertainty associated with the parameter estimated is low for most data sources where only the CV of the catch at age 0 is somewhat high (Figure 2.6.1.47). However, the CV quantities do not indicate a lack of convergence of the assessment model.

The analytical retrospective pattern has increased compared to the 2018 assessment. This is particularly pronounced in the SSB showing a higher perception in the current assessment, but a very similar perception in F and recruits (Figure 2.6.1.48). The mean mohn's rho with a 5 year period for the peel is of -12% (Fbar), 8% (rec), 11.3% (SSB). The difference in perception of SSB is a result of the inclusion of the 2018 HERAS (Figure 2.6.2.9). For 2018, the HERAS index for ages 2–8+ exemplifies an increase in the SSB while the assessment model predicts a decrease in the SSB (Figure 2.6.2.10).

Figure 2.6.1.49 shows the model uncertainty plot, representing the parametric uncertainty of the fit of the assessment model in terminal F and SSB.

Further data screening of the input data on mature – immature biomass ratios, survey CPUEs, proportion of catch numbers- and weights-at-age and proportion of IBTS and acoustic survey ages have been executed, as well as correlation coefficient analyses for the acoustic and IBTS survey and assessment parameters (see Figure 2.6.1.50).

2.6.2 Exploratory Assessment for NS herring

An exploratory assessment using fleet disaggregated data for (1) catches at age (2) weight in the catch at age was carried out. The configuration of the multi-fleet model is presented in Table 2.6.2.1. It is important to note that fleet B and D are combined because of their similarity. More details on the model configuration exploration is provided in the 2018 benchmark report (ICES WKPELA, 2018). Tables for the multi-fleet assessment and results (including fleet wise fishing mortalities) are given in Table 2.6.2.2 to 2.6.2.5.

Of particular relevance when running the SAM model using a multi-fleet configuration is the fishing mortality at age that is outputted for each fleet. The subsequent catch residuals for each fleet is shown in Figure 2.6.2.1 to Figure 2.6.2.3. The observation variance is shown in Figure 2.6.2.4, with high levels for fleet B and D. Expectedly, the model is driven by catch data from fleet A which represents most of the overall catches. The model uncertainty and the correlation coefficients between the estimated parameters are shown in Figure 2.6.2.5 and 2.6.2.6 respectively.

As for the single fleet assessment, the retrospective over 7 year for SSB, F_{bar} and the recruitment is low (Figure 2.6.2.7). With respect to SSB, F_{bar} and recruitment, the multi-fleet assessment yields very similar results to the single fleet assessment (Figure 2.6.2.8).

2.6.3 Final Assessment for NS herring

In accordance with the settings described in the Stock Annex, the final assessment of North Sea herring was carried out by fitting the state space model (SAM, in the FLR environment). The input data and model settings are shown in tables 2.6.3.1–2.6.3.11, the SAM output is presented in tables 2.6.3.13–2.6.3.33, the stock summary in Table 2.6.3.12. Figure 2.6.3.1 shows the stock time series for SSB, F_{bar} and recruitment and Figure 2.6.3.2 shows the management strategy currently under assessment, including the biomass trigger points and contains the F_{2-6} vs SSB estimates of the past 10 years.

The spawning stock at spawning time in 2018 is estimated at approximately 1.5 million tonnes, which is a decrease of 21% in comparison to 2017.

The abundance of 0-wr fish in 2019 (2018 year class) is estimated to be at approximately 26 billion, which is 22% below the 10 year weighted mean (33 billion, see Table 2.6.3.14).

Mean F_{2-6} in 2018 is estimated at approximately 0.21, which is below the management agreement target F. The mean F_{0-1} is 0.052.

2.6.4 State of the Stock

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as is being harvested sustainably. Fishing mortality is below the estimated F_{MSY} (0.26) and the management plan target (0.26).

The SSB in autumn 2018 was estimated at 1.5 million tonnes, which is above B_{pa} (0.9 million t) and MSY $B_{trigger}$(1.4 million t).

The recruitment for the stock in recent years (since 2013) is low and the further aging of the 2013 and 2012 year classes is driving the decrease in SSB. In line with the recruitment level since 2014, the recruitment in 2019 remains low (26 billion, 22% lower than the 10 years weighted mean).

Similarly to recent years' assessments, fishing mortality on older ages remains high in recent years. According to the assessment, the fishing mortality at age 7 is around 0.54 in 2018, which is substantially higher than F_{bar2-6} (0.21). In the 2017 assessment (ICES HAWG, 2017), comparison of the only acoustic survey and catch data gave the same impression that the catches at the older ages are relatively high compared to the estimated number of fish in those ages.

2.7 Short term predictions

Short term predictions for the years 2019, 2020 and 2021 were done with code developed in the R programming language. During HAWG 2019, a modification to the code has been made because the 2015 EU-Norway management rule is no longer in force and because the ICES advice for WBSS herring resulted in a zero catch advice. The revamping of the R code also resulted in a more functional and intelligible code. As a result, it is now easier to implement different assumptions on the different fleets (e.g. TAC status quo or zero TAC for WBSS).

The various assumptions for the short term predictions for both the stock and the four different fleets are given in Table 2.7.1 and 2.7.2 respectively.

In the short-term predictions, recruitment is assumed constant at 33 billion for the years 2020 and 2021 following the same recruitment regime since 2002 (weighted mean of the past 10 year-classes, weighted by the uncertainty in the estimate). The recruitment estimate of the 2018 year class, obtained from the assessment served as the estimate for 2019.

For the intermediate year (2019), no overshoot for the A fleet was assumed, as there was minimal deviation from the TAC in 2018. Previous negotiations between the EU and Norway resulted in the allowance of 50% of the C-fleet TAC in the Kattegat-Skagerrak area to be taken in the North Sea. Because a TAC for the C-fleet had been agreed for 2019, despite the zero advice for WBSS herring, the pelagic AC was requested to estimate the percentage of the 3.a herring TAC that would be taken in the North Sea. The pelagic AC estimated it at 48% in 2019. The same proportion has been used in this projection for the scenarios where the C-fleet catch was not set to zero.

The expected catches of Western Baltic Spring Spawning herring caught under the North Sea TAC are deducted from the expected A fleet catches (amounting to 22 276 t) in the intermediate year. In the projected year 2020, the C and D fleet outtake was set to 0 in agreement with the 0-catch advice for WBSS for 2020.

For the catch options with a TAC status quo for the C and D fleets, the fraction of North Sea Autumn Spawning (NSAS) herring caught in 3.a by the C and D fleet was used to derive C and D fleet NSAS catches, based on projected TACs in 3.a for these fleets.

In the absence of an agreed management plan for NSAS herring, it has not been possible to derive fleet based fishing mortalities for the prediction year. Therefore, the ICES MSY Advice Rule (MSY AR) has been used as the basis for the advice. The MSY AR stipulates a fishing mortality of $F_{MSY} = 0.26$ when the stock is above MSY $B_{trigger}$ (1 400 000 tonnes) and a linear decline in F when the stock is below MSY $B_{trigger}$. There is no specific allowance in the ICES MSY AR for multiple fishing mortality targets, such as the F for 0 and 1 WR herring, which were previously integral part of the management plans for NSAS herring. Therefore additional assumptions needed to be made for e.g. the B-fleet. An 86% uptake (3 year average) of the advised TAC in 2019 was used. For the projection year 2020, an F status quo for the B fleet was assumed ($F_{0\text{-}1} = 0.046$). In addition, two scenarios are presented in which the TACs of the C and D fleet are the same as in 2019.

EU and Norway have requested ICES to evaluate a number of different potential management strategies to be used in the future (EU-Norway 2018[1]). While the Management Strategy Evaluations (MSE) have not been completely finalized, preliminary results for applicable target fishing mortalities and trigger biomasses were already available and have been tentatively used as scenarios in the projection.

It is noted that making fleet-wise predictions for four fleets that are more or less independent, could potentially result in many different options for 2020. The scenarios presented in Table 2.7.5 are based on certain assumptions to limit the number of options. The scenarios are for illustrative purposes only.

All predictions are for North Sea autumn spawning herring only.

2.7.1 Comments on the short-term projections

Although the SSB is expected to decrease between 2019 to 2021, due to a series of weak year-classes recruiting to the fishery, the projection still estimates a substantially higher catch compared to the projection that was carried out in HAWG 2018. This counter-intuitive result was further investigated during the working group. It was concluded that the main reasons for the higher predicted catch were: 1) a higher estimate of stock size due to a retrospective bias in this year's assessment (see Section 2.10), 2) a relatively large contribution of older fish in the population (year classes 2012 and 2013, age 6 and 7 in 2020), and 3) a high selection on the oldest ages in the population. The high proportion of age 6 and 7 in the forecast year (2020) is exemplified in Figure 2.7.2.1 and 2.7.2.2. This leads to a projection where the estimated catch (in tonnes) in 2020 consists for around 50% of fish that are age 6 (WR) and older, and that the average fishing mortality on ages 7 and 8 (WR) is around 0.54.

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[1] EU–Norway. 2018. Agreed record of consultations of long-term management strategies on joint stocks between Norway and the European Union, London, 7 June 2018. 5 pp.

The predicted catch according to the MSY Advice Rule for 2020 (418 649 tonnes) implies a 44% increase compared to the recommended catch for the A fleet in 2019 (291 040 tonnes) and a 9% increase compared to the A fleet TAC in 2019 (385 008 tonnes).

2.7.2 Exploratory short-term projections

To explore the sensitivity of the short-term projection to the particular situation for North Sea herring (stock mainly consisting of older fish that are highly selected for), HAWG 2019 carried out two exploratory short-term projections:

1. Using an age range of 2–8 WR for fishing mortality instead of the standard 2–6 WR.
2. Extending the MSY AR projection to 2025, using a fixed recruitment and fixed F patterns.

Age range 2–8

When using the age range 2–8 instead of 2–6, the highly selected older ages are included in the average fishing mortality which is being optimizing in the projection to comply to the MSY approach (F = 0.26). This resulted in a projected catch of 309 000 tonnes with an $F_{2–8}$ of 0.25, compared to the recommended catch of 418 000 tonnes with the $F_{2–6}$. Of course, it was noted that, although this may be seen as an expression of the dependency of the forecast on the oldest ages, it is not a fair comparison. Normally, if the mean age of fishing mortality would be changed, this would also require the re-estimation of reference points and this has not been attempted as part of the HAWG 2019.

Extending projection to 2025

To explore the future consequences of harvesting the recommended catch in 2020, the MSY AR projection was extended, deterministically, using the same (low) recruitment and the same fishing patterns by fleet for the years 2021–2025 (Figure 2.7.2.3). This resulted in a catch for the A fleet of 311 000 tonnes in 2021 and catches around 280 000 tonnes in the subsequent year, while the SSB would be around 1 200 000 tonnes in all years. It should be noted that this does not constitute a real evaluation of the MSY AR rule because the fishing mortality was not adapted according to the rule, but simply kept constant during the years of the projection.

Conclusions on the sensitivity of the short-term projections

The projection according to the MSY AR resulted in an A-fleet catch of 418 000 tonnes in 2020. This result is heavily dependent on the skewed age composition of the stock (many old fish due to strong 2013 year class) and a high selection for the oldest ages. Using a different age range for calculating the average fishing mortality resulted in a substantially lower projected catch (311 000 tonnes) under the assumption that F_{MSY} would not change (untested). If the current projection is extended into the future, the projected catches would be in the range of 280–310 000 tonnes.

2.8 Medium term predictions and HCR simulations

No medium term prediction or HCR simulations were carried out during the Working Group. The management strategy evaluation was still being evaluated (ICES WKNSMSE, 2019) at the time of the working group, following a EU-Norway request (EU–Norway, 2018[2]).

2.9 Precautionary and Limit Reference Points and FMSY targets

The precautionary reference points for this stock were originally adopted in 1998.

New reference points were calculated during the 2018 benchmark meeting (ICES WKPELA, 2018) and did not change the perception of the stock assessment. Reference points prior to 2018 and out of the 2018 benchmark are presented in Table 2.9.1 and 2.9.2 respectively. Overall, the fishing pressure remains below F_{MSY} while the SSB is above MSY $B_{Trigger}$. The derivation of reference points and the history of the reference points for North Sea herring are further described in the Stock Annex.

2.10 Quality of the assessment

The data used within the assessment, the assessment methods and settings were carefully scrutinized during the 2018 benchmark (ICES WKPELA, 2018) and these are described in the North Sea Herring Stock Annex (a list of links to the Stock Annexes can be found in Annex 4). The 2019 assessment was classified as an update assessment and was carried out following these procedures and settings.

The natural mortality is very impactful for the assessment and. The time series are those from the latest SMS key run available. To date, it is the SMS key run from 2017 (ICES WGSAM, 2018). However, the assessment model is sensitive to the absolute level of these time series and previous changes have caused the perception of the stock to change (ICES HAWG, 2016). During the benchmark in 2018 (ICES WKPELA, 2018), a methodology was developed to use an optimal offset (time and age independent) based on the assessment performance. This resulted in improved consistency between different assessments.

The 2019 assessment has increased the estimates of the 2016–2018 recruitments by 4.6% compared to the 2018 assessment. The SSB has been increased by 33% for 2018 and the fishing mortality is estimated to be lower by around 44.7% (see text table below and discussion in Section 2.6.4 and 2.7).

	2018 Assessment				2019 Assessment				% change 2019/2018			
Year	Rec	SSB	Catch	F_{2-6}	Rec	SSB	Catch	F_{2-6}	Rec	SSB	Catch	F_{2-6}
2016	321	2357	544	0.22	329	2596	563	0.2	2.5	10.1	3.5	-9.1
2017	185	1887	497	0.21	200	2214	498	0.18	8.1	17.3	0.2	-14.3
2018	357	1404	639	0.38	368	1870	603	0.21	3.1	33.2	-5.6	-44.7

[2] EU–Norway. 2018. Agreed record of consultations of long-term management strategies on joint stocks between Norway and the European Union, London, 7 June 2018. 5 pp.

2.11 North Sea herring spawning components

The North Sea autumn-spawning herring stock is generally understood as representing a complex of multiple spawning components (Cushing, 1955; Harden Jones, 1968; Iles and Sinclair, 1982; Heath *et al.*, 1997). Monitoring and maintaining the diversity of local populations is widely viewed as critical to the successful management of marine fish stocks.

2.11.1 International Herring Larval Survey

The spawning component abundance index (SCAI: Payne 2010) was developed to characterize the relative dynamics of the individual North Sea spawning components.

The dynamics of the components are documented in Table 2.3.2.1 and can be observed in Figure 2.11.1 (SSB based on index proportions) and Figure 2.11.2 (proportions).

Prior to 2002 there were large differences in the contributions of each of the components to the total SSB with northern components (Orkney/Shetland and Buchan) being the major contributors. Since 2002 there has been a more even contribution from each of the four components with some inter-annual variability. However, the Downs component may be under-represented in some years due late spawning and Orkney-Shetland due to a lack of sampling due to vessel constraints.

2.11.2 IBTS0 Larval Index

The ring net hauls for 0-ringers during the IBTS in the North Sea and eastern English Channel also include Downs herring larvae. These larvae are, however, too small to have passed their critical period of high and highly variable mortality. Their abundance cannot be used for recruitment prediction. These small larvae (separated as <18 mm) have been excluded from the standard estimation of 0-ringer recruitment (IBTS0 index).

2.11.3 Component considerations

The Downs TAC was set up to conserve the spawning aggregation of Downs herring. Uncertainties concerning the status of, and recruitment to, this component of the North Sea herring stock are high, and HAWG is not aware of any evidence to suggest that this measure is inappropriate. HAWG therefore recommends that the 4.c–7.d TAC be maintained at 11% of the total North Sea TAC (as recommended by ICES). Any new management approach should provide an appropriate balance of F across stock components and be similarly conservative until the uncertainty about contribution of the Downs and other components to the catch in all fisheries in the North Sea is reduced.

2.12 Ecosystem considerations

The status as of 2015 can be found in ICES HAWG (2015) and the stock annex.

2.13 Changes in the environment

For all herring stocks in the working group, the mean weight at age in the catch and in the stock has been decreasing since the early 1980s. This applies to the Celtic Sea herring, Irish Sea herring and North Sea Autumn Spawning herring. No real pattern is observed for Western Baltic Spring Spawning herring and an increase in mean weight is seen in the combined Malin Shelf herring.

Decreases in mean weight in the catch could drive the recent increase in selectivity of the fisheries for older ages. The fisheries often target certain weight classes of herring which could be of an older age in the recent years.

The North Sea Autumn Spawning herring stock has, since 2002, produced a series of below average year classes, a situation which has not been observed previously (Payne *et al.*, 2009): the most recent year class also appears to represent a continuation of this trend. This low recruitment has occurred in spite of a spawning stock biomass that is well above the B_{lim} of 800 000 tonnes (where impaired recruitment is expected to set in) (Figure 2.13.1).

Stock productivity, as represented by the number of recruits-per-spawner from the assessment, has been low for the last decade (Figure 2.13.2). Although there have been changes during this low-productivity regime, at no point has this metric approached the levels seen during the 1990s. The most recent recruits-per-spawner is amongst the lowest observed during the recent period.

Year-class strength in this stock is determined during the larvae phase (Dickey-Collas and Nash, 2005; Payne *et al*. 2009). Updating these analyses with the most recent data sets suggests that the trend of reduced larval survival between the early (as indicated by the SSB/LAI index) and the late (as indicated by the IBTS0 index) larval stages has continued in the most recent years (Figure 2.13.3). (It should be noted that the switch from the SCAI calculation to the LAI calculation inside the assessment model, has caused a higher variability in the larvae survival relationship between SSB/LAI and IBTS0 indices). The most recent observation continues the trend of relatively poor survival.

The IBTS0 index is regarded by the working group as not being representative of recruitment to the Downs spawning component, as observations of small larvae in this region are removed from the index calculation. A more appropriate metric is therefore to base the metric of larval survival on the abundance of larvae from the three northern components (i.e. excluding the Downs). However, this refined metric shows a very similar trend (Figure 2.13.4) with continued poor survival.

All indicators therefore suggest that the stock remains in the low-productivity regime observed in previous years.

Table 2.1.1: Herring caught in the North Sea. Total catch (tonnes) by country, 2014–2018. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2014	2015	2016	2017	2018
Belgium	27	18	26	13	32
Denmark *	124423	113481	133962	110318	132231
Faroe Islands	118	981	833	442	497
France	29679	30269	35177	28801	31505
Germany	36767	44377	44231	43707	51636
Netherlands	74647	70076	98859	84914	111302
Norway	142002	134349	150183	134132	162594
Lithuania	9830	-	-	-	-
Sweden	15583	13184	16625	18518	19408
Ireland	68	183	127	868	515
UK (England)	19287	18897	20485	16997	19591
UK (Scotland)	45119	48332	59240	49514	66005
UK (N.Ireland)	6612	5948	-	3469	6916
Unallocated landings	3292	1516	8	0	0
Total landings	507454	481611	559756	491693	602232
Discards/BMS	31	-	170	-	96
Total catch	507485	481611	559926	491693	602328
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
WBSS	2953	2204	1839	632	2164
Thames estuary **	10	10	1	0	0
Norw. Spring Spawners ***	2307	2191	216	83	310

*** Including any by-catches in the industrial fishery**

**** Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).**

***** These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.**

Table 2.1.2: Herring caught in the North Sea. Catch in tonnes in Division 4.a (West). These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2014	2015	2016	2017	2018
Denmark *	74719	68017	81080	76277	90763
Faroe Islands	118	981	811	405	496
France	12620	13401	15073	11064	14745
Germany	23245	32253	27926	32736	35884
Netherlands	37380	44309	66740	55832	56990
Norway	89974	47010	57056	57744	78647
Lithuania	8129	-	-	-	-
Sweden	7760	10388	9933	12447	14132
Ireland	68	183	127	868	515
UK (England)	10085	12249	13010	12072	12313
UK (Scotland)	41844	46931	58557	49012	64424
UK (N. Ireland)	6021	4878	-	3469	5582
Unallocated landings **	3292	1939	0	0	0
Total Landings	315255	282539	330313	311926	374491
Discards/BMS	31	-	100	-	-
Total catch	315286	282539	330413	311926	374491

*** Including any by-catches in the industrial fishery.**

**** May include misreported catch from 6.aN and discards. Negative unallocated catches due to misreporting into other areas.**

Table 2.1.3: Herring caught in the North Sea. Catch in tonnes in Division 4.a (East). These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2014	2015	2016	2017	2018
Denmark *	-	16739	16305	3928	751
Faroe Islands	-	-	-	-	-
France	30	-	-	-	-
Germany	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway	44060	67254	78125	74216	73452
UK (Scotland)	124	1369	-	-	-
Sweden	940	570	3985	705	377
Unallocated landings	0	-423	0	0	0
Total landings	45154	85509	98415	78849	74580
Discards/BMS	-	-	-	-	-
Total catch	45154	85509	98415	78849	74580
Norw. Spring Spawners ***	2307	2191	216	85	310

*** Including any bycatches in the industrial fishery.**

**** Negative unallocated catches due to misreporting into other areas.**

***** These catches (including some fjord-type spring spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.**

Table 2.1.4: Herring caught in the North Sea. Catch in tonnes in Division 4.b. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2014	2015	2016	2017	2018
Denmark*	49118	28551	36149	30045	4067
Faroe Islands	-	-	22	37	1
France	7839	6342	6225	7423	6090
Germany	4424	107	3419	2048	4964
Lithuania	1701	-	-	-	-
Netherlands	22628	10606	17233	15739	34491
UK (N. Ireland)	591	1070	-	-	1334
Norway	7968	20077	15002	2172	10495
Sweden	6883	2226	2705	5366	4899
UK (England)	4498	3484	3820	2435	3262
UK (Scotland)	3151	32	683	502	1581
Unallocated landings**	0	0	0	0	0
Total landings	108801	72495	85258	65767	107794
Discards	-	-	-	-	1
Total catch	108801	72495	85258	65767	107795

*** Including any bycatches in the industrial fishery**

**** Negative unallocated catches due to misreporting into other areas.**

Table 2.1.5: Herring caught in the North Sea. Catch in tonnes in Division 4.c and 7.d. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2014	2015	2016	2017	2018
Belgium	27	18	26	13	32
Denmark*	586	174	428	68	40
France	9190	10526	13879	10314	10670
Germany	9098	12017	12886	8923	10788
Netherlands	14639	15161	14886	13343	19821
Norway	-	8	-	-	-
Sweden	-	-	2	-	-
UK (England)	4704	3164	3655	2490	4016
UK (Scotland)	-	-	-	-	-
Unallocated landings***	0	0	8	0	0
Total landings	38244	41068	45770	35151	45367
Discards/BMS	-	-	70	-	95
Total catch	38244	41068	45840	35151	45462
Coastal spring spawners included above**	10	10	1	-	10

*** Including any bycatches in the industrial fishery**

**** Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).**

***** Negative unallocated catches due to misreporting into other areas.**

Table 2.1.6 ("The Wonderful Table"): Herring caught in the North Sea. Catch in thousand tonnes in Subarea 4, Division 7.d and Division 3.a.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sub-Area 4 and Division 7.d: TAC (4 and 7.d)														
Agreed Divisions 4.a,b	404.7	303.5	174.6	147.4	149.0	173.5	360.4	427.7	418.3	396.3	461.2	428.7	534.5	342.7
Agreed Div. 4.c, 7.d	50.0	37.5	26.7	23.6	15.3	26.5	44.6	50.3	51.7	49.0	57.0	53.0	66.0	42.4
Bycatch ceiling in the small mesh fishery *	42.5	31.9	18.8	16.0	13.6	16.5	17.9	14.4	13.1	15.7	13.4	11.4	9.7	13.2
CATCH (4 and 7.d)														
National catch Divisions 4.a,b **	439.2	326.8	201.2	145.0	148.1	191.7	387.2	453.8	465.9	439	514.0	456.5	556.9	
Unallocated catch Divisions 4.a,b	13.3	21.9	14.0	-1.1	0.0	0.0	-3.0	0.0	3.3	1.5	0.0	0.0	0.0	
Discard/slipping Divisions 4.a,b ***	1.5	0.1	0.2	0.1	0.0	-	-	-	0.0	-	0.1	-	0.0	
Total catch Divisions 4.a,b #	454.0	348.8	215.4	143.9	148.1	191.7	384.2	453.9	469.2	440.5	514.1	456.5	556.9	
National catch Divisions 4.c, 7.d **	51.2	34.3	26.5	21.5	26.5	26.7	37.1	44.7	38.2	41.1	45.8	35.2	45.4	
Unallocated catch Divisions 4.c,7.d	5.4	4.7	3.1	0.4	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	
Discard/slipping Divisions 4.c, 7.d ***	-	-	-	-	-	-	-	-	-	-	0.1	-	0.1	
Total catch Divisions 4.c, 7.d	56.6	39.0	29.6	21.9	26.5	26.7	40.4	44.7	38.2	41.1	45.8	35.2	45.5	
Total catch 4 and 7.d as used by ICES #	510.6	387.8	245.0	165.8	174.6	218.4	424.6	498.5	507.5	481.6	559.9	491.7	602.3	
CATCH BY FLEET/STOCK (4 and 7.d) ##														
North Sea autumn spawners directed fisheries (Fleet A)	487.1	379.6	236.3	152.1	164.8	209.2	411.8	489.9	490.5	471.5	543.6	484.1	591.7	
North Sea autumn spawners industrial (Fleet B)	11.9	7.1	8.6	9.8	9.1	8.9	10.6	8.1	14.0	7.9	14.5	7.0	8.5	

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
North Sea autumn spawners in 4 and 7.d total	499.0	386.7	244.9	161.9	173.9	218.1	422.5	498.1	504.5	479.4	558.1	491.1	600.2	
Baltic-3.a-type spring spawners in 4	11.0	1.1	0.1	3.9	0.8	0.3	2.1	0.5	3.0	2.2	1.8	0.6	2.2	
Coastal-type spring spawners	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
Norw. Spring Spawners caught under a separate quota in 4 ###	0.6	0.7	2.7	44.6	56.9	12.2	9.6	3.2	2.3	2.2	0.2	0.1	0.3	
Division 3.a: TAC (3.a)														
Agreed herring TAC	81.6	69.4	51.7	37.7	33.9	30.0	45.0	55.0	46.8	43.6	51.1	50.7	48.4	29.3
Bycatch ceiling in the small mesh fishery	20.5	15.4	11.5	8.4	7.5	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
CATCH (3.a)														
National catch	88.9	47.3	38.2	38.8	37.3	20.0	27.7	31.2	28.9	27.8	29.9	26.8	23.3	
Catch as used by ICES	51.2	47.4	38.2	38.8	37.3	20.0	27.7	31.2	28.9	27.8	29.9	26.8	23.3	
CATCH BY FLEET/STOCK (3.a) ##														
Autumn spawners human consumption (Fleet C)	11.6	16.4	9.2	5.1	12.0	6.6	7.8	11.8	9.5	10.2	4.1	7.4	3.2	
Autumn spawners mixed clupeoid (Fleet D)	3.4	3.4	3.7	1.5	1.8	1.8	4.4	1.6	3.3	4.4	1.4	0.2	0.2	
Autumn spawners in 3.a total	15.0	19.8	12.9	6.5	13.8	8.4	12.2	13.4	12.8	14.7	5.5	7.6	3.4	
Spring spawners human consumption (Fleet C)	30.2	25.3	23.0	29.4	23.0	10.8	14.5	16.6	15.4	11.3	23.3	19.0	19.7	
Spring spawners mixed clupeoid (Fleet D)	5.9	2.3	2.2	2.9	0.5	0.8	1.0	1.3	0.6	1.8	1.1	0.2	0.2	
Spring spawners in 3.a total	36.1	27.6	25.2	32.3	23.5	11.6	15.5	17.9	16.1	13.1	24.4	19.2	19.9	
North Sea autumn spawners Total as used by ICES	514.6	406.5	257.9	168.4	187.6	226.5	434.6	511.4	517.3	494.1	563.6	498.7	603.5	

Table 2.2.1: North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea and Division 3.a in 2018. Catch in numbers (millions) at age (CANUM), by quarter and division.

WR	3.a NSAS	4.aE all	4.aE WBBS	4.aE NSAS only	4.aW	4.b	4.c	7.d	4.a & 4.b NSAS	4.c & 7.d	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	14.5	0.0	0.0	0.0	54.1	1266.6	2.2	0.0	1320.7	2.2	1337.4	1322.9
1	19.2	1.4	0.0	1.4	11.0	40.5	1.2	0.0	52.9	1.2	73.3	54.1
2	28.5	35.5	0.3	35.2	94.5	25.8	0.3	22.0	155.4	22.3	206.2	178.1
3	1.1	23.3	0.9	22.4	111.7	26.8	4.0	34.4	161.0	38.4	200.5	200.3
4	1.8	110.1	2.3	107.8	798.9	179.5	7.5	83.1	1086.3	90.6	1178.6	1179.1
5	1.0	136.7	4.3	132.5	476.6	154.4	4.6	79.9	763.5	84.4	849.0	852.2
6	0.2	40.1	1.7	38.4	128.8	37.5	0.3	18.4	204.7	18.8	223.6	225.2
7	0.1	19.8	0.9	18.9	91.9	23.4	0.5	10.1	134.2	10.6	145.0	145.7
8	0.1	18.4	0.3	18.2	95.8	19.8	0.4	10.0	133.8	10.3	144.2	144.4
9+	0.0	24.3	0.4	24.0	115.1	26.9	0.0	22.3	166.0	22.3	188.3	188.7
Sum	66.5	409.8	11.0	398.7	1978.5	1801.2	21.0	280.3	4178.4	301.2	4546.1	4490.6
Quarter: 1												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5.2	0.0	0.0	0.0	1.3	11.1	1.0	0.0	12.4	1.0	18.6	13.4
2	23.6	0.2	0.0	0.2	6.4	1.6	0.3	0.9	8.2	1.2	33.1	9.5
3	0.5	0.1	0.0	0.1	5.4	0.0	2.3	4.4	5.6	6.6	12.7	12.2
4	0.1	0.5	0.0	0.5	25.4	0.3	6.1	11.9	26.1	18.0	44.3	44.1
5	0.0	0.6	0.0	0.6	16.6	0.2	3.6	10.7	17.4	14.3	31.8	31.7
6	0.0	0.2	0.0	0.2	3.7	0.0	0.2	1.2	3.9	1.4	5.3	5.3
7	0.0	0.1	0.0	0.1	1.7	0.0	0.3	3.5	1.8	3.8	5.5	5.5
8	0.0	0.1	0.0	0.1	0.2	0.0	0.2	2.7	0.3	2.9	3.2	3.2
9+	0.0	0.1	0.0	0.1	2.1	0.0	0.0	6.1	2.2	6.1	8.4	8.4
Sum	29.5	1.7	0.0	1.7	62.9	13.3	14.0	41.4	77.9	55.4	162.8	133.3
Quarter: 2												
0	0.0	0.0	0.0	0.0	0.0	232.5	0.0	0.0	232.5	0.0	232.5	232.5
1	0.5	1.1	0.0	1.1	1.9	5.1	0.0	0.0	8.1	0.0	8.6	8.1
2	0.6	31.1	0.2	30.9	36.2	0.1	0.0	0.0	67.2	0.0	67.8	67.4
3	0.0	18.4	0.1	18.2	20.3	0.0	0.0	0.0	38.6	0.1	38.7	38.8
4	0.0	84.9	0.4	84.5	117.6	0.7	0.1	0.1	202.9	0.2	203.1	203.5
5	0.0	111.4	0.8	110.5	80.2	0.5	0.1	0.1	191.2	0.2	191.4	192.2
6	0.0	31.1	0.0	31.1	11.8	0.2	0.0	0.0	43.0	0.0	43.1	43.1
7	0.0	15.3	0.0	15.3	6.4	0.1	0.0	0.0	21.7	0.0	21.8	21.8
8	0.0	15.0	0.0	15.0	8.7	0.1	0.0	0.0	23.7	0.0	23.7	23.7
9+	0.0	19.3	0.0	19.3	8.7	0.1	0.0	0.1	28.1	0.1	28.1	28.1
Sum	1.2	327.5	1.6	325.9	291.7	239.4	0.2	0.4	857.0	0.6	858.8	859.2
Quarter: 3												
0	4.0	0.0	0.0	0.0	1.9	899.9	0.0	0.0	901.8	0.0	905.9	901.8
1	4.8	0.2	0.0	0.2	2.1	15.1	0.0	0.0	17.3	0.0	22.1	17.4
2	3.7	3.6	0.1	3.5	35.8	10.0	0.0	0.0	49.4	0.0	53.1	49.5
3	0.5	4.2	0.8	0.0	74.7	14.6	0.1	0.0	89.3	0.1	89.9	93.6
4	1.6	21.5	1.8	0.0	533.8	127.3	0.1	0.0	661.0	0.1	662.7	682.6
5	1.0	21.5	3.5	0.0	283.5	98.1	0.1	0.0	381.6	0.1	382.6	403.2
6	0.2	7.7	1.7	0.0	93.9	26.3	0.0	0.0	120.2	0.0	120.3	127.9
7	0.1	3.9	0.8	0.0	68.1	15.9	0.0	0.0	84.0	0.0	84.1	87.8
8	0.1	3.0	0.2	0.0	71.8	11.3	0.0	0.0	83.0	0.0	83.1	86.1
9+	0.0	4.3	0.3	0.0	83.7	11.4	0.0	0.0	95.2	0.0	95.2	99.5
Sum	15.9	70.0	9.2	3.8	1249.3	1229.7	0.4	0.0	2482.8	0.4	2499.0	2549.3
Quarter: 4												
0	10.5	0.0	0.0	0.0	52.2	134.2	2.2	0.0	186.4	2.2	199.1	188.6
1	8.7	0.0	0.0	0.0	5.7	9.3	0.1	0.0	15.1	0.1	23.9	15.2
2	0.6	0.6	0.0	0.6	16.0	14.1	0.0	21.1	30.7	21.1	52.3	51.7
3	0.1	0.6	0.0	0.6	11.3	12.2	1.5	30.0	24.1	31.6	55.7	55.7
4	0.1	3.2	0.0	3.1	122.2	51.2	1.2	71.1	176.5	72.2	248.8	248.8
5	0.1	3.3	0.0	3.3	96.3	55.6	0.8	69.0	155.2	69.8	225.1	225.1
6	0.0	1.2	0.1	1.1	19.5	11.0	0.2	17.2	31.6	17.3	48.9	49.0
7	0.0	0.6	0.0	0.6	15.8	7.4	0.2	6.6	23.8	6.8	30.6	30.6
8	0.0	0.4	0.0	0.4	15.1	8.4	0.2	7.2	23.9	7.4	31.3	31.4
9+	0.0	0.6	0.1	0.6	20.6	15.4	0.0	16.1	36.5	16.1	52.7	52.7
Sum	20.0	10.5	0.2	10.3	374.5	318.9	6.4	238.4	703.8	244.8	968.5	948.8

Table 2.2.2: North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea and Division 3.a in 2018. Mean weight-at-age (kg) in the catch (WECA), by quarter and division.

WR	3.a NSAS	4.aE all	4.aE WBSS	4.aW	4.b	4.c	7.d	4.a & 4.b all	4.c & 7.d	Total NSAS	Herring caught in the North Sea
Quarters: 1-4											
0	**0.010**	**0.000**	**0.000**	**0.010**	**0.005**	**0.010**	**0.000**	**0.005**	**0.010**	**0.005**	**0.005**
1	**0.049**	**0.091**	**0.096**	**0.065**	**0.027**	**0.011**	**0.000**	**0.037**	**0.011**	**0.039**	**0.036**
2	**0.058**	**0.125**	**0.127**	**0.114**	**0.117**	**0.061**	**0.114**	**0.117**	**0.113**	**0.109**	**0.117**
3	**0.103**	**0.152**	**0.163**	**0.156**	**0.138**	**0.104**	**0.118**	**0.152**	**0.116**	**0.145**	**0.145**
4	**0.156**	**0.173**	**0.183**	**0.188**	**0.192**	**0.121**	**0.146**	**0.187**	**0.144**	**0.184**	**0.184**
5	**0.179**	**0.188**	**0.197**	**0.193**	**0.211**	**0.132**	**0.157**	**0.195**	**0.156**	**0.191**	**0.192**
6	**0.190**	**0.201**	**0.213**	**0.220**	**0.237**	**0.170**	**0.164**	**0.220**	**0.164**	**0.215**	**0.215**
7	**0.187**	**0.212**	**0.224**	**0.241**	**0.248**	**0.164**	**0.190**	**0.238**	**0.189**	**0.234**	**0.234**
8	**0.203**	**0.219**	**0.232**	**0.250**	**0.246**	**0.218**	**0.195**	**0.245**	**0.196**	**0.242**	**0.242**
9+	**0.000**	**0.230**	**0.243**	**0.258**	**0.258**	**0.259**	**0.209**	**0.254**	**0.209**	**0.249**	**0.249**
Quarter: 1											
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	**0.000**
1	0.029	0.088	0.088	0.015	0.013	0.007	0.000	0.013	0.007	**0.017**	**0.013**
2	0.050	0.110	0.110	0.085	0.028	0.055	0.075	0.074	0.000	**0.057**	**0.074**
3	0.074	0.125	0.125	0.102	0.085	0.084	0.092	0.102	0.000	**0.094**	**0.095**
4	0.096	0.154	0.154	0.137	0.135	0.111	0.113	0.137	0.112	**0.127**	**0.127**
5	0.118	0.174	0.174	0.150	0.148	0.119	0.136	0.150	0.132	**0.142**	**0.142**
6	0.143	0.190	0.190	0.170	0.170	0.113	0.149	0.171	0.145	**0.164**	**0.164**
7	0.175	0.200	0.200	0.177	0.176	0.135	0.153	0.178	0.000	**0.160**	**0.160**
8	0.000	0.216	0.216	0.196	0.000	0.193	0.175	0.200	0.176	**0.178**	**0.178**
9+	0.000	0.224	0.224	0.214	0.215	0.000	0.187	0.214	0.187	**0.194**	**0.194**
Quarter: 2											
0	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	**0.003**	**0.003**
1	0.023	0.088	0.088	0.078	0.010	0.000	0.000	0.037	0.000	**0.036**	**0.037**
2	0.048	0.123	0.123	0.104	0.136	0.071	0.075	0.113	0.000	**0.112**	**0.113**
3	0.063	0.149	0.149	0.128	0.142	0.084	0.092	0.138	0.088	**0.138**	**0.138**
4	0.091	0.169	0.169	0.149	0.201	0.111	0.113	0.157	0.112	**0.157**	**0.157**
5	0.119	0.185	0.185	0.163	0.215	0.119	0.136	0.176	0.130	**0.176**	**0.176**
6	0.000	0.198	0.198	0.180	0.229	0.113	0.149	0.193	0.143	**0.193**	**0.193**
7	0.000	0.208	0.208	0.190	0.246	0.135	0.153	0.203	0.000	**0.203**	**0.203**
8	0.000	0.216	0.216	0.204	0.259	0.193	0.175	0.212	0.177	**0.212**	**0.212**
9+	0.000	0.227	0.227	0.220	0.270	0.000	0.187	0.225	0.187	**0.225**	**0.225**
Quarter: 3											
0	0.008	0.000	0.000	0.005	0.005	0.000	0.000	0.005	0.000	**0.005**	**0.005**
1	0.059	0.104	0.104	0.094	0.033	0.000	0.000	0.041	0.000	**0.045**	**0.041**
2	0.106	0.138	0.138	0.127	0.127	0.000	0.000	0.128	0.000	**0.126**	**0.128**
3	0.133	0.164	0.164	0.168	0.137	0.131	0.000	0.163	0.131	**0.163**	**0.163**
4	0.161	0.186	0.186	0.203	0.199	0.170	0.000	0.202	0.170	**0.202**	**0.202**
5	0.181	0.200	0.200	0.207	0.223	0.184	0.000	0.211	0.184	**0.211**	**0.211**
6	0.192	0.213	0.213	0.233	0.246	0.225	0.000	0.235	0.225	**0.235**	**0.235**
7	0.187	0.224	0.224	0.254	0.261	0.212	0.000	0.254	0.212	**0.254**	**0.254**
8	0.202	0.232	0.232	0.262	0.267	0.245	0.000	0.262	0.245	**0.262**	**0.262**
9+	0.000	0.244	0.244	0.270	0.284	0.000	0.000	0.270	0.000	**0.271**	**0.271**
Quarter: 4											
0	0.011	0.000	0.000	0.010	0.010	0.010	0.000	0.010	0.010	**0.010**	**0.010**
1	0.056	0.104	0.104	0.061	0.045	0.041	0.000	0.051	0.041	**0.053**	**0.051**
2	0.082	0.138	0.138	0.122	0.121	0.127	0.116	0.122	0.116	**0.119**	**0.120**
3	0.119	0.164	0.164	0.152	0.139	0.131	0.122	0.146	0.122	**0.132**	**0.132**
4	0.148	0.184	0.184	0.173	0.174	0.169	0.152	0.173	0.152	**0.167**	**0.167**
5	0.178	0.200	0.200	0.182	0.189	0.184	0.161	0.185	0.161	**0.177**	**0.177**
6	0.181	0.213	0.213	0.192	0.216	0.224	0.165	0.201	0.165	**0.188**	**0.188**
7	0.196	0.223	0.223	0.211	0.220	0.212	0.210	0.214	0.210	**0.213**	**0.213**
8	0.226	0.231	0.231	0.219	0.217	0.244	0.203	0.219	0.204	**0.215**	**0.215**
9+	0.000	0.242	0.242	0.231	0.238	0.259	0.218	0.234	0.218	**0.229**	**0.229**

Table 2.2.3: North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea in 2018. Mean length-at-age (cm) in the catch, by quarter and division.

WR	3.a NSAS	4.aE all	4.aW WBSS	4.aW	4.b	4.c	7.d	4.a & 4.b all	4.c & 7.d	Herring caught in the North Sea
Quarters: 1-4										
0	**n.d.**	**0.0**	**n.d.**	**11.0**	**8.8**	**11.1**	**0.0**	**8.9**	**11.1**	**8.9**
1	**n.d.**	**20.6**	**n.d.**	**19.0**	**14.7**	**11.5**	**0.0**	**15.8**	**11.5**	**15.7**
2	**n.d.**	**23.1**	**n.d.**	**23.2**	**23.3**	**20.1**	**23.9**	**23.2**	**23.8**	**23.3**
3	**n.d.**	**24.8**	**n.d.**	**25.7**	**24.7**	**23.7**	**24.2**	**25.4**	**24.2**	**25.2**
4	**n.d.**	**26.0**	**n.d.**	**27.1**	**27.1**	**24.9**	**25.9**	**27.0**	**25.8**	**26.9**
5	**n.d.**	**26.9**	**n.d.**	**27.5**	**28.0**	**25.9**	**26.5**	**27.5**	**26.5**	**27.4**
6	**n.d.**	**27.6**	**n.d.**	**28.6**	**29.0**	**27.4**	**26.9**	**28.5**	**26.9**	**28.4**
7	**n.d.**	**28.1**	**n.d.**	**29.5**	**29.5**	**27.4**	**28.6**	**29.3**	**28.5**	**29.2**
8	**n.d.**	**28.5**	**n.d.**	**29.7**	**29.6**	**30.3**	**28.7**	**29.6**	**28.7**	**29.5**
9+	**n.d.**	**29.0**	**n.d.**	**29.9**	**30.1**	**30.5**	**29.3**	**29.8**	**29.3**	**29.8**
Quarter: 1										
0	n.d.	0.0	n.d.	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
1	n.d.	20.4	n.d.	12.3	12.1	10.6	0.0	12.1	10.6	**12.0**
2	n.d.	22.6	n.d.	21.9	16.2	19.6	21.7	20.8	0.0	**20.8**
3	n.d.	23.9	n.d.	23.3	22.6	23.0	23.3	23.3	0.0	**23.2**
4	n.d.	26.0	n.d.	25.8	26.1	24.6	24.5	25.9	24.5	**25.3**
5	n.d.	26.8	n.d.	26.7	26.9	25.6	26.1	26.7	26.0	**26.4**
6	n.d.	27.6	n.d.	27.6	27.7	25.8	27.6	27.6	27.4	**27.6**
7	n.d.	28.0	n.d.	28.0	28.1	27.0	27.9	28.0	0.0	**27.9**
8	n.d.	28.4	n.d.	28.2	0.0	29.8	28.7	28.2	28.8	**28.7**
9+	n.d.	29.0	n.d.	29.3	29.4	0.0	29.6	29.3	29.6	**29.5**
Quarter: 2										
0	n.d.	0.0	n.d.	0.0	7.6	0.0	0.0	0.0	0.0	**7.6**
1	n.d.	20.4	n.d.	19.8	11.0	0.0	0.0	14.4	0.0	**14.4**
2	n.d.	23.0	n.d.	22.3	24.2	20.8	21.7	22.6	0.0	**22.6**
3	n.d.	24.7	n.d.	23.9	24.6	23.0	23.3	24.3	23.2	**24.3**
4	n.d.	25.9	n.d.	25.1	27.4	24.6	24.5	25.5	24.5	**25.5**
5	n.d.	26.8	n.d.	26.0	28.0	25.6	26.1	26.5	25.9	**26.5**
6	n.d.	27.5	n.d.	26.8	28.7	25.8	27.6	27.3	27.3	**27.3**
7	n.d.	28.0	n.d.	27.4	29.5	27.0	27.9	27.8	0.0	**27.8**
8	n.d.	28.4	n.d.	28.0	30.1	29.8	28.7	28.3	28.8	**28.3**
9+	n.d.	28.9	n.d.	28.6	30.6	0.0	29.6	28.8	29.6	**28.8**
Quarter: 3										
0	n.d.	0.0	n.d.	8.8	8.8	0.0	0.0	8.8	0.0	**8.8**
1	n.d.	21.4	n.d.	21.2	15.9	0.0	0.0	16.6	0.0	**16.6**
2	n.d.	23.8	n.d.	24.0	24.0	0.0	0.0	24.0	0.0	**24.0**
3	n.d.	25.3	n.d.	26.3	24.7	24.6	0.0	26.0	24.6	**26.0**
4	n.d.	26.6	n.d.	27.6	27.4	26.4	0.0	27.6	26.4	**27.6**
5	n.d.	27.3	n.d.	27.8	28.4	27.2	0.0	27.9	27.2	**27.9**
6	n.d.	27.9	n.d.	28.9	29.2	28.8	0.0	28.9	28.8	**28.9**
7	n.d.	28.4	n.d.	29.7	29.9	27.8	0.0	29.7	27.8	**29.7**
8	n.d.	28.8	n.d.	30.0	30.5	30.8	0.0	30.0	30.8	**30.0**
9+	n.d.	29.3	n.d.	30.1	31.0	0.0	0.0	30.2	0.0	**30.2**
Quarter: 4										
0	n.d.	0.0	n.d.	11.1	11.1	11.1	0.0	11.1	11.1	**11.1**
1	n.d.	21.4	n.d.	19.4	18.1	17.8	0.0	18.6	17.8	**18.6**
2	n.d.	23.8	n.d.	24.2	23.5	25.0	24.0	23.9	24.0	**23.9**
3	n.d.	25.3	n.d.	26.0	24.8	24.6	24.4	25.4	24.4	**24.8**
4	n.d.	26.5	n.d.	27.2	26.4	26.4	26.1	27.0	26.1	**26.7**
5	n.d.	27.3	n.d.	27.9	27.2	27.2	26.6	27.6	26.6	**27.3**
6	n.d.	27.9	n.d.	28.4	28.4	28.8	26.9	28.4	26.9	**27.8**
7	n.d.	28.4	n.d.	29.4	28.6	28.0	28.9	29.1	28.9	**29.1**
8	n.d.	28.8	n.d.	29.5	28.5	30.8	28.7	29.2	28.7	**29.1**
9+	n.d.	29.3	n.d.	29.9	29.4	30.5	29.2	29.7	29.2	**29.5**

Table 2.2.4: North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea and Division 3.a in 2018. Catches (tonnes) at-age (SOP figures), by quarter and division.

WR	3.a NSAS	4.aE all	4.aE WBSS	4.aE NSAS only	4.aW	4.b	4.c	7.d	4.a & 4.b NSAS	4.c & 7.d	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	0.1	0.0	0.0	0.0	0.5	6.6	0.0	0.0	7.1	0.0	7.3	7.1
1	0.9	0.1	0.0	0.1	0.7	1.1	0.0	0.0	1.9	0.0	2.9	2.0
2	1.6	4.4	0.0	4.4	10.8	3.0	0.0	2.5	18.2	2.5	22.4	20.8
3	0.1	3.5	0.1	3.4	17.4	3.7	0.4	4.1	24.5	4.5	29.1	29.1
4	0.3	19.0	0.4	18.6	150.4	34.4	0.9	12.1	203.3	13.0	216.7	216.8
5	0.2	25.7	0.8	24.8	91.8	32.5	0.6	12.6	149.2	13.2	162.5	163.2
6	0.0	8.1	0.4	7.7	28.4	8.9	0.1	3.0	45.0	3.1	48.1	48.4
7	0.0	4.2	0.2	4.0	22.1	5.8	0.1	1.9	31.9	2.0	34.0	34.1
8	0.0	4.0	0.1	4.0	23.9	4.9	0.1	2.0	32.8	2.0	34.8	34.9
9+	0.0	5.6	0.1	5.5	29.7	6.9	0.0	4.7	42.2	4.7	46.8	46.9
Sum	3.4	74.7	2.2	72.5	375.8	107.8	2.2	42.8	556.1	45.0	604.5	603.3
Quarter: 1												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.3	0.2
2	1.2	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.6	0.1	1.9	0.7
3	0.0	0.0	0.0	0.0	0.6	0.0	0.2	0.4	0.6	0.6	1.2	1.2
4	0.0	0.1	0.0	0.1	3.5	0.0	0.7	1.3	3.6	2.0	5.6	5.6
5	0.0	0.1	0.0	0.1	2.5	0.0	0.4	1.5	2.6	1.9	4.5	4.5
6	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.2	0.7	0.2	0.9	0.9
7	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.3	0.6	0.9	0.9
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.5	0.6	0.6
9+	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.1	0.5	1.1	1.6	1.6
Sum	1.4	0.3	0.0	0.3	8.5	0.3	1.4	5.6	9.1	7.0	17.5	16.1
Quarter: 2												
0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.7	0.7
1	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.3	0.0	0.3	0.3
2	0.0	3.8	0.0	3.8	3.7	0.0	0.0	0.0	7.6	0.0	7.6	7.6
3	0.0	2.7	0.0	2.7	2.6	0.0	0.0	0.0	5.3	0.0	5.3	5.3
4	0.0	14.4	0.1	14.3	17.5	0.1	0.0	0.0	31.9	0.0	31.9	32.0
5	0.0	20.6	0.1	20.5	13.1	0.1	0.0	0.0	33.7	0.0	33.7	33.8
6	0.0	6.2	0.0	6.2	2.1	0.0	0.0	0.0	8.3	0.0	8.3	8.3
7	0.0	3.2	0.0	3.2	1.2	0.0	0.0	0.0	4.4	0.0	4.4	4.4
8	0.0	3.2	0.0	3.2	1.8	0.0	0.0	0.0	5.0	0.0	5.0	5.0
9+	0.0	4.4	0.0	4.4	1.9	0.0	0.0	0.0	6.3	0.0	6.3	6.3
Sum	0.0	58.6	0.3	58.3	44.1	1.1	0.0	0.1	103.5	0.1	103.6	103.9
Quarter: 3												
0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	4.5	0.0	4.5	4.5
1	0.3	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.7	0.0	1.0	0.7
2	0.4	0.5	0.0	0.5	4.5	1.3	0.0	0.0	6.3	0.0	6.7	6.3
3	0.1	0.7	0.1	0.6	12.6	2.0	0.0	0.0	15.1	0.0	15.2	15.3
4	0.3	4.0	0.3	0.0	108.3	25.3	0.0	0.0	133.6	0.0	137.5	137.6
5	0.2	4.3	0.7	3.6	58.7	21.8	0.0	0.0	84.2	0.0	84.4	84.9
6	0.0	1.6	0.4	0.0	21.9	6.5	0.0	0.0	28.4	0.0	29.7	30.0
7	0.0	0.9	0.2	0.7	17.3	4.1	0.0	0.0	22.1	0.0	22.1	22.3
8	0.0	0.7	0.1	0.6	18.8	3.0	0.0	0.0	22.5	0.0	22.5	22.5
9+	0.0	1.0	0.1	1.0	22.6	3.3	0.0	0.0	26.8	0.0	26.8	26.9
Sum	1.3	13.8	1.8	7.0	264.9	72.3	0.1	0.0	344.2	0.1	350.5	351.1
Quarter: 4												
0	0.1	0.0	0.0	0.0	0.5	1.3	0.0	0.0	1.9	0.0	2.0	1.9
1	0.5	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.8	0.0	1.3	0.8
2	0.0	0.1	0.0	0.1	2.0	1.7	0.0	2.4	3.7	2.4	6.2	6.2
3	0.0	0.1	0.0	0.1	1.7	1.7	0.2	3.7	3.5	3.9	7.4	7.4
4	0.0	0.6	0.0	0.6	21.1	8.9	0.2	10.8	30.6	11.0	41.6	41.5
5	0.0	0.7	0.0	0.7	17.5	10.5	0.1	11.1	28.7	11.2	39.9	39.9
6	0.0	0.2	0.0	0.2	3.7	2.4	0.0	2.8	6.4	2.9	9.2	9.2
7	0.0	0.1	0.0	0.1	3.3	1.6	0.0	1.4	5.1	1.4	6.5	6.5
8	0.0	0.1	0.0	0.1	3.3	1.8	0.0	1.5	5.2	1.5	6.7	6.8
9+	0.0	0.2	0.0	0.1	4.7	3.7	0.0	3.5	8.5	3.5	12.1	12.1
Sum	0.7	2.1	0.0	2.0	58.2	34.1	0.7	37.2	94.3	37.9	132.9	132.2

Table 2.2.5: North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea in 2018. Percentage age composition (based on numbers, 3+ group summarised), by quarter and division.

WR	3.a NSAS	4.aE all	4.aE WBSS	4.aE NSAS only	4.aW	4.b	4.c	7.d	4.a & 4.b NSAS	4.c & 7.d	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	21.8%	0.0%	0.0%	0.0%	2.7%	70.3%	10.6%	0.0%	31.6%	0.7%	29.4%	29.5%
1	28.8%	0.3%	0.3%	0.3%	0.6%	2.2%	5.7%	0.0%	1.3%	0.4%	1.6%	1.2%
2	42.8%	8.7%	3.0%	8.8%	4.8%	1.4%	1.6%	7.9%	3.7%	7.4%	4.5%	4.0%
3	1.7%	5.7%	8.2%	5.6%	5.6%	1.5%	19.0%	12.3%	3.9%	12.8%	4.4%	4.5%
4	2.7%	26.9%	20.6%	27.0%	40.4%	10.0%	35.7%	29.6%	26.0%	30.1%	25.9%	26.3%
5	1.6%	33.4%	38.7%	33.2%	24.1%	8.6%	21.7%	28.5%	18.3%	28.0%	18.7%	19.0%
6	0.3%	9.8%	15.8%	9.6%	6.5%	2.1%	1.6%	6.6%	4.9%	6.2%	4.9%	5.0%
7	0.2%	4.8%	7.8%	4.7%	4.6%	1.3%	2.4%	3.6%	3.2%	3.5%	3.2%	3.2%
8	0.1%	4.5%	2.3%	4.6%	4.8%	1.1%	1.7%	3.6%	3.2%	3.4%	3.2%	3.2%
9+	0.0%	5.9%	3.3%	6.0%	5.8%	1.5%	0.0%	8.0%	4.0%	7.4%	4.1%	4.2%
Sum 3+	6.5%	91.0%	96.8%	90.8%	91.9%	26.0%	82.1%	92.1%	63.4%	91.4%	64.4%	65.4%
Quarter: 1												
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	17.6%	0.2%	0.0%	0.2%	2.1%	83.4%	7.5%	0.0%	15.9%	1.9%	11.4%	10.1%
2	80.0%	8.8%	2.9%	8.8%	10.2%	12.3%	2.2%	2.3%	10.5%	2.2%	20.3%	7.1%
3	1.8%	6.1%	3.8%	6.1%	8.6%	0.3%	16.3%	10.5%	7.1%	12.0%	7.8%	9.2%
4	0.4%	30.8%	22.3%	30.8%	40.3%	1.9%	43.6%	28.7%	33.6%	32.4%	27.2%	33.1%
5	0.1%	32.6%	61.6%	32.5%	26.5%	1.4%	25.8%	25.9%	22.3%	25.9%	19.5%	23.8%
6	0.0%	8.9%	9.3%	8.9%	5.9%	0.4%	1.1%	3.0%	5.0%	2.5%	3.2%	4.0%
7	0.0%	4.2%	0.0%	4.2%	2.6%	0.2%	2.2%	8.3%	2.3%	6.8%	3.4%	4.1%
8	0.0%	3.1%	0.0%	3.1%	0.4%	0.0%	1.3%	6.6%	0.4%	5.2%	2.0%	2.4%
9+	0.0%	5.4%	0.0%	5.4%	3.4%	0.2%	0.0%	14.8%	2.9%	11.1%	5.1%	6.3%
Sum 3+	2.3%	91.0%	97.1%	91.0%	87.7%	4.4%	90.3%	97.7%	73.6%	95.9%	68.3%	82.8%
Quarter: 2												
0	0.0%	0.0%	0.0%	0.0%	0.0%	97.1%	0.0%	0.0%	27.1%	0.0%	27.1%	27.1%
1	41.6%	0.3%	0.8%	0.3%	0.7%	2.1%	0.0%	0.0%	0.9%	0.0%	1.0%	0.9%
2	55.4%	9.5%	14.3%	9.5%	12.4%	0.0%	1.4%	2.3%	7.8%	2.0%	7.9%	7.8%
3	2.3%	5.6%	6.4%	5.6%	7.0%	0.0%	17.8%	10.5%	4.5%	13.0%	4.5%	4.5%
4	0.5%	25.9%	26.9%	25.9%	40.3%	0.3%	47.6%	28.7%	23.7%	35.1%	23.6%	23.7%
5	0.1%	34.0%	50.2%	33.9%	27.5%	0.2%	28.2%	25.9%	22.3%	26.7%	22.3%	22.4%
6	0.0%	9.5%	0.0%	9.5%	4.0%	0.1%	1.2%	3.0%	5.0%	2.4%	5.0%	5.0%
7	0.0%	4.7%	1.3%	4.7%	2.2%	0.1%	2.4%	8.3%	2.5%	6.3%	2.5%	2.5%
8	0.0%	4.6%	0.0%	4.6%	3.0%	0.0%	1.4%	6.6%	2.8%	4.8%	2.8%	2.8%
9+	0.0%	5.9%	0.0%	5.9%	3.0%	0.0%	0.0%	14.8%	3.3%	9.8%	3.3%	3.3%
Sum 3+	2.9%	90.2%	84.8%	90.2%	86.9%	0.7%	98.6%	97.7%	64.1%	98.0%	64.0%	64.2%
Quarter: 3												
0	25.3%	0.0%	0.0%	0.0%	0.2%	73.2%	0.0%	0.0%	36.3%	0.0%	36.2%	35.4%
1	29.9%	0.4%	0.2%	6.2%	0.2%	1.2%	0.0%	0.0%	0.7%	0.0%	0.9%	0.7%
2	23.2%	5.2%	1.1%	93.8%	2.9%	0.8%	0.0%	0.0%	2.0%	0.0%	2.1%	1.9%
3	3.3%	6.0%	8.6%	0.0%	6.0%	1.2%	40.0%	0.0%	3.6%	40.0%	3.6%	3.7%
4	9.9%	30.7%	19.5%	0.0%	42.7%	10.4%	28.0%	0.0%	26.6%	28.0%	26.5%	26.8%
5	6.1%	30.8%	37.5%	0.0%	22.7%	8.0%	20.0%	0.0%	15.4%	20.0%	15.3%	15.8%
6	1.0%	11.0%	18.2%	0.0%	7.5%	2.1%	4.0%	0.0%	4.8%	4.0%	4.8%	5.0%
7	0.7%	5.5%	9.1%	0.0%	5.5%	1.3%	4.0%	0.0%	3.4%	4.0%	3.4%	3.4%
8	0.5%	4.3%	2.4%	0.0%	5.7%	0.9%	4.0%	0.0%	3.3%	4.0%	3.3%	3.4%
9+	0.0%	6.2%	3.4%	0.0%	6.7%	0.9%	0.0%	0.0%	3.8%	0.0%	3.8%	3.9%
Sum 3+	21.5%	94.4%	98.7%	0.0%	96.8%	24.8%	100.0%	0.0%	61.0%	100.0%	60.7%	62.0%
Quarter: 4												
0	52.5%	0.0%	0.0%	0.0%	13.9%	42.1%	35.0%	0.0%	26.5%	0.9%	20.6%	19.9%
1	43.7%	0.4%	0.0%	0.4%	1.5%	2.9%	2.3%	0.0%	2.1%	0.1%	2.5%	1.6%
2	2.8%	5.4%	0.0%	5.5%	4.3%	4.4%	0.4%	8.8%	4.4%	8.6%	5.4%	5.5%
3	0.3%	6.1%	0.0%	6.3%	3.0%	3.8%	23.8%	12.6%	3.4%	12.9%	5.8%	5.9%
4	0.4%	30.1%	21.0%	30.2%	32.6%	16.1%	18.2%	29.8%	25.1%	29.5%	25.7%	26.2%
5	0.3%	31.1%	0.0%	31.8%	25.7%	17.4%	12.7%	29.0%	22.1%	28.5%	23.2%	23.7%
6	0.1%	11.1%	32.9%	10.7%	5.2%	3.4%	2.4%	7.2%	4.5%	7.1%	5.1%	5.2%
7	0.0%	5.5%	0.0%	5.6%	4.2%	2.3%	2.7%	2.8%	3.4%	2.8%	3.2%	3.2%
8	0.0%	4.2%	18.8%	3.9%	4.0%	2.6%	2.5%	3.0%	3.4%	3.0%	3.2%	3.3%
9+	0.0%	6.1%	27.3%	5.7%	5.5%	4.8%	0.1%	6.8%	5.2%	6.6%	5.4%	5.6%
Sum 3+	1.0%	94.2%	100.0%	94.1%	80.3%	50.6%	62.4%	91.2%	67.0%	90.4%	71.6%	73.1%

Table 2.2.6: Total catch of herring caught in the North Sea and Division 3.a: North Sea autumn spawners (NSAS). Catch in numbers (millions) at mean weight-at-age (kg) by fleet, and SOP catches ('000 t). SOP catch might deviate from reported catch as used for the assessment.

2016	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0	0.0	0.000	1450.3	0.007	0.0	0.000	133.3	0.007	**1'583.6**	**0.007**
1	2.3	0.102	83.6	0.021	10.8	0.054	12.5	0.023	**109.2**	**0.026**
2	556.2	0.135	23.0	0.055	42.1	0.061	5.4	0.040	**626.7**	**0.127**
3	807.1	0.156	9.6	0.084	5.9	0.124	0.1	0.081	**822.7**	**0.155**
4	292.7	0.181	1.2	0.093	0.5	0.149	0.0	0.000	**294.4**	**0.180**
5	281.3	0.206	0.0	0.000	0.2	0.188	0.1	0.078	**281.6**	**0.206**
6	368.0	0.215	0.8	0.146	0.2	0.208	0.0	0.000	**369.0**	**0.215**
7	308.0	0.231	0.0	0.000	0.0	0.209	0.0	0.000	**308.0**	**0.231**
8	186.3	0.221	0.0	0.000	0.1	0.235	0.0	0.000	**186.4**	**0.221**
9+	173.9	0.239	0.0	0.000	0.0	0.000	0.0	0.000	**173.9**	**0.239**
TOTAL	2'975.7		1'568.4		59.9		151.4		4'755.4	
SOP catch		**545.5**		**14.4**		**4.1**		**1.4**		**565.4**

Figures for A fleet include unsampled bycatch in the industrial fishery

2017	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0	0.0	0.000	462.0	0.009	0.1	0.034	0.0	0.000	**462.1**	**0.009**
1	11.4	0.083	121.9	0.026	75.6	0.052	0.4	0.016	**209.4**	**0.039**
2	74.3	0.114	0.0	0.000	26.7	0.080	7.7	0.025	**108.7**	**0.099**
3	1072.9	0.156	0.0	0.000	6.9	0.103	0.0	0.075	**1'079.9**	**0.156**
4	834.8	0.173	0.0	0.000	3.0	0.138	0.0	0.000	**837.8**	**0.173**
5	221.6	0.188	0.0	0.000	1.2	0.172	0.0	0.000	**222.8**	**0.188**
6	145.4	0.215	0.0	0.000	0.1	0.153	0.0	0.000	**145.5**	**0.214**
7	175.5	0.220	0.0	0.000	0.0	0.147	0.0	0.000	**175.5**	**0.220**
8	106.5	0.230	0.0	0.000	0.0	0.160	0.0	0.000	**106.6**	**0.230**
9+	114.7	0.231	0.0	0.000	0.0	0.000	0.0	0.000	**114.7**	**0.231**
TOTAL	2'757.2		583.9		113.8		8.0		3'463.0	
SOP catch		**484.2**		**7.3**		**7.4**		**0.2**		**499.1**

Figures for A fleet include unsampled bycatch in the industrial fishery

2018	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0	0.0	0.000	1322.9	0.005	0.1	0.022	14.4	0.010	**1'337.4**	**0.005**
1	8.6	0.089	45.5	0.026	17.6	0.050	1.6	0.036	**73.3**	**0.039**
2	175.9	0.118	1.9	0.027	28.2	0.057	0.3	0.044	**206.2**	**0.108**
3	199.4	0.145	0.0	0.000	1.1	0.105	0.0	0.048	**200.5**	**0.145**
4	1176.8	0.184	0.0	0.000	1.8	0.158	0.0	0.000	**1'178.6**	**0.184**
5	847.9	0.191	0.0	0.000	1.0	0.181	0.0	0.000	**849.0**	**0.191**
6	223.5	0.215	0.0	0.000	0.2	0.189	0.0	0.000	**223.6**	**0.215**
7	144.9	0.234	0.0	0.000	0.1	0.187	0.0	0.000	**145.0**	**0.234**
8	144.1	0.242	0.0	0.000	0.1	0.202	0.0	0.000	**144.2**	**0.241**
9+	188.3	0.249	0.0	0.000	0.0	0.000	0.0	0.000	**188.3**	**0.249**
TOTAL	3'109.3		1'370.3		50.2		16.3		4'546.1	
SOP catch		**592.7**		**8.4**		**3.1**		**0.2**		**604.5**

Figures for A fleet include unsampled bycatch in the industrial fishery

Table 2.2.7: Catch at age (numbers in millions) of North Sea herring, 2003–2018.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
2003	347	172	1022	507	809	244	106	121	37	8	3375
2004	627	136	274	1333	517	721	170	100	70	22	3970
2005	919	408	203	487	1326	480	577	116	108	39	4664
2006	844	72	354	309	475	1017	257	252	65	44	3689
2007	553	46	142	413	284	307	628	147	133	23	2677
2008	713	148	260	183	199	137	118	215	74	43	2090
2009	533	98	253	108	96	88	40	58	112	34	1421
2010	526	84	243	234	124	84	63	34	59	56	1508
2011	575	124	306	271	218	130	63	52	60	66	1865
2012	627	110	412	671	403	306	151	104	89	109	2982
2013	461	327	239	482	571	422	327	145	153	160	3287
2014	1104	309	303	380	616	487	284	192	92	123	3890
2015	508	225	454	241	282	456	431	270	167	170	3204
2016	1450	86	578	813	293	280	368	307	186	173	4534
2017	462	133	74	1075	836	222	146	176	107	115	3345
2018	1323	54	178	200	1179	852	225	146	144	189	4491

Table 2.2.8: Catch at age (numbers in millions) of WBSS Herring taken in the North Sea, and transferred to the assessment of the spring spawning stock in 3.a, 2003–2018.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
2003	0.0	0.0	0.0	3.1	6.0	3.5	1.2	1.3	0.5	0.1	15.7
2004	0.0	0.0	15.1	27.9	3.5	4.1	1.0	0.5	0.1	0.0	52.3
2005	0.0	0.0	6.6	17.4	12.7	2.6	3.8	1.1	0.4	0.3	44.8
2006	0.0	0.1	3.5	8.8	14.0	22.4	5.1	5.3	2.1	1.0	62.2
2007	0.0	0.0	0.1	2.6	1.3	0.6	0.8	0.4	0.5	0.2	6.3
2008	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.0	0.0	0.7
2009	0.0	0.0	1.0	2.1	3.4	1.4	1.7	4.5	1.8	1.4	17.2
2010	0.0	0.0	0.0	0.5	1.0	0.4	0.5	0.3	0.3	0.7	3.8
2011	0.0	0.0	0.1	0.4	0.4	0.2	0.1	0.1	0.1	0.2	1.6
2012	0.0	0.0	0.0	0.2	0.4	0.0	1.4	0.0	1.1	6.3	9.4
2013	0.0	0.0	0.1	0.4	0.2	0.5	0.3	0.1	0.2	0.5	2.2
2014	0.0	0.0	2.5	3.4	5.4	0.8	2.1	1.0	0.5	1.1	16.8
2015	0.0	0.0	0.1	0.9	1.4	3.9	1.8	1.4	0.9	1.2	11.7
2016	0.0	0.0	1.2	4.1	1.0	1.1	1.2	0.7	0.4	0.8	10.6
2017	0.0	0.0	0.0	2.4	1.0	0.2	0.1	0.1	0.0	0.1	4.0
2018	0.0	0.0	0.3	0.9	2.3	4.3	1.7	0.9	0.3	0.4	11.0

Table 2.2.9: Catch at age (numbers in millions) of NSAS taken in 3.a, and transferred to the assessment of NSAS, 2003–2018.

Year/rings	0	1	2	3	4	5	6	7	8+	Total
2003	21.6	445.0	182.3	13.0	16.2	1.8	1.1	1.2	0.2	682.4
2004	88.4	70.9	179.9	20.7	6.0	9.7	1.8	2.0	0.9	380.4
2005	96.4	307.5	159.2	16.2	5.4	2.4	2.3	0.5	0.2	589.9
2006	35.1	150.1	50.2	10.2	3.3	3.3	0.6	0.4	0.2	253.3
2007	67.7	189.3	76.9	2.1	0.4	1.4	0.3	0.6	0.0	338.7
2008	85.7	86.6	72.0	1.9	0.3	0.1	0.1	0.3	0.1	247.0
2009	116.8	77.5	7.0	0.4	0.2	0.0	0.0	0.0	0.1	202.0
2010	48.6	197.0	43.3	0.3	0.1	0.1	0.0	0.1	0.0	289.6
2011	203.8	35.4	61.5	3.2	0.3	0.2	0.1	0.1	0.0	304.6
2012	145.8	174.9	43.7	1.9	1.2	0.2	0.2	0.1	0.0	368.0
2013	0.9	86.2	85.8	2.4	0.4	0.3	0.0	0.0	0.0	175.9
2014	284.7	61.1	80.2	5.9	0.5	0.5	0.2	0.0	0.1	433.3
2015	30.7	169.6	97.6	7.0	1.3	4.9	1.1	1.2	0.4	313.6
2016	133.3	23.3	47.6	6.0	0.5	0.3	0.2	0.0	0.1	211.3
2017	0.1	76.0	34.4	6.9	3.0	1.2	0.1	0.0	0.0	121.8
2018	14.5	19.2	28.5	1.1	1.8	1.0	0.2	0.1	0.1	66.5

Table 2.2.10: Catch at age (numbers in millions) of the total NSAS stock 2003–2018.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
2003	369	617	1204	517	820	243	106	120	37	8	4042
2004	716	207	439	1326	520	726	171	101	71	22	4298
2005	1016	716	355	486	1318	480	576	115	108	39	5209
2006	879	222	401	311	465	999	253	249	63	44	3885
2007	621	236	219	412	283	308	628	147	132	23	3009
2008	798	235	332	185	199	137	118	215	74	43	2336
2009	650	176	259	107	93	86	38	53	110	33	1606
2010	575	281	287	233	123	83	63	34	59	55	1794
2011	779	160	368	274	218	130	63	52	60	65	2168
2012	773	285	455	673	404	306	150	104	88	102	3341
2013	462	413	325	484	571	422	327	145	152	160	3461
2014	1389	371	383	386	617	488	285	192	92	123	4323
2015	538	395	552	248	283	461	432	271	168	170	3517
2016	1584	109	625	819	293	280	368	307	186	173	4745
2017	462	209	109	1080	838	223	146	176	107	115	3463
2018	1337	73	206	201	1179	849	224	145	144	188	4546

Table 2.2.11: Comparison of mean weight (kg) at age (rings) in the catch of adult North Sea herring (by Division) and NSAS caught in Division 3.a in 2008–2018

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
3.a	2008	0.087	0.109	0.139	0.168	0.176	0.204	0.198	-
	2009	0.101	0.082	0.206	0.000	0.000	0.000	0.269	-
	2010	0.077	0.122	0.149	0.191	0.221	0.216	0.205	-
	2011	0.084	0.114	0.134	0.191	0.193	0.234	0.248	-
	2012	0.067	0.124	0.169	0.175	0.200	0.221	0.216	-
	2013	0.075	0.134	0.160	0.201	0.000	0.000	0.000	-
	2014	0.074	0.109	0.162	0.191	0.209	0.221	0.228	-
	2015	0.068	0.133	0.157	0.180	0.196	0.197	0.215	-
	2016	0.059	0.123	0.149	0.157	0.208	0.211	0.235	-
	2017	0.068	0.103	0.139	0.173	0.171	0.185	0.162	-
	2018	0.058	0.103	0.156	0.179	0.190	0.187	0.203	-
4.a(E)	2008	0.138	0.173	0.172	0.174	0.216	0.210	0.253	0.266
	2009	0.139	0.167	0.208	0.219	0.232	0.245	0.253	0.288
	2010	0.131	0.154	0.201	0.201	0.210	0.223	0.248	0.235
	2011	0.142	0.162	0.180	0.204	0.215	0.209	0.216	0.222
	2012	0.146	0.185	0.195	0.203	0.216	0.225	0.225	0.232
	2013	0.129	0.147	0.184	0.191	0.205	0.215	0.215	0.228
	2014	0.146	0.161	0.167	0.195	0.200	0.216	0.227	0.224
	2015	0.127	0.148	0.163	0.178	0.191	0.203	0.212	0.227
	2016	0.129	0.153	0.167	0.183	0.195	0.205	0.216	0.229
	2017	0.132	0.154	0.170	0.182	0.193	0.198	0.203	0.209
	2018	0.125	0.152	0.173	0.188	0.201	0.212	0.219	0.230
4.a(W)	2008	0.142	0.187	0.187	0.188	0.230	0.219	0.262	0.281
	2009	0.152	0.180	0.211	0.223	0.266	0.251	0.252	0.278
	2010	0.137	0.166	0.195	0.223	0.220	0.216	0.236	0.252
	2011	0.141	0.161	0.185	0.195	0.216	0.223	0.220	0.243
	2012	0.132	0.184	0.186	0.206	0.226	0.240	0.242	0.254
	2013	0.139	0.158	0.201	0.197	0.218	0.234	0.234	0.251

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
	2014	0.143	0.172	0.184	0.215	0.212	0.227	0.246	0.242
	2015	0.124	0.158	0.198	0.211	0.233	0.228	0.239	0.252
	2016	0.138	0.161	0.189	0.215	0.227	0.242	0.233	0.250
	2017	0.120	0.160	0.177	0.192	0.218	0.226	0.236	0.236
	2018	0.114	0.156	0.188	0.193	0.220	0.241	0.250	0.258
4.b	2008	0.142	0.172	0.185	0.191	0.222	0.228	0.265	0.223
	2009	0.140	0.188	0.228	0.219	0.223	0.243	0.255	0.255
	2010	0.134	0.176	0.182	0.229	0.237	0.235	0.232	0.265
	2011	0.145	0.162	0.187	0.206	0.235	0.234	0.240	0.268
	2012	0.131	0.141	0.178	0.209	0.214	0.245	0.250	0.258
	2013	0.125	0.162	0.205	0.206	0.228	0.251	0.261	0.246
	2014	0.133	0.187	0.208	0.233	0.240	0.249	0.256	0.277
	2015	0.140	0.162	0.189	0.203	0.208	0.216	0.227	0.250
	2016	0.126	0.161	0.192	0.211	0.218	0.236	0.236	0.253
	2017	0.095	0.157	0.184	0.194	0.230	0.240	0.249	0.263
	2018	0.117	0.138	0.192	0.211	0.237	0.248	0.246	0.258

Table 2.2.11 continued: Comparison of mean weight (kg) at age (rings) in the catch of adult North Sea herring (by Division) and NSAS caught in Division 3.a in 2008–2018.

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
4.a & 4.b	2008	0.142	0.182	0.185	0.188	0.226	0.220	0.262	0.275
	2009	0.142	0.183	0.217	0.221	0.248	0.248	0.253	0.277
	2010	0.136	0.167	0.192	0.224	0.222	0.220	0.236	0.250
	2011	0.142	0.161	0.184	0.198	0.220	0.224	0.224	0.243
	2012	0.132	0.171	0.185	0.207	0.222	0.239	0.243	0.248
	2013	0.132	0.158	0.198	0.198	0.217	0.234	0.235	0.244
	2014	0.138	0.174	0.187	0.216	0.213	0.227	0.246	0.243
	2015	0.129	0.157	0.190	0.203	0.223	0.219	0.228	0.245
	2016	0.134	0.159	0.185	0.210	0.218	0.235	0.226	0.242
	2017	0.116	0.159	0.176	0.190	0.217	0.223	0.231	0.230
	2018	0.117	0.152	0.187	0.195	0.220	0.238	0.245	0.254
4.c & 7.d	2008	0.120	0.157	0.156	0.173	0.188	0.192	0.215	0.247
	2009	0.156	0.162	0.197	0.197	0.211	0.192	0.219	0.244
	2010	0.145	0.167	0.187	0.204	0.207	0.207	0.223	0.216
	2011	0.122	0.154	0.179	0.189	0.195	0.205	0.209	0.217
	2012	0.119	0.165	0.186	0.202	0.212	0.234	0.209	0.226
	2013	0.126	0.144	0.180	0.196	0.206	0.216	0.218	0.226
	2014	0.119	0.148	0.166	0.183	0.208	0.222	0.227	0.233
	2015	0.114	0.127	0.154	0.157	0.183	0.197	0.204	0.210
	2016	0.114	0.127	0.137	0.166	0.177	0.199	0.193	0.216
	2017	0.100	0.122	0.146	0.165	0.186	0.193	0.220	0.241
	2018	0.113	0.116	0.144	0.156	0.164	0.189	0.196	0.209
Total	2008	0.141	0.180	0.181	0.183	0.216	0.216	0.256	0.273
North Sea	2009	0.145	0.181	0.216	0.216	0.239	0.243	0.248	0.273
Catch	2010	0.138	0.167	0.192	0.222	0.219	0.217	0.234	0.245
	2011	0.141	0.160	0.183	0.197	0.217	0.221	0.223	0.240
	2012	0.130	0.171	0.185	0.206	0.222	0.239	0.239	0.247
	2013	0.131	0.156	0.198	0.198	0.215	0.233	0.234	0.241

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
	2014	0.137	0.173	0.186	0.215	0.212	0.226	0.244	0.241
	2015	0.123	0.154	0.188	0.200	0.221	0.217	0.226	0.243
	2016	0.132	0.155	0.180	0.206	0.215	0.231	0.221	0.239
	2017	0.114	0.156	0.173	0.189	0.215	0.220	0.230	0.231
	2018	0.117	0.145	0.184	0.192	0.215	0.234	0.242	0.249

Table 2.2.12: Sampling of commercial landings of North Sea herring (Division 4 and 7.d) in 2018 by quarter. Sampled catch means the proportion of the reported catch to which sampling was applied. It is not possible to judge the quality of the sampling by this figure alone. Note that only one nation sampled their by-catches in the industrial fishery (Denmark, fleet B). Metiers are each reported combination of nation/fleet/area/quarter.

Country (fleet)	Quarter	No of metiers	Metiers sampled	Sampled Catch %	Official landings	No. of samples	No. fish aged	No. fish measured	>1 sample per 1 kt catch
Belgium	1	2	0	0%	17	0	0	0	n
	2	2	0	0%	2	0	0	0	n
	3	1	0	0%	1	0	0	0	n
	4	2	0	0%	11	0	0	0	n
total		**7**	**0**	**0%**	**31**	**0**	**0**	**0**	**n**
Denmark (A)	1	3	1	97%	6335	7	184	888	y
	2	2	1	81%	1893	1	29	138	n
	3	3	2	99%	77149	43	1184	4859	n
	4	2	2	100%	38379	22	612	2500	n
total		**10**	**6**	**99%**	**123756**	**73**	**2009**	**8385**	**n**
Denmark (B)	1	3	2	90%	214	7	17	17	y
	2	2	1	100%	768	3	23	47	y
	3	3	1	100%	5126	42	382	798	y
	4	3	1	71%	2368	16	92	99	y
total		**11**	**5**	**92%**	**8476**	**68**	**514**	**961**	**y**
England and Wales	1	3	2	100%	736	7	175	1430	y
	2	4	1	100%	3479	10	250	1870	y
	3	4	2	100%	11563	15	375	1744	y
	4	3	1	84%	3814	6	150	1372	y
total		**14**	**6**	**97%**	**19592**	**38**	**950**	**6416**	**y**
France	1	2	0	0%	4541	0	0	0	n
	2	4	0	0%	3454	0	0	0	n
	3	4	0	0%	15537	0	0	0	n
	4	4	0	0%	8072	0	0	0	n
total		**14**	**0**	**0%**	**31604**	**0**	**0**	**0**	**n**
Germany	2	1	0	0%	2221	0	0	0	n
	3	3	1	89%	33936	21	200	15505	n
	4	3	1	70%	15479	53	195	15559	y
total		**7**	**2**	**79%**	**51636**	**74**	**395**	**31064**	**y**
Ireland	4	1	0	0%	515	0	0	0	n
total		**1**	**0**	**0%**	**515**	**0**	**0**	**0**	**n**
Netherlands	1	1	0	0%	1721	0	0	0	n
	2	2	0	0%	1270	0	0	0	n
	3	2	2	100%	81019	59	1475	7321	n
	4	4	2	6%	27292	2	50	261	n
total		**9**	**4**	**74%**	**111302**	**61**	**1525**	**7582**	**n**
Norway	1	2	0	0%	763	0	0	0	n
	2	3	2	100%	83313	33	1438	3300	n
	3	3	2	95%	47128	8	269	800	n
	4	3	2	93%	31390	5	220	430	n
total		**11**	**6**	**97%**	**162594**	**46**	**1927**	**4530**	**n**
Scotland	1	1	0	0%	1269	0	0	0	n
	2	1	1	100%	2882	5	187	781	y
	3	2	2	100%	60965	26	1163	4074	n
	4	1	0	0%	888	0	0	0	n
total		**5**	**3**	**97%**	**66005**	**31**	**1350**	**4855**	**n**
Sweden	2	2	0	0%	4378	0	0	0	n
	3	3	1	65%	11983	3	198	198	n
	4	2	0	0%	3046	0	0	0	n
total		**7**	**1**	**40%**	**19407**	**3**	**198**	**198**	**n**
Faroese	3	2	0	0%	401	0	0	0	n
	4	1	0	0%	96	0	0	0	n
total		**3**	**0**	**0%**	**497**	**0**	**0**	**0**	**n**
Northern Ireland	1	1	0	0%	453	0	0	0	n
	3	2	0	0%	5411	0	0	0	n
	4	1	0	0%	1052	0	0	0	n
total		**4**	**0**	**0%**	**6916**	**0**	**0**	**0**	**n**
grand total		103	33	83%	602328	394	8868	63991	n
Period total	1	18	5	44%	16050	21	376	2335	y
Period total	2	23	6	89%	103660	52	1927	6136	n
Period total	3	32	13	91%	350219	217	5246	35299	n
Period total	4	30	9	64%	132403	104	1319	20221	n
Total for stock 2018		103	33	83%	602328	394	8868	63991	n
Human Cons. only		92	28	84%	593851	326	8354	63030	n
Total for stock 2016		109	42	89%	559919	445	10296	69930	n
Total for stock 2017		100	27	84%	491694	326	7783	58280	n
Human Cons. only		89	24	84%	484718	288	7439	57846	n

Table 2.3.1.1. North Sea herring. Acoustic Surveys in the North Sea (HERAS) in June–July 2018. Vessels, areas and cruise dates.

Vessel	Period	Contributing to Stocks	Strata
Celtic Explorer (IRL) EIGB	3 – 21 July	MSHAS, WoS	2, 3, 4, 5, 6
Scotia (SCO) MXHR6	29 June – 19 July	MSHAS,WoS, NSAS, Sprat NS	1, 91 (north of 58°30'N), 111, 121
Johan Hjort (NOR) LDGJ	2 – 17 July	NSAS, WBSS	11, 141
Tridens (NED) PBVO	2 – 20 July	NSAS, Sprat NS	81, 91 (south of 58°30'N), 101
Solea (GER) DBFH	29 June – 19 July	NSAS, Sprat NS	51, 61, 71, 131
Dana (DEN) OXBH	25 June – 10 July	NSAS, WBSS, Sprat NS, Sprat 3.a	21, 31, 41, 42, 151, 152
Celtic Explorer (IRL) EIGB	3 – 21 July	MSHAS, WoS	2, 3, 4, 5, 6

Table 2.3.1.2. North Sea herring. Acoustic Surveys in the North Sea (HERAS) in June–July 2018. Total numbers (millions of fish) and biomass (thousands of tonnes) of North Sea autumn spawning herring in the area surveyed in the pelagic acoustic surveys, with mean weight and mean length by age ring.

Age (ring)	Numbers	Biomass	Maturity	Weight(g)	Length (cm)
0	7,480	39	0.00	5.2	8.9
1	9,938	401	0.01	40.3	17.2
2	4,254	392	0.37	92.3	22.0
3	1,692	246	0.91	145.4	25.2
4	5,150	991	0.98	192.4	27.2
5	2,440	546	1.00	223.8	28.5
6	719	164	1.00	228.0	28.8
7	529	127	1.00	240.1	29.3
8	293	80	1.00	272.1	30.3
9+	111	30	1.00	272.9	30.4
Immature	20,290	679		33.5	14.7
Mature	12,315	2,337		189.7	27.0
Total	32,606	3,016	0.38	92.5	19.4

Table 2.3.1.3. Estimates of North Sea autumn spawners (millions) at age from acoustic surveys, 1986–2018. For 1986 the estimates are the sum of those from the Division 4.a summer survey, the Division 4.b autumn survey, and the divisions 4.c, 7.d winter survey. The 1987 to 2018 estimates are from summer surveys in divisions 4.a, b, c, and 3.a excluding estimates of Western Baltic spring spawners. For 1999 and 2000 the Kattegat was excluded from the results because it was not surveyed. Total numbers include 0-ringers from 2008 onwards.

Years / Age (rings)	1	2	3	4	5	6	7	8	9+	Total	SSB ('000 t)
1986	1,639	3,206	1,637	833	135	36	24	6	8	7,542	942
1987	13,736	4,303	955	657	368	77	38	11	20	20,165	817
1988	6,431	4,202	1,732	528	349	174	43	23	14	13,496	897
1989	6,333	3,726	3,751	1,612	488	281	120	44	22	16,377	1,637
1990	6,249	2,971	3,530	3,370	1,349	395	211	134	43	18,262	2,174
1991	3,182	2,834	1,501	2,102	1,984	748	262	112	56	12,781	1,874
1992	6,351	4,179	1,633	1,397	1,510	1,311	474	155	163	17,173	1,545
1993	10,399	3,710	1,855	909	795	788	546	178	116	19,326	1,216
1994	3,646	3,280	957	429	363	321	238	220	132	13,003	1,035
1995	4,202	3,799	2,056	656	272	175	135	110	84	11,220	1,082
1996	6,198	4,557	2,824	1,087	311	99	83	133	206	18,786	1,446
1997	9,416	6,363	3,287	1,696	692	259	79	78	158	22,028	1,780
1998	4,449	5,747	2,520	1,625	982	445	170	45	121	16,104	1,792
1999	5,087	3,078	4,725	1,116	506	314	139	54	87	15,107	1,534
2000	24,735	2,922	2,156	3,139	1,006	483	266	120	97	34,928	1,833
2001	6,837	12,290	3,083	1,462	1,676	450	170	98	59	26,124	2,622
2002	23,055	4,875	8,220	1,390	795	1,031	244	121	150	39,881	2,948
2003	9,829	18,949	3,081	4,189	675	495	568	146	178	38,110	2,999
2004	5,183	3,415	9,191	2,167	2,590	317	328	342	186	23,722	2,584
2005	3,113	1,890	3,436	5,609	1,211	1,172	140	127	107	16,805	1,868
2006	6,823	3,772	1,997	2,098	4,175	618	562	84	70	20,199	2,130
2007	6,261	2,750	1,848	898	806	1,323	243	152	65	14,346	1,203
2008	3,714	2,853	1,709	1,485	809	712	1,749	185	270	20,355	1,784
2009	4,655	5,632	2,553	1,023	1,077	674	638	1,142	578	31,526	2,591
2010	14,577	4,237	4,216	2,453	1,246	1,332	688	1,110	1,619	43,705	3,027
2011	10,119	4,166	2,534	2,173	1,016	651	688	440	1,207	25,524	2,431

Years / Age (rings)	1	2	3	4	5	6	7	8	9+	Total	SSB ('000 t)
2012	7,437	4,718	4,067	1,738	1,209	593	247	218	478	23,641	2,269
2013	6,388	2,683	3,031	2,895	1,546	849	464	250	592	36,484	2,261
2014	11,634	4,918	2,827	2,939	1,791	1,236	669	211	250	61,339	2,610
2015	6,714	9,495	2,831	1,591	1,549	926	520	275	221	24,508	2,280
2016	9,034	12,011	5,832	1,273	822	909	395	220	146	51,686	2,648
2017	3,054	1,761	6,095	3,142	787	365	298	153	140	30,055	1,943
2018	9,938	4,254	1,692	5,150	2,440	719	529	293	111	32,606	2,337

Table 2.3.2.1: North Sea herring – LAI time-series of herring larval abundance <10 mm long (<11 mm for the SNS), by standard sampling area and time periods. The number of larvae are expressed as mean number per ICES rectangle * 10^9.

	Orkney/ Shetland		Buchan		Central North Sea			Southern North Sea		
Period/ Year	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Oct.	16–31 Dec.	1–15 Jan.	16–31 Jan.
1972	1133	4583	30		165	88	134	2	46	
1973	2029	822	3	4	492	830	1213			1
1974	758	421	101	284	81		1184		10	
1975	371	50	312			90	77	1	2	
1976	545	81		1	64	108			3	
1977	1133	221	124	32	520	262	89	1		
1978	3047	50		162	1406	81	269	33	3	
1979	2882	2362	197	10	662	131	507		111	89
1980	3534	720	21	1	317	188	9	247	129	40
1981	3667	277	3	12	903	235	119	1456		70
1982	2353	1116	340	257	86	64	1077	710	275	54
1983	2579	812	3647	768	1459	281	63	71	243	58
1984	1795	1912	2327	1853	688	2404	824	523	185	39
1985	5632	3432	2521	1812	130	13039	1794	1851	407	38
1986	3529	1842	3278	341	1611	6112	188	780	123	18
1987	7409	1848	2551	670	799	4927	1992	934	297	146

	Orkney/ Shetland		Buchan		Central North Sea			Southern North Sea		
Period/ Year	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Oct.	16–31 Dec.	1–15 Jan.	16–31 Jan.
1988	7538	8832	6812	5248	5533	3808	1960	1679	162	112
1989	11477	5725	5879	692	1442	5010	2364	1514	2120	512
1990		10144	4590	2045	19955	1239	975	2552	1204	
1991	1021	2397		2032	4823	2110	1249	4400	873	
1992	189	4917		822	10	165	163	176	1616	
1993		66		174		685	85	1358	1103	
1994	26	1179				1464	44	537	595	
1995		8688					43	74	230	164
1996		809		184		564		337	675	691
1997		3611		23				9374	918	355
1998		8528		1490	205	66		1522	953	170
1999		4064		185		134	181	804	1260	344
2000		3352	28	83		376		7346	338	106
2001		11918		164		1604		971	5531	909
2002		6669		1038			3291	2008	260	925
2003		3199		2263		12018	3277	12048	3109	1116
2004		7055		3884		5545		7055	2052	4175
2005		3380		1364		5614		498	3999	4822
2006	6311	2312		280		2259		10858	2700	2106
2007		1753		1304		291		4443	2439	3854
2008	4978	6875		533		11201		8426	2317	4008
2009		7543		4629		4219		15295	14712	1689
2010		2362		1493		2317		7493	13230	8073
2011		3831		2839		17766		5461	6160	1215
2012		19552		5856		517		22768	11103	3285
2013		21282		8618		7354		5	9314	2957
2014		6604		5033		1149				1851

	Orkney/ Shetland		Buchan		Central North Sea			Southern North Sea		
Period/ Year	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Sep.	16–30 Sep.	1–15 Oct.	16–31 Dec.	1–15 Jan.	16–31 Jan.
2015		9631		3496		3424		2011	1200	645
2016				3872		3288		20710	1442	1545
2017				5833		3965		10553	5880	
2018		102		1740		1509		1140		

Table 2.3.3.1 North Sea herring. Density and abundance estimates of 0-ringers caught in February during the IBTS. Values given for the 1991 to 2018 year classes by areas are density estimates in numbers per square metre according to the new index calculation algorithm. Total abundance is found by multiplying density by area and summing up. Data for the period 1976 to 1994, calculated with the old algorithm, are recorded in the stock annex.

Area	North west	North east	Central west	Central east	South west	South east	Division 3.a	South'Bight	IBTS-0 index
Area $m^2 \times 10^9$	83	34	86	102	37	93	31	31	
Year class									no. in 10^9
1991	0.227	0.074	0.364	0.444	0.466	0.329	0.330	0.259	164.0
1992	0.191	0.037	0.576	0.387	0.638	0.300	0.359	0.871	195.8
1993	0.574	0.231	0.545	0.178	0.117	0.140	0.223	0.322	155.1
1994	0.131	0.023	0.438	0.359	0.360	0.174	0.503	1.277	170.5
1995	0.222	0.053	0.644	0.069	0.246	0.015	0.015	0.424	107.0
1996	0.026	0.003	0.878	0.099	0.443	0.298	0.040	0.034	134.5
1997	0.039	0.021	0.295	0.059	0.181	0.035	0.021	0.186	51.7
1998	0.095	0.054	1.074	0.543	0.994	0.296	0.242	0.839	255.5
1999	0.042	0.011	0.725	0.149	0.316	0.141	0.105	0.043	111.1
2000	0.237	0.005	0.764	0.161	0.813	0.790	0.065	4.354	342.0
2001	0.076	0.018	0.528	0.456	0.487	0.301	0.261	NA	152.9
2002	0.117	0.031	0.241	0.030	0.127	0.058	0.003	0.841	70.9
2003	0.044	0.004	0.248	0.068	0.119	0.019	0.036	0.145	43.9
2004	0.016	0.008	0.205	0.097	0.511	0.228	0.053	0.399	83.3
2005	0.013	0.018	0.315	0.079	0.291	0.154	0.011	0.068	64.5

Area	North west	North east	Central west	Central east	South west	South east	Division 3.a	South'Bight	IBTS-0 index
Area m^2 x 10^9	83	34	86	102	37	93	31	31	
Year class									no. in 10^9
2006	0.004	0.001	0.213	0.038	0.133	0.020	0.065	0.698	52.9
2007	0.013	0.009	0.185	0.031	0.084	0.058	0.019	0.320	39.5
2008	0.145	0.138	0.281	0.253	0.158	0.139	0.160	0.279	99.2
2009	0.073	0.074	0.194	0.052	0.390	0.291	0.000	0.042	73.5
2010	0.025	0.004	0.595	0.063	0.188	0.082	NA	0.096	77.6
2011	0.008	0.001	0.312	0.132	0.214	0.129	0.076	0.059	65.1
2012	0.022	0.003	0.193	0.072	0.144	0.257	0.005	0.195	61.2
2013	0.132	0.151	0.240	0.253	0.389	0.313	0.037	0.213	113.8
2014	0.009	0.006	0.150	0.047	0.038	0.002	0.009	0.038	21.7
2015	0.015	0.015	0.136	0.059	0.083	0.324	0.002	0.927	81.2
2016	0.005	0.001	0.143	0.020	0.082	0.035	0.020	0.196	27.8
2017	0.111	0.001	0.395	0.181	0.397	0.260	0.031	0.019	102.1
2018	0.017	0.023	0.290	0.103	0.112	0.029	0.083	0.144	51.6

Table 2.3.3.2. North Sea herring. Indices of 1-ringers from the IBTS 1st Quarter for the 1995 to 2017 year classes (the data for the 1977 to 1994 year classes can be found in the stock annex). Estimation of the small sized component (possibly Downs herring) in different areas. " North Sea" = total area of sampling minus 3.a.

Year class	Year of sampling	All 1-ringers in total area (IBTS-1 index) (no/hour)	Small<13cm 1-ringers in total area (no/hour)	Proportion of small in total area vs. all sizes	Small<13cm 1-ringers in North Sea (no/hour)	Proportion of small in North Sea vs. all sizes	Proportion of small in 3.a vs small in total area
1995	1997	4403	1356	0.31	1089	0.25	0.25
1996	1998	2276	1322	0.58	1399	0.61	0.02
1997	1999	753	152	0.2	149	0.20	0.09
1998	2000	3304	1068	0.32	939	0.28	0.18
1999	2001	2499	328	0.13	307	0.12	0.13
2000	2002	3881	1520	0.39	1436	0.37	0.12
2001	2003	2837	664	0.23	180	0.06	0.75
2002	2004	979	665	0.68	710	0.73	0.01
2003	2005	1015	341	0.34	357	0.35	0.02
2004	2006	900	115	0.13	121	0.13	0.02
2005	2007	1322	303	0.23	304	0.23	0.07
2006	2008	1792	417	0.23	444	0.25	0.01
2007	2009	2339	734	0.31	623	0.27	0.21
2008	2010	1206	279	0.23	286	0.24	0.05
2009	2011	2939	1331	0.45	1407	0.48	0.02
2010	2012	1353	279	0.21	288	0.21	0.04
2011	2013	1665	747	0.45	796	0.48	0.01
2012	2014	2615	1297	0.5	1245	0.48	0.11
2013	2015	3918	1808	0.46	1105	0.28	0.43
2014	2016	783	368	0.47	364	0.47	0.08
2015	2017	2396	1306	0.54	1008	0.42	0.28
2016	2018	778	406	0.52	424	0.55	0.03
2017	2019	1539	432	0.28	397	0.26	0.15

Table 2.4.1.1. North Sea herring. Mean stock weight-at-age (wr) in the third quarter, in divisions 4.a, 4.b and 3.a. Mean catch weight-at-age for the same quarter and area is included for comparison. AS = acoustic survey, 3Q = catch.

W. rings	1		2		3		4		5		6		7		8		9+	
Year	AS	3Q	AS	3Q	AS	3Q	AS	3Q	AS	3Q	AS	3Q	AS	3Q	AS	3Q	AS	3Q
1996	45	75	119	135	196	186	253	224	262	229	299	253	306	292	325	300	335	302
1997	45	43	120	129	168	175	233	220	256	247	245	255	265	278	269	295	329	295
1998	52	54	109	131	198	172	238	209	275	237	307	263	289	269	308	313	363	298
1999	52	62	118	128	171	163	207	193	236	228	267	252	272	263	230	275	260	306
2000	46	54	118	123	180	172	218	201	232	228	261	241	295	266	300	286	280	271
2001	50	69	127	136	162	167	204	199	228	218	237	237	255	262	286	288	294	298
2002	45	50	138	140	172	177	194	200	224	224	247	244	261	252	280	281	249	298
2003	46	65	104	119	185	177	209	198	214	210	243	236	281	247	290	272	307	282
2004	35	45	116	125	139	159	206	203	231	234	253	250	262	264	279	262	270	299
2005	43	53	135	124	171	177	181	201	229	234	248	249	253	261	274	287	295	270
2006	45	61	127	139	158	163	188	192	188	205	225	242	243	257	244	260	265	285
2007	66	75	123	153	155	171	171	183	204	215	198	211	218	252	247	263	233	273
2008	62	67	141	151	180	192	183	207	194	211	230	240	217	243	268	276	282	312
2009	56	56	148	166	208	217	236	242	232	259	240	261	266	274	249	274	263	292
2010	38	74	138	150	183	190	229	222	245	245	233	239	237	248	252	265	251	271
2011	35	86	151	155	171	176	210	201	242	227	258	244	249	246	252	253	275	267
2012	48	61	125	142	192	198	194	205	212	223	232	223	242	251	239	256	243	268
2013	38	48	131	149	161	170	221	217	210	207	236	222	257	252	249	254	252	265
2014	44	49	130	142	177	191	195	208	225	239	218	233	225	243	250	264	246	266
2015	49	33	121	134	146	168	183	212	200	226	220	253	205	243	210	255	229	276
2016	37	31	112	141	158	169	187	200	223	227	235	241	243	259	232	244	236	263
2017	43	47	100	109	156	167	178	187	198	207	225	235	233	242	237	254	230	252
2018	40	45	92	126	145	163	192	202	224	211	228	235	240	254	272	262	273	270

Table 2.4.2.1. North Sea herring. Percentage maturity at 2, 3, 4, 5, 6 and 7+ ring for autumn spawning herring in the North Sea. The values are derived from the acoustic survey for 1988 to 2018. In the period 1988–2014, maturity of age 5+ were set to 100%.

Year \ Ring	2	3	4	5	6	7+
1988	65.6	87.7	100	100	100	100
1989	78.7	93.9	100	100	100	100
1990	72.6	97.0	100	100	100	100
1991	63.8	98.0	100	100	100	100
1992	51.3	100	100	100	100	100
1993	47.1	62.9	100	100	100	100
1994	72.1	85.8	100	100	100	100
1995	72.6	95.4	100	100	100	100
1996	60.5	97.5	100	100	100	100
1997	64.0	94.2	100	100	100	100
1998	64.0	89.0	100	100	100	100
1999	81.0	91.0	100	100	100	100
2000	66.0	96.0	100	100	100	100
2001	77.0	92.0	100	100	100	100
2002	86.0	97.0	100	100	100	100
2003	43.0	93.0	100	100	100	100
2004	69.8	64.9	100	100	100	100
2005	76.0	97.0	96.0	100	100	100
2006	66.0	88.0	98.0	100	100	100
2007	71.0	92.0	93.0	100	100	100
2008	86.0	98.0	99.0	100	100	100
2009	89.0	100	100	100	100	100
2010	45.0	90.0	100	100	100	100
2011	87.0	84.0	99.0	100	100	100
2012	91.0	99.0	100	100	100	100
2013	83.0	96.0	98.0	100	100	100
2014	85.0	100	100	100	100	100
2015	70.0	90.0	96.0	98.0	99.0	100

Year \ Ring	2	3	4	5	6	7+
2016	71.0	89.0	95.0	97.0	98.0	100
2017	55.0	96.0	97.0	98.0	98.0	100
2018	37.0	91.0	0.98	100	100	100

Table 2.6.1.1 North Sea herring. Years of duration of survey and years used in the assessment.

Survey	Age range	Years survey has been running	Years used in assessment
LAI (Larvae survey)	SSB	1972–2018	1973–2018
IBTS 1st Quarter (Trawl survey)	1 wr	1971–2019	1984–2019
IBTS 3rd Quarter (Trawl survey)	0-5 wr	1991–2018	1998–2018
Acoustic (+trawl)	1 wr	1995–2018	1997–2018
	2-9+ wr	1984–2018	1989–2018
IBTS0	0wr	1977–2019	1992–2019

Table 2.6.2.1 North Sea herring multi-fleet assessment model. SAM model configuration (control object).

```
An object of class "FLSAM.control"
Slot "name":
[1] "North Sea herring multifleet"

Slot "desc":
[1] "Imported from a VPA file. ( ./data/index.txt ).  Sun Mar 18 16:36:34 2018"

Slot "range":
      min       max plusgroup   minyear   maxyear   minfbar   maxfbar
        0         8         8      1947      2018         2         6

Slot "fleets":
 catch A catch BD  catch C    HERAS  IBTS-Q1    IBTS0  IBTS-Q3 LAI-ORSH
       0        0        0        2        2        2        2        6
 LAI-BUN  LAI-CNS  LAI-SNS sumFleet
       6        6        6        7

Slot "plus.group":
plusgroup
     TRUE

Slot "states":
          age
fleet       0  1  2  3  4  5  6  7  8
  catch A  -1  0  1  2  3  4  5  6  6
  catch BD  7  8  9 10 10 10 -1 -1 -1
  catch C  -1 11 12 13 14 14 14 -1 -1
  HERAS    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q1  -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS0    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-ORSH -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
  sumFleet -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "logN.vars":
0 1 2 3 4 5 6 7 8
0 1 1 1 1 1 1 1 1

Slot "logP.vars":
[1] 0 1 2

Slot "catchabilities":
          age
fleet       0  1  2  3  4  5  6  7  8
  catch A  -1 -1 -1 -1 -1 -1 -1 -1 -1
  catch BD -1 -1 -1 -1 -1 -1 -1 -1 -1
  catch C  -1 -1 -1 -1 -1 -1 -1 -1 -1
  HERAS    -1  2  3  4  4  4  4  4  4
  IBTS-Q1  -1  0 -1 -1 -1 -1 -1 -1 -1
```

```
  IBTS0      1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3    5  6  7  8  9 10 -1 -1 -1
  LAI-ORSH 11 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  11 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  11 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS  11 -1 -1 -1 -1 -1 -1 -1 -1
  sumFleet -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "power.law.exps":
          age
fleet       0  1  2  3  4  5  6  7  8
  catch A  -1 -1 -1 -1 -1 -1 -1 -1 -1
  catch BD -1 -1 -1 -1 -1 -1 -1 -1 -1
  catch C  -1 -1 -1 -1 -1 -1 -1 -1 -1
  HERAS    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q1  -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS0    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-ORSH -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
```

Table 2.6.2.1 (continued) North Sea herring multi-fleet assessment model. SAM model configuration (control object).

```
  LAI-SNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
  sumFleet -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "f.vars":
          age
fleet       0  1  2  3  4  5  6  7  8
  catch A  -1  0  0  0  0  0  1  1  1
  catch BD  2  3  3  3  3  3 -1 -1 -1
  catch C  -1  4  5  6  6  6  6 -1 -1
  HERAS    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q1  -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS0    -1 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-ORSH -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS  -1 -1 -1 -1 -1 -1 -1 -1 -1
  sumFleet -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "obs.vars":
          age
fleet       0  1  2  3  4  5  6  7  8
  catch A  -1  0  1  1  1  1  2  2  2
  catch BD  3  4  5  5  5  5 -1 -1 -1
  catch C  -1  6  7  8  8  8  8 -1 -1
  HERAS    -1  9 10 10 10 10 10 11 11
  IBTS-Q1  -1 12 -1 -1 -1 -1 -1 -1 -1
  IBTS0    13 -1 -1 -1 -1 -1 -1 -1 -1
```

```
  IBTS-Q3  14 15 16 16 16 16 -1 -1 -1
  LAI-ORSH 17 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  17 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  17 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS  17 -1 -1 -1 -1 -1 -1 -1 -1
  sumFleet -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "srr":
[1] 0

Slot "scaleNoYears":
[1] 0

Slot "scaleYears":
[1] NA

Slot "scalePars":
      age
years  0 1 2 3 4 5 6 7 8

Slot "cor.F":
[1] 2 2 2

Slot "cor.obs":
          age
fleet      0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8
  catch A   NA  NA  NA  NA  NA  NA  NA  NA
  catch BD  NA  NA  NA  NA  NA  NA  NA  NA
  catch C   NA  NA  NA  NA  NA  NA  NA  NA
  HERAS     -1  NA  NA  NA  NA  NA  NA  NA
  IBTS-Q1   -1  -1  -1  -1  -1  -1  -1  -1
  IBTS0     -1  -1  -1  -1  -1  -1  -1  -1
  IBTS-Q3    0   0   0   0   0  -1  -1  -1
  LAI-ORSH  -1  -1  -1  -1  -1  -1  -1  -1
  LAI-BUN   -1  -1  -1  -1  -1  -1  -1  -1
  LAI-CNS   -1  -1  -1  -1  -1  -1  -1  -1
  LAI-SNS   -1  -1  -1  -1  -1  -1  -1  -1
  sumFleet  -1  -1  -1  -1  -1  -1  -1  -1

Slot "cor.obs.Flag":
 [1] ID   ID   ID   ID   ID   ID   AR   ID   ID   ID   ID   <NA>
Levels: ID AR US

Slot "biomassTreat":
 [1] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
```

Table 2.6.2.1 (continued) North Sea herring multi-fleet assessment model. SAM model configuration (control object).

```
Slot "timeout":
[1] 3600

Slot "likFlag":
 [1] LN LN LN LN LN LN LN LN LN LN LN LN
Levels: LN ALN

Slot "fixVarToWeight":
[1] FALSE

Slot "simulate":
[1] FALSE

Slot "residuals":
[1] FALSE

Slot "sumFleets":
[1] "A"  "BD" "C"
```

Table 2.6.2.2 North Sea herring. Weights at age in the catch

```
Units  :  kg
, , area = A

   year
age      1997      1998      1999      2000     2001      2002      2003
  0 0.0000000 0.0000000 0.0090000 0.0170000 0.000000 0.0000000 0.0380000
  1 0.0800000 0.0730000 0.0660000 0.0770000 0.104000 0.0820000 0.0780000
  2 0.1180000 0.1200000 0.1240000 0.1270000 0.126000 0.1290000 0.1150000
  3 0.1480000 0.1460000 0.1530000 0.1600000 0.149000 0.1530000 0.1580000
  4 0.1920000 0.1840000 0.1700000 0.1800000 0.175000 0.1690000 0.1740000
  5 0.2300000 0.2210000 0.2080000 0.2000000 0.194000 0.1990000 0.1850000
  6 0.2300000 0.2370000 0.2330000 0.2190000 0.216000 0.2150000 0.2040000
  7 0.2280000 0.2500000 0.2440000 0.2440000 0.229000 0.2280000 0.2210000
  8 0.2602961 0.2805291 0.2718305 0.2707487 0.221922 0.2505347 0.2358647
   year
age      2004      2005      2006      2007      2008      2009      2010
  0 0.0000000 0.1190000 0.0650000 0.0080000 0.0100000 0.0170000 0.0000000
  1 0.0730000 0.0880000 0.1110000 0.0990000 0.0610000 0.0760000 0.0860000
  2 0.1210000 0.1220000 0.1270000 0.1490000 0.1410000 0.1480000 0.1390000
  3 0.1380000 0.1550000 0.1450000 0.1520000 0.1800000 0.1810000 0.1670000
  4 0.1830000 0.1660000 0.1720000 0.1640000 0.1810000 0.2160000 0.1920000
  5 0.2060000 0.2080000 0.1810000 0.1940000 0.1830000 0.2160000 0.2220000
  6 0.2210000 0.2230000 0.2200000 0.1900000 0.2160000 0.2390000 0.2220000
  7 0.2290000 0.2400000 0.2370000 0.2240000 0.2160000 0.2430000 0.2170000
  8 0.2467643 0.2657338 0.2460451 0.2375272 0.2622255 0.2538328 0.2393368
   year
age      2011     2012      2013      2014      2015      2016      2017
  0 0.0000000 0.035000 0.0000000 0.0180000 0.0000000 0.0000000 0.0000000
```

```
  1 0.1120000 0.086000 0.0460000 0.0840000 0.0750000 0.1020000 0.0832800
  2 0.1410000 0.131000 0.1400000 0.1370000 0.1230000 0.1350000 0.1136900
  3 0.1600000 0.171000 0.1560000 0.1730000 0.1540000 0.1560000 0.1561400
  4 0.1830000 0.185000 0.1980000 0.1860000 0.1880000 0.1810000 0.1732200
  5 0.1970000 0.206000 0.1980000 0.2150000 0.2000000 0.2060000 0.1884900
  6 0.2170000 0.222000 0.2150000 0.2120000 0.2210000 0.2150000 0.2145200
  7 0.2210000 0.239000 0.2330000 0.2260000 0.2170000 0.2310000 0.2203100
  8 0.2318784 0.243845 0.2375962 0.2428564 0.2345792 0.2296907 0.2307355
   year
age      2018
  0 0.0000000
  1 0.0890300
  2 0.1175900
  3 0.1453400
  4 0.1838400
  5 0.1914100
  6 0.2151200
  7 0.2342400
  8 0.2455873

, , area = BD

   year
age       1997       1998        1999       2000       2001       2002
  0 0.01494580 0.01928857 0.009363923 0.01434264 0.01194930 0.01240503
  1 0.02865087 0.03231327 0.029272000 0.01893101 0.02900000 0.02303098
  2 0.04290294 0.06041595 0.066093750 0.06787500 0.05234839 0.05288193
  3 0.09153333 0.11767785 0.123714286 0.12972222 0.09616484 0.11445833
  4 0.12472727 0.13614439 0.142531915 0.14900000 0.12600000 0.16755556
  5 0.15035714 0.19657143 0.163000000 0.11900000 0.12100000 0.18000000
  6 0.15700000 0.21000000 0.174000000 0.18900000 0.12200000 0.19300000
  7 0.00000000 0.23200000 0.165000000 0.17000000 0.15400000 0.22800000
  8 0.00000000 0.28500000 0.000000000 0.19900000 0.25100000 0.24400000
   year
age       2003       2004       2005       2006       2007        2008
  0 0.01343119 0.01396358 0.01133906 0.01010078 0.01191188 0.007894138
  1 0.02360108 0.03315918 0.03273352 0.02647022 0.03649933 0.036908795
  2 0.04800000 0.07020707 0.06800000 0.05114936 0.05900000 0.085000000
  3 0.11653846 0.11005543 0.10500000 0.11453979 0.08500000 0.110000000
  4 0.13278261 0.14056193 0.15800000 0.15009706 0.13000000 0.133000000
  5 0.16200000 0.17357541 0.15700000 0.16580142 0.14500000 0.187000000
  6 0.16880000 0.17186877 0.16000000 0.19700000 0.19100000 0.161000000
  7 0.17800000 0.20480886 0.17800000 0.22500000 0.16500000 0.184000000
  8 0.17800000 0.23136654 0.00000000 0.21352474 0.21600000 0.159000000
   year
age       2009       2010        2011       2012       2013        2014
  0 0.00900000 0.00700000 0.007740515 0.01037637 0.00800000 0.007425728
  1 0.02991054 0.02686938 0.033147062 0.02889486 0.02685119 0.029558819
  2 0.08613572 0.06883792 0.045000000 0.07448209 0.04592681 0.026215384
  3 0.14813705 0.18399001 0.071000000 0.13067637 0.14816174 0.116530800
  4 0.18600000 0.14300000 0.000000000 0.00000000 0.19718703 0.188000000
  5 0.00000000 0.20500000 0.000000000 0.19500000 0.28800000 0.214000000
  6 0.31200000 0.19100000 0.000000000 0.16000000 0.21500000 0.206000000
```

```
  7 0.00000000 0.00000000 0.000000000 0.00000000 0.23300000 0.227000000
  8 0.26300000 0.00000000 0.000000000 0.18400000 0.23400000 0.226309343
   year
age        2015       2016       2017        2018
  0 0.008428322 0.00700000 0.00890000 0.005449234
  1 0.020214437 0.02126004 0.02636988 0.026532076
  2 0.055000000 0.05212731 0.02479000 0.029537017
  3 0.095000000 0.08397668 0.07500000 0.048000000
  4 0.000000000 0.09300000 0.00000000 0.000000000
  5 0.147000000 0.07800000 0.00000000 0.000000000
  6 0.000000000 0.14600000 0.00000000 0.000000000
  7 0.000000000 0.00000000 0.00000000 0.000000000
  8 0.000000000 0.00000000 0.00000000 0.000000000

, , area = C

   year
age  1997  1998  1999  2000  2001  2002  2003  2004  2005  2006  2007
  0 0.021 0.029 0.018 0.022 0.025 0.015 0.013 0.024 0.027 0.020 0.048
  1 0.032 0.060 0.054 0.041 0.066 0.054 0.054 0.060 0.065 0.068 0.071
  2 0.084 0.082 0.091 0.078 0.076 0.101 0.073 0.069 0.072 0.081 0.075
  3 0.130 0.119 0.118 0.108 0.108 0.120 0.124 0.120 0.106 0.119 0.111
  4 0.170 0.163 0.139 0.164 0.130 0.143 0.151 0.138 0.154 0.141 0.123
  5 0.183 0.178 0.159 0.191 0.147 0.161 0.163 0.149 0.175 0.184 0.152
  6 0.192 0.196 0.191 0.183 0.221 0.179 0.193 0.169 0.189 0.188 0.179
  7 0.194 0.179 0.202 0.212 0.179 0.177 0.214 0.187 0.216 0.213 0.175
  8 0.201 0.226 0.210 0.198 0.000 0.000 0.187 0.178 0.209 0.206 0.144
   year
age  2008  2009  2010  2011  2012  2013  2014  2015  2016    2017    2018
  0 0.036 0.018 0.028 0.021 0.027 0.034 0.014 0.015 0.000 0.03380 0.02163
  1 0.071 0.086 0.072 0.053 0.065 0.091 0.065 0.042 0.054 0.05160 0.04951
  2 0.087 0.102 0.080 0.085 0.073 0.080 0.090 0.071 0.061 0.08015 0.05690
  3 0.109 0.081 0.122 0.115 0.124 0.135 0.117 0.133 0.124 0.10318 0.10484
  4 0.139 0.207 0.149 0.134 0.169 0.161 0.162 0.157 0.149 0.13839 0.15789
  5 0.168 0.000 0.191 0.191 0.175 0.200 0.191 0.180 0.188 0.17196 0.18110
  6 0.175 0.000 0.221 0.193 0.199 0.000 0.209 0.196 0.208 0.15292 0.18925
  7 0.203 0.000 0.216 0.234 0.220 0.000 0.221 0.197 0.209 0.14710 0.18664
  8 0.199 0.269 0.205 0.248 0.216 0.000 0.228 0.215 0.235 0.15980 0.20210
```

Table 2.6.2.3 North Sea herring. Fishing mortality at age in the stock

Units : f

, , area = A

year

age	1947	1948	1949	1950	1951	1952
0	0.000000000	0.000000000	0.000000000	0.00000000	0.000000000	0.000000000
1	0.001169498	0.001137948	0.001394607	0.00180942	0.002770707	0.003361101
2	0.036142885	0.034857073	0.043694035	0.05780169	0.091086620	0.111485848
3	0.083349094	0.082967687	0.097375128	0.11422967	0.157135869	0.165444314
4	0.096381376	0.097284351	0.114020430	0.12942817	0.172595304	0.178207629
5	0.126601498	0.124855905	0.144059181	0.14720594	0.178781054	0.191601796
6	0.201566782	0.182792643	0.230566945	0.19885984	0.211122461	0.253210357
7	0.225319608	0.205576929	0.271372399	0.21492187	0.206739870	0.281855825
8	0.225319608	0.205576929	0.271372399	0.21492187	0.206739870	0.281855825

year

age	1953	1954	1955	1956	1957	1958
0	0.000000000	0.0000000	0.000000000	0.000000000	0.000000000	0.000000000
1	0.003965779	0.0050085	0.005357893	0.006175305	0.006577958	0.006933927
2	0.132475384	0.1696193	0.181136524	0.210052569	0.223574944	0.235579638
3	0.179067999	0.2139477	0.204589980	0.215402896	0.225238078	0.227002241
4	0.180611010	0.2049446	0.182735362	0.184080302	0.195995168	0.187292100
5	0.192360078	0.2216014	0.189053115	0.187156189	0.208650546	0.188640856
6	0.243002037	0.3079924	0.213264194	0.202271047	0.232228579	0.164578375
7	0.265687713	0.3338752	0.193517590	0.201666847	0.226967523	0.140567031
8	0.265687713	0.3338752	0.193517590	0.201666847	0.226967523	0.140567031

year

age	1959	1960	1961	1962	1963	1964
0	0.000000000	0.000000000	0.0000000	0.000000000	0.000000000	0.000000000
1	0.007984775	0.006804058	0.0074636	0.007351346	0.005592108	0.008251031
2	0.273429590	0.228739997	0.2521264	0.246658184	0.181815926	0.275623784
3	0.259591831	0.210018074	0.2411735	0.277656201	0.187721071	0.292061896
4	0.221744357	0.178730431	0.2086920	0.256052291	0.155196157	0.249323647
5	0.222763429	0.180008138	0.2015160	0.260383896	0.149616544	0.239023630
6	0.244576084	0.200624995	0.2074843	0.314262496	0.113534890	0.194911852
7	0.242922185	0.226590520	0.1978591	0.298293791	0.124197617	0.189720089
8	0.242922185	0.226590520	0.1978591	0.298293791	0.124197617	0.189720089

year

age	1965	1966	1967	1968	1969	1970
0	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1	0.01402998	0.01277427	0.01525286	0.02630874	0.01955873	0.02149259
2	0.48839311	0.43872583	0.52916627	0.95312464	0.68557111	0.75621445
3	0.54593223	0.51442258	0.68542072	1.20180888	0.86221304	0.95230315
4	0.47731597	0.45306529	0.62398482	0.95064757	0.77365429	0.86091820
5	0.46442529	0.45767109	0.64947769	0.90434202	0.80266984	0.81439004
6	0.46582072	0.39136531	0.73981738	1.12527176	1.13502376	1.13918944
7	0.47480496	0.47814241	0.90539475	1.16470657	1.01116067	0.87102139
8	0.47480496	0.47814241	0.90539475	1.16470657	1.01116067	0.87102139

year

age	1971	1972	1973	1974	1975	1976
0	0.0000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1	0.0233425	0.01656327	0.02331373	0.02175198	0.02630721	0.01843697
2	0.8217631	0.56246210	0.81204050	0.75016280	0.91901782	0.62263842

```
  3 1.0493504 0.64108415 0.95426570 0.88038294 1.14897726 0.85532943
  4 1.0256065 0.54018084 0.81078464 0.77873437 1.01228610 0.73828466
  5 1.0991274 0.49695633 0.81126259 0.84255776 1.11858418 0.78303777
  6 2.7645006 0.48838316 1.00952180 0.89005915 1.21718531 0.69402811
  7 1.6631636 0.28676433 0.66717546 0.78787253 1.52461754 0.98119349
  8 1.6631636 0.28676433 0.66717546 0.78787253 1.52461754 0.98119349
   year
age        1977        1978       1979        1980        1981        1982
  0 0.000000000 0.000000000 0.00000000 0.000000000 0.000000000 0.000000000
  1 0.006505918 0.005317893 0.00505360 0.005204518 0.005976583 0.005135481
  2 0.199427935 0.159379737 0.15010870 0.154371350 0.178393214 0.150444554
  3 0.301904035 0.222252047 0.19487674 0.187851109 0.230943561 0.193657473
  4 0.266490116 0.191236050 0.15841367 0.144649268 0.214026911 0.168324348
  5 0.316097997 0.211637757 0.16129184 0.131864576 0.228563176 0.152831311
  6 0.206828553 0.106940172 0.06497829 0.043439160 0.182324153 0.091158048
  7 0.341610828 0.184961461 0.11320405 0.073402500 0.323501186 0.130631218
  8 0.341610828 0.184961461 0.11320405 0.073402500 0.323501186 0.130631218
   year
age       1983        1984        1985        1986        1987        1988
  0 0.00000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000
  1 0.00607374 0.007259319 0.009172353 0.008689891 0.008276882 0.007822664
  2 0.17964803 0.217013529 0.278334702 0.261240495 0.246785279 0.231149105
  3 0.23863970 0.300451761 0.384844976 0.339836476 0.302989580 0.275135866
  4 0.24133319 0.333448447 0.431261836 0.387717124 0.355899497 0.337441415
  5 0.24149479 0.336577266 0.420065203 0.392829425 0.365139176 0.357992212
  6 0.22056152 0.348661399 0.471495991 0.463762242 0.393165517 0.393537145
  7 0.30014060 0.451038648 0.534541986 0.524262692 0.399796623 0.411269558
  8 0.30014060 0.451038648 0.534541986 0.524262692 0.399796623 0.411269558
   year
age        1989        1990        1991       1992       1993       1994
  0 0.000000000 0.000000000 0.000000000 0.00000000 0.00000000 0.00000000
  1 0.008092362 0.007168658 0.008587611 0.00948557 0.01075777 0.01051794
  2 0.239090319 0.208860084 0.253720539 0.28207685 0.32279018 0.31461714
  3 0.271846932 0.224437679 0.257470735 0.29777361 0.36834541 0.39692750
  4 0.330242439 0.260394771 0.273661366 0.31906446 0.38869970 0.41683999
  5 0.340836805 0.264843554 0.259349382 0.29916153 0.33763841 0.33298279
  6 0.359184410 0.247422331 0.237649899 0.31634595 0.36200932 0.31799641
  7 0.369429803 0.265620756 0.220929567 0.30545155 0.34718163 0.27566160
  8 0.369429803 0.265620756 0.220929567 0.30545155 0.34718163 0.27566160
   year
age        1995        1996        1997        1998        1999
  0 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000
  1 0.008167802 0.003853034 0.003185023 0.004046158 0.003811862
  2 0.238076074 0.104627329 0.084874360 0.108634654 0.099230443
  3 0.342928904 0.162774955 0.143330651 0.186015701 0.184839631
  4 0.364438588 0.171796287 0.154121602 0.195569410 0.192636382
  5 0.324841100 0.164434605 0.150457059 0.195875238 0.189753719
  6 0.328249001 0.125447248 0.118910514 0.180143355 0.159068300
  7 0.273847756 0.094385568 0.094453528 0.119659096 0.099199973
  8 0.273847756 0.094385568 0.094453528 0.119659096 0.099199973
   year
age        2000        2001        2002        2003       2004        2005
  0 0.000000000 0.000000000 0.000000000 0.000000000 0.0000000 0.000000000
```

```
  1 0.003589421 0.002716575 0.002409158 0.002354906 0.00226575 0.002699024
  2 0.090853935 0.065700332 0.056451973 0.053942103 0.05111798 0.059776552
  3 0.176601411 0.137999093 0.120530936 0.122501137 0.12424791 0.141244129
  4 0.197187957 0.169291337 0.157247458 0.175835573 0.19405195 0.228018803
  5 0.197825118 0.186408684 0.179798950 0.220548567 0.26374291 0.313811806
  6 0.162611260 0.164368847 0.162577339 0.211371234 0.32117289 0.455301525
  7 0.106540545 0.144811340 0.149179726 0.183661609 0.27867914 0.474793354
  8 0.106540545 0.144811340 0.149179726 0.183661609 0.27867914 0.474793354
   year
age        2006        2007        2008        2009        2010
  0 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000
  1 0.002911738 0.002809547 0.002688573 0.001938206 0.002050783
  2 0.063168652 0.058869710 0.054464161 0.037628045 0.039612275
  3 0.140164399 0.128220366 0.093108299 0.055318719 0.060053852
  4 0.217166292 0.194025445 0.126495940 0.071509774 0.071543216
  5 0.284763822 0.249630544 0.154333114 0.087347412 0.084475618
  6 0.385458758 0.327381827 0.151669088 0.065109955 0.059720998
  7 0.437922286 0.384243535 0.191012156 0.091894370 0.072728563
  8 0.437922286 0.384243535 0.191012156 0.091894370 0.072728563
   year
age        2011        2012        2013        2014        2015
  0 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000
  1 0.002338586 0.003337446 0.002959385 0.002765175 0.002177255
  2 0.045618917 0.066329964 0.057714957 0.054708370 0.043722274
  3 0.077040133 0.127472235 0.124004224 0.122078685 0.103709645
  4 0.094583522 0.164276293 0.180549048 0.182706187 0.169082281
  5 0.111825994 0.197064741 0.234882768 0.233656512 0.242764995
  6 0.087299693 0.211294742 0.303034914 0.279546869 0.351920810
  7 0.095140620 0.225081061 0.351250994 0.341557584 0.491015440
  8 0.095140620 0.225081061 0.351250994 0.341557584 0.491015440
   year
age        2016        2017        2018        2019
  0 0.000000000 0.000000000 0.000000000 0.000000000
  1 0.002135441 0.001781414 0.001964486 0.001964561
  2 0.044023560 0.036437381 0.040719119 0.040720541
  3 0.118857830 0.112133968 0.126632708 0.126636771
  4 0.191939429 0.183535435 0.223534424 0.223541007
  5 0.266123147 0.231406492 0.285192514 0.285200224
  6 0.397733888 0.286839099 0.368016036 0.368031274
  7 0.605846106 0.440086912 0.579202991 0.579225007
  8 0.605846106 0.440086912 0.579202991 0.579225007

, , area = BD

   year
age         1947         1948         1949         1950         1951
  0 0.0004308753 0.0004101282 0.0007586030 0.0013130647 0.0021697177
  1 0.0006286880 0.0005686453 0.0019860730 0.0060628199 0.0168332478
  2 0.0001758601 0.0001653714 0.0003471257 0.0006761594 0.0012501567
  3 0.0002529521 0.0002442054 0.0003770118 0.0005571681 0.0007983842
   year
age         1952        1953        1954        1955        1956
  0 0.0030001105 0.003729627 0.004697127 0.004948493 0.004461943
```

```
  1 0.0325318031 0.050653124 0.072151780 0.102999129 0.105884951
  2 0.0018512485 0.002398864 0.002943234 0.003641530 0.003712477
  3 0.0009905517 0.001144244 0.001277606 0.001433136 0.001428982
   year
age        1957        1958        1959        1960       1961        1962
  0 0.005084987 0.005402454 0.009176446 0.014875082 0.01523108 0.009042185
  1 0.129662457 0.118814505 0.145484721 0.160634396 0.11384242 0.077984367
  2 0.004143640 0.003937690 0.004398226 0.004604385 0.00373483 0.002901230
  3 0.001512647 0.001460329 0.001531056 0.001536058 0.00136032 0.001175422
   year
age        1963        1964        1965        1966        1967
  0 0.013132038 0.016660653 0.015295214 0.022237794 0.029456463
  1 0.120071551 0.211658023 0.203044662 0.226606310 0.282736252
  2 0.003722241 0.005200043 0.005073039 0.005362213 0.006019418
  3 0.001349254 0.001667440 0.001667439 0.001740669 0.001875400
   year
age        1968        1969        1970        1971        1972
  0 0.031513131 0.021476181 0.035517040 0.049720420 0.065319524
  1 0.299176361 0.259298251 0.313203133 0.495596935 0.563369790
  2 0.006259859 0.005723343 0.006400774 0.008347661 0.009091763
  3 0.001927786 0.001830203 0.001964014 0.002292534 0.002425260
   year
age        1973        1974        1975        1976        1977
  0 0.070502646 0.092877772 0.115611467 0.083816075 0.075558350
  1 0.565283896 0.469487928 0.440053093 0.187769368 0.110590380
  2 0.009063563 0.008072741 0.007687611 0.004550954 0.003228502
  3 0.002429585 0.002276470 0.002220589 0.001630533 0.001325561
   year
age        1978        1979        1980        1981        1982
  0 0.093894997 0.115974144 0.143448131 0.324923014 0.320385250
  1 0.100277331 0.093721593 0.086085796 0.180227216 0.172645054
  2 0.003092176 0.003030648 0.002952982 0.004506611 0.004465142
  3 0.001288112 0.001270840 0.001250345 0.001571264 0.001560173
   year
age        1983        1984        1985        1986        1987
  0 0.317458795 0.192582893 0.126008430 0.099842672 0.135466758
  1 0.201647446 0.181323993 0.228377766 0.237009822 0.320344506
  2 0.005015408 0.004883518 0.005886646 0.006368538 0.008116381
  3 0.001670043 0.001659781 0.001862617 0.001940922 0.002236236
   year
age        1988        1989        1990        1991        1992
  0 0.128996432 0.116733450 0.093809951 0.119791175 0.204018258
  1 0.400976448 0.325952567 0.276054020 0.229697963 0.271072846
  2 0.009877430 0.009636276 0.009769915 0.010223003 0.012634381
  3 0.002500554 0.002455701 0.002455145 0.002512647 0.002857337
   year
age        1993        1994        1995        1996        1997
  0 0.222036668 0.146745052 0.139011122 0.067667348 0.023768167
  1 0.248690283 0.125787734 0.111286449 0.066870381 0.022721983
  2 0.013593518 0.010339827 0.010796173 0.009121549 0.005947058
  3 0.003028262 0.002623274 0.002727878 0.002468370 0.001943285
   year
age        1998        1999        2000        2001        2002
```

```
  0 0.021229026 0.025186593 0.030066107 0.020566130 0.026126945
  1 0.022818314 0.017644046 0.018896219 0.007026746 0.016336999
  2 0.006570483 0.006338086 0.006736067 0.004049759 0.006677948
  3 0.002014357 0.001989735 0.001841882 0.001284373 0.001334168
   year
age        2003         2004         2005        2006         2007
  0 0.028251025 0.0363813207 0.0522822356 0.043048438 0.0302461105
  1 0.024831019 0.0294468367 0.0392793632 0.020246005 0.0112945841
  2 0.007603846 0.0083311712 0.0084456718 0.005443603 0.0027274768
  3 0.001003498 0.0008512123 0.0005845575 0.000395756 0.0001407086
   year
age          2008         2009         2010         2011         2012
  0 0.03136458899 0.0251592233 0.0263721531 0.0312818557 0.0344530762
  1 0.01147505260 0.0108995567 0.0102602778 0.0121202132 0.0176274987
  2 0.00205231879 0.0020225402 0.0023440871 0.0022278983 0.0032948113
  3 0.00007903096 0.0001015617 0.0001968298 0.0001855711 0.0002646568
   year
age        2013         2014         2015          2016          2017
  0 0.025511983 0.0331986882 0.0458908101 0.06059885335 0.04486903308
  1 0.014826916 0.0157264724 0.0168750431 0.01982957074 0.01256092602
  2 0.003233521 0.0031696099 0.0024208938 0.00248500709 0.00132270577
  3 0.000243034 0.0002117316 0.0001066504 0.00009276139 0.00003299441
   year
age          2018          2019
  0 0.04609561841 0.04616935994
  1 0.00880101292 0.00881408292
  2 0.00092349257 0.00092430301
  3 0.00002310725 0.00002311924
```

Table 2.6.2.4 North Sea Herring. Negative log-likelihood

```
1518.22018831688
```

Table 2.6.2.5 North Sea herring. FLR, R software versions

FLSAM.version	2.1.0
FLCore.version	2.6.9
R.version	R version 3.5.2 (2018-12-20)
platform	x86_64-w64-mingw32
run.date	2019-03-17 14:06:48

Table 2.6.3.1 North Sea Herring. CATCH IN NUMBER

Units : thousands

age	1947	1948	1949	1950	1951	1952	1953	1954	1955
0	0	0	0	0	0	0	150000	219000	164000
1	0	3000	0	0	462000	722000	1023000	1451000	2072000
2	494000	247000	478000	535000	660000	1346000	1322000	1493000	1931000
3	415000	672000	644000	1039000	959000	576000	1003000	1111000	1032000
4	638000	328000	396000	617000	1255000	610000	474000	591000	479000
5	526000	601000	287000	290000	630000	652000	386000	361000	337000
6	756000	487000	652000	254000	262000	464000	473000	330000	232000
7	431000	400000	462000	331000	142000	236000	278000	379000	120000
8	1311000	917000	1037000	597000	445000	554000	392000	511000	215000

age	1956	1957	1958	1959	1960	1961	1962	1963
0	96000	279000	97000	0	194600	1269200	141800	442800
1	1697000	1483000	4279000	1609000	2392700	336000	2146900	1262200
2	1860000	1644000	1029000	4934000	1142300	1889400	269600	2961200
3	1221000	736000	999000	488000	1966700	479900	797400	177200
4	516000	644000	322000	497000	165900	1455900	335100	158300
5	249000	344000	461000	233000	167700	124000	1081800	80600
6	194000	207000	147000	249000	112900	157900	126900	229700
7	104000	147000	73000	120000	125800	61400	145100	22400
8	292000	253000	118000	301000	270600	143500	173100	93000

age	1964	1965	1966	1967	1968	1969	1970	1971
0	496900	157100	374500	645400	839300	112000	898100	684000
1	2971700	3209300	1383100	1674300	2425000	2503300	1196200	4378500
2	1547500	2217600	2569700	1171500	1795200	1883000	2002800	1146800
3	2243100	1324600	741200	1364700	1494300	296300	883600	662500
4	148400	2039400	450100	371500	621400	133100	125200	208300
5	149000	145100	889800	297800	157100	190800	50300	26900
6	95000	151900	45300	393100	145000	49900	61000	30500
7	256300	117600	64800	67900	163400	42700	7900	26800
8	84000	491400	331800	254400	105500	52500	24200	12500

age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	750400	289400	996100	263800	238200	256800	NA	NA	1262700	9519700
1	3340600	2368000	846100	2460500	126600	144300	NA	NA	245100	872000
2	1440500	1344200	772600	541700	901500	44700	NA	NA	134000	284300
3	343800	659200	362000	259600	117300	186400	NA	NA	91800	56900
4	130600	150200	126000	140500	52000	10800	NA	NA	32200	39500
5	32900	59300	56100	57200	34500	7000	NA	NA	21700	28500
6	5000	30600	22300	16100	6100	4100	NA	NA	2300	22700
7	200	3700	5000	9100	4400	1500	NA	NA	1400	18700
8	1500	2000	3100	4800	1400	700	NA	NA	500	6600

age	1982	1983	1984	1985	1986	1987	1988	1989
0	11956700	13296900	6973300	4211000	3724700	8229200	3164800	3057800
1	1116400	2448600	1818400	3253000	4801400	6836300	7867000	3145900
2	299400	573800	1146200	1326300	1266700	2137200	2232500	1593700
3	230100	216400	441400	1182400	840800	667900	1090700	1363800

4	33700	105100	201500	368500	465900	467100	383700	809300
5	14400	26200	81100	124500	129800	245800	255800	211800
6	6800	22800	22600	43600	62100	74700	128100	123700
7	7800	12800	25200	20200	20500	23800	38000	61000
8	4700	23100	29700	29200	28400	16200	23800	28200

year								
age	1990	1991	1992	1993	1994	1995	1996	1997
0	1302800	2386600	10331300	10265400	4498900	7438469	2311226	431175
1	3020000	2138900	2303100	3826800	1785200	1664874	1606393	479702
2	899300	1132800	1284900	1176300	1783200	1444061	642084	687920
3	779100	556700	442700	609000	489100	816703	525601	446909
4	861000	548900	361500	305500	347600	231794	172099	284920
5	387500	501200	360500	215600	109000	118536	57586	109178
6	80200	205300	375600	226000	91800	55128	22534	31389
7	54400	39300	152400	188000	76400	41409	9264	11832
8	40700	38600	62500	129000	116600	98200	21143	24467

year									
age	1998	1999	2000	2001	2002	2003	2004	2005	2006
0	259526	1566349	1105085	1832691	730279	369074	715597	1015554	878637
1	977680	303520	1171677	614469	837557	617021	206648	715547	222111
2	1220105	616354	622853	842635	579592	1221992	447918	355453	401087
3	537932	1058716	463170	485628	970577	529386	1366155	485746	310602
4	276333	294066	646814	278884	292205	835552	543376	1318647	464620
5	175817	135648	213466	321743	140701	244780	753231	479961	997782
6	88927	69299	82481	90918	174570	107751	169324	576154	252150
7	15232	27998	35706	38252	48908	123291	104945	115212	247042
8	20550	12228	17087	20602	43322	46715	97142	146808	106412

year									
age	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	621005	798284	650043	574895	778927	773241	461571	1388685	538228
1	235553	235022	175923	280728	159504	284906	413000	370590	394878
2	219115	331772	259434	293887	367820	455259	324920	382990	551802
3	417452	184771	106738	236804	275016	673465	485185	386131	247555
4	285746	199069	93321	126241	218711	404265	571269	616563	282813
5	309454	137529	86137	83893	130127	306234	422765	487582	461041
6	629187	118349	37951	61542	62938	152577	327213	284562	432034
7	147830	215542	53130	33305	52081	104461	145330	191729	271280
8	156750	117258	143131	113675	125734	205427	313638	214513	337811

year			
age	2016	2017	2018
0	1583568	462148	1337404
1	109135	209356	73260
2	625483	108706	206232
3	818585	1079854	200527
4	293372	837770	1178604
5	280451	222790	848961
6	367844	145511	223637
7	307347	175533	144999
8	359076	221296	332482

Table 2.6.3.2 North Sea Herring. WEIGHTS AT AGE IN THE CATCH

Units : kg

age \ year	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
0	0.015	0.015	0.0150	0.015	0.0150	0.015	0.015	0.0150	0.0150	0.015	0.0150
1	0.050	0.050	0.0500	0.050	0.0500	0.050	0.050	0.0500	0.0500	0.050	0.0500
2	0.122	0.122	0.1280	0.128	0.1340	0.137	0.137	0.1390	0.1400	0.140	0.1410
3	0.140	0.140	0.1450	0.151	0.1570	0.165	0.167	0.1690	0.1700	0.172	0.1730
4	0.156	0.156	0.1610	0.166	0.1760	0.183	0.190	0.1930	0.1950	0.197	0.1980
5	0.171	0.171	0.1760	0.180	0.1890	0.199	0.205	0.2110	0.2140	0.216	0.2180
6	0.185	0.185	0.1890	0.193	0.2010	0.210	0.218	0.2230	0.2280	0.231	0.2330
7	0.197	0.197	0.2010	0.204	0.2110	0.219	0.226	0.2330	0.2380	0.242	0.2440
8	0.242	0.242	0.2435	0.245	0.2475	0.251	0.254	0.2565	0.2595	0.261	0.2625

age \ year	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
0	0.0150	0.0150	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
1	0.0500	0.0500	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
2	0.1410	0.1430	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126
3	0.1740	0.1760	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176
4	0.1990	0.2010	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
5	0.2190	0.2210	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243
6	0.2340	0.2360	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251
7	0.2450	0.2470	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267
8	0.2635	0.2645	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271

age \ year	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
1	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
2	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126
3	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176
4	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
5	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243
6	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251	0.251
7	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267
8	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271

age \ year	1980	1981	1982	1983	1984	1985	1986	1987
0	0.015	0.007	0.010000	0.0100000	0.0100000	0.0090000	0.0060000	0.0110000
1	0.050	0.049	0.059000	0.0590000	0.0590000	0.0360000	0.0670000	0.0350000
2	0.126	0.118	0.118000	0.1180000	0.1180000	0.1280000	0.1210000	0.0990000
3	0.176	0.142	0.149000	0.1490000	0.1490000	0.1640000	0.1530000	0.1500000
4	0.211	0.189	0.179000	0.1790000	0.1790000	0.1940000	0.1820000	0.1800000
5	0.243	0.211	0.217000	0.2170000	0.2170000	0.2110000	0.2080000	0.2110000
6	0.251	0.222	0.238000	0.2380000	0.2380000	0.2200000	0.2210000	0.2340000
7	0.267	0.267	0.265000	0.2650000	0.2650000	0.2580000	0.2380000	0.2580000
8	0.271	0.271	0.274234	0.2745238	0.2746263	0.2821301	0.2572113	0.2881358

age \ year	1988	1989	1990	1991	1992	1993	1994
0	0.0110000	0.0170000	0.0190000	0.0170000	0.0100000	0.0100000	0.0060000
1	0.0550000	0.0430000	0.0550000	0.0580000	0.0530000	0.0330000	0.0560000
2	0.1110000	0.1150000	0.1140000	0.1300000	0.1020000	0.1150000	0.1300000
3	0.1450000	0.1530000	0.1490000	0.1660000	0.1750000	0.1450000	0.1590000

```
  4 0.1740000 0.1730000 0.1770000 0.1840000 0.1890000 0.1890000 0.1810000
  5 0.1970000 0.2080000 0.1930000 0.2030000 0.2070000 0.2040000 0.2140000
  6 0.2160000 0.2310000 0.2290000 0.2170000 0.2230000 0.2280000 0.2400000
  7 0.2370000 0.2470000 0.2360000 0.2350000 0.2370000 0.2440000 0.2550000
  8 0.2565714 0.2631489 0.2608182 0.2630415 0.2631664 0.2734558 0.2761973
   year
age      1995      1996      1997      1998     1999      2000     2001
  0 0.0090000 0.0150000 0.0150000 0.0210000 0.009000 0.0150000 0.012000
  1 0.0420000 0.0180000 0.0440000 0.0510000 0.045000 0.0330000 0.048000
  2 0.1300000 0.1120000 0.1080000 0.1140000 0.115000 0.1130000 0.118000
  3 0.1690000 0.1560000 0.1480000 0.1450000 0.151000 0.1570000 0.149000
  4 0.1980000 0.1880000 0.1950000 0.1830000 0.171000 0.1790000 0.177000
  5 0.2070000 0.2040000 0.2270000 0.2190000 0.207000 0.2010000 0.198000
  6 0.2430000 0.2120000 0.2260000 0.2380000 0.233000 0.2160000 0.213000
  7 0.2470000 0.2610000 0.2350000 0.2470000 0.245000 0.2460000 0.238000
  8 0.2809153 0.2814938 0.2549437 0.2878952 0.267719 0.2731261 0.269744
   year
age      2002      2003      2004      2005      2006      2007     2008
  0 0.0120000 0.0140000 0.0140000 0.0110000 0.0100000 0.0124000 0.007900
  1 0.0370000 0.0370000 0.0360000 0.0440000 0.0490000 0.0638000 0.053500
  2 0.1180000 0.1040000 0.1000000 0.0990000 0.1170000 0.1214000 0.128800
  3 0.1530000 0.1580000 0.1380000 0.1530000 0.1440000 0.1513000 0.179600
  4 0.1700000 0.1740000 0.1830000 0.1660000 0.1720000 0.1634000 0.181200
  5 0.1990000 0.1840000 0.2010000 0.2080000 0.1810000 0.1933000 0.183200
  6 0.2140000 0.2050000 0.2160000 0.2230000 0.2200000 0.1900000 0.215700
  7 0.2280000 0.2220000 0.2280000 0.2400000 0.2370000 0.2232000 0.216100
  8 0.2504017 0.2366464 0.2545115 0.2653676 0.2460061 0.2374933 0.262076
   year
age      2009      2010     2011      2012      2013      2014      2015
  0 0.0094000 0.0075000 0.008000 0.0106000 0.0077000 0.0075000 0.0087000
  1 0.0514000 0.0571000 0.041300 0.0463000 0.0468000 0.0522000 0.0261000
  2 0.1440000 0.1292000 0.131700 0.1243000 0.1162000 0.1240000 0.1135000
  3 0.1811000 0.1669000 0.159300 0.1706000 0.1563000 0.1719000 0.1538000
  4 0.2158000 0.1912000 0.183100 0.1854000 0.1977000 0.1861000 0.1883000
  5 0.2162000 0.2203000 0.197000 0.2058000 0.1980000 0.2148000 0.2001000
  6 0.2390000 0.2193000 0.216700 0.2215000 0.2154000 0.2118000 0.2212000
  7 0.2428000 0.2160000 0.221100 0.2387000 0.2334000 0.2264000 0.2170000
  8 0.2532723 0.2383892 0.231918 0.2427213 0.2378432 0.2426541 0.2347182
   year
age      2016      2017      2018
  0 0.0071000 0.0090000 0.0054000
  1 0.0265000 0.0380000 0.0394000
  2 0.1267000 0.0990000 0.1085000
  3 0.1549000 0.1560000 0.1451000
  4 0.1803000 0.1730000 0.1838000
  5 0.2059000 0.1880000 0.1914000
  6 0.2151000 0.2150000 0.2151000
  7 0.2313000 0.2200000 0.2342000
  8 0.2299244 0.2305184 0.2455776
```

Table 2.6.3.3 North Sea Herring. WEIGHTS AT AGE IN THE STOCK

Units : kg

age \ year	1947	1948	1949	1950	1951	1952	1953
0	0.0150	0.0150	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000
1	0.0500	0.0500	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000
2	0.1220	0.1220	0.1240000	0.1260000	0.1300000	0.1330000	0.1360000
3	0.1400	0.1400	0.1416667	0.1453333	0.1510000	0.1576667	0.1630000
4	0.1560	0.1560	0.1576667	0.1610000	0.1676667	0.1750000	0.1830000
5	0.1710	0.1710	0.1726667	0.1756667	0.1816667	0.1893333	0.1976667
6	0.1850	0.1850	0.1863333	0.1890000	0.1943333	0.2013333	0.2096667
7	0.1970	0.1970	0.1983333	0.2006667	0.2053333	0.2113333	0.2186667
8	0.2625	0.2625	0.2630000	0.2640000	0.2658333	0.2683333	0.2713333

age \ year	1954	1955	1956	1957	1958	1959	1960
0	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000
1	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000
2	0.1376667	0.1386667	0.1396667	0.1403333	0.1406667	0.1416667	0.1463333
3	0.1670000	0.1686667	0.1703333	0.1716667	0.1730000	0.1743333	0.1790000
4	0.1886667	0.1926667	0.1950000	0.1966667	0.1980000	0.1993333	0.2076667
5	0.2050000	0.2100000	0.2136667	0.2160000	0.2176667	0.2193333	0.2263333
6	0.2170000	0.2230000	0.2273333	0.2306667	0.2326667	0.2343333	0.2486667
7	0.2260000	0.2323333	0.2376667	0.2413333	0.2436667	0.2453333	0.2636667
8	0.2743333	0.2771667	0.2795000	0.2815000	0.2828333	0.2840000	0.2936240

age \ year	1961	1962	1963	1964	1965	1966	1967
0	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000	0.0150000
1	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000	0.0500000
2	0.1510000	0.1550000	0.1550000	0.1550000	0.1550000	0.1550000	0.1550000
3	0.1833333	0.1870000	0.1870000	0.1870000	0.1870000	0.1870000	0.1870000
4	0.2156667	0.2230000	0.2230000	0.2230000	0.2230000	0.2230000	0.2230000
5	0.2330000	0.2390000	0.2390000	0.2390000	0.2390000	0.2390000	0.2390000
6	0.2626667	0.2760000	0.2760000	0.2760000	0.2760000	0.2760000	0.2760000
7	0.2816667	0.2990000	0.2990000	0.2990000	0.2990000	0.2990000	0.2990000
8	0.3034146	0.3090087	0.3092903	0.3101214	0.3069573	0.3102731	0.3100755

age \ year	1968	1969	1970	1971	1972	1973	1974	1975
0	0.0150000	0.0150000	0.0150000	0.015000	0.0150	0.0150	0.015000	0.01500
1	0.0500000	0.0500000	0.0500000	0.050000	0.0500	0.0500	0.050000	0.05000
2	0.1550000	0.1550000	0.1550000	0.155000	0.1550	0.1550	0.155000	0.15500
3	0.1870000	0.1870000	0.1870000	0.187000	0.1870	0.1870	0.187000	0.18700
4	0.2230000	0.2230000	0.2230000	0.223000	0.2230	0.2230	0.223000	0.22300
5	0.2390000	0.2390000	0.2390000	0.239000	0.2390	0.2390	0.239000	0.23900
6	0.2760000	0.2760000	0.2760000	0.276000	0.2760	0.2760	0.276000	0.27600
7	0.2990000	0.2990000	0.2990000	0.299000	0.2990	0.2990	0.299000	0.29900
8	0.3112209	0.3088686	0.3090248	0.311952	0.3076	0.3078	0.308129	0.30775

age \ year	1976	1977	1978	1979	1980	1981	1982	1983
0	0.0150000	0.015	0.0150	0.0150000	0.0150	0.015	0.0150000	0.0150000
1	0.0500000	0.050	0.0500	0.0500000	0.0500	0.050	0.0500000	0.0500000
2	0.1550000	0.155	0.1550	0.1550000	0.1550	0.155	0.1550000	0.1550000
3	0.1870000	0.187	0.1870	0.1870000	0.1870	0.187	0.1870000	0.1870000

```
  4 0.2230000 0.223 0.2230 0.2230000 0.2230 0.223 0.2230000 0.2230000
  5 0.2390000 0.239 0.2390 0.2390000 0.2390 0.239 0.2390000 0.2390000
  6 0.2760000 0.276 0.2760 0.2760000 0.2760 0.276 0.2760000 0.2760000
  7 0.2990000 0.299 0.2990 0.2990000 0.2990 0.299 0.2990000 0.2990000
  8 0.3077143 0.306 0.3096 0.3068571 0.3072 0.307 0.3074043 0.3091429
   year
age       1984       1985      1986       1987       1988        1989
  0 0.01733333 0.01566667 0.0140000 0.00900000 0.00800000 0.008666667
  1 0.05666667 0.05633333 0.0610000 0.05033333 0.04833333 0.043666667
  2 0.15033333 0.13800000 0.1300000 0.12166667 0.12300000 0.122333333
  3 0.19033333 0.18700000 0.1833333 0.17000000 0.16633333 0.165333333
  4 0.22966667 0.23233333 0.2316667 0.21233333 0.20833333 0.204666667
  5 0.24333333 0.24666667 0.2520000 0.23000000 0.22900000 0.228333333
  6 0.28200000 0.27466667 0.2730000 0.24200000 0.24833333 0.252333333
  7 0.31066667 0.32100000 0.3146667 0.27466667 0.25866667 0.261333333
  8 0.34351178 0.35438242 0.3627746 0.30562963 0.28535714 0.288595745
   year
age       1990       1991       1992        1993        1994       1995
  0 0.01233333 0.01133333 0.01033333 0.005666667 0.007333333 0.00600000
  1 0.05200000 0.05900000 0.06366667 0.061000000 0.060000000 0.05733333
  2 0.12566667 0.13900000 0.13666667 0.134000000 0.126333333 0.12933333
  3 0.17433333 0.18366667 0.19400000 0.184333333 0.191666667 0.18566667
  4 0.21166667 0.21200000 0.21400000 0.213000000 0.214333333 0.21066667
  5 0.24366667 0.23866667 0.23433333 0.234333333 0.239666667 0.22433333
  6 0.27066667 0.26533333 0.25300000 0.261666667 0.274666667 0.26800000
  7 0.28366667 0.27966667 0.27166667 0.272666667 0.291333333 0.29333333
  8 0.30788452 0.30953886 0.29870453 0.307936434 0.320523728 0.32614016
   year
age      1996       1997        1998       1999        2000       2001
  0 0.0060000 0.00500000 0.005666667 0.00600000 0.005666667 0.00600000
  1 0.0540000 0.04866667 0.047333333 0.05066667 0.051333333 0.05066667
  2 0.1296667 0.12333333 0.116000000 0.11600000 0.115666667 0.12166667
  3 0.1993333 0.18333333 0.187333333 0.17933333 0.183666667 0.17166667
  4 0.2273333 0.23033333 0.241333333 0.22633333 0.221333333 0.21000000
  5 0.2343333 0.23733333 0.264333333 0.25600000 0.248333333 0.23266667
  6 0.2736667 0.25666667 0.283666667 0.27333333 0.278666667 0.25533333
  7 0.3006667 0.28033333 0.286666667 0.27600000 0.286000000 0.27466667
  8 0.3270679 0.31004007 0.308339011 0.27811880 0.284171183 0.27449422
   year
age        2002        2003        2004        2005        2006       2007
  0 0.006333333 0.006666667 0.006666667 0.005666667 0.006666667 0.00600000
  1 0.047333333 0.047000000 0.042000000 0.041333333 0.041000000 0.05133333
  2 0.128000000 0.123000000 0.119333333 0.118000000 0.125666667 0.12800000
  3 0.171666667 0.173000000 0.165333333 0.164333333 0.155333333 0.16066667
  4 0.205333333 0.202333333 0.202666667 0.198000000 0.191000000 0.17966667
  5 0.228333333 0.222000000 0.223000000 0.224666667 0.216000000 0.20700000
  6 0.248333333 0.242333333 0.247666667 0.248000000 0.242000000 0.22366667
  7 0.270333333 0.265666667 0.267666667 0.265000000 0.252333333 0.23800000
  8 0.286521182 0.284946134 0.280490193 0.284851772 0.270150625 0.25639104
   year
age       2008        2009        2010        2011       2012       2013
  0 0.00800000 0.007333333 0.007333333 0.006666667 0.00600000 0.00600000
  1 0.05766667 0.061333333 0.052000000 0.043000000 0.04033333 0.04033333
```

age						
2	0.13033333	0.137333333	0.142333333	0.145666667	0.13800000	0.13566667
3	0.16433333	0.181000000	0.190333333	0.187333333	0.18200000	0.17466667
4	0.18066667	0.196666667	0.216000000	0.225000000	0.21133333	0.20866667
5	0.19533333	0.210000000	0.223666667	0.239666667	0.23300000	0.22133333
6	0.21766667	0.222666667	0.234333333	0.243666667	0.24100000	0.24200000
7	0.22600000	0.233666667	0.240000000	0.250666667	0.24266667	0.24933333
8	0.25556215	0.255734029	0.260650879	0.257270953	0.25251076	0.25179433

year

age	2014	2015	2016	2017	2018
0	0.005666667	0.005333333	0.00500000	0.004166667	0.004566667
1	0.043333333	0.043666667	0.04333333	0.042866667	0.039966667
2	0.128666667	0.127333333	0.12100000	0.110866667	0.101300000
3	0.176666667	0.161333333	0.16033333	0.153166667	0.152966667
4	0.203666667	0.200000000	0.18866667	0.182966667	0.185766667
5	0.215666667	0.211666667	0.21600000	0.207100000	0.215033333
6	0.228666667	0.224666667	0.22433333	0.226533333	0.229200000
7	0.241333333	0.229000000	0.22433333	0.227066667	0.238766667
8	0.246572539	0.239358137	0.23372066	0.229232697	0.246755779

Table 2.6.3.4 North Sea Herring. NATURAL MORTALITY

Units : NA

year

age	1947	1948	1949	1950	1951	1952	1953
0	0.8156160	0.8156160	0.8156160	0.8156160	0.8156160	0.8156160	0.8156160
1	0.6679101	0.6679101	0.6679101	0.6679101	0.6679101	0.6679101	0.6679101
2	0.4406172	0.4406172	0.4406172	0.4406172	0.4406172	0.4406172	0.4406172
3	0.3879247	0.3879247	0.3879247	0.3879247	0.3879247	0.3879247	0.3879247
4	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933
5	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702
6	0.3356422	0.3356422	0.3356422	0.3356422	0.3356422	0.3356422	0.3356422
7	0.3302643	0.3302643	0.3302643	0.3302643	0.3302643	0.3302643	0.3302643
8	0.3295564	0.3295564	0.3295564	0.3295564	0.3295564	0.3295564	0.3295564

year

age	1954	1955	1956	1957	1958	1959	1960
0	0.8156160	0.8156160	0.8156160	0.8156159	0.8156160	0.8156159	0.8156161
1	0.6679101	0.6679101	0.6679101	0.6679101	0.6679100	0.6679103	0.6679096
2	0.4406172	0.4406172	0.4406172	0.4406172	0.4406171	0.4406172	0.4406171
3	0.3879247	0.3879247	0.3879247	0.3879247	0.3879247	0.3879248	0.3879246
4	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933	0.3611933
5	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702
6	0.3356422	0.3356422	0.3356422	0.3356422	0.3356422	0.3356421	0.3356422
7	0.3302643	0.3302643	0.3302643	0.3302643	0.3302643	0.3302642	0.3302644
8	0.3295564	0.3295564	0.3295564	0.3295564	0.3295564	0.3295564	0.3295565

year

age	1961	1962	1963	1964	1965	1966	1967
0	0.8156157	0.8156166	0.8156147	0.8156185	0.8156109	0.8156261	0.8155957
1	0.6679110	0.6679082	0.6679138	0.6679026	0.6679251	0.6678800	0.6679703
2	0.4406174	0.4406167	0.4406182	0.4406151	0.4406213	0.4406090	0.4406336
3	0.3879249	0.3879243	0.3879256	0.3879230	0.3879282	0.3879177	0.3879387

4	0.3611934	0.3611931	0.3611936	0.3611926	0.3611947	0.3611905	0.3611990
5	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702	0.3444702
6	0.3356421	0.3356424	0.3356418	0.3356430	0.3356406	0.3356454	0.3356358
7	0.3302641	0.3302646	0.3302637	0.3302654	0.3302620	0.3302688	0.3302552
8	0.3295563	0.3295567	0.3295559	0.3295575	0.3295542	0.3295609	0.3295474

	year						
age	1968	1969	1970	1971	1972	1973	1974
0	0.8156566	0.8155348	0.8157783	0.8152912	0.8162654	0.8143171	0.8182138
1	0.6677896	0.6681510	0.6674282	0.6688739	0.6659825	0.6717652	0.6601998
2	0.4405844	0.4406828	0.4404859	0.4408797	0.4400921	0.4416673	0.4385170
3	0.3878968	0.3879806	0.3878129	0.3881483	0.3874775	0.3888192	0.3861357
4	0.3611820	0.3612159	0.3611480	0.3612838	0.3610122	0.3615555	0.3604690
5	0.3444703	0.3444701	0.3444704	0.3444698	0.3444710	0.3444687	0.3444733
6	0.3356550	0.3356165	0.3356934	0.3355396	0.3358473	0.3352320	0.3364625
7	0.3302824	0.3302281	0.3303366	0.3301196	0.3305537	0.3296854	0.3314221
8	0.3295745	0.3295202	0.3296288	0.3294117	0.3298458	0.3289777	0.3307138

	year						
age	1975	1976	1977	1978	1979	1980	1981
0	0.8104203	0.8057025	0.8047344	0.8064925	0.8102209	0.8172173	0.8274914
1	0.6833306	0.7028286	0.7182187	0.7301416	0.7391092	0.7443256	0.7458190
2	0.4448176	0.4496803	0.4530271	0.4549542	0.4555319	0.4544437	0.4517433
3	0.3915027	0.3953336	0.3974290	0.3980001	0.3972606	0.3948411	0.3907612
4	0.3626420	0.3638296	0.3639133	0.3629697	0.3611322	0.3583281	0.3545417
5	0.3444641	0.3438615	0.3425790	0.3406726	0.3382412	0.3352751	0.3317545
6	0.3340014	0.3313040	0.3283186	0.3250641	0.3216048	0.3180074	0.3142432
7	0.3279486	0.3243595	0.3206191	0.3167357	0.3127549	0.3087363	0.3046563
8	0.3272416	0.3236265	0.3198121	0.3158315	0.3117531	0.3076064	0.3033674

	year						
age	1982	1983	1984	1985	1986	1987	1988
0	0.8383555	0.8590581	0.8809267	0.8934130	0.9037276	0.9089402	0.9055544
1	0.7453371	0.7391267	0.7304259	0.7230871	0.7138885	0.7044524	0.6956670
2	0.4480561	0.4428878	0.4366100	0.4275364	0.4159904	0.4069106	0.3996457
3	0.3858179	0.3782072	0.3694208	0.3592993	0.3472028	0.3381516	0.3327748
4	0.3499919	0.3438174	0.3366285	0.3266155	0.3141998	0.3051551	0.3001102
5	0.3277630	0.3228028	0.3171952	0.3096474	0.3004945	0.2934900	0.2889626
6	0.3102333	0.3057392	0.3008707	0.2945230	0.2870705	0.2811765	0.2771440
7	0.3004356	0.2958686	0.2910635	0.2850467	0.2781549	0.2727453	0.2690913
8	0.2990244	0.2941664	0.2890815	0.2833436	0.2770111	0.2718492	0.2681644

	year						
age	1989	1990	1991	1992	1993	1994	1995
0	0.8969649	0.8905781	0.8847789	0.8765258	0.8710855	0.8653465	0.8611988
1	0.6872170	0.6789194	0.6670819	0.6525472	0.6419350	0.6322777	0.6253381
2	0.3924870	0.3887871	0.3910214	0.3965857	0.4012131	0.4062928	0.4119019
3	0.3287391	0.3266214	0.3289607	0.3346403	0.3387533	0.3412051	0.3434764
4	0.2964264	0.2949764	0.2990174	0.3070347	0.3127427	0.3169675	0.3205615
5	0.2852925	0.2833107	0.2848702	0.2889228	0.2919481	0.2950066	0.2978004
6	0.2738176	0.2716721	0.2719104	0.2738530	0.2751515	0.2759697	0.2768056
7	0.2661460	0.2642858	0.2646607	0.2666571	0.2680060	0.2687452	0.2695653
8	0.2651373	0.2628437	0.2619613	0.2622382	0.2623560	0.2617543	0.2614389

	year						
age	1996	1997	1998	1999	2000	2001	2002
0	0.8644131	0.8714153	0.8809581	0.8953693	0.9138225	0.9303382	0.9462271
1	0.6266946	0.6323094	0.6414736	0.6612056	0.6887892	0.7089131	0.7237124

```
  2 0.4148836 0.4175451 0.4218480 0.4291405 0.4376797 0.4447908 0.4528783
  3 0.3428210 0.3407633 0.3411658 0.3447208 0.3494167 0.3550605 0.3641446
  4 0.3193077 0.3158974 0.3144479 0.3140061 0.3129517 0.3144011 0.3206260
  5 0.2970118 0.2949494 0.2944949 0.2949689 0.2952192 0.2974189 0.3032716
  6 0.2759604 0.2744636 0.2745619 0.2760781 0.2779683 0.2811793 0.2871590
  7 0.2692426 0.2684613 0.2687931 0.2699709 0.2713117 0.2737630 0.2783370
  8 0.2612232 0.2610349 0.2620768 0.2649014 0.2687185 0.2727170 0.2774175
   year
age      2003      2004      2005      2006      2007      2008      2009
  0 0.9636406 0.9778611 0.9924404 1.0051537 1.0126169 1.0176157 1.0160229
  1 0.7391891 0.7458320 0.7351250 0.7212731 0.7089871 0.6927028 0.6815790
  2 0.4623603 0.4675825 0.4670940 0.4651993 0.4606177 0.4534194 0.4486089
  3 0.3756800 0.3842515 0.3917235 0.3982069 0.3992761 0.3979235 0.3972307
  4 0.3294129 0.3371511 0.3469816 0.3567311 0.3614871 0.3648674 0.3680856
  5 0.3111539 0.3182483 0.3270457 0.3358458 0.3408919 0.3449711 0.3487946
  6 0.2949874 0.3020598 0.3098954 0.3176953 0.3228500 0.3272613 0.3316144
  7 0.2843214 0.2900766 0.2964710 0.3030145 0.3082212 0.3132112 0.3182143
  8 0.2830219 0.2882408 0.2937930 0.2992683 0.3031155 0.3064383 0.3102376
   year
age      2010      2011      2012      2013      2014      2015      2016
  0 1.0077651 0.9945248 0.9758610 0.9522143 0.9234139 0.8891311 0.8495409
  1 0.6742762 0.6682724 0.6657074 0.6645925 0.6661190 0.6716350 0.6800092
  2 0.4455843 0.4427270 0.4410072 0.4395108 0.4388913 0.4398892 0.4419012
  3 0.3969625 0.3960316 0.3949324 0.3931928 0.3911678 0.3893188 0.3873211
  4 0.3710640 0.3734170 0.3753545 0.3766790 0.3775302 0.3781232 0.3783272
  5 0.3522990 0.3552698 0.3578357 0.3598761 0.3615013 0.3628765 0.3639009
  6 0.3358301 0.3397322 0.3434756 0.3469157 0.3501437 0.3532930 0.3562775
  7 0.3231951 0.3281086 0.3330175 0.3378633 0.3426801 0.3475198 0.3523502
  8 0.3144489 0.3187356 0.3232706 0.3278875 0.3326709 0.3377392 0.3430125
   year
age      2017      2018
  0 0.8693360 0.8495409
  1 0.6758221 0.6800092
  2 0.4408952 0.4419012
  3 0.3883200 0.3873211
  4 0.3782252 0.3783272
  5 0.3633887 0.3639009
  6 0.3547852 0.3562775
  7 0.3499350 0.3523502
  8 0.3403759 0.3430125
```

Table 2.6.3.5 North Sea Herring. PROPORTION MATURE

Units : NA

age	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1

age	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
1	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
2	1	1	1	1	1	1	1	1	1	1	1	0.82	0.82	0.82
3	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00
4	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00
5	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00
6	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00
7	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00
8	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00

age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.00
2	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.7	0.75	0.8	0.85
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	0.93
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.00	1.0	1.00

age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.82	0.91	0.86	0.50	0.47	0.73	0.67	0.61	0.64	0.64	0.69	0.67	0.77	0.87
3	0.94	0.97	0.99	0.99	0.61	0.93	0.95	0.98	0.94	0.89	0.91	0.96	0.92	0.97
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	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	1.00	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	1.00	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	1.00	1.00	1.00	1.00	1.00

age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.43	0.70	0.76	0.66	0.71	0.86	0.89	0.45	0.87	0.91	0.83	0.85	0.70	0.71
3	0.93	0.65	0.96	0.88	0.92	0.98	1.00	0.90	0.84	0.99	0.96	1.00	0.90	0.89

```
  4 1.00 1.00 0.96 0.98 0.93 0.99 1.00 1.00 1.00 1.00 0.98 1.00 0.96 0.95
  5 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 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 1.00 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 1.00 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 1.00 1.00 1.00 1.00 1.00
   year
age 2017 2018
  0 0.00 0.00
  1 0.00 0.00
  2 0.55 0.37
  3 0.96 0.91
  4 0.97 0.98
  5 1.00 1.00
  6 1.00 1.00
  7 1.00 1.00
  8 1.00 1.00
```

Table 2.6.3.6 North Sea Herring. FRACTION OF HARVEST BEFORE SPAWNING

```
Units  :  NA
   year
age 1947 ...  2018
  0 0.67      0.67
  1 0.67      0.67
  2 0.67      0.67
  3 0.67      0.67
  4 0.67      0.67
  5 0.67      0.67
  6 0.67      0.67
  7 0.67      0.67
  8 0.67      0.67
```

Table 2.6.3.7 North Sea Herring. FRACTION OF NATURAL MORTALITY BEFORE SPAWNING

```
Units  :  NA
   year
age 1947 ...  2018
  0 0.67      0.67
  1 0.67      0.67
  2 0.67      0.67
  3 0.67      0.67
  4 0.67      0.67
  5 0.67      0.67
  6 0.67      0.67
  7 0.67      0.67
  8 0.67      0.67
```

Table 2.6.3.8 North Sea Herring. SURVEY INDICES

HERAS - Configuration

Herring in Sub-area IV, Divisions VIId & IIIa (autumn-spawners) (13/Mar/2018 17:31) .
Imported from VPA file.

min	max	plusgroup	minyear	maxyear	startf	endf
1.00	8.00	8.00	1989.00	2018.00	0.54	0.56

Index type : number

HERAS - Index Values

Units : NA

age	1989	1990	1991	1992	1993	1994	1995	1996
1	-1	-1	-1	-1	-1	-1	-1	-1
2	4090000	3306000	2634000	3734000	2984000	3185000	3849000	4497000
3	3903000	3521000	1700000	1378000	1637000	839000	2041000	2824000
4	1633000	3414000	1959000	1147000	902000	399000	672000	1087000
5	492000	1366000	1849000	1134000	741000	381000	299000	311000
6	283000	392000	644000	1246000	777000	321000	203000	99000
7	120000	210000	228000	395000	551000	326000	138000	83000
8	66000	176000	145000	218000	296000	350000	212000	339000

age	1997	1998	1999	2000	2001	2002	2003	2004
1	9361000	4449000	5087000	24736000	6837000	23055000	9829400	5183700
2	5960000	5747000	3078000	2923000	12290000	4875000	18949400	3415900
3	2935000	2520000	4725000	2156000	3083000	8220000	3081000	9191800
4	1441000	1625000	1116000	3140000	1462000	1390000	4188900	2167300
5	601000	982000	506000	1007000	1676000	794600	675100	2590700
6	215000	445000	314000	483000	450000	1031000	494800	317100
7	46000	170000	139000	266000	170000	244400	568300	327600
8	237000	166000	141000	217000	157000	270500	323200	527650

age	2005	2006	2007	2008	2009	2010	2011	2012
1	3114100	6822800	6261000	3714000	4655000	14577000	10119000	7437000
2	2055100	3772300	2750000	2853000	5632000	4237000	4166000	4719000
3	3648500	1997200	1848000	1709000	2553000	4216000	2534000	4067000
4	5789600	2097500	898000	1485000	1023000	2453000	2173000	1738000
5	1212900	4175100	806000	809000	1077000	1246000	1016000	1209000
6	1174900	618200	1323000	712000	674000	1332000	651000	593000
7	139900	562100	243000	1749000	638000	688000	688000	247000
8	233200	154700	217000	455000	1720000	2729000	1737000	696000

age	2013	2014	2015	2016	2017	2018
1	6388000	11634000	6714000	9034000	3054000	9938000
2	2683000	4918000	9495000	12011000	1761000	4254000
3	3031000	2827000	2831000	5832000	6095000	1692000
4	2895000	2939000	1591000	1273000	3142000	5150000
5	1546000	1791000	1549000	822000	787000	2440000
6	849000	1236000	926000	909000	365000	719000
7	464000	669000	520000	395000	298000	529000
8	842000	461000	496000	366000	293000	404000

IBTS-Q1 - Configuration

```
Herring in Sub-area IV, Divisions VIId & IIIa (autumn-spawners) (13/Mar/2018 17:31) .
Imported from VPA file.
        min          max    plusgroup      minyear      maxyear
   1.0000000    1.0000000           NA 1984.0000000 2019.0000000
      startf         endf
   0.1008259    0.1008259
Index type : number
```

IBTS-Q1 - Index Values

```
Units  :  NA
   year
age    1984    1985    1986    1987    1988    1989     1990    1991
  1 1183824 1761019 1944621 3737913 1800985 1969284 905937.3 1284049
   year
age    1992    1993    1994    1995    1996    1997    1998     1999
  1 1345606 2213999 3260479 2671352 1493010 2166324 1945292 799496.3
   year
age    2000    2001    2002    2003     2004    2005     2006    2007
  1 2476525 1891274 2096503 1577394 856713.3 1073097 832198.3 1016684
   year
age     2008     2009    2010    2011     2012     2013    2014    2015
  1 896865.2 845210.2 1066098 1867168 956023.3 584592.2 1902857 2271779
   year
age     2016    2017     2018    2019
  1 659354.3 1583103 810957.2 1097713
```

IBTS0 - Configuration

```
Herring in Sub-area IV, Divisions VIId & IIIa (autumn-spawners) (13/Mar/2018 17:31) .
Imported from VPA file.
      min       max plusgroup   minyear   maxyear    startf      endf
     0.00      0.00        NA   1992.00   2019.00      0.08      0.17
Index type : number
```

IBTS0 - Index Values

```
Units  :  NA
   year
age     1992     1993     1994     1995    1996     1997     1998     1999
  0 164.0899 195.7571 155.1368 170.4691 106.264 134.6798 51.71666 255.4222
   year
age     2000     2001     2002     2003     2004     2005     2006
  0 109.8237 341.3018 150.7038 70.83748 43.88171 82.06045 64.41743
   year
age     2007     2008     2009     2010     2011     2012     2013
  0 50.91532 39.53371 99.18411 74.10116 77.63466 65.07967 61.17656
   year
age     2014     2015     2016     2017     2018     2019
  0 113.7963 21.76008 81.69031 27.83202 102.1129 51.62587
```

IBTS-Q3 - Configuration

Herring in Sub-area IV, Divisions VIId & IIIa (autumn-spawners) (13/Mar/2018 17:31) .
Imported from VPA file.

min	max	plusgroup	minyear	maxyear
0.0000000	5.0000000	NA	1998.0000000	2018.0000000

startf	endf
0.6084662	0.6084662

Index type : number

IBTS-Q3 - Index Values

Units : NA

age \ year	1998	1999	2000	2001	2002	2003
0	736601.74	4972332.03	1906224.50	1999130.84	2429793.66	969337.07
1	503116.29	335340.88	884908.89	366278.27	2249516.49	537357.22
2	295664.01	218744.95	271211.49	229974.57	462271.51	588611.98
3	97947.77	128557.89	121583.57	97732.25	358071.99	151484.50
4	26069.94	51915.71	69939.37	43207.59	82500.29	114603.90
5	10968.11	18172.64	17499.39	25681.82	31901.09	18828.77

age \ year	2004	2005	2006	2007	2008	2009
0	2316312.94	1185971.32	1145166.63	2472359.75	611072.31	3114966.00
1	448285.49	445773.12	332771.36	152252.41	175498.86	232951.78
2	297259.33	118760.62	203191.92	96658.31	118214.70	97866.71
3	430839.99	85509.40	80358.44	101800.71	60413.30	62699.97
4	97392.71	100442.35	46358.27	50755.44	35406.44	26467.19
5	49998.34	31117.92	51925.25	29973.92	18444.29	11648.39

age \ year	2010	2011	2012	2013	2014	2015
0	1458525.29	904306.31	862989.93	2041832.85	7921339.34	572307.70
1	581879.00	360794.49	236794.88	294376.27	504621.14	818928.15
2	180894.77	182921.12	93819.91	144672.53	201905.50	365465.79
3	82406.95	100642.58	66221.97	122645.81	88459.80	127502.65
4	36443.07	49896.20	37440.73	84485.75	78276.21	66737.91
5	14884.50	20846.98	21009.84	38344.82	43240.10	43526.09

age \ year	2016	2017	2018
0	1863251.77	949196.45	1936647.39
1	193708.69	317596.11	213373.48
2	373987.31	78964.29	95044.71
3	214504.31	200060.41	49447.41
4	67007.08	127534.76	84363.78
5	41023.59	39218.35	40977.28

LAI-ORSH - Configuration

min	max	plusgroup	minyear	maxyear	startf	endf
0.00	1.00	1.00	1972.00	2018.00	0.67	0.67

Index type : partial

LAI-ORSH - Index Values

```
Units  :  NA
   year
age 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985
  0 1133 2029  758  371  545 1133 3047 2882 3534 3667 2353 2579 1795 5632
  1 4583  822  421   50   81  221   50 2362  720  277 1116  812 1912 3432
   year
age 1986 1987 1988  1989  1990 1991 1992 1993 1994 1995 1996 1997 1998
  0 3529 7409 7538 11477    -1 1021  189   -1   26   -1   -1   -1   -1
  1 1842 1848 8832  5725 10144 2397 4917   66 1179 8688  809 3611 8528
   year
age 1999 2000  2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
  0   -1   -1    -1   -1   -1   -1   -1 6311   -1 4978   -1   -1   -1
  1 4064 3972 11918 6669 3199 7055 3380 2312 1753 6875 7543 2362 3831
   year
age  2012  2013 2014 2015 2016 2017 2018
  0    -1    -1   -1   -1   -1   -1   -1
  1 19552 21282 6604 9631   -1   -1   -1
```

LAI-BUN - Configuration

```
      min       max plusgroup   minyear   maxyear    startf      endf
     0.00      1.00      1.00   1972.00   2018.00      0.67      0.67
Index type : partial
```

LAI-BUN - Index Values

```
Units  :  NA
   year
age 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985
  0   30    3  101  312    0  124   -1  197   21    3  340 3647 2327 2521
  1    0    4  284   -1    1   32  162   10    1   12  257  768 1853 1812
   year
age 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
  0 3278 2551 6812 5879 4590   -1   -1   -1   -1   -1   -1   -1   -1   -1
  1  341  670 5248  692 2045 2032  822  174   -1   -1  184   23 1490  185
   year
age 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
  0   28   -1   -1   -1   -1   -1   -1   -1   -1   -1   -1   -1   -1   -1
  1  155  164 1038 2263 3884 1364  280 1304  533 4629 1493 2839 5856 8618
   year
age 2014 2015 2016 2017 2018
  0   -1   -1   -1   -1   -1
  1 5033 3496 3872 5833 1740
```

LAI-CNS - Configuration

```
      min       max plusgroup   minyear   maxyear    startf      endf
     0.00      3.00      3.00   1972.00   2018.00      0.67      0.67
```

Index type : partial

LAI-CNS - Index Values

Units : NA

year

age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	165	492	81	-1	64	520	1406	662	317	903	86	1459	688	130
1	88	830	-1	90	108	262	81	131	188	235	64	281	2404	13039
2	134	1213	1184	77	0	89	269	507	9	119	1077	63	824	1794
3	22	152	-1	6	10	3	2	7	13	0	23	-1	433	215

year

age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1611	799	5533	1442	19965	4823	10	-1	-1	-1	-1	-1	205	-1
1	6112	4927	3808	5010	1239	2110	165	685	1464	-1	564	-1	66	134
2	188	1992	1960	2364	975	1249	163	85	44	43	-1	-1	-1	181
3	36	113	206	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

year

age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	376	1604	-1	12018	5545	5614	2259	291	11201	4219	2317	17766	517
2	-1	-1	3291	3277	-1	-1	-1	-1	-1	-1	-1	-1	-1
3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

year

age	2013	2014	2015	2016	2017	2018
0	-1	-1	-1	-1	-1	-1
1	7354	1149	3424	3288	3965	1509
2	-1	-1	-1	-1	-1	-1
3	-1	-1	-1	-1	-1	-1

LAI-SNS - Configuration

min	max	plusgroup	minyear	maxyear	startf	endf
0.00	2.00	2.00	1972.00	2018.00	0.67	0.67

Index type : partial

LAI-SNS - Index Values

Units : NA

year

age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	2	-1	-1	1	-1	1	33	-1	247	1456	710	71	523	1851
1	46	-1	10	2	3	0	3	111	129	-1	275	243	185	407
2	0	1	-1	0	-1	-1	-1	89	40	70	54	58	39	38

year

age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	780	934	1679	1514	2552	4400	176	1358	537	74	337	9374	1522	804
1	123	297	162	2120	1204	873	1616	1103	595	230	675	918	953	1260
2	18	146	112	512	-1	-1	-1	-1	-1	164	691	355	170	344

year

age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	7346	971	2008	12048	6528	498	10858	4443	8426	15295	7493	5461	22768

```
  1  338 5531  260  3109 2052 3999  2700 2439 2317 14712 13230 6160 11103
  2  106  909  925  1116 4175 4822  2106 3854 4008  1689  8073 1215  3285
   year
age 2013 2014 2015  2016  2017 2018
  0    5   -1 2011 20710 10553   -1
  1 9314   -1 1200  1442  5880   -1
  2 2957 1851  645  1545    -1   -1
```

Table 2.6.3.9 North Sea Herring. STOCK OBJECT CONFIGURATION

```
      min       max plusgroup   minyear   maxyear   minfbar   maxfbar
        0         8         8      1947      2018         2         6
```

Table 2.6.3.10 North Sea Herring. sam CONFIGURATION SETTINGS

```
name            : North Sea Herring
desc             : Imported from a VPA file. ( ./data/index.txt ).  Sat Mar 16 11:07:58
2019
range           :       min       max plusgroup   minyear   maxyear   minfbar   maxfbar
range           :         0         8         8      1947      2019         2         6
fleets          : catch unique        HERAS      IBTS-Q1        IBTS0      IBTS-Q3
fleets          :            0            2            2            2            2
fleets          :     LAI-ORSH      LAI-BUN      LAI-CNS      LAI-SNS
fleets          :            6            6            6            6
plus.group      : TRUE
states          :               age
states          : fleet           0  1  2  3  4  5  6  7  8
states          :   catch unique  0  1  2  3  4  5  6  7  7
states          :   HERAS        -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   IBTS-Q1      -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   IBTS0        -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   IBTS-Q3      -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   LAI-ORSH     -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   LAI-BUN      -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   LAI-CNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
states          :   LAI-SNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
logN.vars       : 0 1 1 1 1 1 1 1 1
logP.vars       : 0 1 2
catchabilities :               age
catchabilities : fleet           0  1  2  3  4  5  6  7  8
catchabilities :   catch unique -1 -1 -1 -1 -1 -1 -1 -1 -1
catchabilities :   HERAS        -1  1  2  3  3  3  3  3  3
catchabilities :   IBTS-Q1      -1  4 -1 -1 -1 -1 -1 -1 -1
catchabilities :   IBTS0         0 -1 -1 -1 -1 -1 -1 -1 -1
catchabilities :   IBTS-Q3       5  6  7  8  9 10 -1 -1 -1
catchabilities :   LAI-ORSH     11 -1 -1 -1 -1 -1 -1 -1 -1
catchabilities :   LAI-BUN      11 -1 -1 -1 -1 -1 -1 -1 -1
```

```
catchabilities :   LAI-CNS      11 -1 -1 -1 -1 -1 -1 -1 -1
catchabilities :   LAI-SNS      11 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :               age
power.law.exps : fleet           0  1  2  3  4  5  6  7  8
power.law.exps :   catch unique -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   HERAS        -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   IBTS-Q1      -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   IBTS0        -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   IBTS-Q3      -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   LAI-ORSH     -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   LAI-BUN      -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   LAI-CNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
power.law.exps :   LAI-SNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :               age
f.vars         : fleet           0  1  2  3  4  5  6  7  8
f.vars         :   catch unique  0  0  1  1  1  1  2  2  2
f.vars         :   HERAS        -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   IBTS-Q1      -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   IBTS0        -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   IBTS-Q3      -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   LAI-ORSH     -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   LAI-BUN      -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   LAI-CNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
f.vars         :   LAI-SNS      -1 -1 -1 -1 -1 -1 -1 -1 -1
obs.vars       :               age
obs.vars       : fleet           0  1  2  3  4  5  6  7  8
obs.vars       :   catch unique  0  0  1  1  1  1  2  2  2
obs.vars       :   HERAS        -1  3  4  4  4  4  4  5  5
obs.vars       :   IBTS-Q1      -1  6 -1 -1 -1 -1 -1 -1 -1
obs.vars       :   IBTS0         7 -1 -1 -1 -1 -1 -1 -1 -1
obs.vars       :   IBTS-Q3       8  9 10 10 10 10 -1 -1 -1
obs.vars       :   LAI-ORSH     11 -1 -1 -1 -1 -1 -1 -1 -1
obs.vars       :   LAI-BUN      11 -1 -1 -1 -1 -1 -1 -1 -1
obs.vars       :   LAI-CNS      11 -1 -1 -1 -1 -1 -1 -1 -1
obs.vars       :   LAI-SNS      11 -1 -1 -1 -1 -1 -1 -1 -1
srr            : 0
scaleNoYears   : 0
scaleYears     : NA
scalePars      :
cor.F          : 0
cor.obs        : NA -1 -1 -1 0 -1 -1 -1 -1 NA NA -1 -1 0 -1 -1 -1 -1 NA NA -1 -1 0 -1 -1
-1 -1 NA NA -1 -1 0 -1 -1 -1 -1 NA NA -1 -1 0 -1 -1 -1 -1 NA NA -1 -1 -1 -1 -1 -1 -1 NA
NA -1 -1 -1 -1 -1 -1 -1 NA NA -1 -1 -1 -1 -1 -1 -1
cor.obs.Flag   : ID ID ID ID AR ID ID ID ID
biomassTreat   : -1 -1 -1 -1 -1 -1 -1 -1 -1
timeout        : 3600
likFlag        : LN LN LN LN LN LN LN LN LN
fixVarToWeight : FALSE
simulate       : FALSE
residuals      : TRUE
sumFleets      :
```

Table 2.6.3.11 North Sea Herring. FLR, R SOFTWARE VERSIONS

FLSAM.version	2.1.0
FLCore.version	2.6.9
R.version	R version 3.5.2 (2018-12-20)
platform	x86_64-w64-mingw32
run.date	2019-03-16 11:10:54

Table 2.6.3.12 North Sea Herring. STOCK SUMMARY

Year	Recruitment Age 0	Low	High	TSB	Low	High	SSB	Low	High	Fbar (Ages 2-6) f	Low f	High f	Landings tonnes	Landings SOP
1947	56498843	30620640	104247309	9606501	7210950	12797880	5499127	3921926	7710598	0.1202	0.0809	0.1785	581760	1.4609
1948	56131111	31906700	98747337	8389309	6325501	11126471	4474572	3211959	6233517	0.1199	0.0832	0.1726	502100	1.3326
1949	50827034	29110164	88745203	8202009	6229780	10798608	4340323	3154805	5971337	0.1316	0.0918	0.1886	508500	1.4502
1950	69744880	40862620	119041518	8194126	6275345	10699603	4292964	3158431	5835029	0.1383	0.0984	0.1943	491700	1.3073
1951	62253823	36950804	104883739	8437900	6505363	10944534	4110431	3037857	5561699	0.1674	0.1214	0.2307	600400	1.3238
1952	59223654	35647795	98391534	8217672	6340386	10650794	4115723	3030463	5589635	0.1696	0.1223	0.2352	664400	1.2720
1953	59817829	37160716	96289123	7871497	6098818	10159421	3893052	2851634	5314796	0.1768	0.1271	0.2459	698500	1.1979
1954	57013588	36110404	90016974	7645433	5950167	9823699	3650056	2657419	5013477	0.1977	0.1414	0.2765	762900	1.2509
1955	48110288	30783785	75188929	7163514	5593932	9173501	3546303	2594784	4846749	0.1948	0.1401	0.2710	806400	1.0598
1956	35317077	22695283	54958376	6468230	5079069	8237336	3280044	2403396	4476454	0.1967	0.1436	0.2694	675200	1.2712
1957	85860021	54954481	134146355	6412407	5087747	8081960	2960955	2179799	4022046	0.2096	0.1534	0.2864	682900	1.1575
1958	32872393	21327397	50666953	6306514	5021727	7920009	2407651	1773153	3269196	0.2190	0.1622	0.2957	670500	1.1674
1959	37590204	23776823	59428606	6855324	5504165	8538165	3582878	2691780	4768969	0.2386	0.1779	0.3199	784500	1.5186
1960	15840010	10045722	24976395	5593026	4519846	6921020	2963112	2238848	3921676	0.2083	0.1577	0.2753	696200	1.1830
1961	70192832	45117348	109204860	5666933	4647609	6909818	2853716	2201424	3699284	0.2437	0.1896	0.3133	696700	1.1348
1962	31786138	20723437	48754390	5193356	4269575	6317011	1996944	1523397	2617693	0.2738	0.2118	0.3539	627800	1.1705
1963	42242324	28200543	63275873	5726691	4749076	6905553	2890983	2266494	3687540	0.1935	0.1514	0.2474	716000	0.8602
1964	44126903	29599452	65784447	5704432	4902714	6637253	2637471	2146847	3240220	0.2842	0.2336	0.3456	871200	1.0656
1965	21543007	14426084	32170971	5119294	4491825	5834415	2127516	1775531	2549279	0.4737	0.3935	0.5702	1168800	1.1496
1966	22437282	15239848	33033900	3788113	3351346	4281801	1627149	1367011	1936789	0.4827	0.4088	0.5698	895500	1.0707
1967	28707627	19583756	42082215	2932396	2612121	3291940	1030211	876347	1211088	0.6403	0.5462	0.7506	695500	1.1757
1968	29523424	20089552	43387356	2525017	2219929	2872033	572620	485464	675423	0.9759	0.8329	1.1436	717800	1.2551
1969	13917587	9291194	20847614	1908024	1655079	2199627	495461	401913	610783	0.8695	0.7420	1.0188	546700	0.9674
1970	29134241	19823998	42816992	1866419	1622797	2146614	476038	384571	589260	0.9354	0.8082	1.0826	563100	0.9657
1971	22495314	15547340	32548280	1725102	1487553	2000585	327242	267550	400253	1.2768	1.0977	1.4850	520100	1.0747
1972	15700734	10873732	22670509	1525825	1326524	1755069	332972	271597	408217	0.6593	0.5564	0.7813	497500	0.9197
1973	7943077	5454630	11566774	1215162	1073350	1375711	296816	245365	359056	0.8735	0.7562	1.0091	484000	0.9575
1974	14125092	9519630	20958611	873783	764106	999201	199400	166314	239069	0.8749	0.7526	1.0170	275100	0.9680
1975	3234709	2120580	4934189	703078	591377	835878	114031	93368	139268	1.0492	0.8666	1.2703	312800	0.9343
1976	4172725	2648909	6573135	507825	424717	607195	152997	114926	203679	0.8144	0.6262	1.0592	174800	0.9530
1977	5007480	3092230	8108989	350528	280200	438508	103059	74928	141752	0.3691	0.2722	0.5006	46000	1.1979
1978	5351563	3213764	8911428	422916	330133	541777	136726	100538	185942	0.2652	0.1909	0.3685	11000	1.2152
1979	10154904	6327825	16296608	559792	444963	704254	180923	137973	237243	0.2170	0.1581	0.2980	25100	1.0056
1980	15476298	10488097	22836918	758817	614997	936270	198388	156486	251510	0.1918	0.1512	0.2433	70764	1.0936
1981	36915280	25882473	52650991	1367608	1112296	1681523	298043	234631	378593	0.2134	0.1695	0.2687	174879	1.0081
1982	58525556	41480591	82574539	2088227	1701799	2562402	416941	331573	524289	0.1890	0.1510	0.2364	275079	0.9786
1983	57946932	41779245	80371172	2880920	2385997	3478504	636454	508532	796554	0.2348	0.1899	0.2903	387202	1.0771
1984	55810044	39556240	78742596	3737447	3153966	4428871	1063317	850072	1330055	0.3046	0.2484	0.3734	428631	1.0543

1985	67271137	46873404	96545278	4267288	3637854	5005628	1161899	944100	1429942	0.3842	0.3117	0.4736	613780	1.0419
1986	81400120	56476345	117323095	4792740	4070076	5643718	1178763	966922	1437016	0.3608	0.2945	0.4420	671488	1.1373
1987	78363264	54933974	111785125	4855865	4152448	5678440	1401032	1148329	1709345	0.3474	0.2860	0.4221	792058	1.0173
1988	44888160	31394064	64182416	4730061	4077637	5486875	1834721	1506527	2234411	0.3287	0.2719	0.3974	887686	1.1641
1989	37759805	26470260	53864330	4127771	3616380	4711477	1875132	1582179	2222327	0.3163	0.2644	0.3785	787899	1.0335
1990	31642520	21947133	45620950	4063191	3565240	4630690	1977732	1675189	2334914	0.2599	0.2159	0.3128	645229	1.0515
1991	35056748	24507867	50146167	3862999	3388321	4404176	1749100	1485708	2059187	0.2848	0.2378	0.3411	658008	1.0197
1992	65995432	48296353	90180662	3942160	3442500	4514344	1367746	1157046	1616815	0.3154	0.2622	0.3794	716799	0.9950
1993	68551684	49507263	94922101	3701372	3188302	4297005	997149	835950	1189432	0.3564	0.2959	0.4293	671397	1.0231
1994	52883203	37595401	74387639	3591860	3042023	4241078	1062653	889581	1269397	0.3709	0.3080	0.4467	568234	1.0498
1995	61076456	43597797	85562431	3520559	2983411	4154417	1137472	943837	1370833	0.3212	0.2629	0.3925	579371	1.0084
1996	50221463	35941421	70175170	3459214	2934664	4077524	1257945	1046952	1511459	0.1841	0.1463	0.2316	275098	0.9987
1997	39918411	28334610	56237919	3529498	3011553	4136523	1422790	1189096	1702413	0.1675	0.1357	0.2069	264313	1.0006
1998	25190062	18165504	34931000	3821681	3288631	4441132	1667748	1407251	1976465	0.1920	0.1572	0.2344	391628	1.0018
1999	80033627	57682107	111046247	3795927	3283609	4388179	1714787	1447404	2031565	0.1850	0.1523	0.2248	363163	1.0000
2000	54550943	39602297	75142241	4668472	4008258	5437433	1775676	1500791	2100909	0.1861	0.1532	0.2261	388157	1.0004
2001	101911822	72472174	143310443	5272611	4526414	6141822	2260925	1911336	2674455	0.1617	0.1320	0.1981	374065	0.9901
2002	49214248	35455231	68312690	6235461	5321187	7306824	2670349	2257415	3158818	0.1511	0.1230	0.1855	394709	0.9974
2003	27618571	19952416	38230231	6587881	5651521	7679380	2743141	2332247	3226426	0.1779	0.1458	0.2171	482281	1.0153
2004	32210582	23242587	44638819	5525183	4787041	6377142	2666900	2268245	3135620	0.2222	0.1795	0.2751	587698	0.9985
2005	29939013	21795786	41124670	4637352	4043810	5318013	2459492	2083990	2902652	0.2400	0.1947	0.2960	663813	1.0033
2006	27222228	19707704	37602032	3924472	3423446	4498826	2003189	1699934	2360543	0.2135	0.1733	0.2631	514597	0.9950
2007	31275814	22313507	43837866	3270134	2838327	3767634	1624274	1375888	1917500	0.1855	0.1501	0.2291	406482	1.0056
2008	29088826	20825130	40631670	3306520	2850154	3835960	1691045	1433299	1995141	0.1164	0.0955	0.1419	257870	1.0040
2009	47585226	34220233	66170028	3773138	3238403	4396169	1986853	1679150	2350941	0.0678	0.0542	0.0848	168443	1.0023
2010	38129806	27593327	52689628	4582165	3934257	5336772	2103979	1767809	2504076	0.0720	0.0586	0.0884	187611	1.0034
2011	34223670	24825811	47179108	4617809	3997698	5334110	2527300	2159041	2958372	0.0935	0.0767	0.1140	226478	0.9938
2012	32791167	23699940	45369761	4629001	4023237	5325973	2682517	2291650	3140051	0.1519	0.1243	0.1856	434710	1.0109
2013	40829468	29131873	57224108	4470275	3903649	5119149	2450179	2097507	2862148	0.1791	0.1464	0.2190	511416	1.0014
2014	65480092	46469608	92267671	4772852	4158357	5478153	2382257	2036402	2786850	0.1823	0.1494	0.2223	517356	1.0029
2015	17336518	12345488	24345321	5039562	4349746	5838773	2207598	1884709	2585804	0.1890	0.1518	0.2354	494099	1.0017
2016	32864572	23764831	45448677	4976585	4275864	5792139	2596513	2198151	3067069	0.1958	0.1573	0.2438	563610	1.0000
2017	20022379	14043056	28547607	4125961	3549110	4796571	2214966	1853509	2646911	0.1792	0.1449	0.2218	498437	1.0013
2018	36780645	24968423	54181069	3808857	3232792	4487574	1870362	1518929	2303106	0.2083	0.1632	0.2658	603536	1.0015
2019	26191234	14436771	47516219	3243613	2585965	4068511	1454934	1090442	1941261	0.2083	0.1310	0.3311		

Table 2.6.3.13 North Sea Herring. ESTIMATED FISHING MORTALITY

Units : f

age \ year	1947	1948	1949	1950	1951
0	0.0038661741	0.0038662635	0.0038676221	0.003863291	0.003864838
1	0.0002098233	0.0002098233	0.0009181941	0.004018362	0.017558989
2	0.0424970463	0.0319309926	0.0403457560	0.053293389	0.079736246
3	0.0912614961	0.1052793472	0.1085242628	0.121412008	0.144898098
4	0.0985225772	0.1087694263	0.1164251562	0.144906319	0.199024504
5	0.1339668466	0.1424411147	0.1492052864	0.148456334	0.199266141
6	0.2345331861	0.2108477341	0.2435877214	0.223369315	0.213920148
7	0.2418795492	0.2339693985	0.3026499558	0.238360684	0.213387269
8	0.2418795492	0.2339693985	0.3026499558	0.238360684	0.213387269

```
   year
age        1952        1953        1954        1955        1956
  0 0.003865515 0.003865372 0.005289537 0.004921243 0.004171613
  1 0.035354971 0.054507651 0.075824545 0.115973417 0.118790273
  2 0.111221338 0.133454174 0.160285163 0.191426319 0.240727208
  3 0.129706337 0.159378397 0.201779790 0.204962636 0.211341119
  4 0.172272203 0.166798611 0.170308933 0.172121970 0.182093352
  5 0.189643470 0.185633608 0.200369491 0.174985448 0.164451316
  6 0.244995088 0.238827195 0.255827470 0.230554862 0.184684729
  7 0.298467993 0.280197650 0.323562492 0.176964932 0.200123751
  8 0.298467993 0.280197650 0.323562492 0.176964932 0.200123751
   year
age        1957        1958        1959       1960       1961        1962
  0 0.004683415 0.004779727 0.009000079 0.01708684 0.02184032 0.008357611
  1 0.148446919 0.139758260 0.168802750 0.17490714 0.10235820 0.096209595
  2 0.230769348 0.253565188 0.284151084 0.28493838 0.31544371 0.197236911
  3 0.216028018 0.247308253 0.247310882 0.21052883 0.24009517 0.321303257
  4 0.189465994 0.182028330 0.219959134 0.18000616 0.23008441 0.279953377
  5 0.209871019 0.233408354 0.215188430 0.15884462 0.20917331 0.259917987
  6 0.201995179 0.178614180 0.226257754 0.20741318 0.22383356 0.310412202
  7 0.207992203 0.131055807 0.231430460 0.24866003 0.19644619 0.268994385
  8 0.207992203 0.131055807 0.231430460 0.24866003 0.19644619 0.268994385
   year
age       1963       1964       1965       1966       1967       1968
  0 0.01434202 0.01569993 0.01237093 0.02344326 0.03224588 0.03619225
  1 0.12876105 0.23296138 0.23865661 0.22547150 0.28230872 0.30735982
  2 0.23377283 0.30893292 0.48427202 0.47341294 0.46101161 0.91672083
  3 0.23384228 0.31176011 0.50153155 0.51565315 0.68470867 1.35089733
  4 0.18280909 0.28559700 0.48741846 0.46726029 0.65696694 0.79921522
  5 0.16577602 0.26600996 0.46481070 0.58680520 0.68864602 0.87449193
  6 0.15132524 0.24856125 0.43053844 0.37015167 0.71021691 0.93833361
  7 0.15834006 0.20263480 0.46157870 0.55571962 0.94617856 1.14944834
  8 0.15834006 0.20263480 0.46157870 0.55571962 0.94617856 1.14944834
   year
age       1969       1970       1971       1972       1973       1974
  0 0.01579872 0.04027013 0.04683482 0.06684017 0.06067618 0.09978477
  1 0.32174722 0.31670313 0.56605303 0.59045575 0.64750393 0.48927003
  2 0.70671094 0.77171172 0.74592531 0.70429489 0.82012018 0.85328377
  3 0.80181003 0.99287505 0.92840418 0.72588849 0.98090840 0.82546871
  4 0.75197970 0.96714238 0.94907720 0.67890078 0.78090078 0.79130625
  5 0.83619094 0.83731167 0.75445327 0.55096336 0.76632178 0.97457008
  6 1.25061482 1.10777171 3.00607256 0.63660476 1.01937475 0.92970974
  7 1.01124709 0.95802464 1.38763493 0.34470995 0.59813915 0.80510541
  8 1.01124709 0.95802464 1.38763493 0.34470995 0.59813915 0.80510541
   year
age      1975       1976       1977      1978      1979       1980
  0 0.1198694 0.08905352 0.08104804 0.1008820 0.1190851 0.14397283
  1 0.5223482 0.20786616 0.12870926 0.1167623 0.1109513 0.09945719
  2 0.9940270 0.69899014 0.18868726 0.1926415 0.2043881 0.21999129
  3 1.0787004 0.95388078 0.51893882 0.3310773 0.2831328 0.25339636
  4 0.9714990 0.88212239 0.32059951 0.2553486 0.1989259 0.18411116
  5 1.2642925 0.90953803 0.47763160 0.3457965 0.2885803 0.23402367
  6 0.9375579 0.62756619 0.33977298 0.2011652 0.1101807 0.06763346
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  7 1.5244753 0.99234772 0.41815722 0.3491106 0.2501784 0.14571034
  8 1.5244753 0.99234772 0.41815722 0.3491106 0.2501784 0.14571034
   year
age      1981      1982      1983      1984      1985       1986      1987
  0 0.3790312 0.3481326 0.3653219 0.2037279 0.1053484 0.08186219 0.1487193
  1 0.1931539 0.1729455 0.1941994 0.1830232 0.2715018 0.28736046 0.3293834
  2 0.1977607 0.1787028 0.1939369 0.2103835 0.2607749 0.27884497 0.2804539
  3 0.2083509 0.2704849 0.2367794 0.2845386 0.3865792 0.34073400 0.3024146
  4 0.2064171 0.2015985 0.2559786 0.3523707 0.4369316 0.37117973 0.3621733
  5 0.2436061 0.1522824 0.2334168 0.3567532 0.4107788 0.36500382 0.3812674
  6 0.2108298 0.1416916 0.2539085 0.3188318 0.4261175 0.44821426 0.4108958
  7 0.4516399 0.2099404 0.3700967 0.5149909 0.5321671 0.52786866 0.3889579
  8 0.4516399 0.2099404 0.3700967 0.5149909 0.5321671 0.52786866 0.3889579
   year
age      1988      1989       1990      1991      1992      1993      1994
  0 0.1177234 0.1196483 0.07410944 0.1134739 0.2327973 0.2353767 0.1509562
  1 0.4573337 0.3472972 0.35247595 0.2654312 0.2835709 0.2728099 0.1432269
  2 0.2497685 0.2619148 0.24279484 0.3320650 0.3438465 0.3680766 0.3556057
  3 0.2728146 0.2657190 0.23226298 0.2674202 0.2935521 0.3699112 0.3886336
  4 0.3414287 0.3527375 0.27539778 0.2714939 0.3074742 0.3847875 0.5070142
  5 0.3830658 0.3499021 0.29828502 0.2702035 0.2994690 0.3190256 0.3016247
  6 0.3964282 0.3513449 0.25062582 0.2829347 0.3327166 0.3402880 0.3017511
  7 0.4061951 0.3614222 0.28427796 0.2206371 0.3164573 0.3689236 0.2840365
  8 0.4061951 0.3614222 0.28427796 0.2206371 0.3164573 0.3689236 0.2840365
   year
age      1995       1996       1997       1998       1999       2000
  0 0.1687947 0.06725581 0.01955715 0.01726855 0.02806390 0.03049085
  1 0.1345996 0.10859619 0.04291320 0.07114879 0.04405623 0.05132189
  2 0.2525195 0.13467828 0.11838422 0.14472363 0.12268453 0.11924626
  3 0.3562753 0.20690441 0.17367296 0.18422512 0.22061705 0.17439384
  4 0.3496113 0.18403822 0.19413855 0.20114426 0.19388531 0.22269825
  5 0.3668984 0.19506964 0.18226333 0.21449718 0.20132377 0.22482521
  6 0.2807715 0.19973977 0.16917464 0.21524704 0.18665826 0.18953329
  7 0.2555028 0.09686403 0.12978200 0.12003350 0.10728503 0.11317385
  8 0.2555028 0.09686403 0.12978200 0.12003350 0.10728503 0.11317385
   year
age       2001       2002       2003       2004       2005       2006
  0 0.02764159 0.02366436 0.02272897 0.03484553 0.05131387 0.04971467
  1 0.04210166 0.03123226 0.04348625 0.03376312 0.06229266 0.03520171
  2 0.07963210 0.07882749 0.07180531 0.07863036 0.09573269 0.08221436
  3 0.15555868 0.13730315 0.12817111 0.13553384 0.13696618 0.13740312
  4 0.18276319 0.17909833 0.19310517 0.20362299 0.22521775 0.21782266
  5 0.20155476 0.17488475 0.27534712 0.30189423 0.31292837 0.27925252
  6 0.18911555 0.18516021 0.22099824 0.39130647 0.42938667 0.35082425
  7 0.12309150 0.16194949 0.18684813 0.28245081 0.52186381 0.46723093
  8 0.12309150 0.16194949 0.18684813 0.28245081 0.52186381 0.46723093
   year
age       2007       2008       2009       2010       2011       2012
  0 0.03466932 0.03991967 0.02400061 0.02520725 0.03462607 0.03451844
  1 0.03587872 0.03083513 0.02377248 0.02205477 0.01688644 0.03094793
  2 0.06812824 0.07793902 0.05654685 0.05781323 0.05923026 0.07427581
  3 0.14427665 0.08882657 0.04808283 0.06777258 0.08515577 0.13639793
  4 0.19459089 0.12528973 0.07634260 0.07240315 0.09918710 0.15838979
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  5 0.24604275 0.14765894 0.08954221 0.09020184 0.11911432 0.19263406
  6 0.27422981 0.14243047 0.06833312 0.07164222 0.10484653 0.19775562
  7 0.37705869 0.18213992 0.09579685 0.07167322 0.09513919 0.22179500
  8 0.37705869 0.18213992 0.09579685 0.07167322 0.09513919 0.22179500
   year
age       2013       2014       2015       2016       2017       2018
  0 0.02060872 0.03231707 0.04733709 0.06452758 0.03970319 0.05275195
  1 0.04366785 0.02901607 0.02157146 0.02148032 0.02148952 0.01258808
  2 0.07331662 0.07076370 0.05918835 0.05167726 0.04311670 0.04606404
  3 0.12450024 0.12659413 0.09216315 0.12622307 0.14185241 0.11455586
  4 0.18084262 0.19949177 0.16237291 0.17368945 0.20756407 0.25293465
  5 0.23384042 0.24772573 0.26240532 0.25684190 0.21826380 0.31694265
  6 0.28280236 0.26671677 0.36905700 0.37066147 0.28544336 0.31095937
  7 0.33868727 0.34838909 0.50227857 0.62608893 0.47431093 0.53511001
  8 0.33868727 0.34838909 0.50227857 0.62608893 0.47431093 0.53511001
   year
age       2019
  0 0.05286042
  1 0.01259689
  2 0.04606404
  3 0.11455586
  4 0.25293465
  5 0.31694265
  6 0.31095937
  7 0.53511001
  8 0.53511001
```

Table 2.6.3.14 North Sea Herring. ESTIMATED POPULATION ABUNDANCE

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Units  :  NA
   year
age     1947     1948     1949     1950       1951       1952     1953
  0 56498843 56131111 50827034 69744880 62253823.0 59223654.4 59817829
  1 20124116 24912696 24960383 21503904 32055912.2 27262116.9 25944896
  2 14176580 10317061 14966214 12904080 10544409.2 15507285.7 13042336
  3  5817385  8010399  7550991 10921771  8250421.6  5909396.2  8235633
  4  8168927  3760007  4371523  5438422  7748375.0  4637209.1  3670170
  5  4974061  5312821  2419714  2564945  3902886.9  4449448.3  2708273
  6  4137732  3138543  3334941  1492115  1629215.5  2371668.2  2641210
  7  2336022  2312380  1895938  1852699   864301.2   990039.6  1351357
  8  7079019  5296559  4416593  3331819  2943427.8  2352906.9  1859602
   year
age     1954       1955     1956       1957       1958       1959
  0 57013588 48110288.2 35317077 85860021.2 32872392.6 37590204.4
  1 27411634 24363702.3 21255320 14264551.3 44809877.0 13886715.9
  2 12395440 13643517.7 10410898  9905460.6  5689157.1 23746836.1
  3  7132134  6692307.1  7644136  4637102.3  5355424.5  2637384.0
  4  4484722  3627320.4  3668141  4370854.7  2361066.2  2856691.7
  5  2276278  2497201.1  2004699  2105709.4  2547157.2  1380067.0
  6  1633101  1295567.1  1449731  1251193.6  1152601.1  1368005.4
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  7  1517427   903987.9   715244   874487.5   735956.5   689324.7
  8  1866585  1734663.1  1704524  1460359.1  1332053.2  1448605.3
   year
age       1960       1961       1962       1963       1964       1965
  0 15840010.0 70192832.2 31786137.6 42242324.5 44126903.3 21543006.5
  1 18172321.9  5266581.8 33278829.7 14735631.6 17975395.9 19969958.4
  2  5721975.6  8034311.0  2006842.9 17452435.5  7186773.6  6787185.0
  3 12716953.0  2739859.1  3302974.4  1083079.3 10068894.5  3767154.1
  4  1260751.9  8232700.1  1515391.5  1254592.8   699851.4  5762338.0
  5  1440182.5   764922.7  5120766.9   692419.4   752846.7   431590.2
  6   744573.8   941970.5   447419.0  2548986.1   480701.7   429356.0
  7   726760.2   420400.7   589487.6   212643.4  1661522.5   301977.1
  8  1255377.7  1040292.8   849057.2   763841.2   585125.0  1447218.4
   year
age       1966       1967       1968        1969        1970        1971
  0 22437282.1 28707626.5 29523423.9 13917586.70 29134240.71 22495314.31
  1  9602256.2  9190230.6 12288613.9 12280796.07  6329345.21 12523943.11
  2  8251792.5  4101186.2  3368541.2  4615771.90  4455549.32  2577297.06
  3  2290565.5  3352679.9  2042059.3   700719.08  1579430.19  1276895.69
  4  1478381.0   895864.6  1261869.6   309965.76   226118.11   386805.73
  5  2336319.6   689734.9   307443.0   391124.55   101595.81    58103.79
  6   196508.6   877884.9   258390.4    83847.68   120686.93    30450.99
  7   192132.7   107016.0   291577.0    73827.64    16286.98    30995.93
  8   851938.8   453813.8   161855.0   100120.16    45591.62    17302.46
   year
age          1972        1973         1974       1975        1976
  0 15700733.9271 7943076.866 14125092.423 3234709.25 4172725.320
  1  9795713.2861 6381948.503  3135694.825 6553338.63 1046285.694
  2  3513171.8538 2848571.313  1642853.093  988291.43 1982118.999
  3   815701.7697 1177680.057   788292.062  446901.26  219066.693
  4   325206.2241  310085.493   276876.803  251592.19   97120.467
  5    96943.7296  125089.205   102874.670   87463.13   65158.134
  6    18229.8261   44308.336    42013.145   27983.99   15859.999
  7      975.0296    8019.109    11416.107   12023.08    7665.757
  8     7921.2639    4846.571     5611.231    5873.64    2682.971
   year
age        1977        1978         1979         1980        1981
  0 5007480.019 5351562.757 10154904.335 15476298.269 36915279.62
  1 1752335.823 2154658.742  2041709.032  4096447.291  6152909.92
  2  373527.111  799291.331   963878.938   824894.198  1942664.57
  3  565718.869  259513.488   445970.612   488685.794   383690.06
  4   50944.315  220117.345   165380.243   231014.656   246942.90
  5   22790.044   29230.248   115508.654   122340.889   144906.58
  6   17431.531    9565.108    16741.060    59251.238    91226.64
  7    5665.782    8609.189     5386.860    12335.635    47153.21
  8    2615.846    3890.813     6085.963     5892.008    14306.51
   year
age        1982        1983        1984        1985        1986
  0 58525556.13 57946931.70 55810044.06 67271136.67 81400120.13
  1 10359627.88 18682601.00 16144251.92 18395576.42 25807940.91
  2  2305944.79  4005117.02  7495017.22  6895231.07  6300391.79
  3  1105022.61  1262192.38  2138491.63  4137379.93  3416311.62
  4   222843.30   552197.77   772301.59  1157311.87  1776992.74
```

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  5   131913.28   144897.85   303711.51   411617.05   499159.48
  6    75164.94   100125.65    91618.14   143917.35   194442.30
  7    56922.56    49945.68    64641.27    53291.18    65078.80
  8    30302.93    66066.12    70627.73    70001.22    61913.26
   year
age        1987        1988       1989       1990       1991       1992
  0 78363263.87 44888159.60 37759804.8 31642519.6 35056747.8 65995431.9
  1 33823678.13 26202203.62 15997431.2 13006384.7 12900272.9 12700999.7
  2 10324219.62 12347074.15  8159086.9  5251088.5  4661049.5  5324481.8
  3  3008955.73  5360616.88  6674402.4  4500903.9  2745198.8  2074120.2
  4  1756881.89  1541820.38  2999095.3  4176418.9  2684785.1  1584340.2
  5   884391.21   907941.30   808964.6  1716497.7  2463569.5  1580296.5
  6   255200.14   442163.50   452439.1   452617.6   950619.0  1478449.8
  7    90446.66   127942.44   220194.6   246932.3   259779.8   560641.0
  8    57081.34    77612.86   104287.4   185914.2   227617.4   287234.4
   year
age       1993       1994       1995       1996        1997       1998
  0 68551684.4 52883202.7 61076455.8 50221462.9 39918410.72 25190061.9
  1 20565871.0 20721078.5 18044265.3 18990414.4 19407717.18 16606604.0
  2  4606851.3  7023828.4  7699248.5  6635355.9  7860880.78 10556274.4
  3  2291559.0  1767269.8  3068008.3  3475724.7  3411962.42  3848461.6
  4  1116290.4   953140.3   885847.0  1299885.9  1880069.57  1765809.2
  5   893943.4   499166.0   409727.4   400967.0   773888.11  1030993.6
  6   893055.0   431857.4   255354.9   158614.4   251635.04   490983.2
  7   731188.0   415562.9   215263.5   124687.3    89986.19   158561.9
  8   449317.4   533836.9   441690.3   332734.5   270408.82   207608.4
   year
age       1999       2000        2001       2002       2003       2004
  0 80033627.2 54550943.0 101911821.9 49214247.8 27618571.2 32210582.5
  1 10535662.4 30573076.8  20465526.1 41876954.2 18667350.1 10134082.6
  2  6687727.4  6468850.4  14244543.1  9393766.6 22413767.6  7496517.2
  3  5980672.1  3476095.4   3983131.6  9031064.0  5330603.5 12867375.5
  4  1984394.6  3605743.8   1985262.9  2112443.6  5536534.9  3459407.2
  5   878068.0  1192910.0   2023825.6  1089122.6  1139616.2  3325101.0
  6   502441.5   548156.2    623529.0  1243096.2   677246.7   566807.2
  7   254700.8   307535.5    312616.9   356660.0   742895.0   420325.6
  8   187174.4   240138.9    271438.0   353562.9   395167.7   596573.5
   year
age       2005       2006       2007       2008       2009       2010
  0 29939013.4 27222228.3 31275813.6 29088826.3 47585226.3 38129806.3
  1 13609493.2  9922317.3  9058784.5 10495247.4 10575994.8 17095801.6
  2  4651229.7  6307520.2  4306535.7  5181597.5  6066119.9  6449802.5
  3  4553671.3  2922099.4  3527159.5  2586207.8  3078075.8  4298517.7
  4  7552218.4  2773776.7  1829740.9  1997448.8  1592200.7  2251212.5
  5  2044709.7  4745558.4  1581176.0  1173749.5  1255794.8  1184694.4
  6  1797291.7  1002087.9  2636368.1   991318.2   795678.7  1104435.3
  7   277500.8   827752.9   511835.3  1776143.4   694013.6   598787.8
  8   470502.2   308807.8   514826.5   629664.9  1834395.5  2008962.4
   year
age       2011       2012       2013       2014       2015       2016
  0 34223670.4 32791166.5 40829468.0 65480092.4 17336518.0 32864572.2
  1 15030054.8 12253462.7 11563672.1 17913819.8 26517416.0  7078298.5
  2  8080422.2  7615785.5  5649089.4  6781838.9 11847802.6 15229436.7
```

age						
3	4169972.8	5905447.5	5016394.8	3744237.3	3655273.0	8061944.0
4	2809933.8	3126418.4	4066106.1	3874968.1	2320502.1	2220746.0
5	1404793.6	1979680.1	2319224.2	2607203.8	2328081.5	1439131.5
6	786174.5	917523.3	1326328.4	1488758.4	1490263.7	1308824.7
7	729885.8	498623.4	575660.9	789299.8	824532.0	744497.5
8	1716852.4	1378781.5	1151820.4	847829.8	878714.3	768926.3

age \ year	2017	2018	2019
0	20022378.5	36780645.0	26191234.3
1	12461780.5	8790338.4	14066353.7
2	3274372.2	5620370.6	4397586.7
3	9410218.1	2275811.4	3450200.5
4	5291507.4	6114577.5	1377760.9
5	1416926.3	3498836.4	3252467.2
6	726788.5	922321.2	1771075.3
7	606557.2	462910.6	473265.6
8	610748.7	656236.1	463287.4

Table 2.6.3.18 North Sea Herring. PREDICTED INDEX AT AGE catch unique

Units : NA

age \ year	1947	1948	1949	1950	1951	1952
0	149093.09	148126.108	134176.07	183910.6	164223.1	156256.9
1	3079.91	3812.781	16711.53	62921.4	407407.9	692167.4
2	477791.72	262536.199	479344.73	542693.3	655501.1	1325532.4
3	421802.00	665721.108	645920.46	1039053.7	926751.0	598328.8
4	645197.03	326312.546	404656.23	618425.2	1180679.0	619111.6
5	529604.20	599115.866	284937.23	300626.4	599909.1	653751.6
6	739642.13	509822.692	616623.04	255316.0	268130.2	440769.2
7	430273.02	413468.284	425161.35	336821.1	142271.0	219357.6
8	1304305.70	947362.442	990728.71	605919.8	484668.2	521485.9

age \ year	1953	1954	1955	1956	1957	1958	1959
0	157818.8	205714.7	161529.2	100546.7	274370.1	107201.1	230406.0
1	1007027.9	1466251.6	1958603.3	1748078.2	1447281.3	4296443.1	1588124.6
2	1324270.8	1493432.0	1935915.5	1817312.4	1664904.8	1040119.2	4799961.9
3	1010852.9	1087224.1	1034782.5	1215241.7	751953.0	980327.0	482785.9
4	475619.4	592459.5	483892.6	515341.3	636790.7	331600.2	476545.3
5	390221.9	351645.3	340823.0	258376.0	339253.0	451558.1	227428.0
6	479841.5	315381.6	228071.9	208746.4	195495.7	160953.6	236796.2
7	283398.3	360410.6	125473.5	111086.0	140653.3	77264.2	122058.5
8	390108.3	443480.5	240849.3	264818.5	234961.0	139890.9	256586.5

age \ year	1960	1961	1962	1963	1964	1965
0	183685.0	1038289.02	180972.7	411651.08	470453.91	181238.42
1	2147738.6	375900.98	2238592.3	1307923.92	2760131.71	3133725.54
2	1159389.1	1778234.56	292638.2	2967610.46	1562266.77	2144428.86
3	2014669.3	488486.51	760112.4	188599.88	2257829.01	1251384.67
4	175260.6	1430023.63	313184.7	176894.33	147182.01	1893131.65
5	179750.9	122866.72	998895.7	89906.98	149886.84	137531.44

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  6  119163.9  161481.72  102303.6  305364.12   90491.79  129129.94
  7  137193.4   64201.02  119280.5   26635.16  260993.19   96285.58
  8  237058.5  158918.48  171858.2   95707.87   91941.54  461588.42
   year
age       1966       1967       1968       1969        1970       1971
  0  356002.26  624159.88  719214.04  149313.48  788277.136  706025.03
  1 1431604.21 1674633.90 2412526.31 2508285.23 1275546.438 4070908.83
  2 2560500.88 1245788.34 1689599.10 1940438.23 1992520.808 1125494.84
  3  777619.64 1407990.58 1307708.30  328530.93  850248.956  659069.30
  4  469676.42  369227.10  596759.81  140601.36  121021.227  204593.25
  5  892039.89  296131.71  155377.66  191946.90   49903.031   26597.80
  6   52176.69  386669.86  137079.75   52575.27   70751.566   26424.15
  7   70823.92   57192.66  174922.87   41102.46    8771.718   20545.37
  8  314136.45  242600.25   97126.25   55755.89   24561.270   11471.73
   year
age         1972        1973       1974        1975       1976        1977
  0  696971.9577  321197.024 922271.019  252396.235 245566.303 269229.6373
  1 3292994.9052 2294934.764 911863.223 1988869.326 142752.820 152132.5329
  2 1473663.9481 1327236.187 786989.850  520809.681 823738.057  52016.9073
  3  357141.8414  629010.376 377170.480  252519.065 114695.767 192229.7351
  4  137260.7811  144332.085 130098.357  134951.821  48980.298  11826.7246
  5   35286.9984   57879.943  55684.551   54979.173  33781.776   7427.4195
  6    7421.0714   24738.961  22152.333   14847.930   6401.160   4320.1339
  7     244.3769    3125.513   5491.670    8342.521   4228.936   1674.9742
  8    1985.9730    1889.557   2700.038    4076.594   1480.530    773.5961
   year
age        1978       1979         1980        1981         1982
  0 354860.9227 787505.756 1431592.0074 8126759.249 11929698.967
  1 169699.4856 152593.451  275186.0356  770774.794  1172206.357
  2 113342.7855 144221.654  131993.3519  282557.515   306172.822
  3  61002.6569  91600.074   91126.4882   60139.007   219162.567
  4  41919.6770  25189.591   32827.8115   39013.138    34530.454
  5   7312.7770  24765.968   21830.2554   26841.840    15953.638
  6   1496.1424   1497.945    3325.1100   14962.809     8568.694
  7   2194.4811   1030.541    1444.4442   14940.922     9359.598
  8    992.1669   1164.813     690.2866    4535.705     4985.835
   year
age        1983       1984       1985       1986       1987       1988
  0 12207637.11 6939324.04 4482099.01 4237678.33 7192322.56 3308093.51
  1  2358664.79 1937163.13 3164236.19 4685474.39 6943835.39 7112062.87
  2   574519.67 1161021.15 1299838.32 1266340.19 2093995.13 2268235.69
  3   223228.34  446637.03 1127247.61  841627.12  671925.61 1096974.44
  4   106302.83  196665.91  353639.46  477429.13  464279.20  388550.66
  5    25941.59   78826.33  120507.58  133048.68  245222.46  253246.73
  6    19469.27   21772.26   43703.33   61709.34   75676.99  127544.64
  7    13495.74   22854.46   19376.09   23584.84   25733.72   37786.22
  8    17865.14   24992.50   25470.43   22448.76   16247.16   22931.44
   year
age       1989       1990       1991       1992      1993       1994
  0 2836122.32 1504446.63 2516428.70 9282177.19 9759965.6 5012028.60
  1 3461832.54 2860245.39 2226800.45 2338661.47 3676295.3 2064747.88
  2 1568273.57  945228.74 1101821.07 1293406.15 1182905.4 1748044.26
  3 1336983.31  800860.88  552945.89  452091.63  607287.0  487480.49
```

4	778174.25	876557.50	555467.40	363940.26	309243.3	329206.76
5	209518.31	388227.69	510839.21	357741.77	213401.9	113390.75
6	118192.76	88362.27	206426.88	368810.85	226942.8	98983.24
7	59108.55	54029.86	45410.51	134435.47	199514.5	90675.78
8	28007.33	40705.50	39837.82	69013.28	122912.7	116853.83

year

age	1995	1996	1997	1998	1999	2000
0	6435805.34	2197378.36	516746.493	287038.70	1466297.14	1076303.70
1	1701238.00	1460233.79	605566.360	844997.20	333032.94	1108653.93
2	1420447.78	687507.53	720401.319	1166309.86	630576.05	591473.30
3	786172.33	553220.82	463240.383	551483.34	1007849.44	471881.05
4	225691.43	187969.81	285910.411	277518.44	301677.95	621693.64
5	109816.90	61775.62	112167.027	173312.28	139348.59	209126.66
6	54958.17	25211.42	34381.689	83555.66	75079.03	82989.08
7	42788.44	10113.66	9633.388	15768.89	22762.60	28895.03
8	88122.35	27090.73	29048.980	20711.53	16767.57	22590.07

year

age	2001	2002	2003	2004	2005	2006	2007
0	1812368.28	745533.46	399078.80	705734.8	953590.08	836178.1	672059.4
1	605898.93	918140.76	562999.23	237619.9	584208.60	245028.6	229168.7
2	882724.12	574331.82	1246894.99	454178.5	340509.28	399343.0	227869.8
3	485229.55	975151.43	536711.39	1360021.6	484415.16	310859.6	392575.7
4	285898.88	297764.18	832717.96	544101.4	1295192.41	459588.4	273113.1
5	321152.58	151400.67	237404.48	748056.5	472600.55	989788.6	294276.5
6	94070.98	183450.53	116922.47	159976.0	545480.65	256380.8	544375.5
7	31762.22	46722.83	110691.14	90390.2	98894.81	269686.2	139700.3
8	27591.88	46336.86	58915.15	128398.6	167870.40	100775.9	140835.3

year

age	2008	2009	2010	2011	2012	2013	2014
0	716679.1	709995.75	599270.21	740034.69	712402.6	537986.3	1362736.1
1	230333.1	180383.38	271596.74	183730.03	273124.6	361826.6	374618.5
2	313280.1	269298.63	292980.16	376295.41	442042.4	324019.0	375991.5
3	181881.6	119440.94	233001.14	281864.64	624856.5	487511.9	369987.1
4	197830.7	98135.63	131652.54	222106.28	383721.5	563670.6	587357.8
5	136849.9	91040.41	86351.80	133238.56	293268.0	408976.6	483670.7
6	112670.1	44813.84	64987.25	66543.36	140122.2	278320.2	296339.1
7	255123.3	54439.62	35457.09	56616.64	84879.8	141679.1	198541.2
8	90726.1	144428.92	119447.73	133756.80	235749.4	284740.6	214212.2

year

age	2015	2016	2017	2018	2019
0	532803.4	1389956.8	522152.6	1278088.79	911947.0
1	412614.0	109272.7	192819.5	79839.08	127847.9
2	552075.7	621160.2	111918.7	204864.60	160293.7
3	267369.3	795839.8	1036061.3	204984.39	310762.7
4	291073.0	296417.4	831229.4	1146793.35	258400.0
5	454197.4	275374.8	234492.9	804298.07	747663.7
6	391653.1	344767.9	153213.2	209278.09	401863.5
7	279004.3	297318.2	195964.4	164206.41	167879.6
8	298592.8	308280.9	198135.9	233714.82	164997.2

Table 2.6.3.19 North Sea Herring. INDEX AT AGE RESIDUALS catch unique

Units : NA

age	1947	1948	1949	1950	1951	1952
0	0.0000000	0.00000000	0.00000000	0.00000000	0.0000000	0.0000000
1	0.0000000	1.94346471	0.00000000	0.00000000	3.8170622	0.8222697
2	1.8421113	1.20391087	1.36193081	0.30552405	-1.0685014	-0.7855888
3	1.5470236	2.42735109	1.33964311	-0.02375496	-0.7444538	-1.9332768
4	1.9543560	1.19933020	-0.37954817	1.47835609	0.7114516	-1.6193702
5	1.2860612	-0.02786206	0.06485348	-0.46358838	1.3739474	-0.8769467
6	1.2760881	0.04097824	0.38747974	-0.23811965	-0.1609107	0.1022259
7	2.6652682	-0.11252856	0.87989143	-0.45480347	-0.1655704	0.5963787
8	0.2787166	0.30777779	0.59626633	-0.07948342	-0.1644379	0.6530203

age	1953	1954	1955	1956	1957	1958
0	2.1651379	0.47383769	-0.30651699	-0.6479877	1.20511809	-1.15536367
1	0.3042004	0.21876212	0.25146097	-0.0455826	0.09566492	0.80305250
2	-0.6878225	-0.33746714	-0.08440229	-0.5010708	-0.03806113	-0.48515294
3	-1.0722129	-0.25177817	-0.55799161	-0.3447222	-1.20221550	0.55530763
4	-0.8793797	-1.33501009	-1.04430364	-0.2568855	-0.18526513	-0.95811303
5	-0.7775660	-0.30473657	-1.38525397	-1.0315976	0.13504574	0.03153996
6	-0.4420838	-0.17993819	-0.64613189	-0.8962650	-0.01900979	-0.88405197
7	-0.4280307	-0.09078207	-1.36045958	-0.4294156	-0.09305762	-1.06653176
8	0.1248446	0.53670420	-0.86038212	0.6924429	0.03756783	-0.88671725

age	1959	1960	1961	1962	1963	1964
0	0.0000000	0.6163014	2.22172762	-2.4131977	1.16878620	0.2122808
1	-0.5570481	0.2440031	-2.61338671	0.9781509	0.60578414	0.6022140
2	1.4680605	-1.1130528	-0.06630833	-2.1256002	1.64886176	0.5711457
3	-0.5132241	0.1373801	-0.44710271	-0.1913299	0.01063235	1.0456373
4	0.3332807	-0.9676762	1.35843252	-0.0344911	-2.55916769	2.3013291
5	-0.4506934	-1.5140449	0.81116772	0.9378105	-2.30820954	1.0419713
6	0.1080948	-0.4059496	0.35862291	0.6111654	-1.93861603	1.2126919
7	0.4392387	-0.6798594	-0.49210475	1.2249883	-1.60133018	0.8509192
8	1.1884657	0.6225652	-0.94415741	-0.8044316	-0.45975257	-0.7972422

age	1965	1966	1967	1968	1969	1970
0	-1.3351960	0.9263975	0.70094765	0.35568294	-2.33417586	2.2801530
1	0.1256037	-0.4253516	-0.30233029	0.06463085	-0.04816627	0.1010212
2	-0.2675679	0.1117252	-0.29117314	0.14191289	-0.41447653	-0.1285849
3	0.6755196	-1.7964929	0.52526053	1.71544013	-3.54706730	1.0364728
4	1.3214629	-1.4585439	-0.48286382	0.14999330	-2.65129123	0.6189823
5	1.7967214	-0.7406609	-0.22259117	-1.10062003	-1.10900550	-1.3702788
6	0.6797649	-0.9658635	-0.09957544	0.02150147	-1.14693741	-0.7064129
7	1.8039591	-0.8127937	0.68028763	-1.47777704	-0.82266246	-1.4986882
8	0.1744003	0.3065786	-0.66069283	-0.43723248	-2.44060087	-1.3210978

age	1971	1972	1973	1974	1975	1976
0	-0.1656694	0.09593125	-1.1520999	1.3859931	-1.47992005	-0.2273537
1	0.5406456	-0.20247029	-0.5099261	-0.9651437	0.64525123	-3.0575551
2	0.4350879	-1.09915773	-0.1484415	-0.8021310	0.10282243	-0.4707146
3	-0.5047930	-0.17505112	0.1021686	-0.9673700	-0.20140585	-0.4264093

```
  4 -0.4612794 -0.66063386  1.1460789 -1.1815665  0.56935591 -0.6939589
  5 -1.0540414 -0.91490704  1.4935872  0.3325670 -0.09937525 -0.5687259
  6  0.2314600 -1.80539682  1.8776681 -0.4547026 -0.44554566 -1.3203331
  7 -1.0169002 -3.49743349  2.7147912 -0.1623169  0.51547252 -0.6427491
  8 -2.6974843 -1.47408061  2.0513726  1.5275829  0.90153084 -1.4126692
   year
age       1977 1978 1979       1980       1981       1982       1983
  0  0.0773059    0    0  1.3163004  2.5837657  0.4763490  0.1855080
  1 -0.1876420    0    0 -0.2400897  1.0606562 -0.5926166  0.7219756
  2 -2.7076758    0    0 -0.8903279  0.7128919 -0.9999738 -0.1071316
  3  0.2503787    0    0 -1.5764137 -0.7749925  1.1202437 -0.5298739
  4 -1.1464003    0    0 -1.1938387 -0.6014581  0.1974118 -0.1458076
  5 -1.2060857    0    0  1.8799093 -1.1834880 -1.8034376  1.0052919
  6 -0.2846519    0    0 -0.7175033  3.7672383 -1.4740319  1.8241983
  7 -0.9802701    0    0  1.6717579  2.7088576 -1.2506028  0.5455615
  8 -0.9155971    0    0 -0.2221135  4.1768745  0.2626584  2.8350745
   year
age       1984       1985        1986         1987         1988
  0 -0.7870204 -0.6779534 -0.19685825  0.943001720 -1.076706649
  1 -0.2806486  1.0209462  0.96689628  0.682278076 -0.122312446
  2  0.3743608  1.0057687  0.04337091  0.888179674 -0.555824703
  3  0.1363107  1.1245469 -0.13176607 -0.435086617 -0.019302262
  4  1.3415404  0.5609999 -0.85141585  0.260366159 -0.228042711
  5  0.5641788  0.6667780 -0.91119752  0.139001608  0.160410950
  6  0.1771584 -0.3157969 -0.12827536 -0.232068954 -0.212182571
  7  1.1436133 -0.0600321 -1.46886763 -0.846299215 -0.001799564
  8  1.9434334  1.7209342  1.85515742 -0.009515068  0.216200278
   year
age        1989        1990        1991       1992         1993
  0 -0.12117287 -1.02622599  0.65105275  1.8034422  0.124855081
  1 -0.73798595 -0.11170943 -0.05270445 -0.3134555 -0.156116536
  2  0.01754074 -0.99820958  1.15119632  0.3896613 -0.308780450
  3  0.09821208 -0.45927000  0.18109875 -0.2684612  0.001664254
  4  0.44071147 -0.28283501 -0.02022524  0.3710180  0.375662423
  5 -0.06718194  0.06301689 -0.10861969  0.3805161  0.272381197
  6 -0.15015527 -0.53413520  0.24075495  0.4048049  0.198310544
  7 -0.24471121 -0.37122756 -0.66948395  0.9745291 -0.119292921
  8 -0.18306436 -0.03001701 -0.33980360 -0.4010850  0.338504941
   year
age        1994       1995       1996       1997        1998       1999
  0 -1.00445519  0.5029326 -1.3618230 -2.1100892 -0.83047902  2.1108385
  1 -1.33379257 -0.1063281 -0.3165317 -1.4544390  0.98213362 -0.6212383
  2 -0.71430882 -1.9907337 -2.8825110 -0.8408304  1.17029453 -1.1148200
  3 -0.60123126 -0.6088555 -1.9375378 -0.9685606 -0.40545530  0.7223627
  4  0.06041035 -0.6906329 -2.4031358 -0.1470455 -0.46454570 -0.4798811
  5 -0.73375288  0.8937614 -1.8831296 -0.3965354 -0.01253578 -0.7406529
  6 -0.54254036 -0.1908471 -1.3668233 -0.2748007  0.55545480 -0.7630360
  7 -1.05878965 -0.3789460 -2.1984638  0.7286039 -0.11820557 -0.1561018
  8 -0.11936906 -0.2314674 -1.2178434 -0.8245446 -0.52354346 -1.5677166
   year
age         2000        2001        2002       2003        2004       2005
  0 -0.329409114  0.62683166 -1.08842848 -0.8373581  0.75989858  0.5192909
  1 -0.001335337 -0.30824534 -0.48794548  0.5259788 -0.67848865  1.7738782
```

```
  2  0.871543104 -1.29693452 -0.09971803  0.1639090 -0.27581625  0.6421128
  3 -0.997194189  0.03446253 -0.01008369 -0.2681858 -0.04104904  0.1924584
  4  0.706837897 -0.60504080 -0.41630136  0.3711593  0.36392803  0.2628070
  5  0.334295259 -0.29917288 -0.97222745  0.8757329  0.41505493  0.1606577
  6  0.104412961 -0.25243343 -0.03069281  0.1504675  0.78358406  0.2889529
  7  0.556981877  0.42065409  0.38039614  0.3957233  1.19766878  1.4420664
  8 -1.644601333 -1.67795371 -0.14821008 -0.9631578 -1.24377235 -0.7297025
   year
age        2006         2007       2008       2009         2010       2011
  0 -0.11068115 -0.406750733  0.2128440 -0.1809278 -0.251895772  0.3649548
  1 -1.35781535  0.044101584 -0.5259603 -0.1992293 -0.190808591 -0.3580449
  2 -0.37715548 -0.877583901  1.1341852 -0.2260714  0.728319925 -0.1670180
  3  0.33703657  0.087276506 -1.2176703 -1.8359593  1.472446002  0.7782027
  4  0.01271054 -0.001212949 -1.3416433 -1.4562849  0.035056135  0.9877643
  5  0.20894062 -0.150234657 -1.0326809 -1.4535711  0.219193514  0.5633343
  6 -0.48642302 -0.131628575 -1.0184010 -1.4694591  0.636517000  0.6582280
  7 -0.38114812 -0.213711574 -1.0864035 -1.0215439 -0.413423571  0.3512444
  8 -0.06649090 -0.130153658  0.4111375 -0.0230213  0.007620405  0.1029386
   year
age        2012       2013       2014       2015       2016       2017
  0  0.03991368 -0.6018539  1.2047903 -1.0769918 1.33910063 -1.3830113
  1  1.05989130  0.8272874 -0.2836109 -0.8438681 0.12041411 -0.0508591
  2  0.51308401 -0.4251481  0.6276753  0.5669175 0.14514375 -0.8666124
  3  1.94003301 -0.1349728  0.3861336 -1.3528921 1.41628979  0.3589712
  4  2.00062295  0.7769652  1.2696679 -0.5331685 0.05336169  0.7267264
  5  1.82841923  1.3786845  0.5559808  0.4399412 0.14341234 -0.1452581
  6  1.43950751  1.2877036  0.0988419  0.8695554 0.19614930 -0.6316221
  7  1.91231855  0.9761748  0.4346081  0.5582410 0.46672640 -0.9108986
  8 -0.53375136  0.4683506 -0.4316434  0.7430224 0.57794257  0.5358086
   year
age       2018 2019
  0  1.1750628    0
  1 -0.6263576    0
  2 -0.1683390    0
  3 -0.3666175    0
  4  0.8633635    0
  5  1.6585807    0
  6  0.3645246    0
  7  0.3874848    0
  8  1.4733597    0
```

Table 2.6.3.20 North Sea Herring. PREDICTED INDEX AT AGE LAI-ORSH

Units : NA

age	1972	1973	1974	1975	1976	1977	1978
0	2010.607	1792.284	1053.7661	617.9344	945.1026	573.0173	720.7835
1	1274.497	1136.105	667.9682	391.7003	599.0879	363.2280	456.8950

age	1979	1980	1981	1982	1983	1984	1985
0	1034.3124	1245.3690	1806.704	2230.787	2481.913	3856.294	4473.396
1	655.6368	789.4227	1145.246	1414.066	1573.252	2444.454	2835.626

age	1986	1987	1988	1989	1990	1991	1992
0	4896.612	5757.758	6809.703	7455.893	NA	3904.464	918.3486
1	3103.897	3649.766	4316.580	4726.191	4412.202	2474.987	582.1289

age	1993	1994	1995	1996	1997	1998	1999	2000
0	NA	885.3702	NA	NA	NA	NA	NA	NA
1	536.3866	561.2243	1789.011	4717.807	6098.57	7194.262	7739.55	8040.251

age	2001	2002	2003	2004	2005	2006	2007	2008
0	NA	NA	NA	NA	NA	5999.077	NA	4407.035
1	9162.548	9181.56	6943.136	5633.295	5025.835	3802.735	2591.637	2793.561

age	2009	2010	2011	2012	2013	2014	2015
0	NA	NA	NA	NA	NA	NA	NA
1	2834.292	2966.867	4027.229	4591.077	4352.545	4181.661	3986.522

Table 2.6.3.21 North Sea Herring. INDEX AT AGE RESIDUALS LAI-ORSH

Units : NA

age	1972	1973	1974	1975	1976	1977
0	0.9490267	-0.4157534	-0.5276573	-0.7739073	0.3010899	1.9468407
1	1.4993577	-0.7449251	-0.5728094	-1.8471075	-0.9093256	0.7534575

age	1978	1979	1980	1981	1982	1983
0	2.8129509	2.104064	1.4317779	0.848349	0.31561605	-0.1226669
1	-0.5261923	1.833793	0.3452657	-0.943263	0.04063867	-0.6490039

age	1984	1985	1986	1987	1988	1989
0	-0.6968928	0.18531729	-0.1259333	0.3959302	0.2612484	0.7176941
1	-0.2588474	0.06856921	-0.3035306	-0.4168490	0.6748034	0.3943493

age	1990	1991	1992	1993	1994	1995
0	NA	-1.2625979	-2.001111	NA	-1.730110	NA
1	0.6566063	-0.1901818	1.260943	-1.098491	1.966871	2.294189

age	1996	1997	1998	1999	2000	2001
0	NA	NA	NA	NA	NA	NA

```
  1 -0.01235815 0.00768455 0.2559046 -0.2674838 -0.503655 0.1055157
   year
age       2002       2003       2004      2005       2006       2007
  0         NA         NA         NA        NA  0.1835403         NA
  1 -0.4377433 -0.9313368 0.09634665 -0.133518 -0.2962107 -0.1714446
   year
age      2008      2009       2010      2011     2012     2013      2014
  0 0.4385315        NA         NA        NA       NA       NA        NA
  1 0.9142136 0.8323503 -0.0262811 0.3392524 1.564697 1.629567 0.4608897
   year
age      2015
  0        NA
  1 0.8190273
```

Table 2.6.3.22 North Sea Herring. PREDICTED INDEX AT AGE LAI-BUN

```
Units  :  NA
   year
age     1972      1973      1974     1975     1976     1977     1978
  0 20.17108 17.980788 115.21680 79.23387       NA 62.17679       NA
  1       NA  6.894264  44.17688       NA 9.976697 23.84007 46.30571
   year
age     1979      1980     1981     1982     1983     1984     1985
  0 62.50242 15.543846 28.18107 353.2187 1912.314 3095.003 2775.272
  1 23.96492  5.959882 10.80530 135.4325  733.227 1186.698 1064.106
   year
age      1986     1987     1988     1989     1990     1991     1992
  0 2442.7277 2729.098 4852.736 4347.070 5222.146       NA       NA
  1  936.6002 1046.401 1860.655 1666.771 2002.296 3183.409 4406.128
   year
age     1993     1996     1997     1998     1999      2000     2001
  0       NA       NA       NA       NA       NA 198.95632       NA
  1 3000.924 585.9286 167.9755 341.6611 160.0735  76.28461 224.2111
   year
age     2002    2003     2004     2005     2006     2007     2008     2009
  0       NA      NA       NA       NA       NA       NA       NA       NA
  1 736.3416 1438.28 1751.812 1299.705 712.9991 826.2714 720.1596 1283.587
   year
age     2010     2011     2012     2013     2014     2015     2016
  0       NA       NA       NA       NA       NA       NA       NA
  1 1364.208 2063.419 2731.211 3558.615 3340.625 2829.269 3052.609
   year
age     2017     2018
  0       NA       NA
  1 2555.367 2041.325
```

Table 2.6.3.23 North Sea Herring. INDEX AT AGE RESIDUALS LAI-BUN

```
Units  :  NA
   year
age      1972        1973     1974      1975      1976      1977     1978
  0 -0.192697 -1.44740636 1.392899 0.3871624        NA 2.0335323       NA
  1        NA  0.03000258 2.020192        NA -2.344996 0.8131908 1.980602
   year
age       1979       1980       1981     1982      1983       1984
  0  0.5277311 -0.7308945 -0.9774579 1.586980 1.3387578 -0.3309883
  1 -1.1060083 -1.7826202  1.0775252 1.267803 0.3130329  0.2181331
   year
age       1985        1986        1987      1988       1989      1990
  0 -0.2487577 -0.04353208 -0.06607528 0.7538161  0.4927131 0.2022081
  1  0.2442604 -0.99252176 -0.34130037 0.9628135 -0.5722317 0.1940743
   year
age       1991       1992      1993      1996      1997     1998
  0         NA         NA        NA        NA        NA       NA
  1 0.02600095 -0.4470565 -2.669971 -2.165549 -2.270617 1.224697
   year
age       1999       2000      2001      2002     2003      2004
  0         NA -1.6878898        NA        NA       NA        NA
  1 -0.7027666  0.9883683 0.3863908 0.9177875 0.533921 0.7381779
   year
age       2005       2006      2007        2008     2009       2010
  0         NA         NA        NA          NA       NA         NA
  1 -0.1688856 -0.8455476 0.6599171 -0.06212379 1.440589 0.08051891
   year
age      2011     2012     2013      2014      2015      2016      2017
  0        NA       NA       NA        NA        NA        NA        NA
  1 0.5370518 1.178228 1.443701 0.6086508 0.4513514 0.1892798 0.7267083
   year
age       2018
  0         NA
  1 -0.1543912
```

Table 2.6.3.24 North Sea Herring. PREDICTED INDEX AT AGE LAI-CNS

```
Units  :  NA
   year
age      1972      1973     1974       1975       1976       1977
  0 436.97309 389.52405 293.0104         NA 181.199918 133.717081
  1 615.41030 548.58553       NA 216.800085 255.192596 188.320223
  2 299.17351 266.68754 200.6095 105.394469         NA  91.549364
  3  20.53753  18.30745       NA   7.235074   8.516313   6.284642
   year
age       1978       1979       1980     1981      1982     1983
  0 173.667767 204.228614 169.960254 259.0735 382.18278 564.0432
  1 244.584704 287.625021 239.363234 364.8658 538.24646 794.3693
  2 118.901590 139.825066 116.363242 177.3746 261.66134 386.1720
```

```
  3   8.162305   9.598651   7.988054       NA  17.96242       NA
   year
age       1984       1985       1986       1987       1988       1989
  0 1184.90921 1419.58991 1449.14463 1759.87536 2049.04685 1741.33764
  1 1668.76487 1999.27704 2040.90037 2478.51748 2885.77164 2452.40991
  2  811.24778  971.92186  992.15648 1204.89820 1402.87938 1192.20635
  3   55.69019   66.72008   68.10913   82.71334   96.30426   81.84207
   year
age     1990     1991     1992     1993     1994     1995     1996
  0 1759.153 1041.749 200.8764       NA       NA       NA       NA
  1 2477.500 1467.145 282.9039 246.5006 206.1376       NA 539.1198
  2 1204.403  713.233 137.5300 119.8330 100.2110 163.2379       NA
  3       NA       NA       NA       NA       NA       NA       NA
   year
age     1998     1999     2000     2001     2002     2003     2004
  0 339.3828       NA       NA       NA       NA       NA       NA
  1 477.9692 521.2126 700.2131 1456.917       NA 3334.394 3232.993
  2       NA 253.3806       NA       NA 1287.909 1620.971       NA
  3       NA       NA       NA       NA       NA       NA       NA
   year
age     2005     2006     2007     2008     2009     2010     2011
  0       NA       NA       NA       NA       NA       NA       NA
  1 3065.506 2261.331 1594.225 1877.436 2022.673 2089.757 2712.303
  2       NA       NA       NA       NA       NA       NA       NA
  3       NA       NA       NA       NA       NA       NA       NA
   year
age     2012     2013     2014     2015     2016     2017     2018
  0       NA       NA       NA       NA       NA       NA       NA
  1 2476.588 2342.377 2207.447 2216.571 2591.573 2146.804 1814.087
  2       NA       NA       NA       NA       NA       NA       NA
  3       NA       NA       NA       NA       NA       NA       NA
```

Table 2.6.3.25 North Sea Herring. INDEX AT AGE RESIDUALS LAI-CNS

```
Units  :  NA
   year
age       1972      1973      1974       1975       1976        1977
  0  0.3973697 0.6810220 -1.243468         NA -0.7104605  2.07419265
  1 -0.5600099 0.6728195        NA -1.2555050 -0.4229849  0.94892775
  2  0.4471919 1.4043932  1.333157 -0.5658798         NA  0.54685897
  3  0.9580033 1.6642744        NA -0.3548709  0.4380947 -0.08224662
   year
age       1978       1979       1980       1981       1982       1983
  0  2.6079172  1.1603823  0.4101570  1.1408653 -1.1487182  0.8363521
  1 -0.3153520 -0.5677118 -0.3352371 -0.3694387 -1.4416647 -0.8536445
  2  1.2431209  1.1396007 -2.1217312 -0.2900957  1.5467230 -1.3216019
  3 -0.6759367 -0.2797871  0.5526948         NA  0.4141005         NA
   year
age       1984      1985        1986       1987      1988       1989
  0 0.09048517 -1.729994 -0.02282842 -0.4969550 0.8762427 -0.3030657
```

```
  1 0.74543702  1.856765  0.74931566  0.7232437 0.1769417  0.4405487
  2 0.33456137  0.563368 -1.53381168  0.4724372 0.1957637  0.3653056
  3 1.88126478  0.928993 -0.54059484  0.2615294 0.5129956 -3.2019186
   year
age       1990        1991       1992       1993      1994      1995
  0  1.9471020  0.88308982 -3.6505950         NA        NA        NA
  1 -0.7867734 -0.21253955 -0.5623065  0.9732768  1.329654        NA
  2 -0.3228175 -0.04450022  0.1060051 -0.3516324 -1.109544 -1.466135
  3         NA          NA         NA         NA        NA        NA
   year
age       1996      1998       1999      2000     2001     2002      2003
  0         NA -1.000978         NA        NA       NA       NA        NA
  1 -0.4196611 -1.741295 -0.7120917 0.2410947 1.011164       NA 1.5269742
  2         NA        NA  0.2319685        NA       NA 1.566209 0.7346993
  3         NA        NA         NA        NA       NA       NA        NA
   year
age      2004      2005       2006      2007     2008      2009      2010
  0        NA        NA         NA        NA       NA        NA        NA
  1 0.6104844 0.6437605 -0.1176368 -1.177745 1.789406 0.7473975 0.1319794
  2        NA        NA         NA        NA       NA        NA        NA
  3        NA        NA         NA        NA       NA        NA        NA
   year
age    2011     2012     2013       2014      2015      2016     2017
  0      NA       NA       NA         NA        NA        NA       NA
  1 1.63655 -1.19891 1.254208 -0.3677732 0.6006234 0.3949573 0.777624
  2      NA       NA       NA         NA        NA        NA       NA
  3      NA       NA       NA         NA        NA        NA       NA
   year
age          2018
  0            NA
  1 -0.008393717
  2            NA
  3            NA
```

Table 2.6.3.26 North Sea Herring. PREDICTED INDEX AT AGE LAI-SNS

```
Units  :  NA
   year
age     1972     1973     1974     1975     1976     1977     1978
  0 7.902370       NA       NA 3.586381       NA 6.202026 19.15012
  1 6.238526       NA 5.407603 2.831268 4.203718       NA 15.11806
  2       NA 2.340763       NA       NA       NA       NA       NA
   year
age     1979     1980      1981      1982      1983     1984     1985
  0       NA 99.65826 190.50796 261.12185 242.96086 335.5443 377.5922
  1 51.01048 78.67522        NA 206.14265 191.80546 264.8954 298.0902
  2 21.47115 33.11569  63.30436  86.76882  80.73406 111.4988 125.4710
   year
age     1986     1987     1988      1989     1990     1991     1992
  0 337.0138 506.5710 770.2386 1326.6631 1794.013 1678.971 605.5996
```

```
  1 266.0555 399.9125 608.0649 1047.3342 1416.283 1325.464 478.0906
  2 111.9871 168.3297 255.9445  440.8401       NA       NA       NA
   year
age     1993     1994     1995      1996      1997     1998      1999
  0 622.5602 457.5958 579.2585 1077.7781 1270.6562 1276.309 1190.2914
  1 491.4801 361.2490 457.2957  850.8519 1003.1196 1007.583  939.6755
  2       NA       NA 192.4832  358.1375  422.2295  424.108  395.5248
   year
age      2000     2001      2002     2003     2004     2005     2006
  0 1184.6146 2003.991 2581.9084 3872.084 4529.302 4831.710 5123.479
  1  935.1940 1582.051 2038.2876 3056.817 3575.657 3814.393 4044.731
  2  393.6385  665.911  857.9487 1286.664 1505.053 1605.541 1702.493
   year
age     2007     2008     2009     2010     2011     2012      2013
  0 4581.339 4663.266 5471.740 5882.609 5568.579 5028.711 2506.2060
  1 3616.738 3681.415 4319.665 4644.026 4396.115 3969.916 1978.5244
  2 1522.345 1549.568 1818.218 1954.747 1850.397 1671.003  832.7934
   year
age     2014      2015     2016     2017
  0       NA 2708.8780 4186.297 4110.988
  1       NA 2138.5238 3304.872 3245.420
  2 921.8612  900.1397 1391.075       NA
```

Table 2.6.3.27 North Sea Herring. INDEX AT AGE RESIDUALS LAI-SNS

```
Units  :  NA
   year
age       1972       1973      1974         1975      1976       1977
  0 -0.3436058         NA        NA -1.037185489        NA -0.1125556
  1  1.9649304         NA 0.3953511 -0.006516598 0.5462398         NA
  2         NA -0.9882598        NA           NA        NA         NA
   year
age       1978     1979      1980        1981       1982         1983
  0  2.1403865       NA 1.4831072  1.89604703  0.4670675 -1.477541202
  1 -0.1410572 1.979629 0.7537183          NA -0.1909969  0.001776721
  2         NA 1.831647 0.3565640 -0.02975208 -0.7453715 -0.428241718
   year
age       1984       1985       1986        1987       1988      1989
  0 -0.0104493  1.0622316  0.3752982  0.77808659  0.8842070 0.8527329
  1 -0.6035512 -0.1691486 -0.9162394 -0.10552493 -0.9107911 1.0564683
  2 -0.9995780 -1.2831276 -1.5200202  0.03275564 -0.3520904 0.4185960
   year
age      1990       1991       1992      1993        1994       1995
  0 0.6713228  0.9809731 -0.5974161 0.6762656 -0.26927439 -1.9184910
  1 0.1190824 -0.3192837  1.3424928 0.4095101  0.05942296 -0.2840734
  2        NA         NA         NA        NA          NA  0.1785786
   year
age       1996       1997       1998       1999      2000       2001
  0 -0.7850661  1.5335364 -0.2349257 -0.3829672  1.319074 -0.3062637
  1  0.1531099 -0.4491055 -0.3551512  0.2215876 -1.146096  1.2409494
```

```
  2  0.7529942 -0.4195821 -0.9340476 -0.1565826 -1.130872  0.2706269
   year
age       2002       2003       2004       2005       2006        2007
  0 -0.2308005 1.34525983  0.6619628 -1.3701593  0.9887725  0.34107362
  1 -1.5456231 0.20063622 -0.1885606  0.6646223 -0.1079630 -0.01274843
  2  0.3842286 0.03683787  1.0669840  1.3503173  0.3845864  1.02583295
   year
age        2008       2009      2010        2011      2012      2013
  0  0.85590931 1.23993099 0.3244882 -0.05923322 1.2815459 -5.001002
  1 -0.09829849 1.25059987 0.9154226  0.21734052 0.7214930  1.967243
  2  1.04304087 0.08691057 1.1281742 -0.41874880 0.3619254  1.350660
   year
age      2014         2015       2016      2017
  0        NA -0.007473306  1.7011867 1.1735474
  1        NA -0.231789761 -0.5270191 0.6712067
  2 0.8197007 -0.007107003  0.2749441        NA
```

Table 2.6.3.28 North Sea Herring. PREDICTED INDEX AT AGE IBTS-Q1

```
Units  :  NA
   year
age    1984    1985    1986    1987    1988    1989    1990    1991
  1 1431037 1617310 2267470 2961980 2267154 1400818 1139265 1141292
   year
age    1992    1993    1994    1995    1996    1997    1998     1999
  1 1123254 1822733 1862454 1624404 1713833 1762133 1502130 953697.8
   year
age    2000    2001    2002    2003     2004    2005     2006     2007
  1 2757796 1844032 3771799 1676648 910496.9 1220550 893551.4 816741.6
   year
age     2008     2009    2010    2011    2012    2013    2014    2015
  1 948290.4 957340.1 1548922 1363295 1110158 1046438 1623232 2403300
   year
age     2016    2017     2018    2019
  1 640977.8 1128956 796726.2 1274925
```

Table 2.6.3.29 North Sea Herring. INDEX AT AGE RESIDUALS IBTS-Q1

```
Units  :  NA
   year
age       1984        1985      1986     1987      1988      1989
  1 -0.5983535 -0.02108412 0.1714256 0.999168 -1.333818 0.9813158
   year
age       1990      1991        1992         1993     1994      1995
  1 -0.7428275 0.9269406 -0.08925471 -0.005913962 1.379777 0.8798408
   year
age       1996     1997      1998      1999       2000      2001      2002
```

```
  1 -0.8198707 1.352621 0.8475135 0.1238665 -0.8663838 0.4228553 -1.281313
   year
age       2003       2004      2005       2006      2007        2008
  1 -0.5338658 -0.1567298 0.4342834 -0.3732443 0.3052899 -0.02695991
   year
age    2009      2010     2011       2012      2013     2014      2015
  1 0.40285 -1.273407 1.229416 -0.7958101 -1.684211 1.164109 0.2899732
   year
age       2016    2017      2018       2019
  1 -0.2531854 1.18272 0.2108529 -0.8614033
```

Table 2.6.3.30 North Sea Herring. PREDICTED INDEX AT AGE HERAS

```
Units  :  NA
   year
age       1989      1990      1991      1992      1993       1994
  1 6942865.74 5654446.3 5921770.9 5818747.4 9533314.8 10369753.0
  2 4703570.23 3065393.3 2587400.4 2927615.4 2493147.2  3816656.7
  3 4638824.04 3190013.1 1905943.6 1415049.5 1495708.7  1140147.6
  4 2022640.30 2941387.9 1890710.5 1089067.0  733082.3   583885.8
  5  549787.19 1201464.9 1749716.9 1102003.8  615687.8   346514.5
  6  309187.20  327313.0  675249.2 1020725.9  613567.2   302924.1
  7  150277.29  176009.4  191723.4  392093.8  496454.8   295520.2
  8   71213.01  132621.8  168236.4  201371.1  306022.6   381091.2
   year
age      1995       1996        1997      1998      1999       2000
  1 9107802.3 9716190.92 10263229.73 8603141.3 5480197.7 15600889.7
  2 4414089.2 4052215.85  4836774.60 6386692.7 4079118.6  3934562.6
  3 2012340.3 2475858.51  2478072.06 2778306.7 4223779.4  2511668.0
  4  590566.6  949869.62  1368783.21 1281673.4 1446442.1  2588436.0
  5  273976.1  294820.74   573692.48  751045.2  644127.2   863729.6
  6  181112.8  117680.62   190016.70  361458.8  375443.3   408531.0
  7  155432.0   98256.69    69669.01  123399.1  199483.6   239908.3
  8  320353.2  263362.19   210212.49  162166.9  147005.8   187599.6
   year
age       2001       2002       2003      2004      2005      2006
  1 10380748.2 21195424.6  9305204.3 5060150.4 6729205.8 5017815.1
  2  8820264.7  5793396.5 13804503.3 4586568.0 2819860.9 3856560.3
  3  2898986.0  6606190.3  3894166.0 9317984.2 3281457.4 2097717.8
  4  1455637.8  1546710.1  4003292.2 2476397.0 5313575.2 1949042.9
  5  1482436.9   806960.6   795526.7 2278585.5 1385974.2 3261014.1
  6   463991.6   924005.6   491458.1  373083.0 1153509.5  668668.5
  7   242218.9   269820.9   552550.4  295678.5  170523.5  522284.7
  8   210434.1   267613.2   294128.0  420084.2  289548.5  195249.4
   year
age      2007      2008      2009      2010      2011      2012      2013
  1 4610461.8 5404575.5 5500905.5 8936286.4 7904907.5 6403965.6 6005012.6
  2 2660287.2 3196245.6 3796175.3 4040188.8 5065628.5 4739483.1 3520312.8
  3 2521041.3 1907156.4 2322200.9 3208485.9 3084500.2 4249395.5 3636834.0
  4 1298831.1 1470228.1 1201793.3 1700113.8 2088324.1 2246698.7 2884011.3
```

```
  5 1103501.2  862767.5  951055.1  895155.9 1043011.6 1409605.8 1612558.1
  6 1829680.8  737922.2  615452.3  850745.4  593355.5  656638.8  904116.3
  7  338401.2 1303606.3  532678.8  464454.2  557373.2  354191.4  382431.3
  8  341336.0  463869.4 1414150.9 1565780.5 1317840.8  984666.1  769403.8
   year
age      2014       2015      2016      2017      2018
  1 9370040.6 13884976.3 3689472.8 6510486.9 4604315.2
  2 4233582.7  7439177.7 9591454.8 2073069.1 3550637.9
  3 2714430.3  2703342.3 5858177.8 6775644.6 1664354.7
  4 2719120.7  1661372.2 1579908.9 3695264.9 4164577.6
  5 1797391.9  1590856.8  985865.3  991748.5 2318915.6
  6 1022041.9   965406.3  845731.3  492573.2  615876.5
  7  520188.5   497980.1  418928.9  371517.9  273845.5
  8  561847.3   533566.2  434902.8  376057.1  390210.6
```

Table 2.6.3.31 North Sea Herring. INDEX AT AGE RESIDUALS HERAS

```
Units  :  NA
   year
age       1989       1990       1991       1992       1993       1994
  1  0.0000000 0.00000000  0.0000000  0.0000000  0.0000000  0.0000000
  2 -0.4997891 0.08757695 -0.4071305  0.7125765 -0.3001368 -1.5932529
  3 -0.2556513 0.92770463 -0.6537292 -0.6756033 -0.7038773 -2.1003089
  4 -0.4760817 1.57243138  0.3712930  0.1707639  0.2750398 -2.4455885
  5 -0.1256785 1.24715698  0.4932707  0.1203052  0.5835859 -0.1014317
  6 -0.3032145 1.18595806 -0.2924060  0.7010468  0.6742106 -0.4707923
  7 -0.5756844 0.79127019  0.3433285 -0.2531009 -0.2470806 -0.4225409
  8  0.1022161 1.01423918 -0.9326227  0.1042860 -0.5994916 -1.1088739
   year
age         1995       1996        1997        1998        1999       2000
  1  0.000000000  0.0000000  0.59382846 -1.50905212  0.27004185  0.5811244
  2 -1.023898782  0.1874657  0.29114901 -0.48405705 -1.52419947 -0.1909411
  3 -0.007069201  0.6541166  0.21408537 -1.21928096  0.04896456 -0.4842538
  4  1.090183571  0.6974731 -0.24028014  0.01362543 -1.53747617  0.7241888
  5 -0.241085008  0.3221618  0.17189788  0.15302782 -1.61748372  0.3257476
  6 -0.107687482 -1.8689733  0.52417606  0.45547149 -1.57925943  0.5236265
  7 -1.023275066 -1.1011936 -2.07931732  0.63824175 -2.30220841 -0.4686081
  8 -2.077204403  0.4160988  0.01380628 -0.64313061 -0.71669693 -0.1368256
   year
age        2001       2002        2003       2004        2005        2006
  1 -0.56963743  0.4522552 -0.11714039 -0.0410010 -1.20845824  0.60810395
  2  1.75976096 -0.6432086  1.68693013 -1.7201674 -1.23057036  0.28505147
  3  0.61397256  1.1525890 -0.97163992 -0.1832011  0.60204945  0.28863591
  4  0.09630612 -0.8717869 -0.04250517 -0.2963818  0.08909411  0.52912669
  5  0.25257261 -0.2619733 -1.71162429  0.2293520 -0.49929914  1.38733159
  6 -0.84799271  0.3331718 -0.17045622 -1.5202492 -0.05102923 -0.47035055
  7 -2.09014712 -0.9236711 -0.57202497 -0.2672249 -1.42679007  0.06125273
  8 -1.57942502 -0.3828816 -0.11579984  0.1413266 -1.23842369 -1.04927764
   year
age         2007       2008      2009     2010        2011        2012
```

```
  1  0.470777792 -0.7661988 0.4653971 1.031416  0.88754517 -0.02028598
  2  0.007592787  0.3428270 2.8843242 1.061746 -0.89248394 -0.35772785
  3 -1.277377383  0.4689400 1.3311281 1.323719 -0.68802995 -0.06349536
  4 -0.757689938  0.8028564 0.2511395 1.996154 -0.09257157 -0.75625636
  5 -0.663157023  1.1796720 1.4432803 1.917712 -0.55986642 -0.65041405
  6 -0.497106932  1.2102040 1.3594423 2.914958  0.21338543 -0.50887296
  7 -0.581515584  2.6221923 1.4629882 1.808710  0.44074215 -1.73942688
  8 -0.894969084  0.6959986 1.5662652 2.214007  0.48996415 -1.39359975
   year
age        2013       2014       2015         2016       2017      2018
  1 -0.01701774  1.3085861 -1.2213366  1.965612851 -1.6266804 2.0492775
  2 -1.13413528  1.5207392  2.3216758  1.495511522 -0.5625399 0.2686137
  3  0.01840042  0.6783569  0.2864125  0.008896981 -0.4173627 0.7782660
  4  0.67093220  1.2694409  0.3106172 -0.848643502 -0.2989013 0.9292208
  5  0.65611111  0.5554172  0.1429052 -0.263051787 -0.0631868 0.4203207
  6  0.38998213  1.4698560 -0.0541759  0.583447562 -0.8696689 1.3297020
  7  0.83958064  1.0689964  0.2927098  0.109332765 -0.1919954 3.1888322
  8  0.24183081 -0.7852922 -0.2110726 -0.334532817 -0.2616707 0.1486244
```

Table 2.6.3.32 North Sea Herring. PREDICTED INDEX AT AGE IBTS0

```
Units  :  NA
   year
age     1992     1993     1994     1995     1996     1997     1998
  0 141.5892 147.1261 114.7846 132.3417 110.1666 88.01224 55.48879
   year
age     1999     2000     2001     2002     2003     2004     2005
  0 175.7439 119.4748 222.8213 107.4426 60.17169 69.94551 64.76096
   year
age     2006     2007     2008     2009     2010     2011     2012
  0 58.80255 67.62273 62.81363 102.9794 82.58967 74.16434 71.22697
   year
age     2013     2014     2015     2016     2017     2018     2019
  0 89.10461 143.2068 38.00685 72.25102 44.04582 80.97941 57.66408
```

Table 2.6.3.33 North Sea Herring. INDEX AT AGE RESIDUALS IBTS0

```
Units  :  NA
   year
age       1992      1993      1994         1995      1996     1997
  0 -0.2111753 0.2642233 0.4882644 -0.007001825 0.5985823 2.000488
   year
age       1998     1999       2000     2001      2002       2003      2004
  0 -0.4833896 1.546787 -0.7140618 1.567597 0.3369015 -0.2801556 -1.084573
   year
age      2005       2006        2007      2008     2009       2010
  0 0.1449227 0.05225986 -0.08132162 -1.057652 1.271977 -0.3363734
```

age \ year	2011	2012	2013	2014	2015	2016
0	-0.4354624	-0.300994	0.4554999	-0.2777381	-2.649368	0.369407

age \ year	2017	2018	2019
0	-0.8051455	0.7306622	-0.6343659

Table 2.6.3.34 North Sea Herring. PREDICTED INDEX AT AGE IBTS-Q3

Units : NA

age \ year	1998	1999	2000	2001	2002	2003
0	1140152.35	3567345.94	2400807.59	4448035.42	2132489.17	1184793.84
1	455137.95	290047.49	824019.29	547948.58	1118545.07	490267.56
2	263600.35	168504.20	162484.28	364940.29	239600.94	570838.94
3	93633.59	142016.37	84655.24	97785.10	222951.56	131405.29
4	36063.96	40718.58	72748.52	41003.15	43562.00	112599.75
5	16596.62	14244.52	19074.40	32778.13	17864.42	17500.09

age \ year	2004	2005	2006	2007	2008	2009
0	1359817.08	1240266.33	1120119.06	1292863.75	1194983.67	1975765.89
1	266654.48	354239.28	264781.21	243451.09	285739.59	291141.96
2	189528.60	116410.66	159351.64	110042.12	132191.71	157244.58
3	314134.61	110569.28	70654.38	84873.14	64419.74	78629.33
4	69578.79	149020.32	54653.79	36460.34	41431.11	33957.27
5	50026.10	30393.65	71616.33	24274.33	19083.71	21103.44

age \ year	2010	2011	2012	2013	2014	2015
0	1589978.41	1430418.28	1386288.94	1766017.59	2861852.41	766637.49
1	473213.08	418870.84	339109.85	317768.38	496216.84	735400.86
2	167369.27	209866.91	196201.92	145752.45	175316.67	308253.97
3	108515.50	104221.83	143162.02	122622.57	91521.66	91341.35
4	48040.26	58909.52	63150.96	80952.14	76236.81	46679.97
5	19858.23	23095.19	31074.07	35458.28	39486.74	34916.60

age \ year	2016	2017	2018
0	1473246.33	900309.97	1660651.40
1	195313.82	344737.26	243870.64
2	397564.74	85976.56	147221.86
3	197567.19	228286.74	56168.71
4	44361.19	103552.16	116393.83
5	21643.81	21822.79	50731.18

Table 2.6.3.35 North Sea Herring. INDEX AT AGE RESIDUALS IBTS-Q3

Units : NA

age	1998	1999	2000	2001	2002	2003
0	-0.7560070	0.4200079	-0.4668525	-1.525232	-0.23934514	-0.69209641
1	0.6074119	0.6503711	0.3219327	-0.241683	3.18019506	0.56108311
2	0.5447389	0.6180975	2.7377160	-1.208554	1.09556288	-0.07957729
3	-0.3819099	-1.2269802	0.1646301	1.116597	0.08614789	0.85982490
4	-1.9013636	1.2625924	-1.3528556	0.300127	1.21076555	-0.45107882
5	-1.3468705	0.4560511	-0.5832169	-1.173541	0.73598111	-0.05445450

age	2004	2005	2006	2007	2008	2009
0	1.30840879	-0.4224704	-0.09665864	1.516398	-0.6617842	1.22109093
1	0.97464397	1.6598890	0.71555364	-2.820022	-0.8048809	-0.90986104
2	0.76091742	-0.1225612	0.73680025	0.256353	0.8010929	-1.64108674
3	0.08391895	-1.2703853	0.18252924	1.417595	0.3608337	0.35448710
4	0.82927172	-1.1661535	-1.02661536	1.577488	-0.3978765	0.07894876
5	-1.06134281	1.1157579	-1.01472310	0.450406	0.7192678	-1.64378549

age	2010	2011	2012	2013	2014	2015
0	-0.06903613	-0.97012647	-0.7225147	1.0108577	1.9719730	-0.39763630
1	0.99289163	0.06020663	-0.7026192	-0.2480358	-0.8204336	1.23428222
2	0.17052129	0.08292843	-2.0401699	0.1118545	0.3052040	0.49548939
3	-1.63836736	0.37284146	-1.1120149	0.4017984	-0.3427725	0.62032115
4	-0.67924773	-0.82516698	0.1294128	0.1144980	0.3611965	0.91215772
5	-0.56724093	-0.20497729	-0.3170592	0.4589684	0.3118637	0.09091115

age	2016	2017	2018
0	0.30393817	0.5972817	0.10096161
1	-0.51121593	-0.7619947	-0.45961360
2	-0.09002203	0.1131114	-1.85644017
3	0.45555807	-0.2698410	0.90005666
4	1.58875726	1.2795814	-1.20897485
5	1.79299417	2.2780654	-0.06095479

Table 2.6.3.37 North Sea Herring. FIT PARAMETERS

	name	value	std.dev
1	logFpar	-12.9135007	0.09439437
2	logFpar	-0.2657307	0.12262130
3	logFpar	-0.1908894	0.07304127
4	logFpar	-0.0368668	0.07044761
5	logFpar	-2.3310657	0.07536233
6	logFpar	-2.5487471	0.14163121
7	logFpar	-3.1633485	0.10161671
8	logFpar	-3.3453018	0.09427366
9	logFpar	-3.3963570	0.09491828
10	logFpar	-3.5773500	0.09694926
11	logFpar	-3.8193747	0.09894651
12	logFpar	-4.2600988	0.11287755

```
13         logSdLogFsta  -0.5960752 0.11981768
14         logSdLogFsta  -1.1344043 0.09819444
15         logSdLogFsta  -0.6697067 0.09990409
16            logSdLogN  -0.5519211 0.11601123
17            logSdLogN  -1.7136356 0.09217653
18            logSdLogP   0.1509277 0.09921606
19            logSdLogP  -0.3418938 0.17591259
20            logSdLogP  -0.1961220 0.12796682
21          logSdLogObs  -1.5048191 0.45071808
22          logSdLogObs  -2.1971163 0.49099302
23          logSdLogObs  -1.4005467 0.18500732
24          logSdLogObs  -0.7421974 0.16017598
25          logSdLogObs  -1.5753020 0.08853870
26          logSdLogObs  -1.2410904 0.14189622
27          logSdLogObs  -1.2473213 0.15130768
28          logSdLogObs  -1.1127152 0.18083902
29          logSdLogObs  -0.6097656 0.18316388
30          logSdLogObs  -1.0802296 0.18090664
31          logSdLogObs  -1.1723392 0.10694524
32          logSdLogObs   0.1697697 0.04443655
33       transfIRARdist  -0.3945483 0.27665461
34                 rhop   0.4174042 0.24047329
35 logAlphaSCB.LAI-ORSH  -0.4558852 0.31715525
36  logAlphaSCB.LAI-BUN  -0.9586141 0.34968719
37  logAlphaSCB.LAI-CNS   0.3424176 0.33883253
38  logAlphaSCB.LAI-CNS  -0.3788479 0.35328456
39  logAlphaSCB.LAI-CNS  -3.0576174 0.40751305
40  logAlphaSCB.LAI-SNS  -0.2364188 0.25391303
41  logAlphaSCB.LAI-SNS  -1.1017398 0.27359799
```

Table 2.6.3.38 North Sea Herring. NEGATIVE LOG-LIKELIHOOD

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1305.49216198626
```

Table 2.7.1. North Sea herring. Intermediate year (2019) assumptions for the stock.

Variable	Value	Notes
$F_{ages\ (wr)\ 2–6}$ (2019)	0.19	Catch constraint
SSB (2019)	1 528 855	Calculated based on catch constraint (in tonnes).
$R_{age\ (wr)\ 0}$ (2019)	26 191 234	Estimated by assessment model (in thousands).
$R_{age\ (wr)\ 0}$ (2020)	33 943 979	Weighted mean over 2009–2018 (in thousands)
Total catch (2019)	412 462	Agreed catch options, including a 48% transfer (14 076t) of C-fleet TAC to the A-fleet in the North Sea (in tonnes).

Table 2.7.1. North Sea herring. Intermediate year (2019), fleet wise assumptions for the catches and the fishing mortality. Weights are in tonnes

	Field	Value	Note
TACs	A-fleet TAC	385008	
	B-fleet TAC	13190	
	C-fleet TAC	29326	Total TAC in IIIa (including WBSS and NSAS)
	D-fleet TAC	6659	Total TAC in IIIa (including WBSS and NSAS)
TACs to catches variables	WBSS/NSAS split in the north sea	0.0036	Value from terminal year
	B-fleet uptake	0.86	Average over the last 3 years (2016-2018)
	C-fleet transfer	0.48	Value for the Intermediate year
	C-fleet NSAS/WBSS split	0.19	Average over the last 3 years (2016-2018)
	D-fleet NSAS/WBSS split	0.56	Average over the last 3 years (2016-2018)
	D-fleet uptake	0.16	Average over the last 3 years (2016-2018)
F by fleet and total	$F_{(wr)\ 2–6}$ A-fleet	0.19	
	$F_{(wr)\ 0–1}$ B-fleet	0.046	
	$F_{(wr)\ 0–1}$ C-fleet	0.002	
	$F_{(wr)\ 0–1}$ D-fleet	0.002	
	$F_{(wr)\ 2–6}$	0.19	
	$F_{(wr)\ 0–1}$	0.052	
NSAS catches by fleet	Catches A-fleet	397648	Includes C-fleet transfer and split of WBSS/NSAS in the north sea
	Catches B-fleet	11324	Includes fleet uptake
	Catches C-fleet	2886	Includes TAC transfer to the A fleet and WBSS/NSAS split.
	Catches D-fleet	604	Includes WBSS/NSAS split and fleet uptake

Table 2.7.1. North Sea herring. Reference points prior used at HAWG 2018.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	1 500 000 t	Biomass trigger value that results in < 5% probability of being below B_{lim} when the ICES MSY AR is applied.	ICES (2016a)
	F_{MSY}	0.33	Stochastic simulations with Beverton and Ricker stock–recruitment curve from short time-series (2002–2015).	ICES (2016a)
Precautionary approach	B_{lim}	800 000 t	Breakpoint in the segmented regression of the stock-recruitment time-series (1985–2015).	ICES (2016a)
	B_{pa}	1 000 000 t	$B_{pa} = B_{lim} \times \exp(1.645 \times \sigma)$ with $\sigma \approx 0.10$, based on the average CV from the terminal assessment year.	ICES (2012)
	F_{lim}	0.39	FP50% from stochastic simulations with Beverton and Ricker stock–recruitment curve (2002–2015).	ICES (2016a)
	F_{pa}	0.34	$F_{pa} = F_{lim} \times \exp(-1.645 \times \sigma)$ with $\sigma \approx 0.08$, based on the average CV from the terminal assessment year.	ICES (2016a)
Management plan	SSB_{mgt}	800 000 t and 1 500 000 t	Informed by simulations and chosen by managers.	EU–Norway (2014)
	F_{mgt}	$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.26$	SSB is greater than the SSB_{MGT} upper trigger of 1.5 million t (based on simulations).	EU–Norway (2014)
		$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} =$ $0.26 - (0.16 \times (1\,500\,000 - SSB) / 700\,000)$	SSB is between the SSB_{MP} triggers of 0.8 and 1.5 million t (based on simulations).	EU–Norway (2014)
		$F_{ages\ (wr)0-1} = 0.04$ $F_{ages\ (wr)2-6} = 0.10$	SSB is less than the SSB_{MP} lower trigger of 0.8 million t (based on simulations).	

Table 2.7.2. North Sea herring. Framework from new management plan requested (ICES, 2018).

Framework^	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	1 400 000	5th percentile of B_{FMSY}	ICES (2018d)
	F_{MSY}	0.26	Stochastic simulations with a segmented regression and Ricker stock–recruitment curve from the short time-series (2002–2016).	ICES (2018d)
Precautionary approach	B_{lim}	800 000	Breakpoint in the segmented regression of the stock–recruitment time-series (1947–2016).	ICES (2018d)
	B_{pa}	900 000	$B_{pa} = B_{lim} \times \exp(1.645 \times \sigma)$ with $\sigma \approx 0.10$, based on the average *CV* from the terminal assessment year.	ICES (2018d)
	F_{lim}	0.34	$F_{P50\%}$ leading to 50% probability of SSB > B_{lim} with a segmented regression and Ricker stock–recruitment curve (2002–2016).	ICES (2018d)
	F_{pa}	0.30	$F_{pa} = F_{lim} \times \exp(-1.645 \times \sigma)$ with $\sigma \approx 0.08$, based on the average *CV* from the terminal assessment year.	ICES (2018d)
Management plan option A	$B_{trigger}$	1 500 000 t	Informed by simulations.	EU–Norway (2017; 2018)
	F_{target}	$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.23$	SSB is greater than $B_{trigger}$	EU–Norway (2017; 2018)
		$F_{ages\ (wr)0-1} = 0.05*SSB/B_{trigger}$ $F_{ages\ (wr)2-6} = 0.23*SSB/B_{trigger}$	SSB is less than $B_{trigger}$	EU–Norway (2017; 2018)
Management plan option A+C*	$B_{trigger}$	1 500 000 t	Informed by simulations.	EU–Norway (2017; 2018)
	F_{target}	$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.23$	SSB is greater than $B_{trigger}$	EU–Norway (2017; 2018)
		$F_{ages\ (wr)0-1} = 0.05*SSB/B_{trigger}$ $F_{ages\ (wr)2-6} = 0.23*SSB/B_{trigger}$	SSB is less than $B_{trigger}$	EU–Norway (2017; 2018)
Management plan option A+D**	$B_{trigger}$	1 500 000 t	Informed by simulations.	EU–Norway (2017; 2018)
	F_{target}	$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.23$	SSB is greater than $B_{trigger}$	EU–Norway (2017; 2018)
		$F_{ages\ (wr)0-1} = 0.05*SSB/B_{trigger}$ $F_{ages\ (wr)2-6} = 0.23*SSB/B_{trigger}$	SSB is less than $B_{trigger}$	EU–Norway (2017; 2018)
Management plan option B	$B_{trigger}$	1 500 000 t	Informed by simulations.	EU–Norway (2017; 2018)
	F_{target}	$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.23$	SSB is greater than $B_{trigger}$	EU–Norway (2017; 2018)
		$F_{ages\ (wr)0-1} = 0.05$ $F_{ages\ (wr)2-6} = 0.23*SSB/B_{trigger}$	SSB is less than $B_{trigger}$ and greater than B_{lim}	EU–Norway (2017; 2018)
		$F_{ages\ (wr)0-1} = 0.04$ $F_{ages\ (wr)2-6} = 0.1$	SSB is less than B_{lim}	EU–Norway (2017; 2018)

* When SSB is greater $B_{trigger}$ TAC inter annual variability limited to 25% up and 20% down from the intermediate TAC for the A fleet.

** When SSB is greater $B_{trigger}$ TAC inter annual variability limited to 25% up and 20% down from the intermediate TAC for the A and B fleets.

^ No reference points satisfying long term risk criteria could be achieved for management plan option B+E.

Table 2.7.3. North Sea Herring. Scenarios for prediction year (2019). Weights in tonnes.

Basis	F values by fleet and total						Catches by fleet				Total stock catch	Biomass*				% Advice change ^
	A-fleet $F_{ages\ (wr)\ 2–6}$	B-fleet $F_{ages\ (wr)\ 0–1}$ ^^^	C-fleet $F_{ages\ (wr)\ 0–1}$	D-fleet $F_{ages\ (wr)\ 0–1}$	$F_{ages\ (wr)\ 2–6}$	$F_{ages\ (wr)\ 0–1}$	A-fleet	B-fleet	C-fleet[#]	D-fleet[#]		SSB 2020	SSB 2021 **	%SSB change ***	A-fleet **** %TAC change	
MSY approach^^	0.24	0.046	0	0	0.24	0.048	418649	12413	0	0	431062	1286788	1167712	-15.8	8.7	38.4
Other scenarios																
EU–Norway Management strategy option A[‡]	0.20	0.043	0	0	0.20	0.044	364795	11563	0	0	376359	1323117	1227801	-13.5	-5.2	20.8
EU–Norway Management strategy option A+C[‡‡]	0.20	0.043	0	0	0.20	0.044	364795	11563	0	0	376359	1323117	1227801	-13.5	-5.2	20.8
EU–Norway Management strategy option A+D[‡‡‡]	0.20	0.043	0	0	0.20	0.044	364795	11563	0	0	376359	1323117	1227801	-13.5	-5.2	20.8
EU–Norway Management strategy option B[‡‡‡‡]	0.21	0.049	0	0	0.21	0.050	376286	13090	0	0	389376	1315365	1214353	-14.0	-2.3	25.0
$F = F_{MSY}$	0.26	0.046	0	0	0.26	0.048	448772	12412	0	0	461185	1266292	1135230	-17.2	16.6	48.0
F = 0	0	0	0	0	0	0	0	0	0	0	0	1558516	1699799	1.9	-100.0	-100.0
No change in A-fleet TAC	0.22	0.046	0	0	0.22	0.047	385008	12414	0	0	397422	1309518	1204811	-14.3	0.0	27.6
A-fleet TAC reduction of 15%	0.18	0.046	0	0	0.18	0.047	327257	12415	0	0	339672	1348146	1270564	-11.8	-15.0	9.0

Basis	F values by fleet and total						Catches by fleet				Total stock catch	Biomass*				% Advice change ^
	A-fleet $F_{ages\ (wr)\ 2\text{–}6}$	B-fleet $F_{ages\ (wr)\ 0\text{–}1}$ ^^^	C-fleet $F_{ages\ (wr)\ 0\text{–}1}$	D-fleet $F_{ages\ (wr)\ 0\text{–}1}$	$F_{ages\ (wr)\ 2\text{–}6}$	$F_{ages\ (wr)\ 0\text{–}1}$	A-fleet	B-fleet	C-fleet#	D-fleet#		SSB 2020	SSB 2021 **	%SSB change ***	A-fleet **** %TAC change	
A-fleet TAC increase of 15%	0.26	0.046	0	0	0.26	0.048	442759	12412	0	0	455172	1270395	1141659	-16.9	15.0	46.1
$F = F_{2018}$	0.19	0.046	0	0	0.19	0.047	351394	12415	0	0	363809	1332061	1242761	-12.9	-8.7	16.8
F_{pa}	0.30	0.046	0	0	0.30	0.048	503560	12411	0	0	515971	1228661	1077894	-19.6	30.8	65.6
F_{lim}	0.34	0.046	0	0	0.34	0.048	555312	12409	0	0	567721	1192695	1025745	-22.0	44.2	82.2
$SSB_{2020} = B_{pa}$	0.75	0.046	0	0	0.75	0.050	957157	12395	0	0	969552	899590	679381	-41.2	148.6	211.2
$SSB_{2020} = B_{lim}$	0.95	0.046	0	0	0.95	0.051	1087848	12388	0	0	1100237	799618	585305	-47.7	182.6	253.1
SSB_{2020} = MSY $B_{trigger}$	0.13	0.046	0	0	0.13	0.047	249400	12417	0	0	261817	1399457	1363458	-8.5	-35.2	-16.0
MSY approach with C and D fleets catches and C fleet TAC transfer##	0.25	0.046	0.002	0.002	0.25	0.052	429474	12392	2886	604	445357	1286867	1165739	-15.8	11.5	42.9
MSY approach with C and D fleets catches and no C fleet TAC transfer###	0.24	0.046	0.003	0.002	0.24	0.053	415398	12388	5550	604	433940	1286942	1164080	-15.8	7.9	39.3

* For autumn-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1 January and spawning.

** Assuming same catch scenario in 2020 as in 2019.

*** SSB (2020) relative to SSB (2019).

**** A-fleet catches (2020) relative to TAC 2019 for the A-fleet (385 008 tonnes).

^ Advice value 2020 relative to advice value 2019, using catches for all fleets.

^^ Following the MSY advise rule $F_{MSY} \times SSB_{2020}$/MSY $B_{trigger}$ (ICES, 2016).

^^^ Status quo on the fishing mortality for the B fleet for all catch options except management strategy options

The catch for C and D fleets are set to zero because of the zero catch advice given for 2019 for the Western Baltic spring-spawning herring stock.
Following the MSY advise rule $F_{MSY} \times SSB_{2020}$/MSY $B_{trigger}$ (ICES, 2016), assuming same catches as in 2019 for the C and D fleet and a 48% C fleet TAC transfer to the A fleet.
Following the MSY advise rule $F_{MSY} \times SSB_{2020}$/MSY $B_{trigger}$ (ICES, 2016), assuming same catches as in 2019 for the C and D fleet and no C fleet TAC transfer to the A fleet.
‡ scenario based on current MSE results[1)] for case A: $B_{trigger}$ = 1500000, F_{target} = 0.23 , F_{01}=0.05.
‡‡ scenario based on current MSE results[1)] for case A+C: $B_{trigger}$ = 1500000, F_{target} = 0.23, F_{01}=0.05.
‡‡‡ scenario based on current MSE results[1)] for case A+D: $B_{trigger}$ = 1500000, F_{target} = 0.23, F_{01}=0.05.
‡‡‡‡ scenario based on current MSE results[1)] for case B: $B_{trigger}$ = 1500000, F_{target} = 0.23, F_{01}=0.05.

[1)] The MSE assumed a fixed transfer from the C-fleet into the North Sea (between 19 370 tonnes and 24214 tonnes) while the scenarios above are based on a 0 catch option for the C and D fleet because of the advice on WBSS herring.

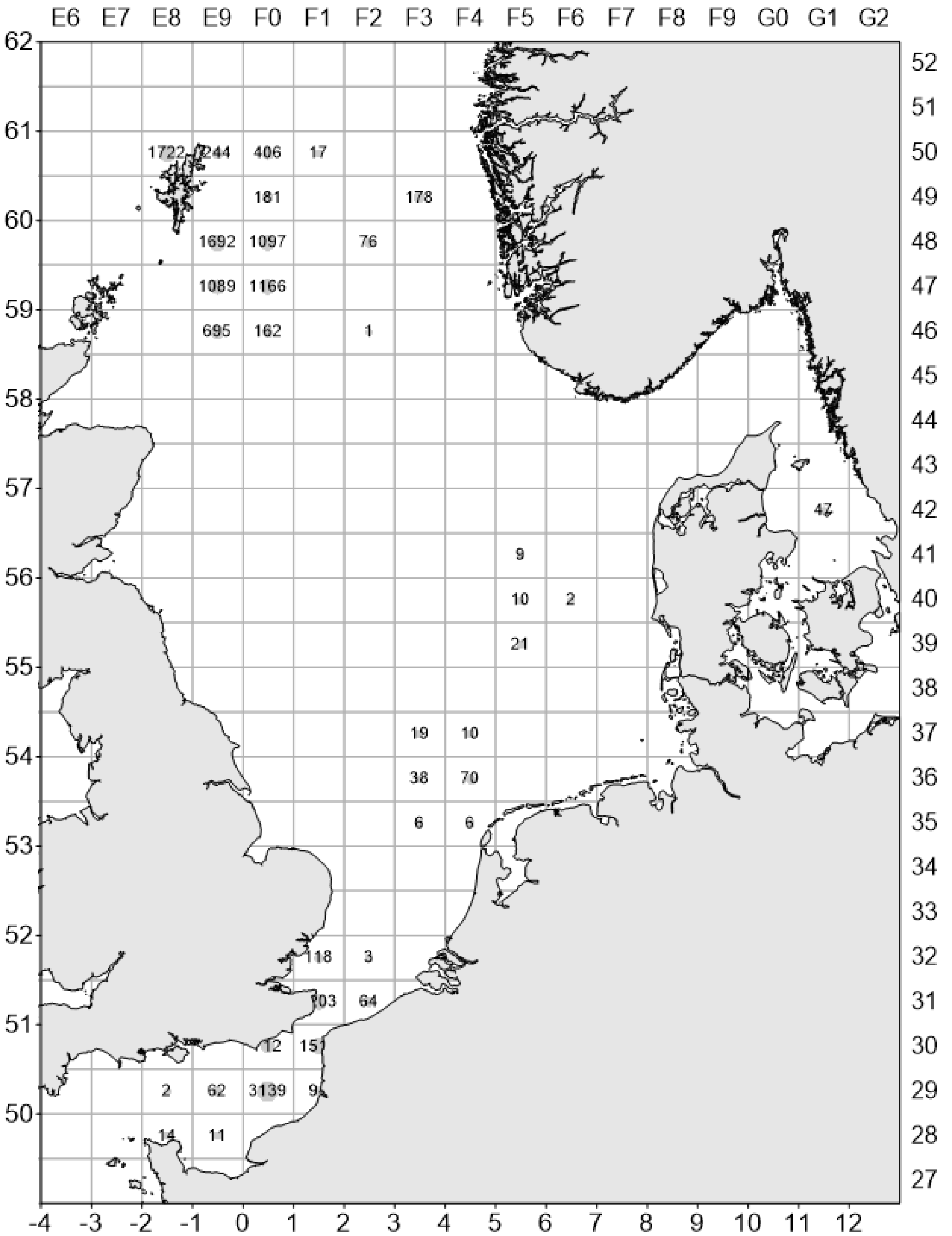

Figure 2.1.1a: Herring catches in the North Sea in the 1st quarter of 2018 (in tonnes) by statistical rectangle.

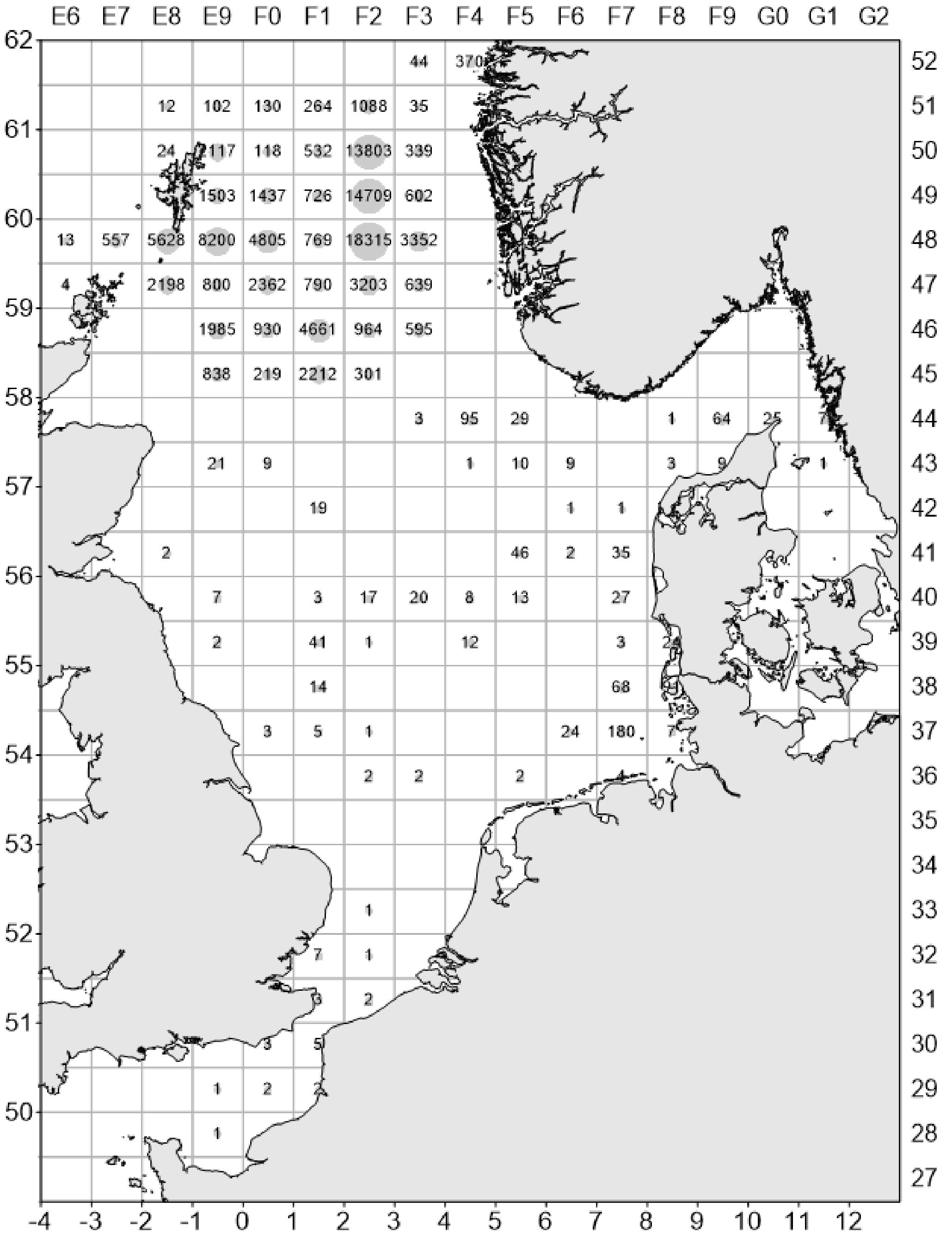

Figure 2.1.1b: Herring catches in the North Sea in the 2nd quarter of 2018 (in tonnes) by statistical rectangle.

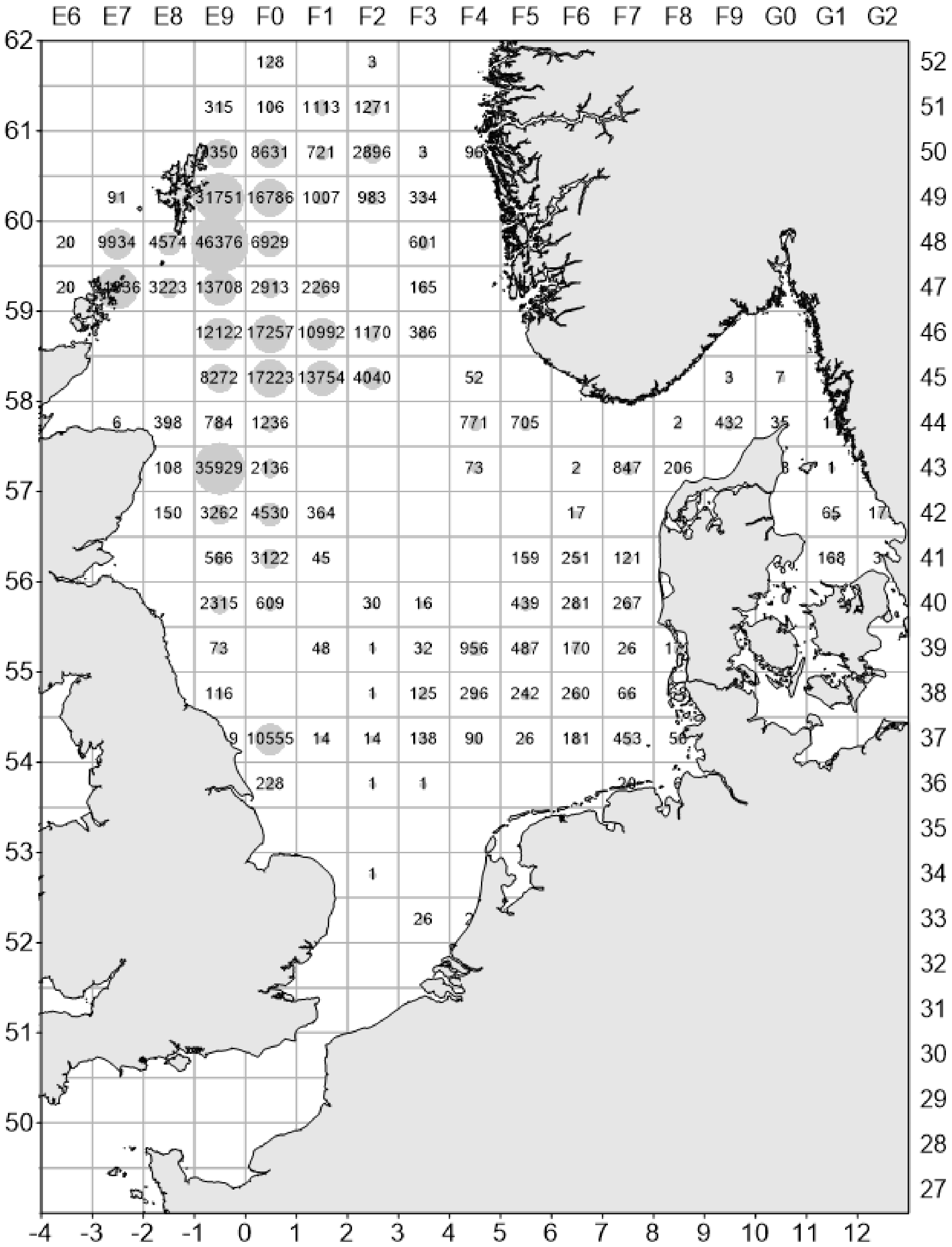

Figure 2.1.1c: Herring catches in the North Sea in the 3rd quarter of 2018 (in tonnes) by statistical rectangle.

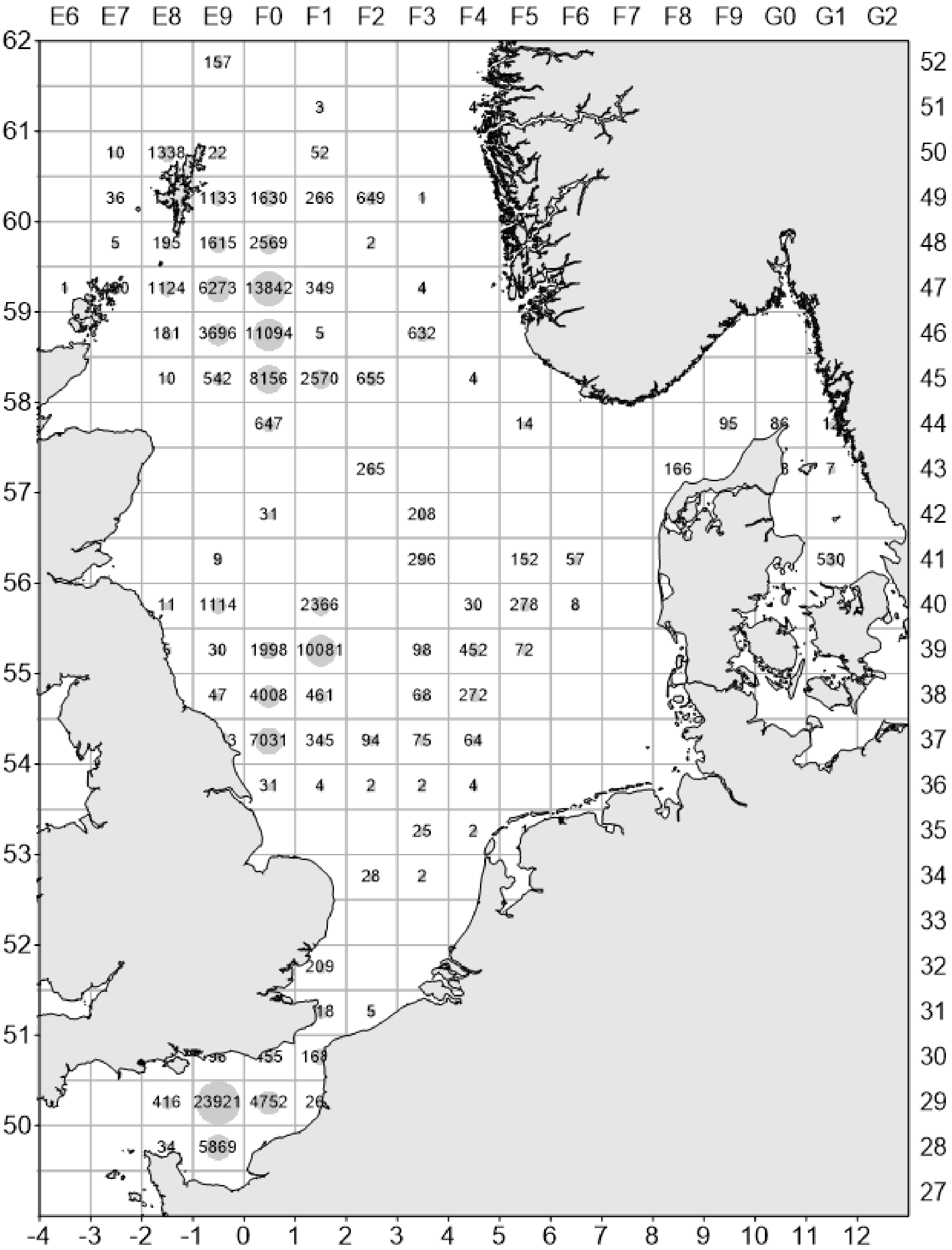

Figure 2.1.1d: Herring catches in the North Sea in the 4th quarter of 2018 (in tonnes) by statistical rectangle.

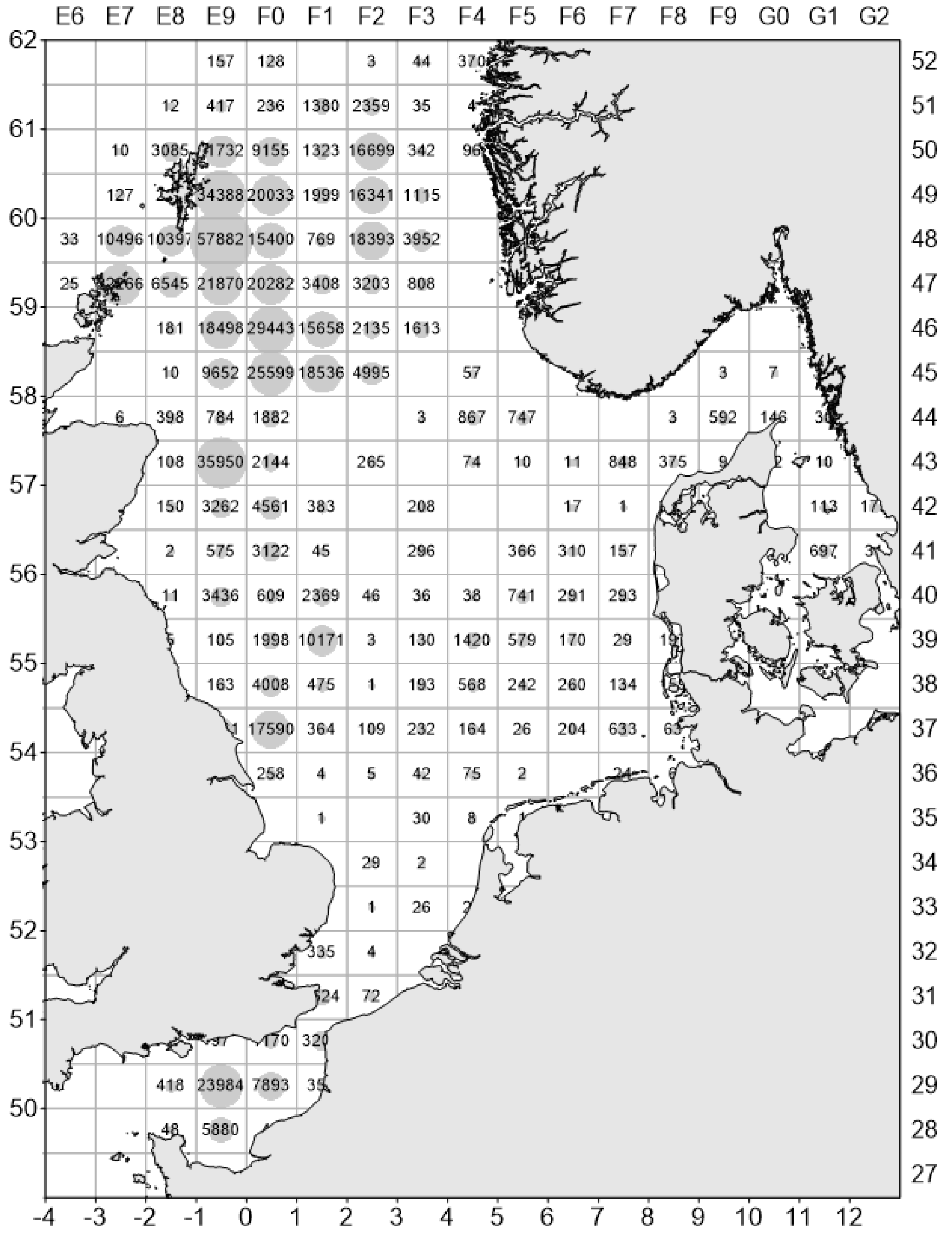

Figure 2.1.1e: Herring catches in the North Sea in all quarters of 2018 (in tonnes) by statistical rectangle.

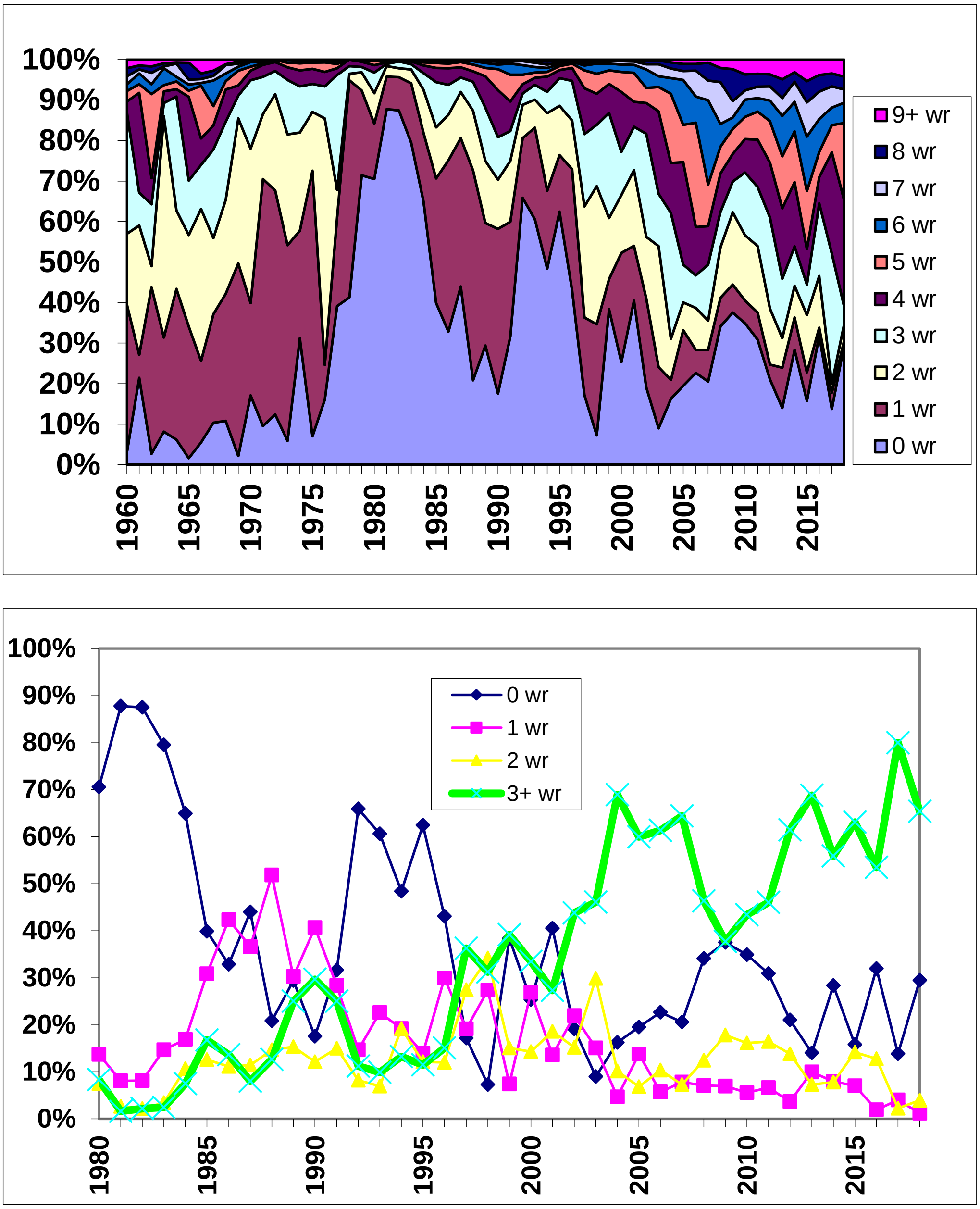

Figure 2.2.1: Proportions of age groups (numbers) in the total catch of herring caught in the North Sea (upper, 1960–2018, and lower panel, 1980–2018).

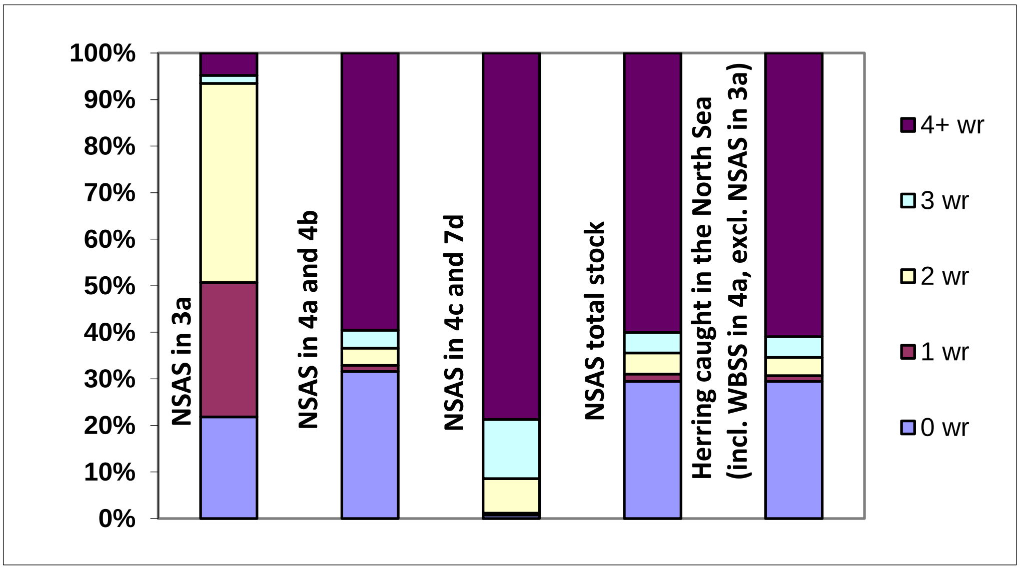

Figure 2.2.2: Proportion of age groups (numbers) in the total catch of NSAS and herring caught in the North Sea in 2018.

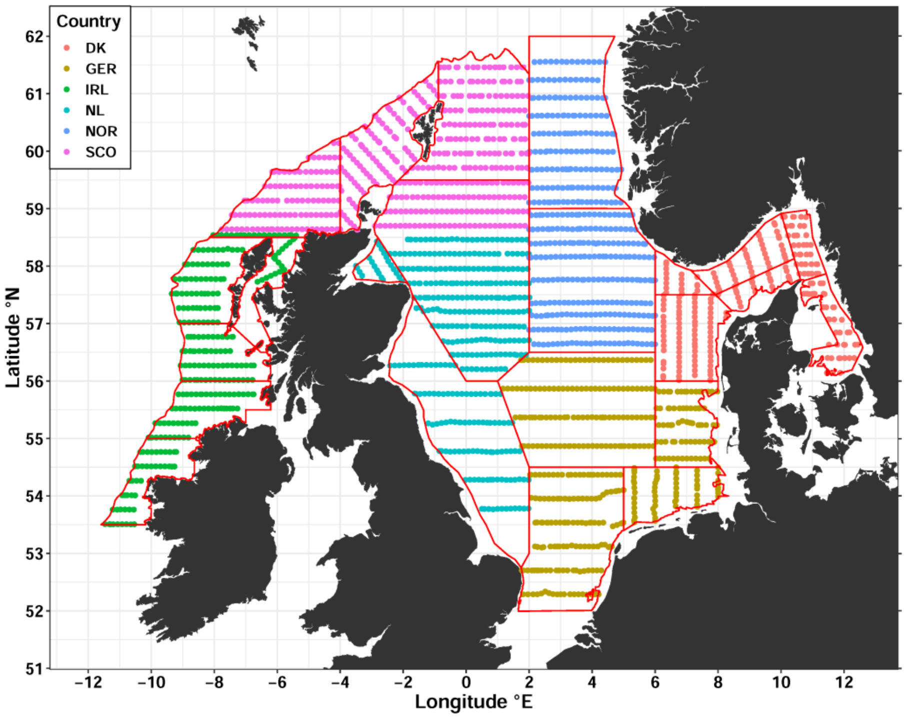

Figure 2.3.1.1. Cruise tracks and survey area coverage in the HERAS acoustic surveys in 2018 by nation.

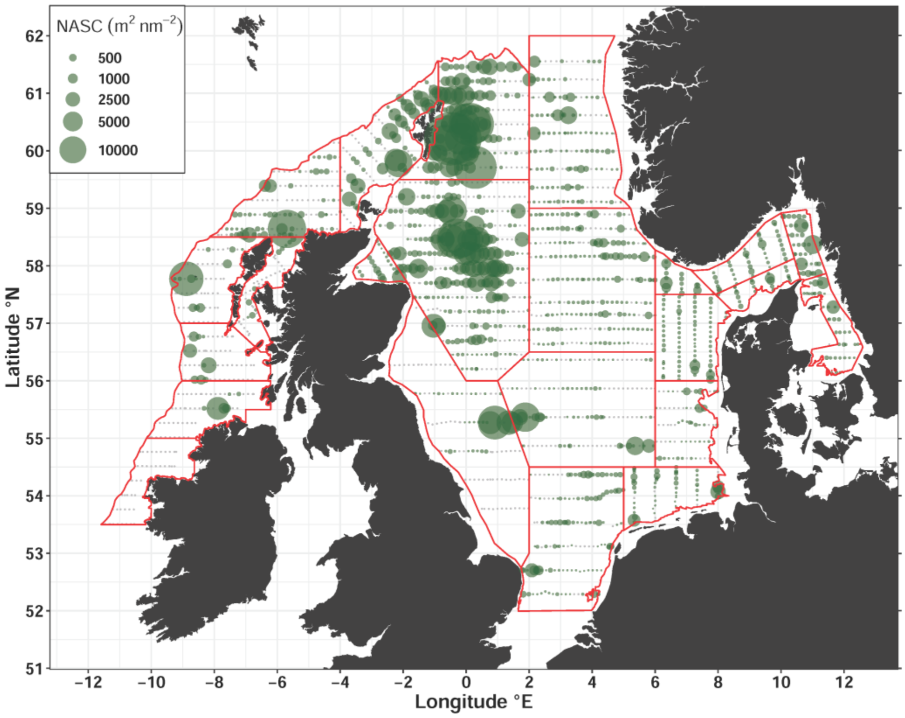

Figure 2.3.1.2. Distribution of NASC attributed to herring in HERAS in 2018. Acoustic intervals represented by light grey dot with green circles representing size and location of herring aggregations. NASC values are resampled at 5 nmi intervals along the cruise track. The red lines show the strata system.

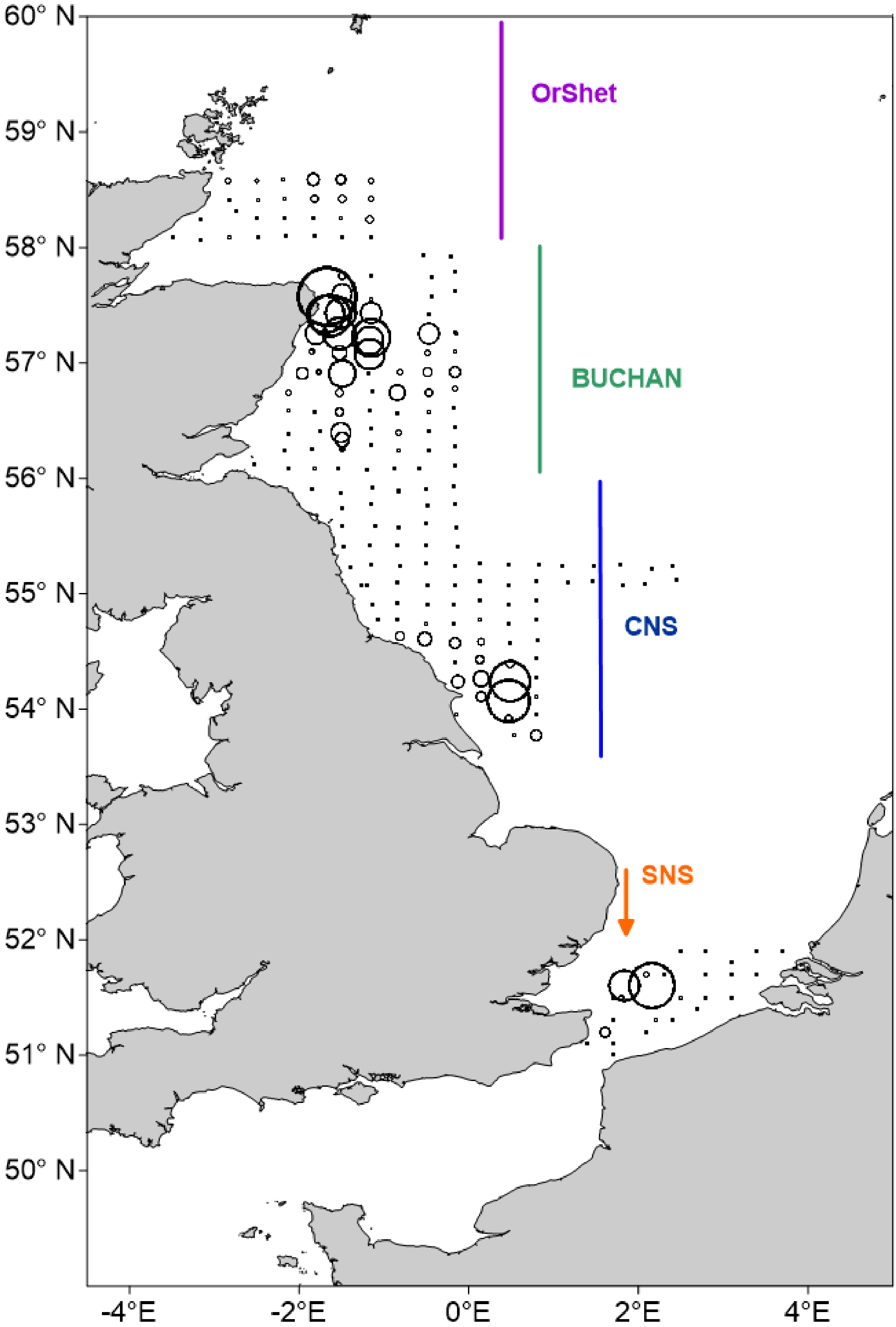

Figure 2.3.2.1: North Sea herring - Abundance of larvae < 10 mm (n/m²) in the Buchan, Central and Southern North Sea as obtained from the International Herring Larvae Surveys in autumn and winter 2018/2019 (maximum circle size = 3500 n/m²). The survey around the Orkneys had to be stopped after 28 hauls due to technical problems of the research vessel.

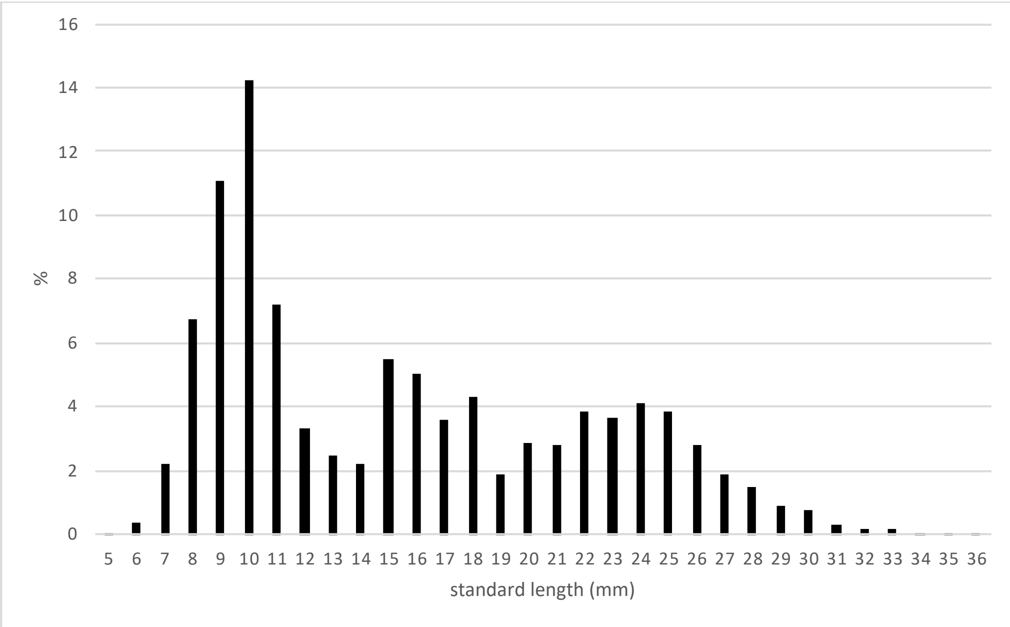

Figure 2.3.3.1. North Sea herring. Length distribution of all herring larvae caught during the 2019 Q1 IBTS.

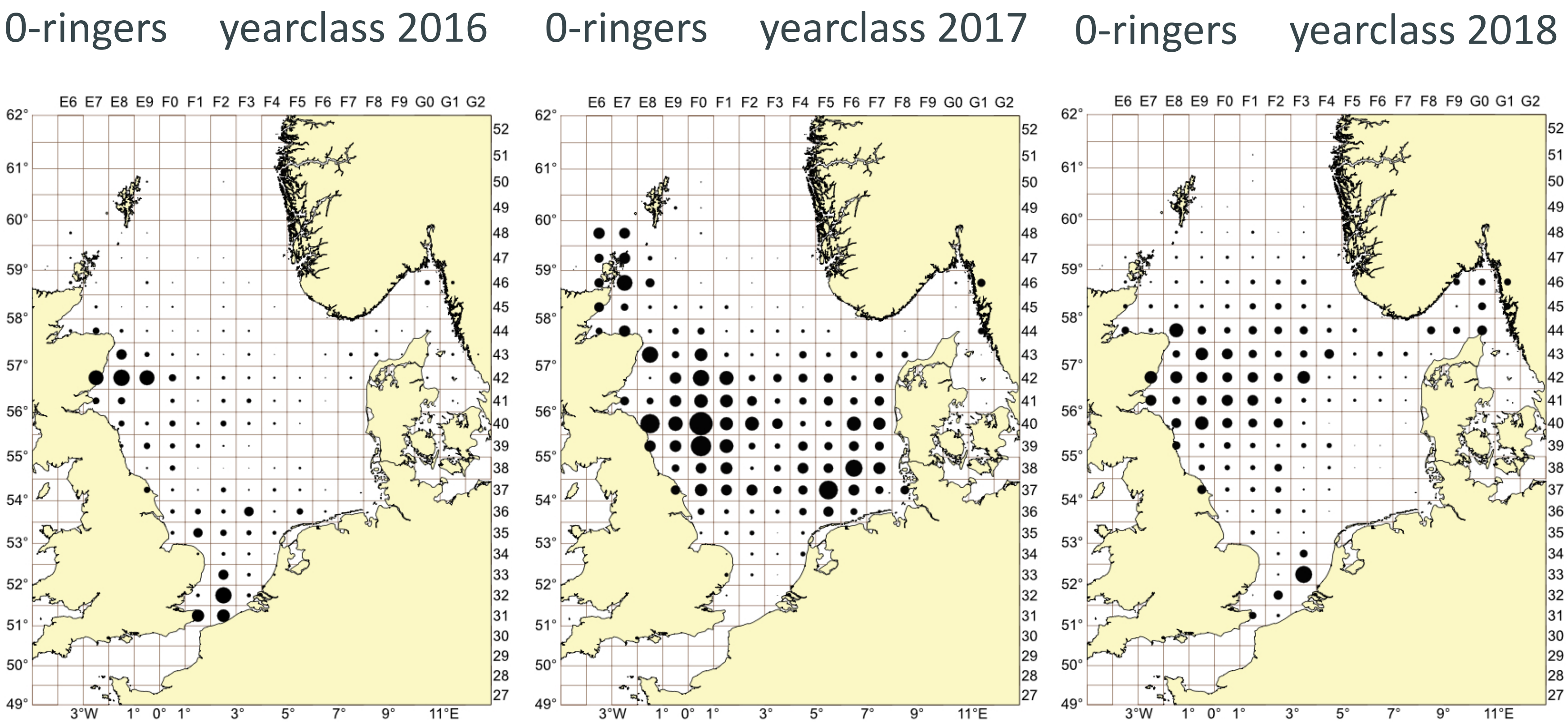

Figure 2.3.3.2. North Sea herring. Distribution of 0-ringer herring, year classes 2015–2017. Density estimates of 0-ringers within each statistical rectangle are based on MIK catches during IBTS in January/February 2016–2018. Areas of filled circles illustrate densities in no m^{-2}, the area of the largest circle represents a density of 1.83 m^{-2}. All circles are scaled to the same order of magnitude of the square root transformed densities.

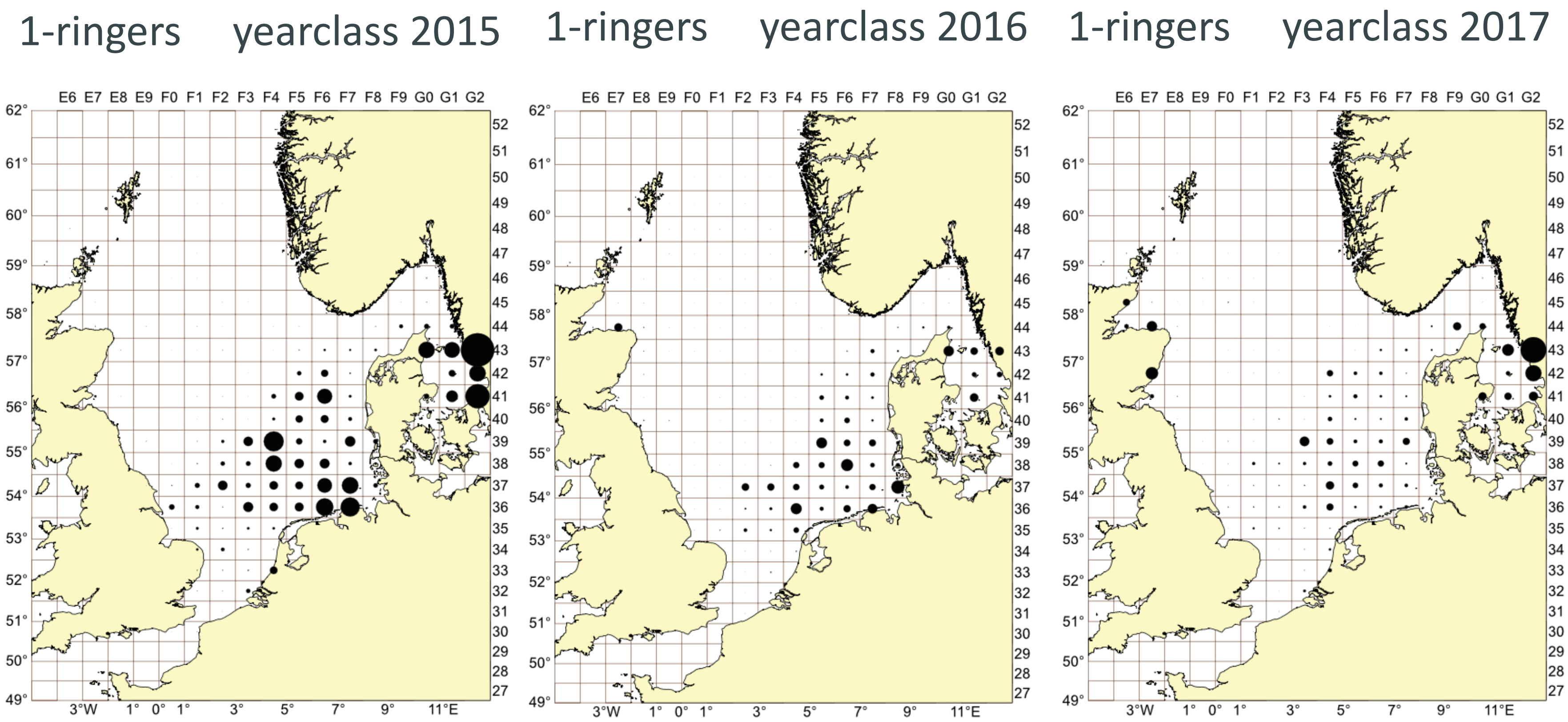

Figure 2.3.3.3. North Sea herring. Distribution of 1-ringer herring, year classes 2014–2016. Density estimates of 1-ringers within each statistical rectangle are based on GOV catches during IBTS in January/February 2016–2018. Areas of filled circles illustrate numbers per hour, scaled proportionally to the square root transformed CPUE data, the area of the largest circle extending across the boundary of a rectangle represents 99 136 h^{-1}.

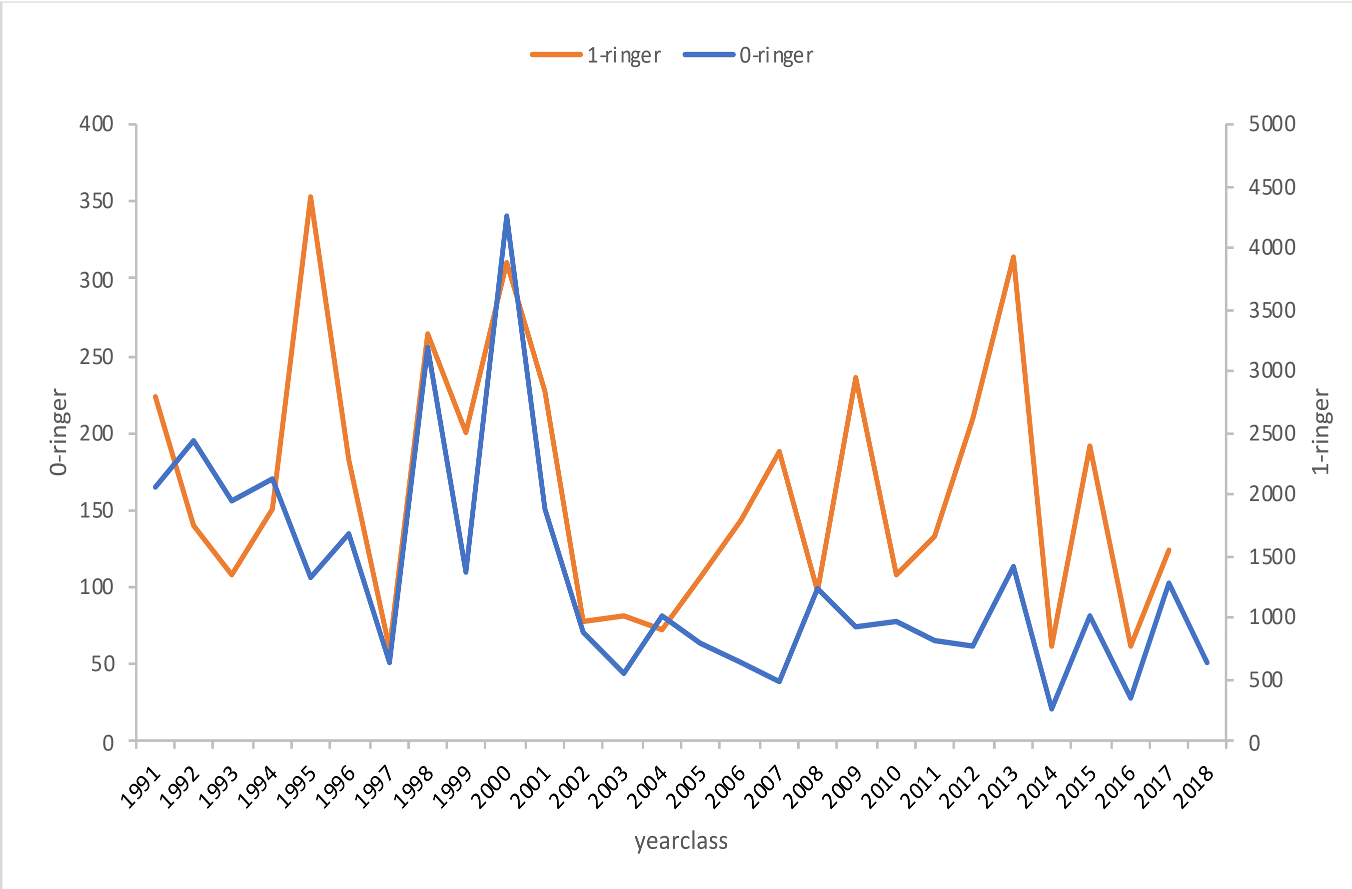

Figure 2.3.3.4 North Sea herring. Time series of 0-ringer, and 1-ringer indices (red). Year classes 1991 to 2018 for 0-ringers, year classes 1991–2017 for 1-ringers. The new 0-ringer index only covers the 1991–2017 year classes

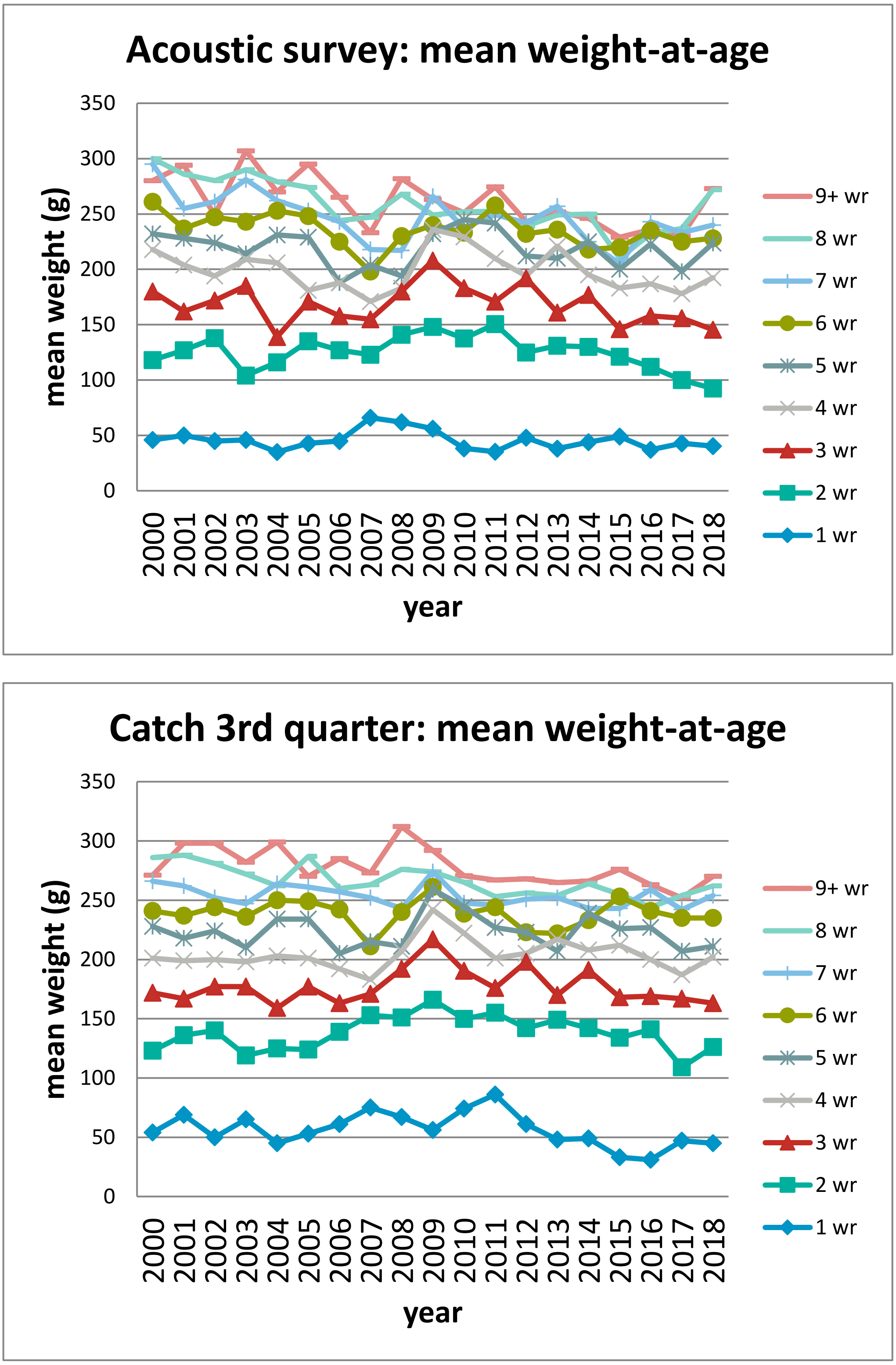

Figure 2.4.1.1. North Sea Herring. Mean weights-at-age for the 3rd quarter in Divisions 4 and 3.a from the acoustic survey (upper panel) and mean weights-in-the-catch (lower panel) for comparison.

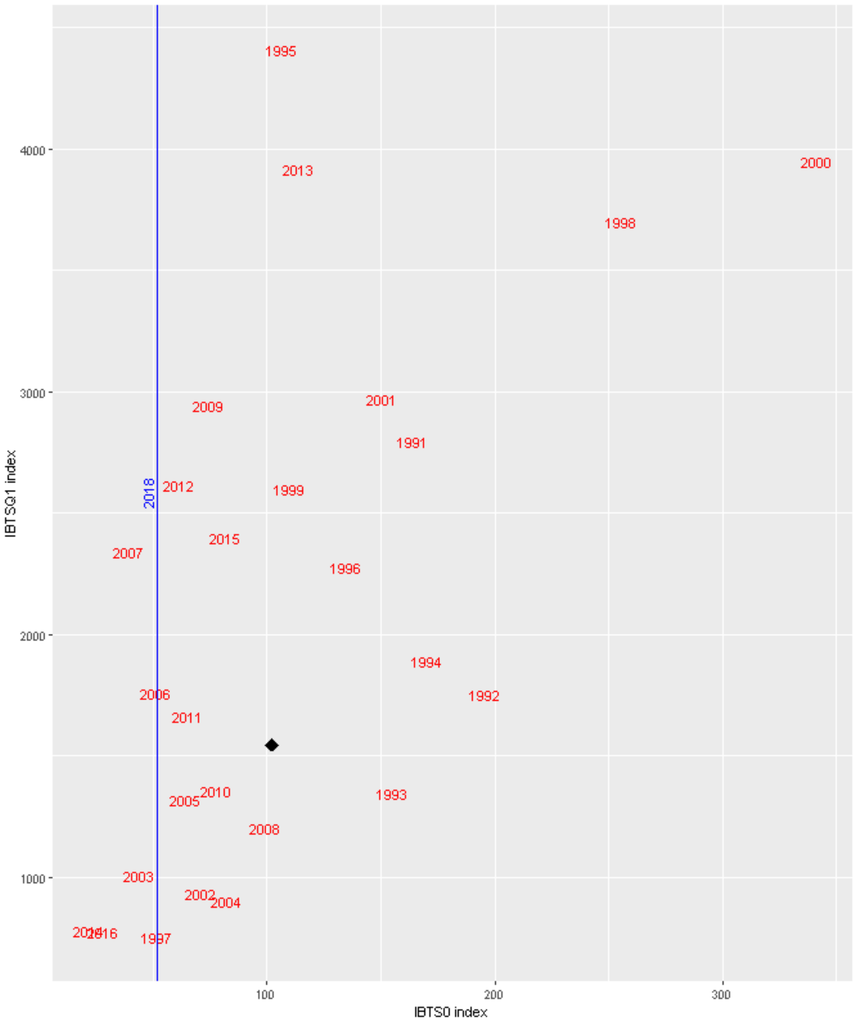

Figure 2.5.1.1 North Sea herring. Relationship between indices of 0-ringers, calculated with the new algorithm, and 1-ringers for year classes 1991 to 2018.

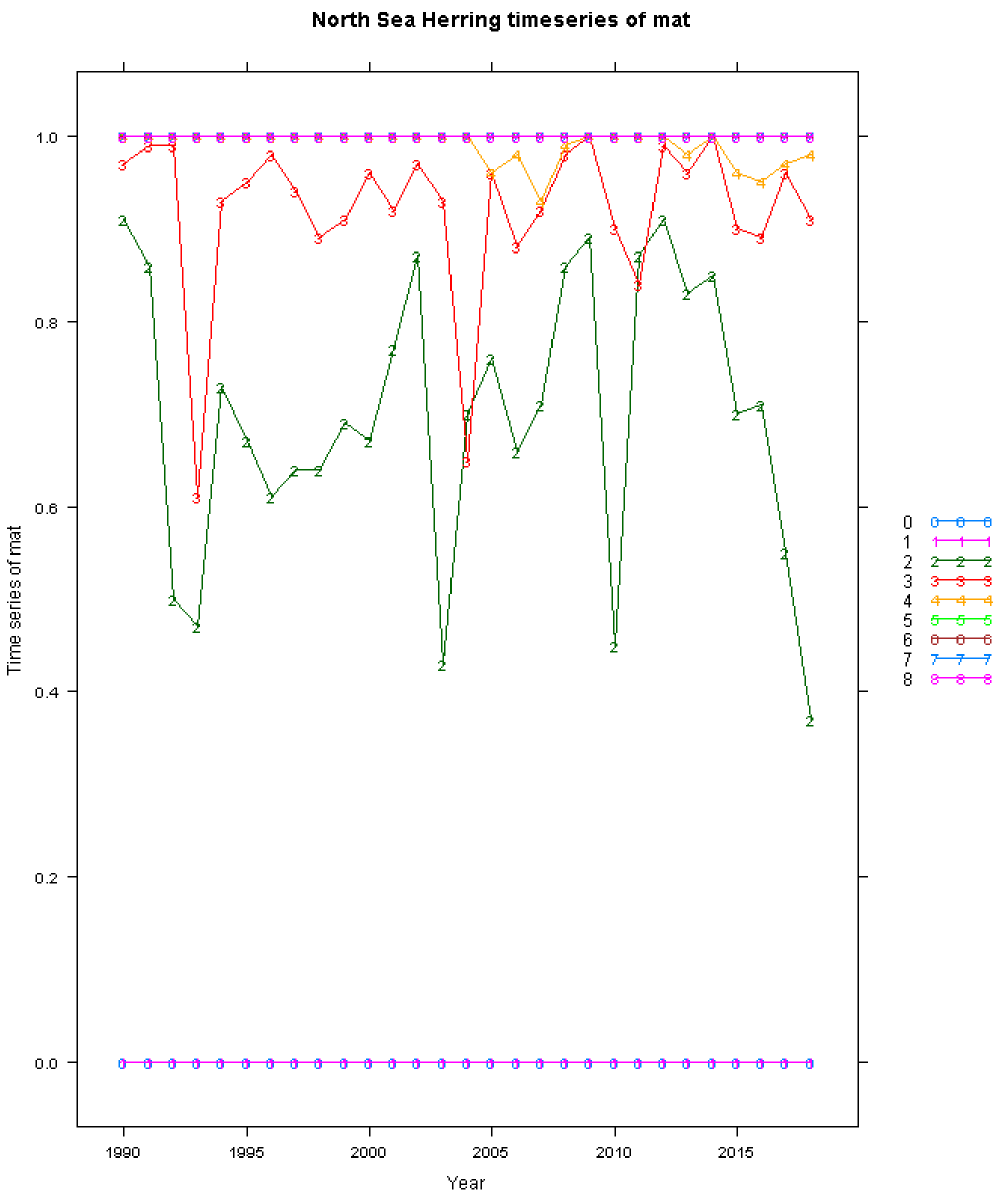

Figure 2.6.1.1 North Sea Herring. Time series of proportion mature at ages 0 to 8+ as used in the North Sea herring assessment.

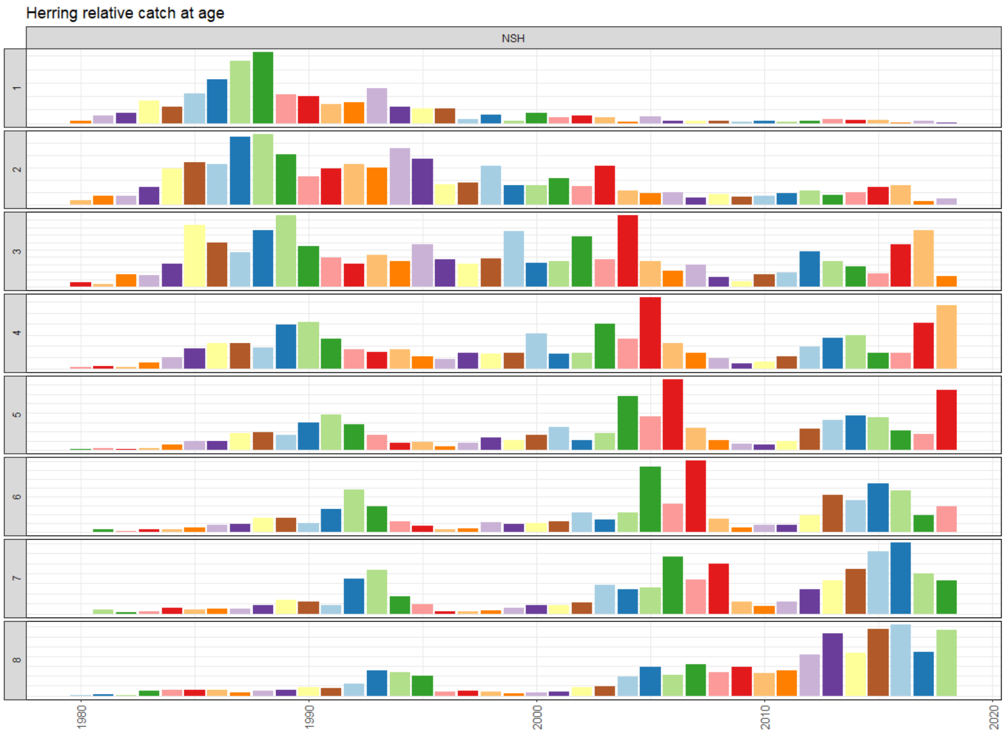

Figure 2.6.1.2. North Sea Herring. Time series of catch-at-age proportion at ages 0–8+ as used in the North Sea herring assessment. Colours indicate year-classes. All ages are scaled independently and therefore the size of the bars can only be compared within an age.

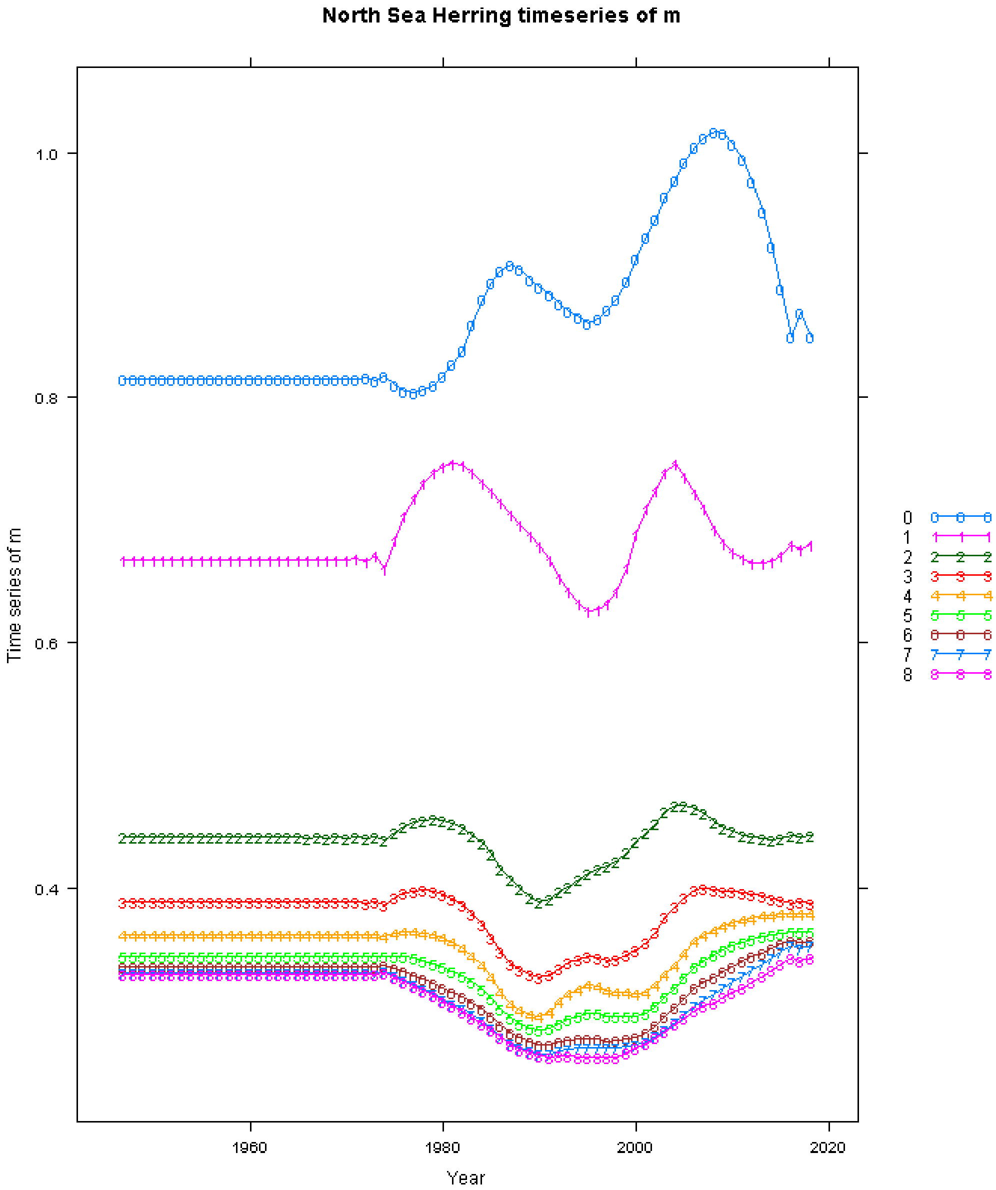

Figure 2.6.1.3. North Sea Herring. Time series of absolute natural mortality values at age 0–8+ as used in the North Sea herring assessment. Natural mortality values are based on the 2017 North Sea key-run (ICES WGSAM, 2018).

Figure 2.6.1.4. North Sea Herring. Time series of the HERAS acoustic index by age 1–8+. Colours indicate year-classes. All ages are scaled independently and cannot be compared between ages.

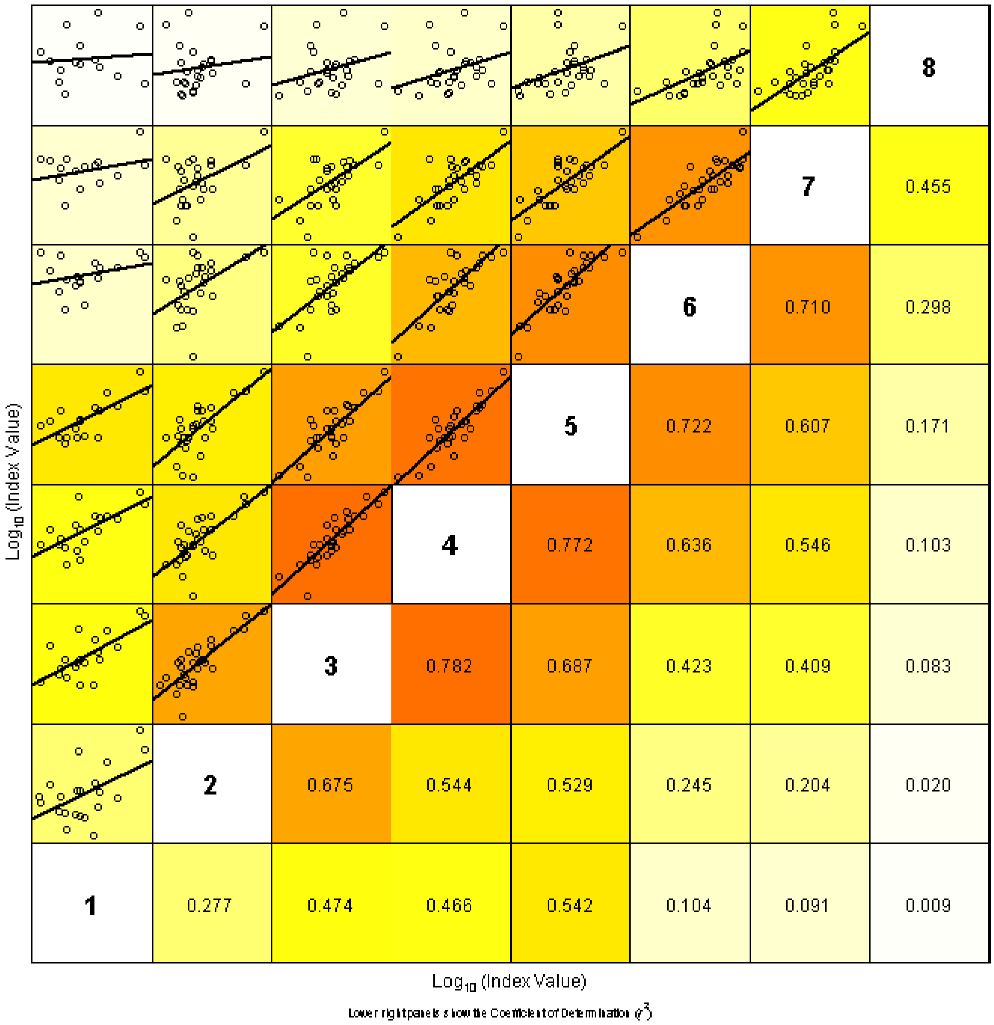

Figure 2.6.1.5. North Sea herring. Internal consistency plot of the acoustic survey (HERAS). Above the diagonal the linear regression is shown including the observations (in points) while under the diagonal the r^2 value that is associated with the linear regression is given.

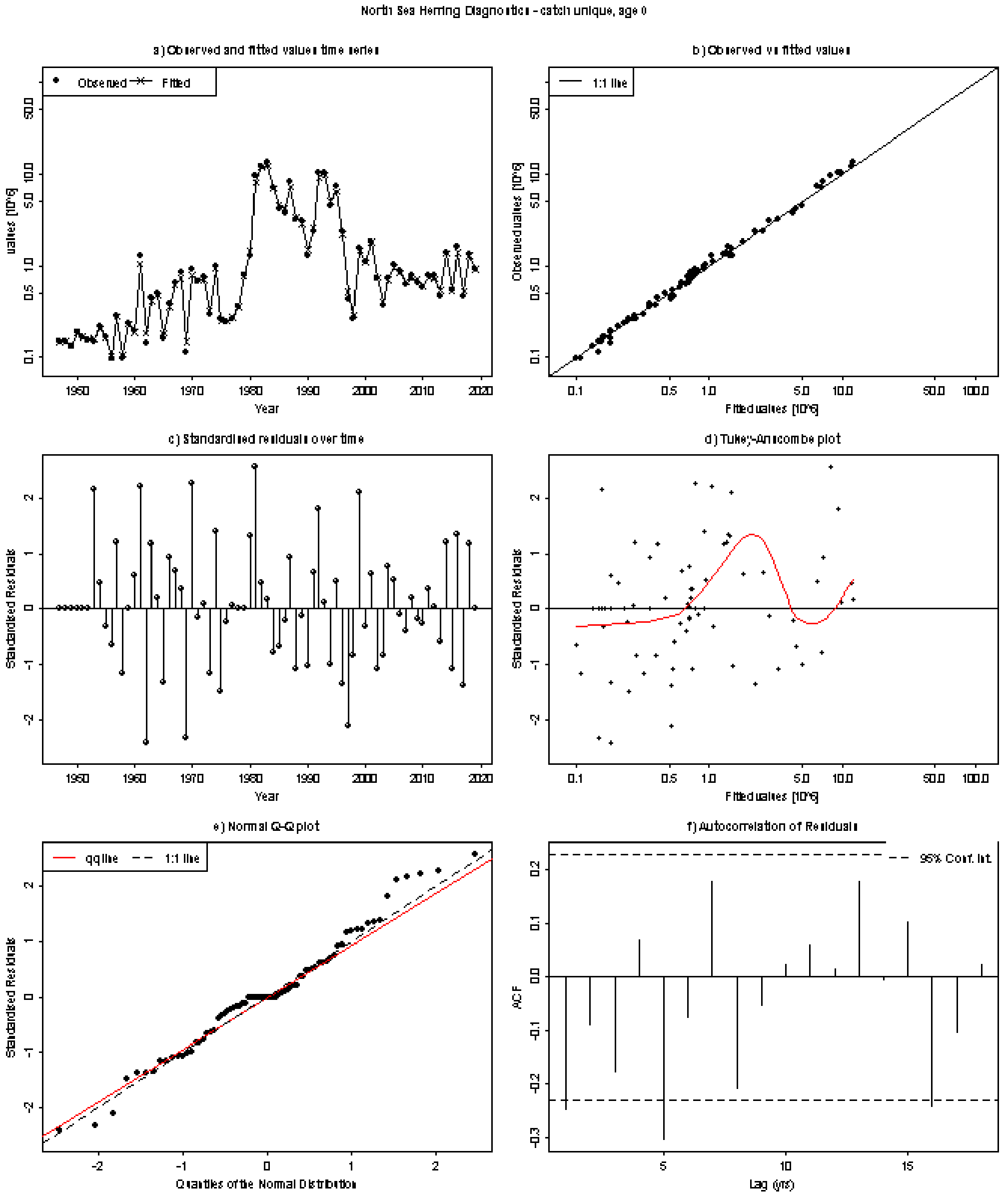

Figure 2.6.1.6 North Sea herring. Diagnostics of the assessment model fit to the catch at age 0 time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from catch abundance at 0 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the catch at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

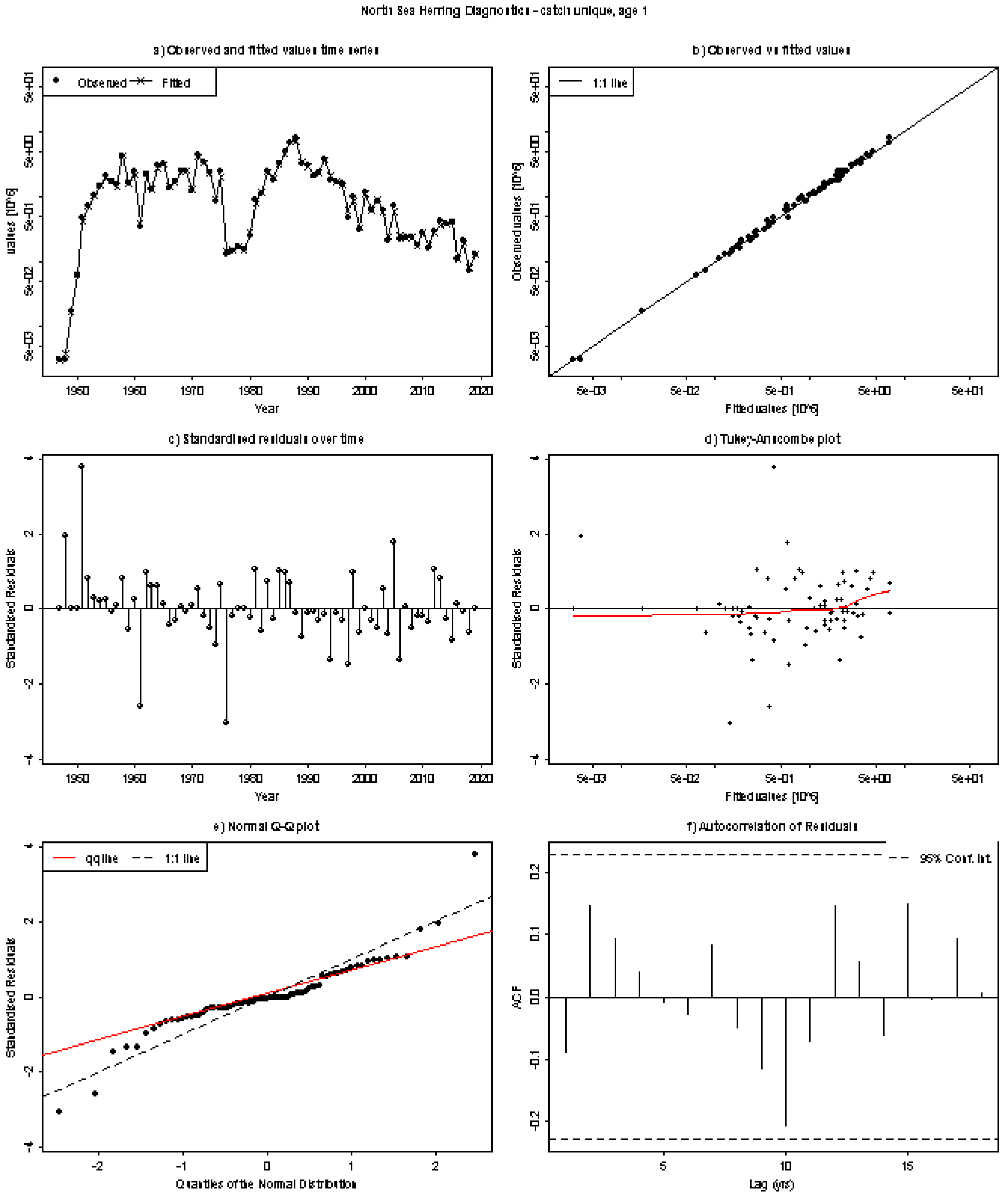

Figure 2.6.1.7 North Sea herring. Diagnostics of the assessment model fit to the catch at age 1 time series. Top left: Estimates of numbers at 1 wr (line) and numbers predicted from catch abundance at 1 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 1 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 1 wr. Middle left: Time series of standardized residuals of the catch at 1 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

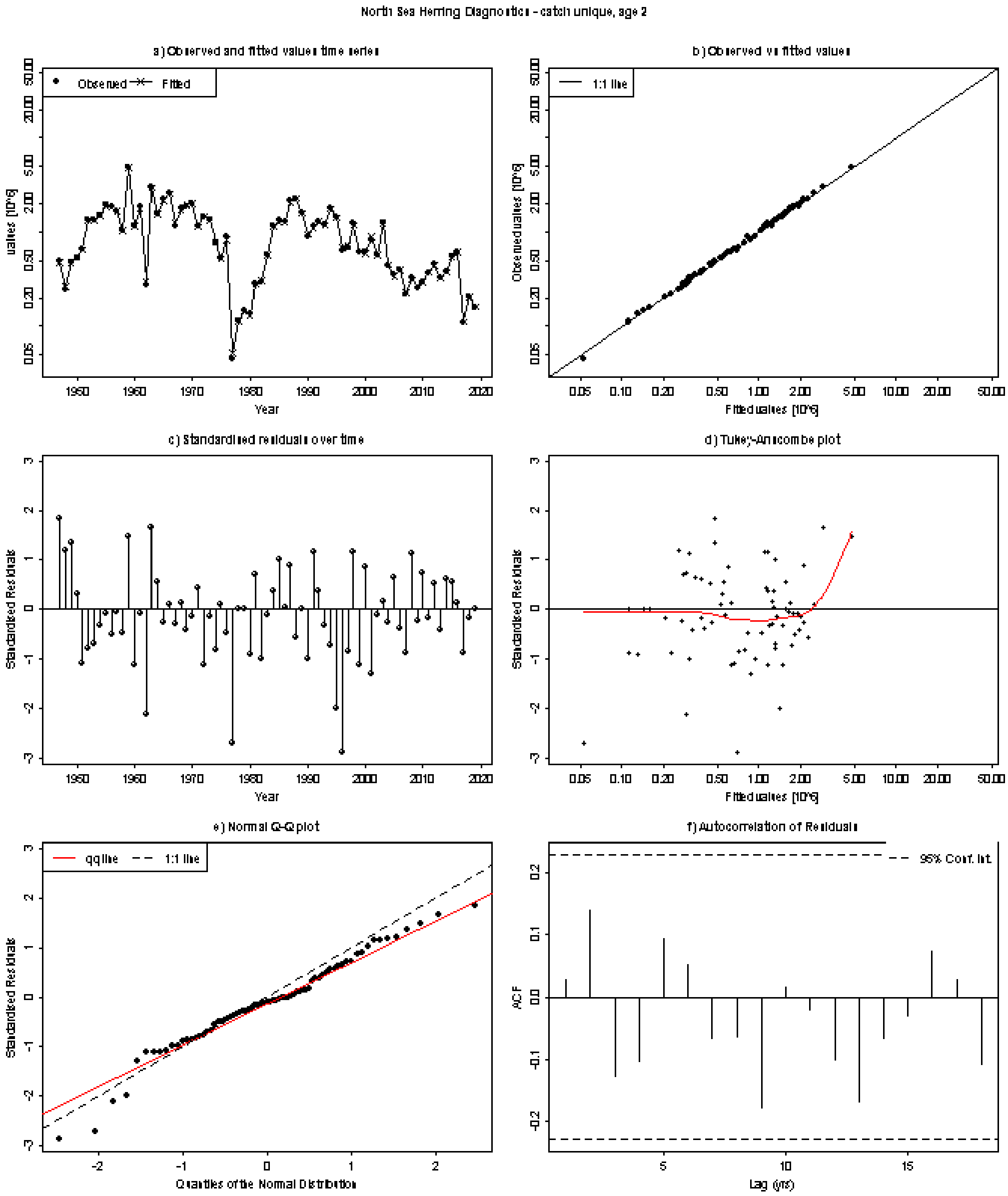

Figure 2.6.1.8 North Sea herring. Diagnostics of the assessment model fit to the catch at age 2 time series. Top left: Estimates of numbers at 2 wr (line) and numbers predicted from catch abundance at 2 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 2 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 2 wr. Middle left: Time series of standardized residuals of the catch at 2 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

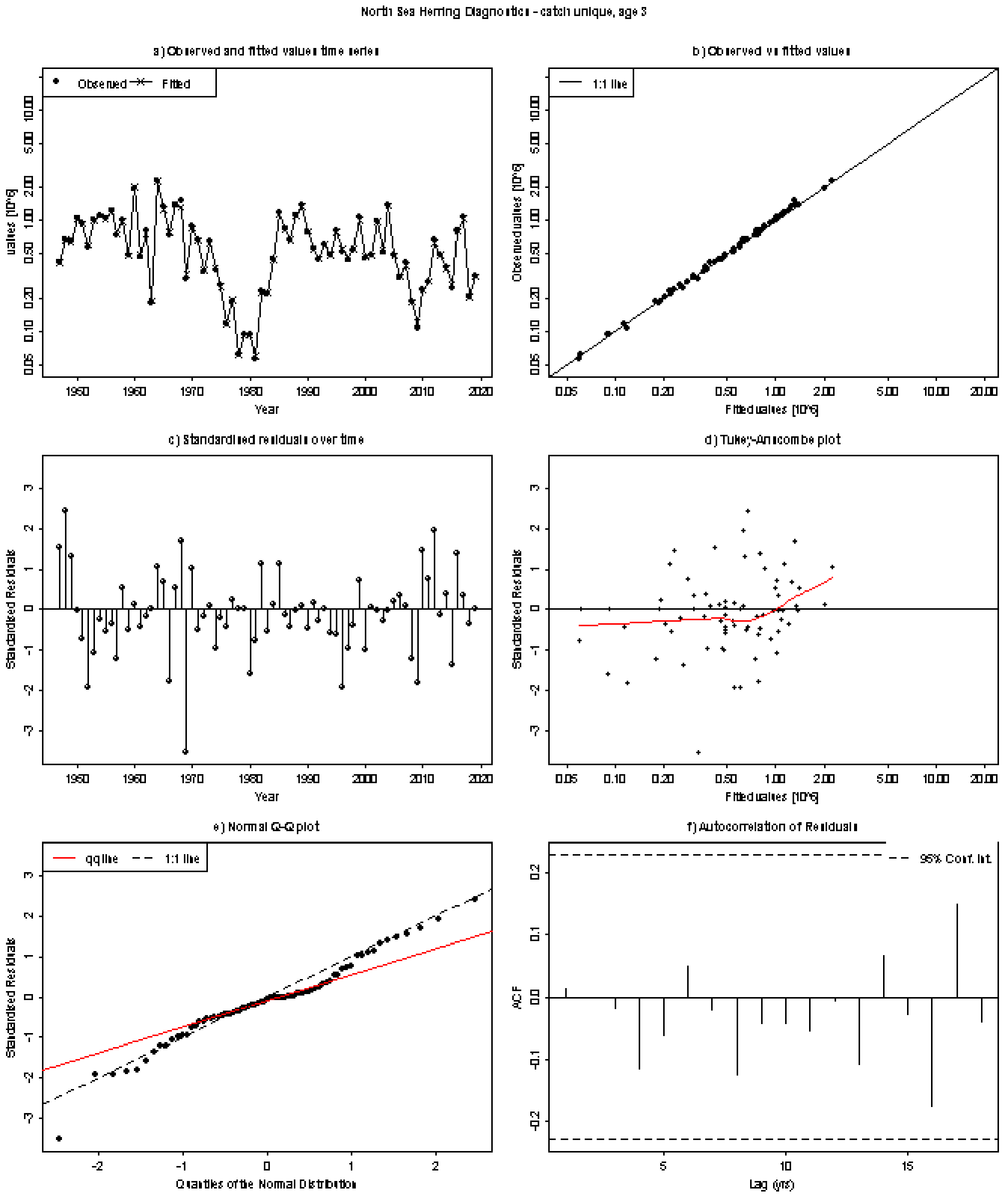

Figure 2.6.1.9 North Sea herring. Diagnostics of the assessment model fit to the catch at age 3 time series. Top left: Estimates of numbers at 3 wr (line) and numbers predicted from catch abundance at 3 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 3 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 3 wr. Middle left: Time series of standardized residuals of the catch at 3 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

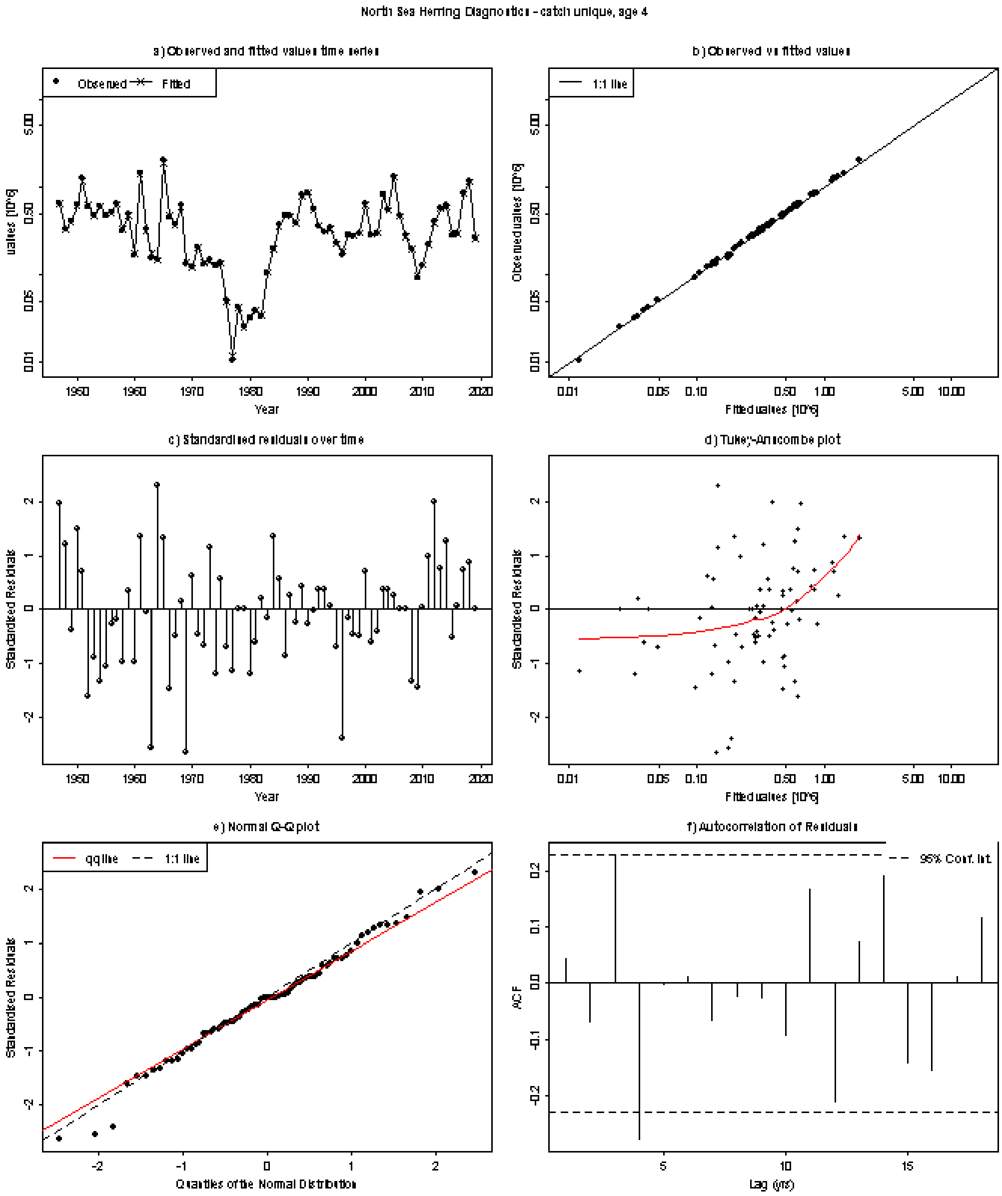

Figure 2.6.1.10 North Sea herring. Diagnostics of the assessment model fit to the catch at age 4 time series. Top left: Estimates of numbers at 4 wr (line) and numbers predicted from catch abundance at 4 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 4 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 4 wr. Middle left: Time series of standardized residuals of the catch at 4 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

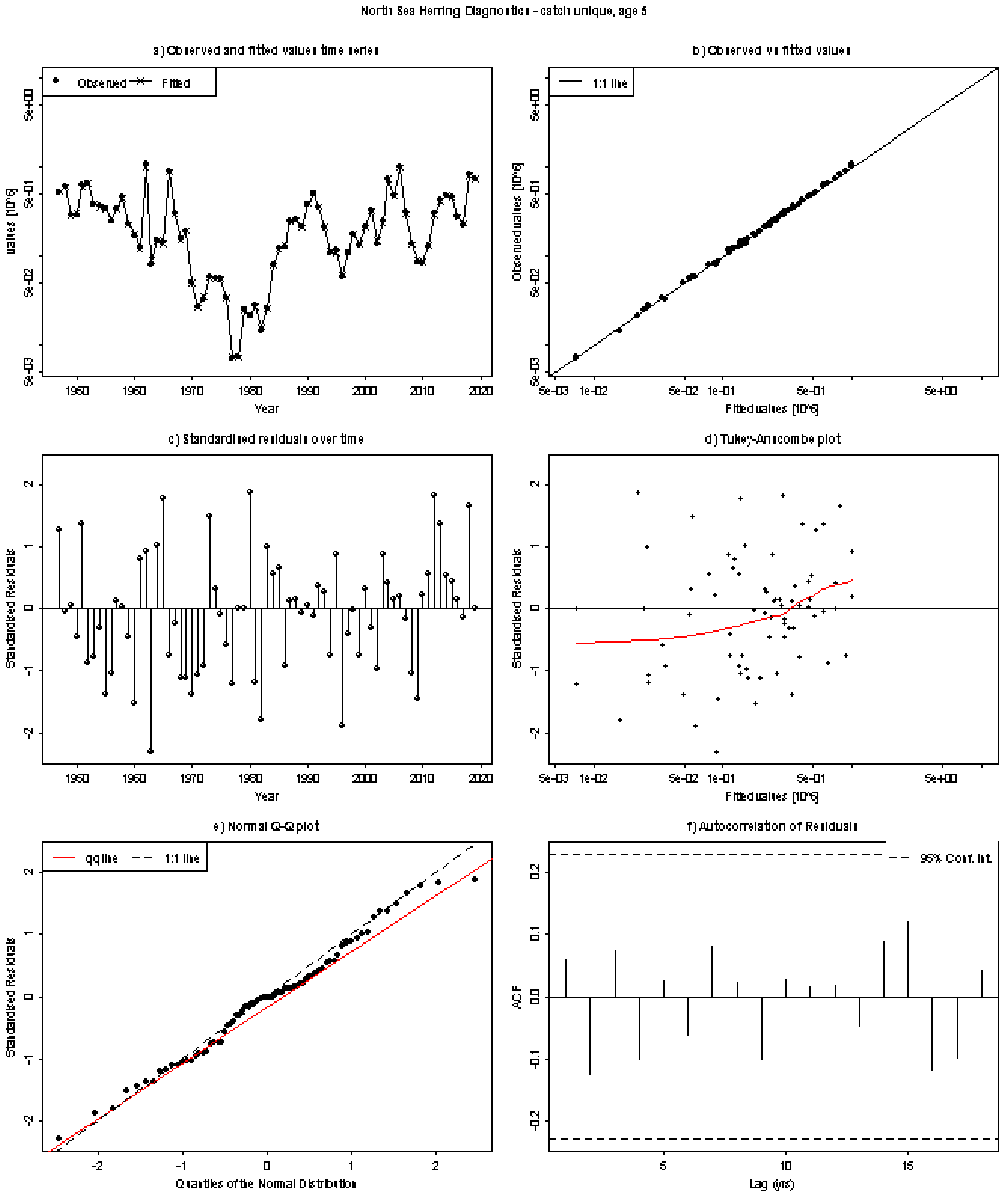

Figure 2.6.1.11 North Sea herring. Diagnostics of the assessment model fit to the catch at age 5 time series. Top left: Estimates of numbers at 5 wr (line) and numbers predicted from catch abundance at 5 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 5 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 5 wr. Middle left: Time series of standardized residuals of the catch at 5 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

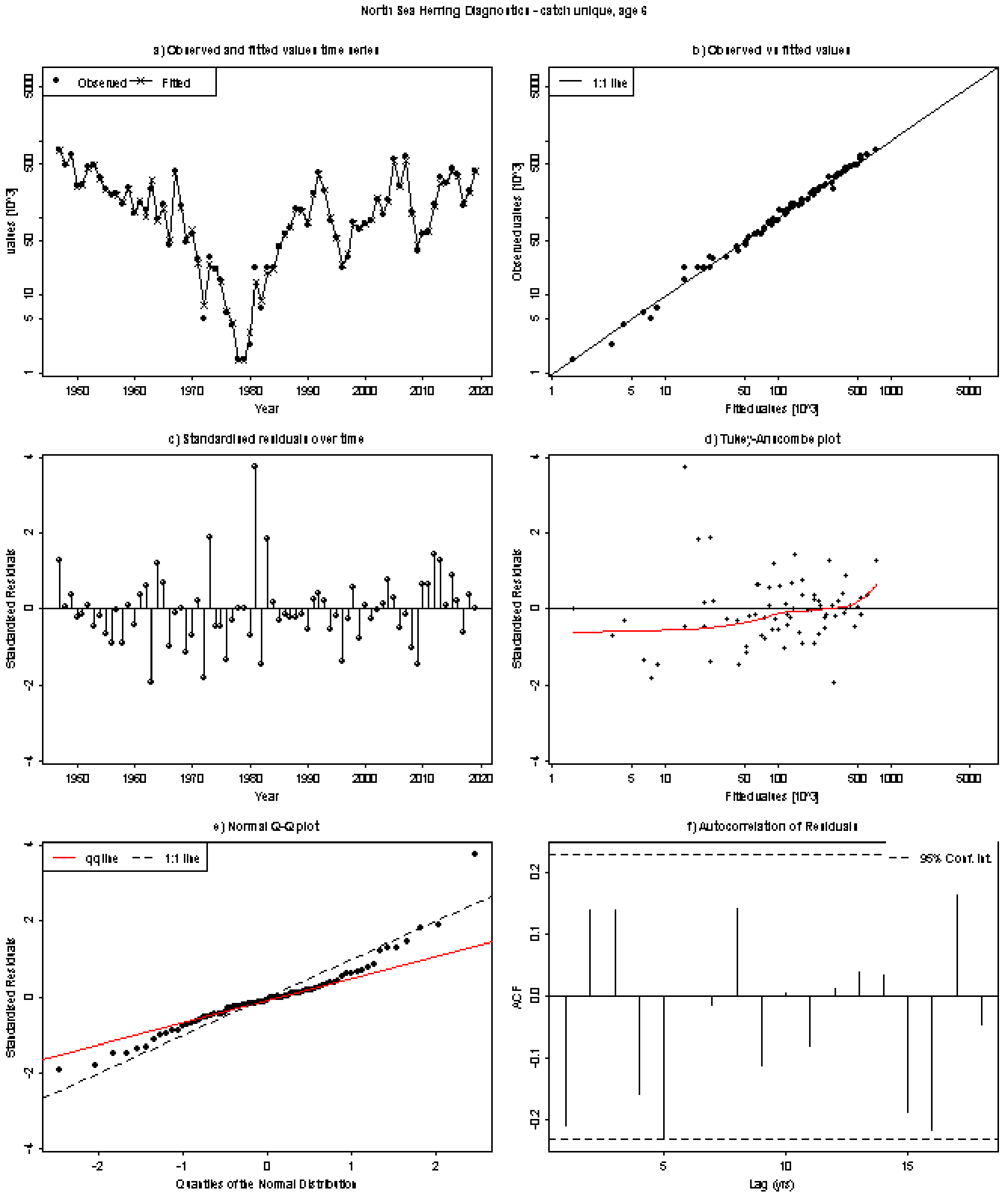

Figure 2.6.1.12 North Sea herring. Diagnostics of the assessment model fit to the catch at age 6 time series. Top left: Estimates of numbers at 6 wr (line) and numbers predicted from catch abundance at 6 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 6 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 6 wr. Middle left: Time series of standardized residuals of the catch at 6 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

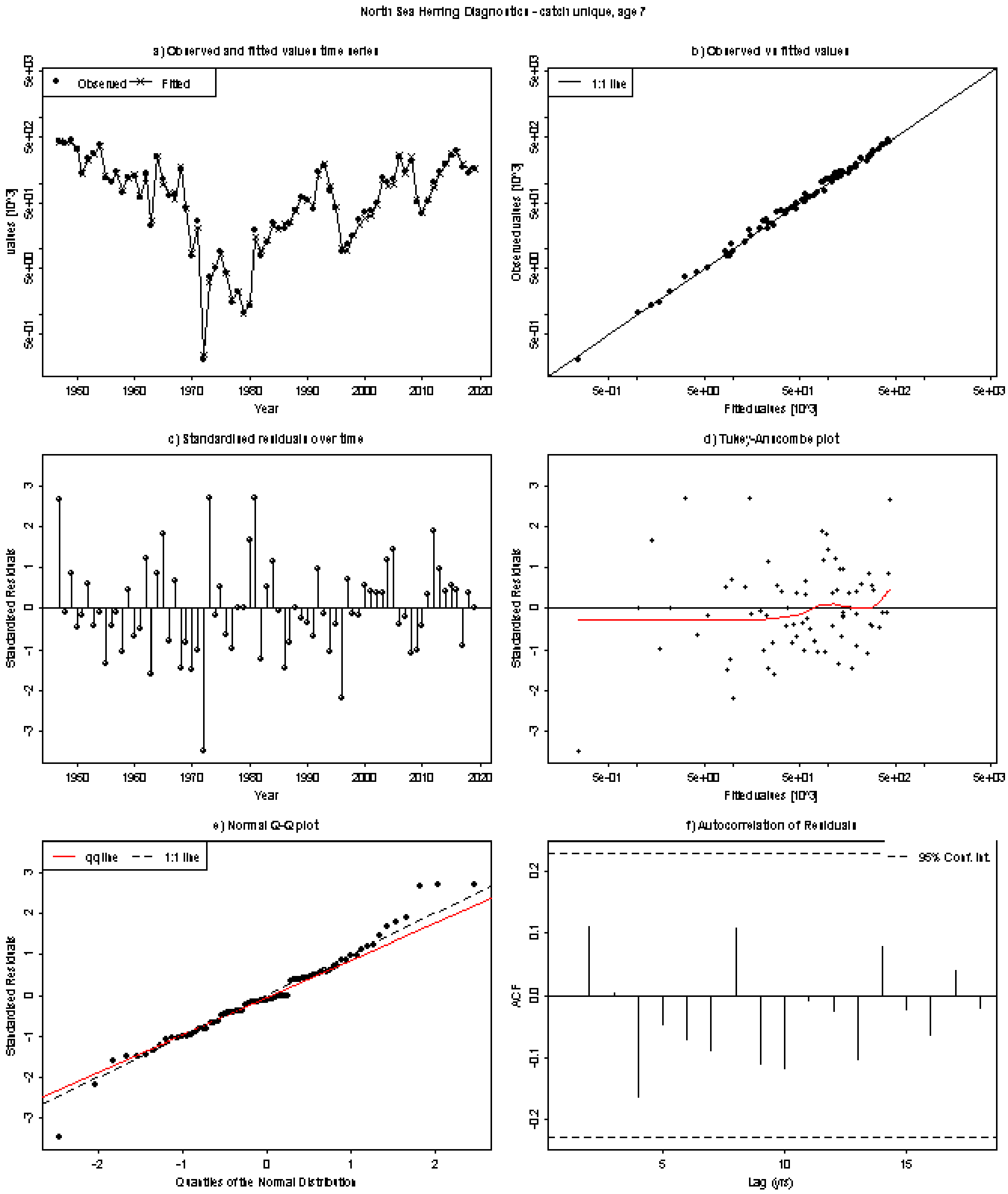

Figure 2.6.1.13 North Sea herring. Diagnostics of the assessment model fit to the catch at age 7 time series. Top left: Estimates of numbers at 7 wr (line) and numbers predicted from catch abundance at 7 wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 7 wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 7 wr. Middle left: Time series of standardized residuals of the catch at 7 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

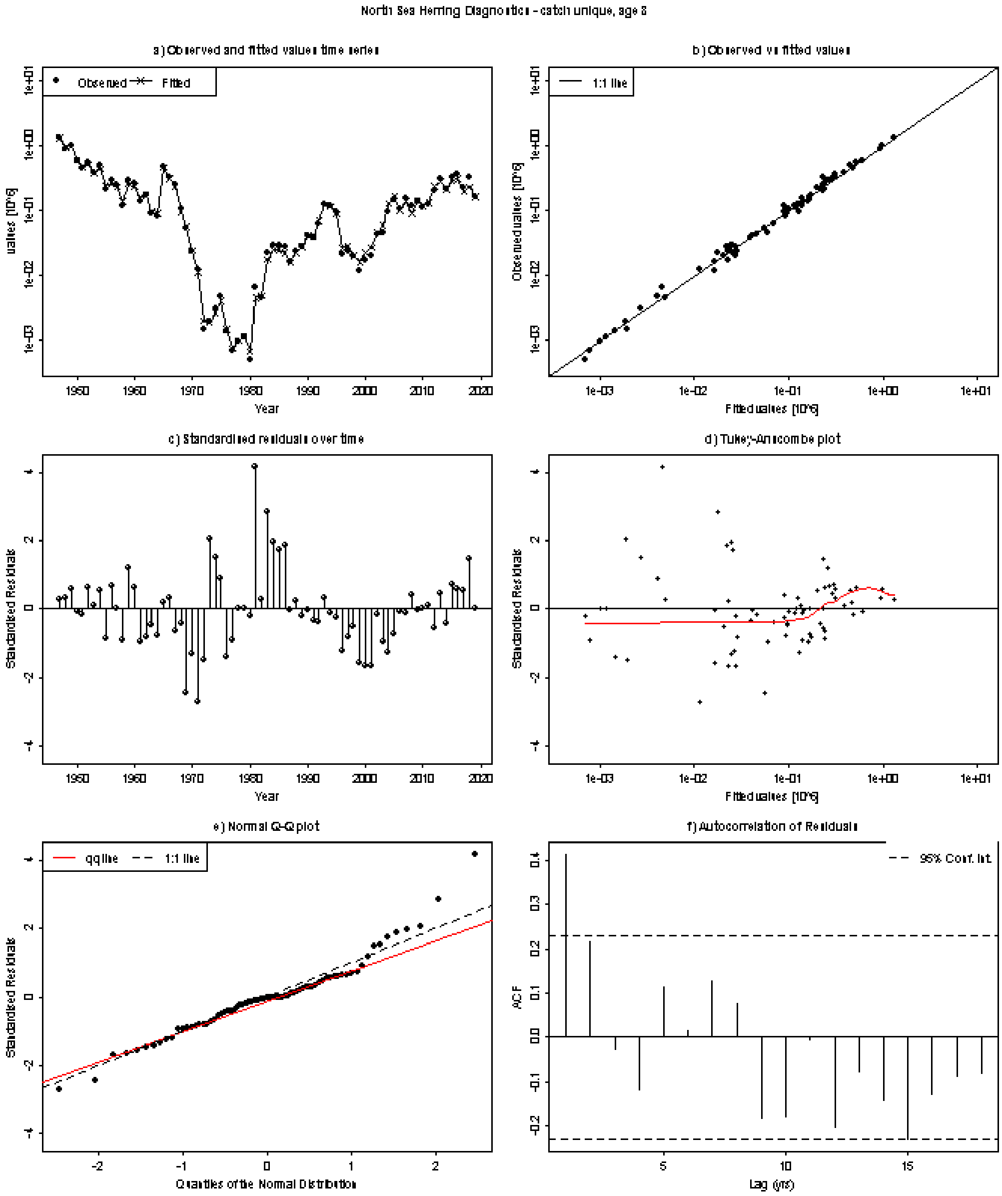

Figure 2.6.1.14. North Sea herring. Diagnostics of the assessment model fit to the catch at age 8+ time series. Top left: Estimates of numbers at 8+ wr (line) and numbers predicted from catch abundance at 8+ wr. Top right: scatterplot of catch observations versus assessment model estimates of numbers at 8+ wr with the best-fit catchability model (linear function). Middle right: catch observation versus standardized residuals at 8+ wr. Middle left: Time series of standardized residuals of the catch at 8+ wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

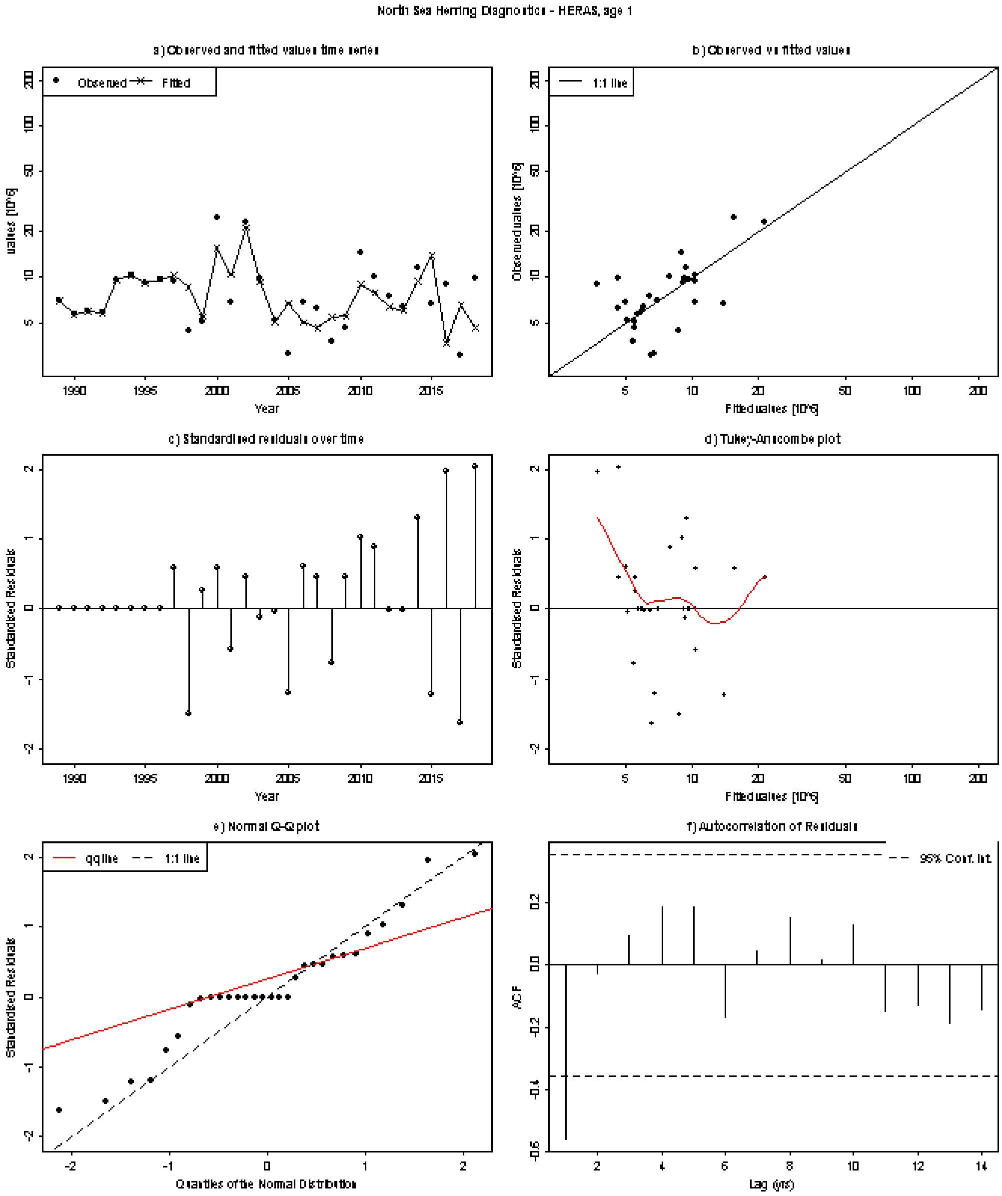

Figure 2.6.1.15. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 1 wr time series. Top left: Estimates of numbers at 1 wr (line) and numbers predicted from index abundance at 1 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 1 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 1 wr. Middle left: Time series of standardized residuals of the index at 1 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

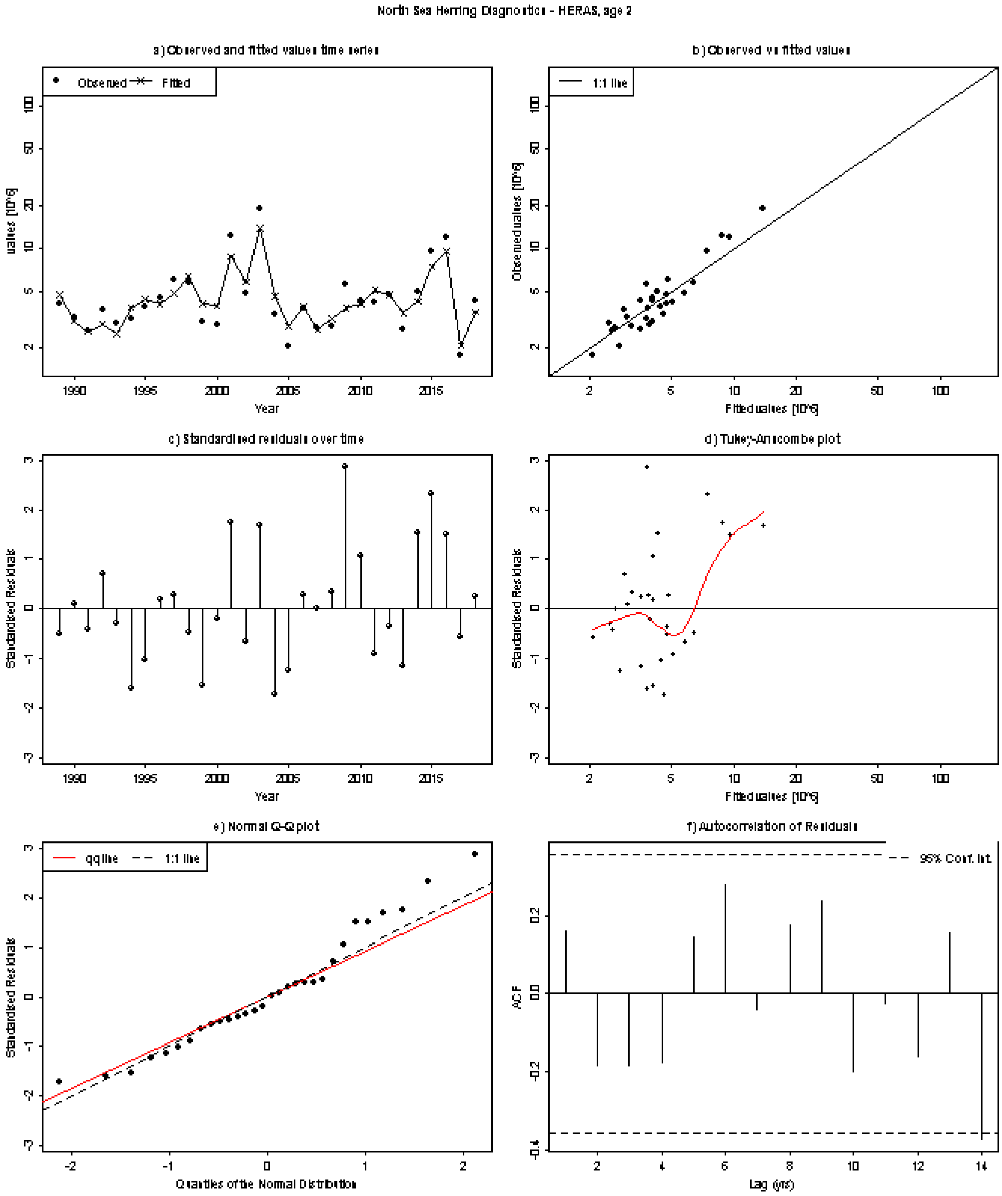

Figure 2.6.1.16. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 2 wr time series. Top left: Estimates of numbers at 2 wr (line) and numbers predicted from index abundance at 2 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 2 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 2 wr. Middle left: Time series of standardized residuals of the index at 2 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

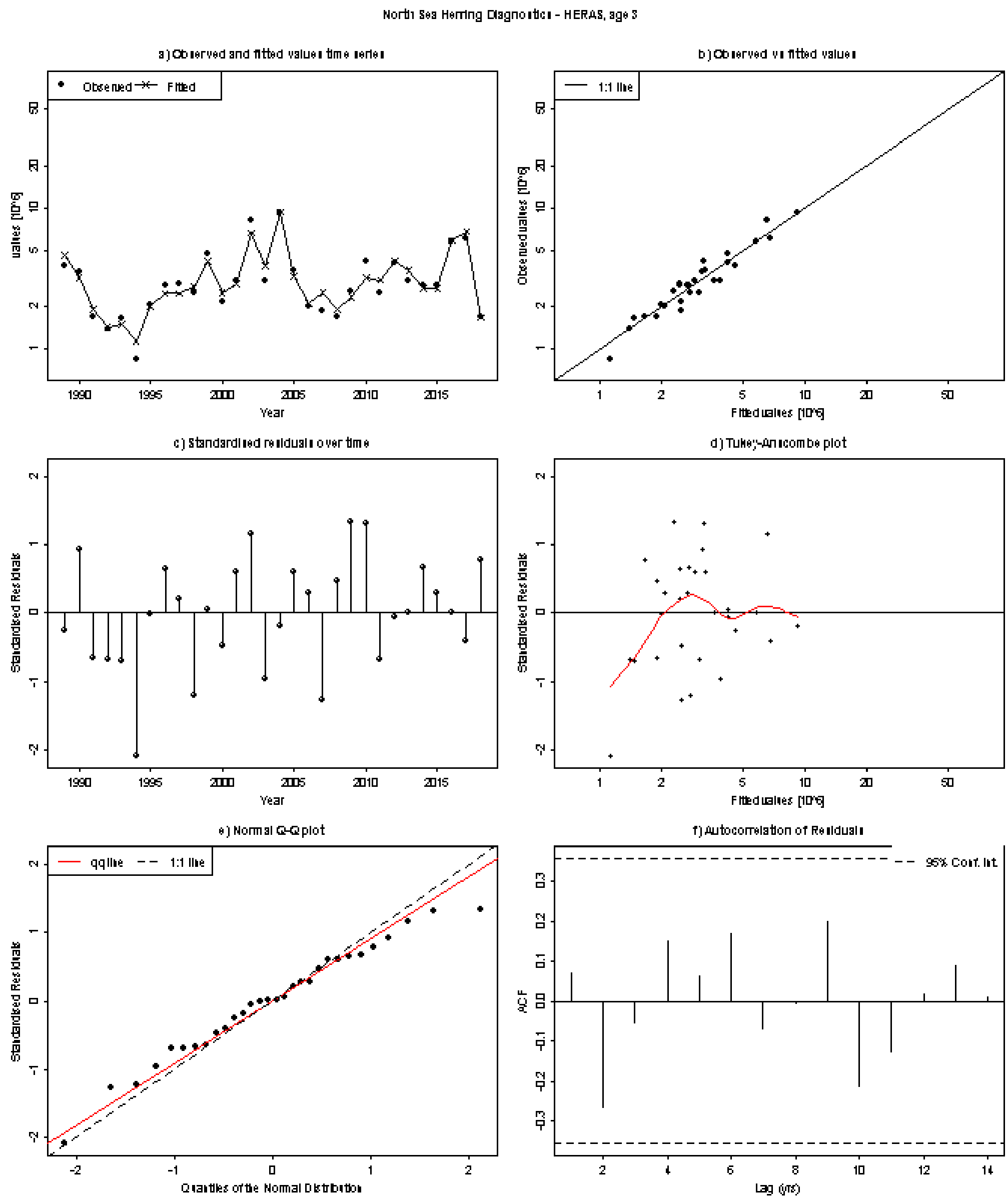

Figure 2.6.1.17. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 3 wr time series. Top left: Estimates of numbers at 3 wr (line) and numbers predicted from index abundance at 3 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 3 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 3 wr. Middle left: Time series of standardized residuals of the index at 3 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

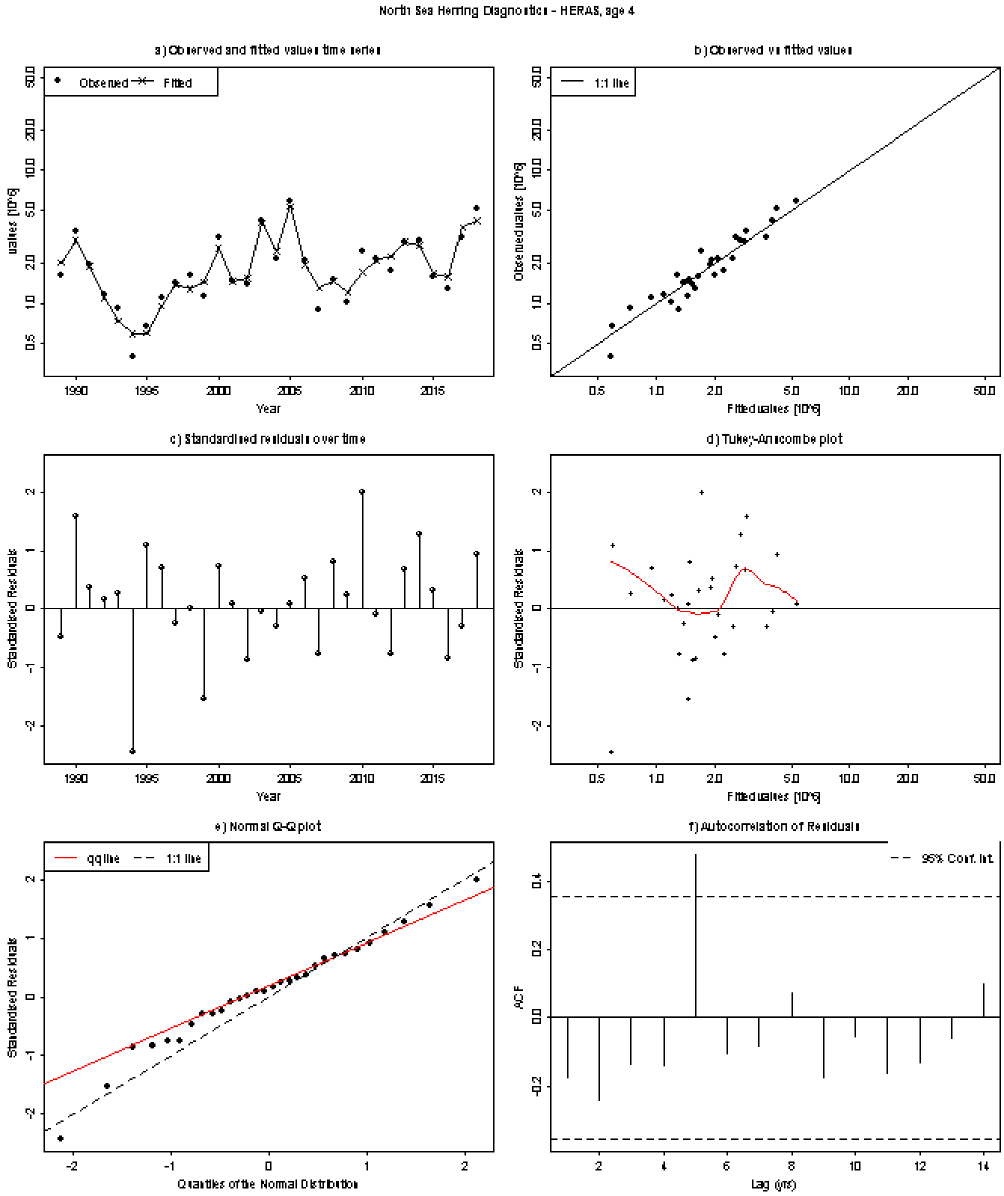

Figure 2.6.1.18. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 4 wr time series. Top left: Estimates of numbers at 4 wr (line) and numbers predicted from index abundance at 4 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 4 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 4 wr. Middle left: Time series of standardized residuals of the index at 4 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

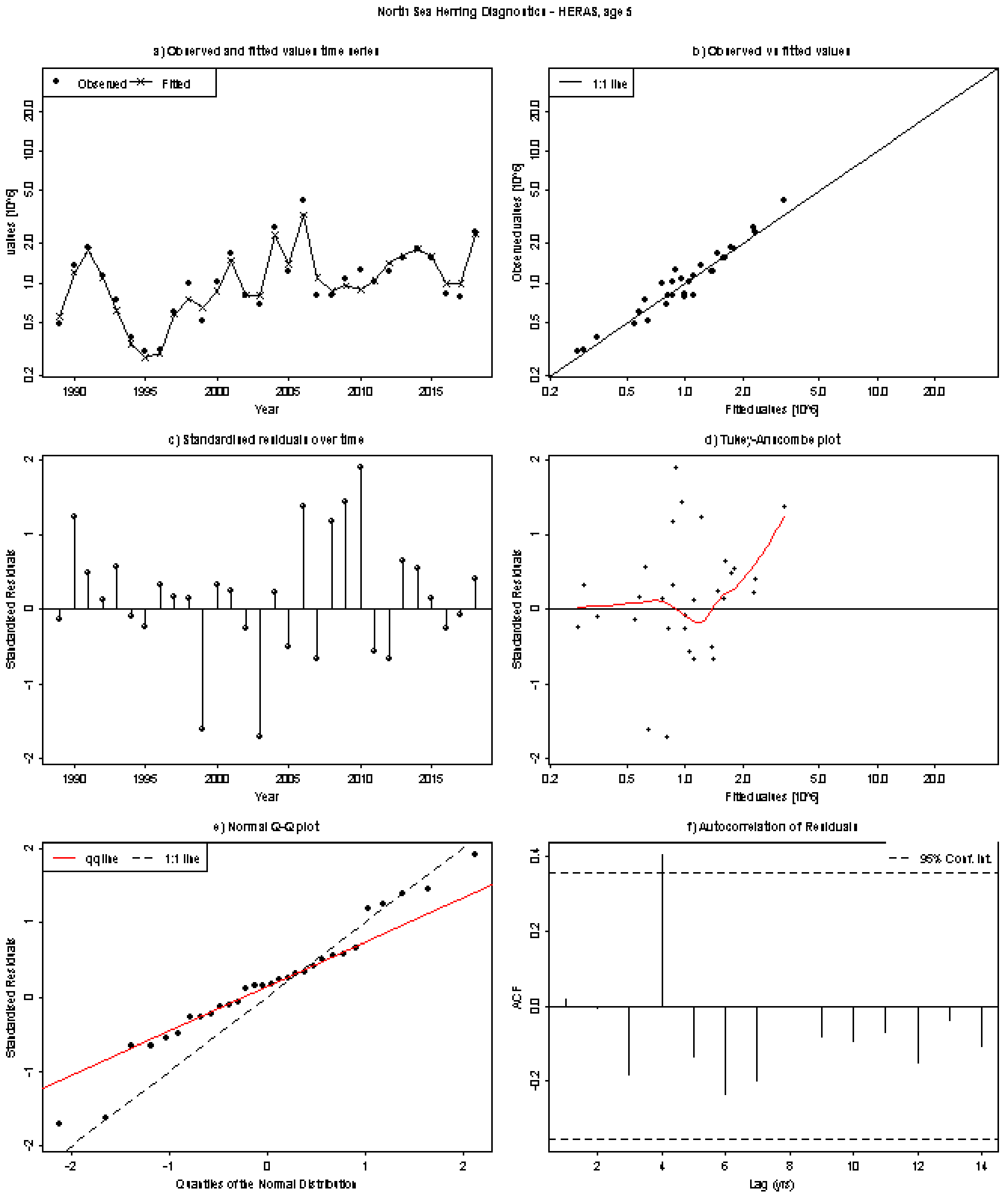

Figure 2.6.1.19. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 5 wr time series. Top left: Estimates of numbers at 5 wr (line) and numbers predicted from index abundance at 5 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 5 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 5 wr. Middle left: Time series of standardized residuals of the index at 5 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

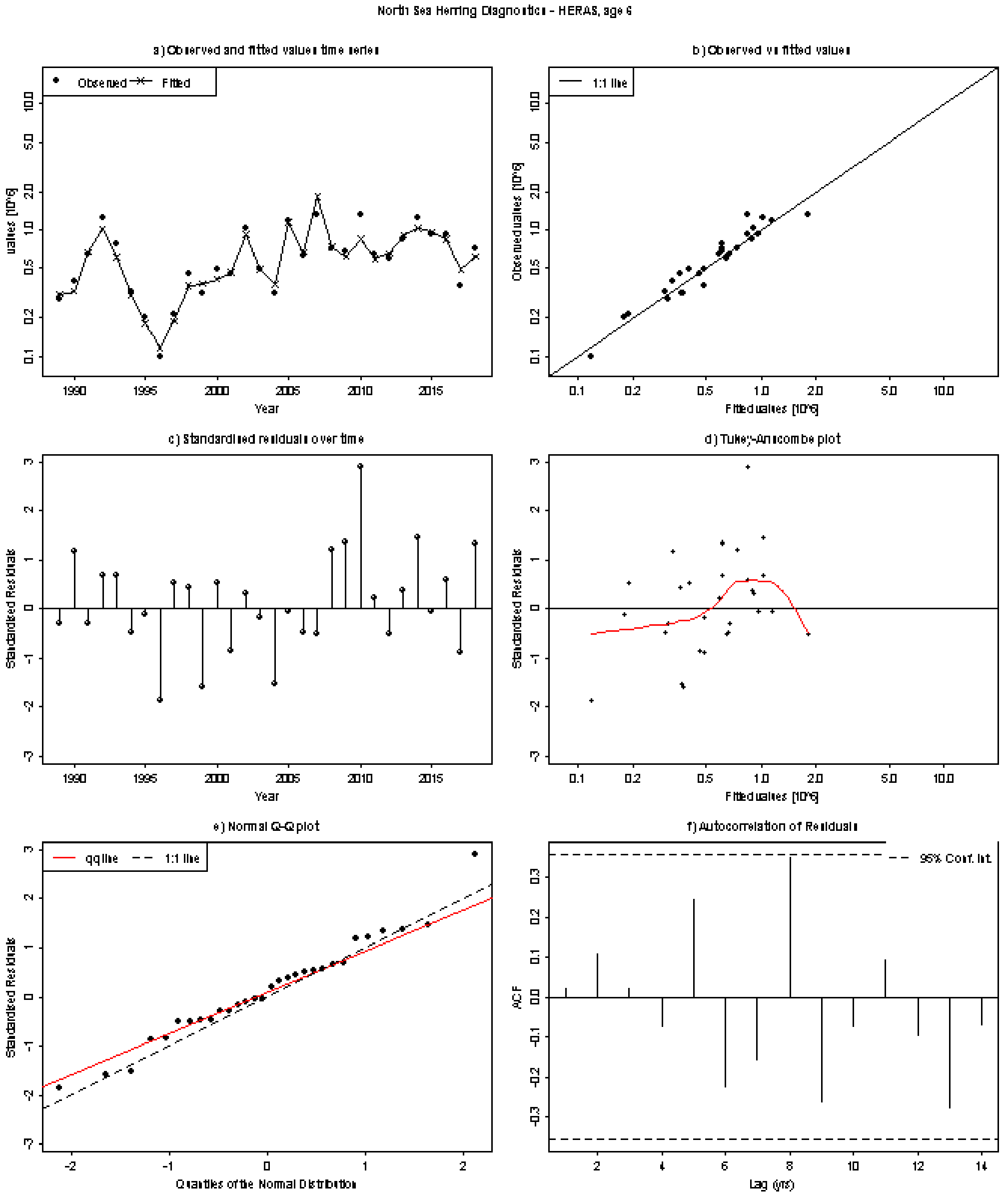

Figure 2.6.1.20. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 6 wr time series. Top left: Estimates of numbers at 6 wr (line) and numbers predicted from index abundance at 6 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 6 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 6 wr. Middle left: Time series of standardized residuals of the index at 6 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

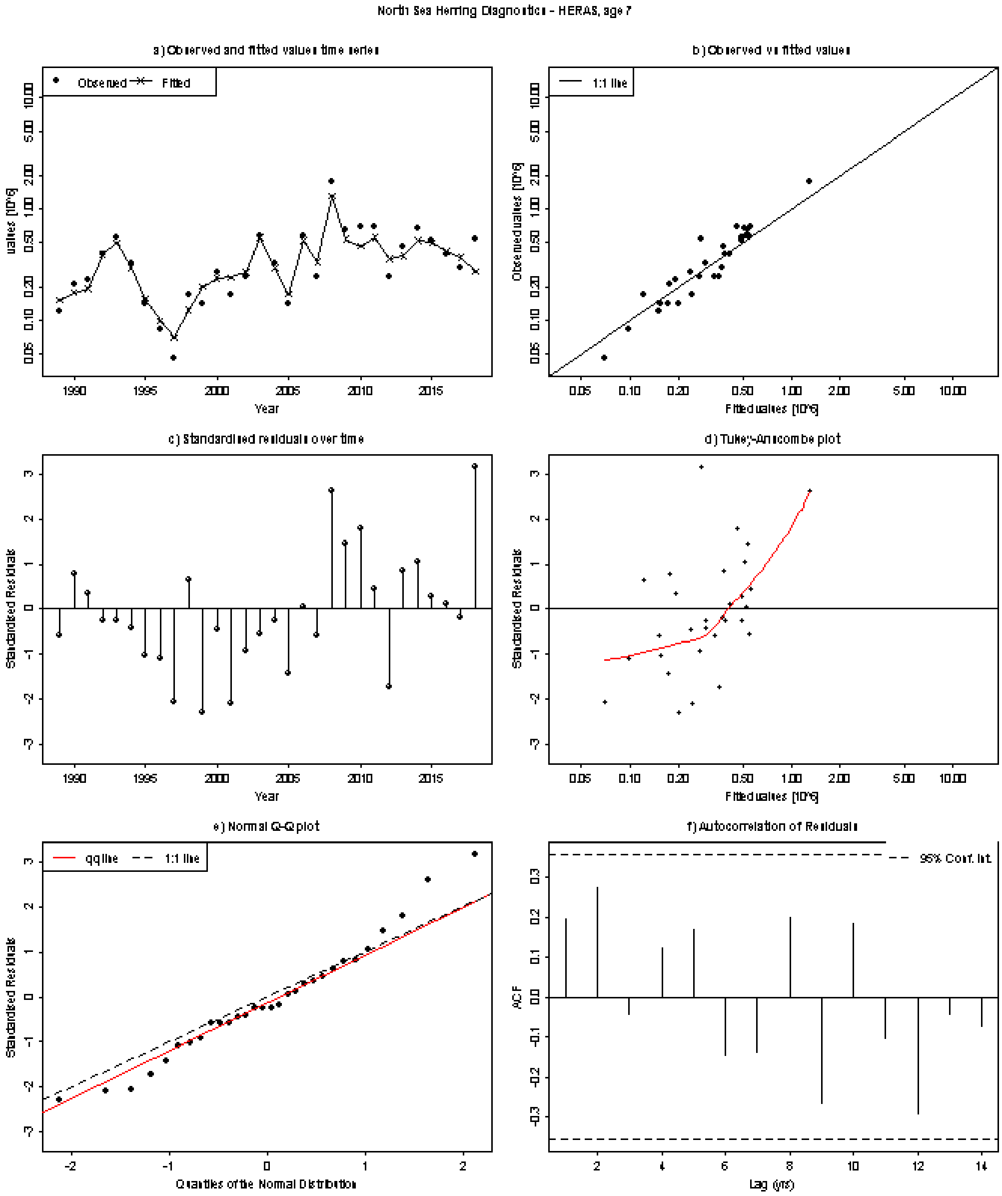

Figure 2.6.1.21. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 7 wr time series. Top left: Estimates of numbers at 7 wr (line) and numbers predicted from index abundance at 7 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 7 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 7 wr. Middle left: Time series of standardized residuals of the index at 7 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

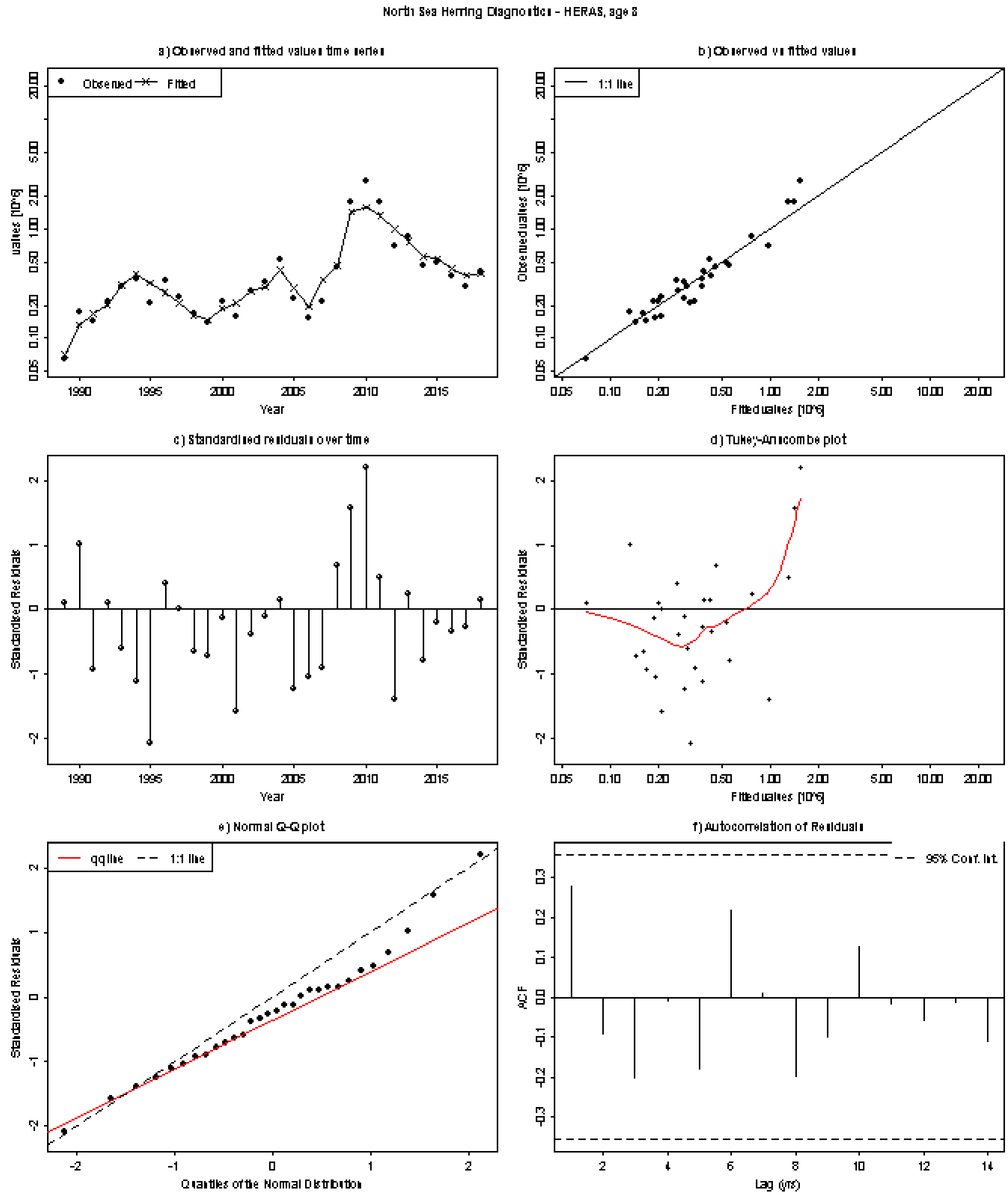

Figure 2.6.1.22. North Sea herring. Diagnostics of the assessment model fit to the HERAS index at age 8+ wr time series. Top left: Estimates of numbers at 8+ wr (line) and numbers predicted from index abundance at 8+ wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 8+ wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 8+ wr. Middle left: Time series of standardized residuals of the index at 8+ wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

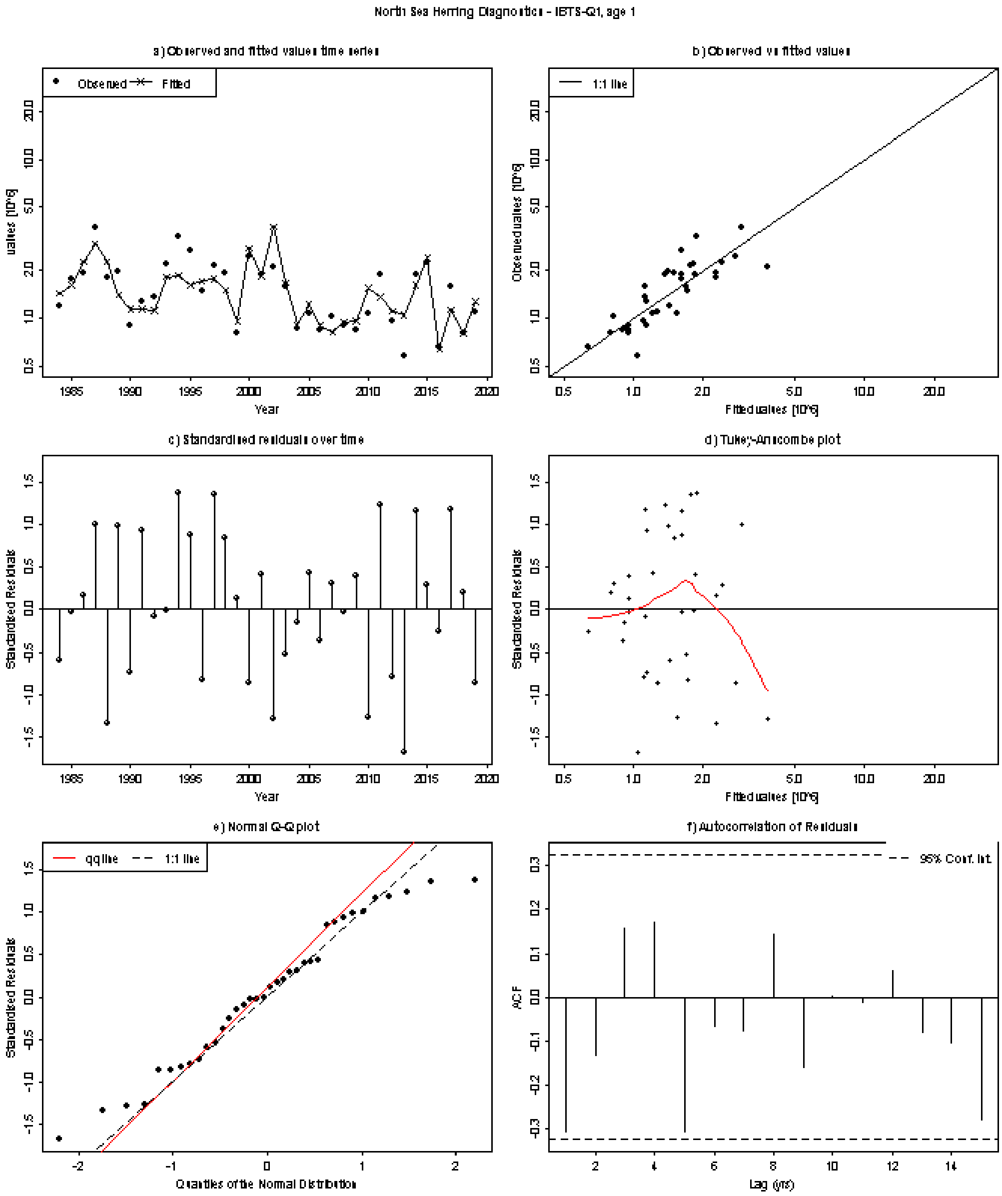

Figure 2.6.1.23 North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q1 index at age 1 wr time series. Top left: Estimates of numbers at 1 wr (line) and numbers predicted from index abundance at 1 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 1 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 1 wr. Middle left: Time series of standardized residuals of the index at 1 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

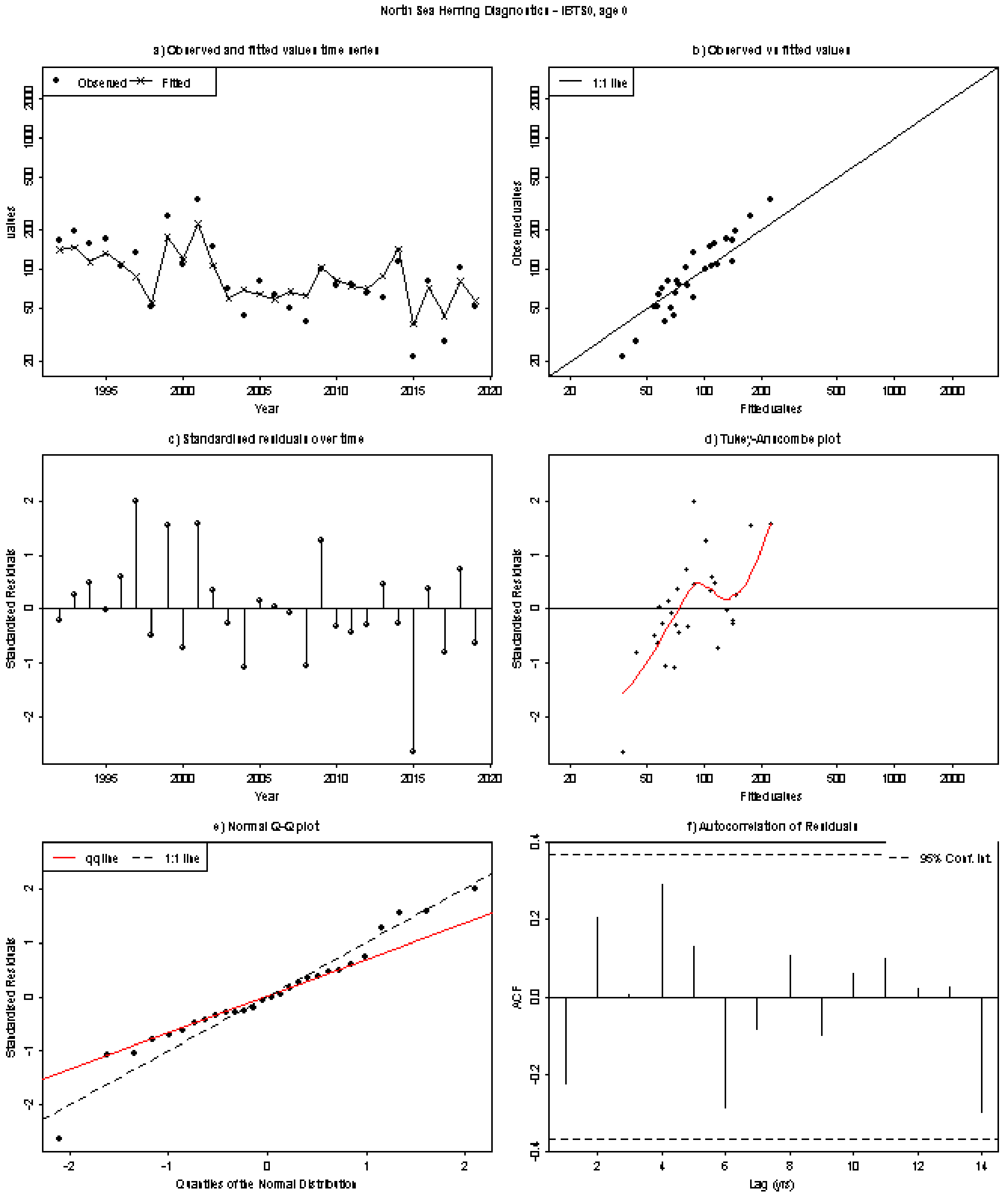

Figure 2.6.1.24. North Sea herring. Diagnostics of the assessment model fit to the IBTS0 index at age 0 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

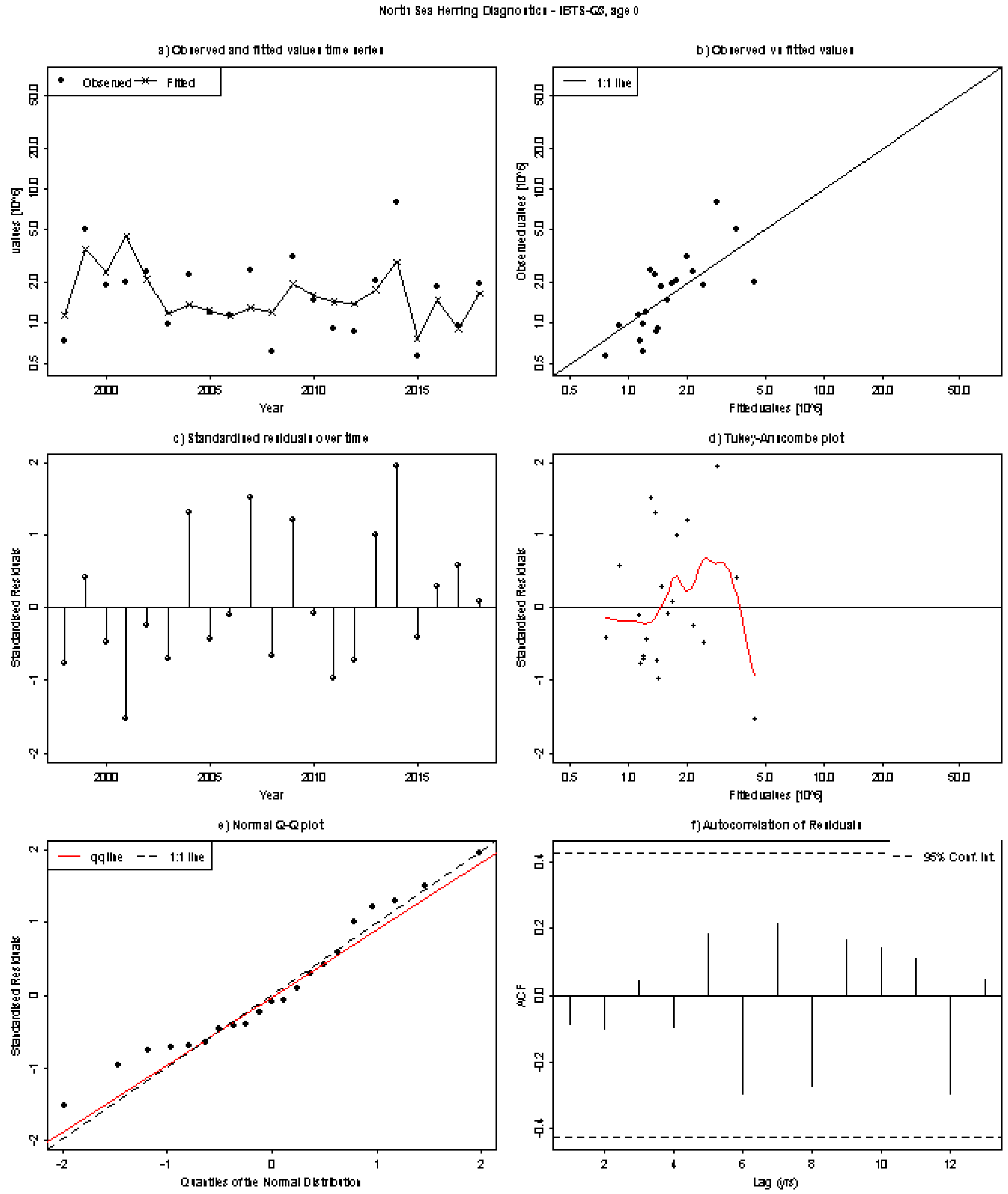

Figure 2.6.1.25. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 0 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

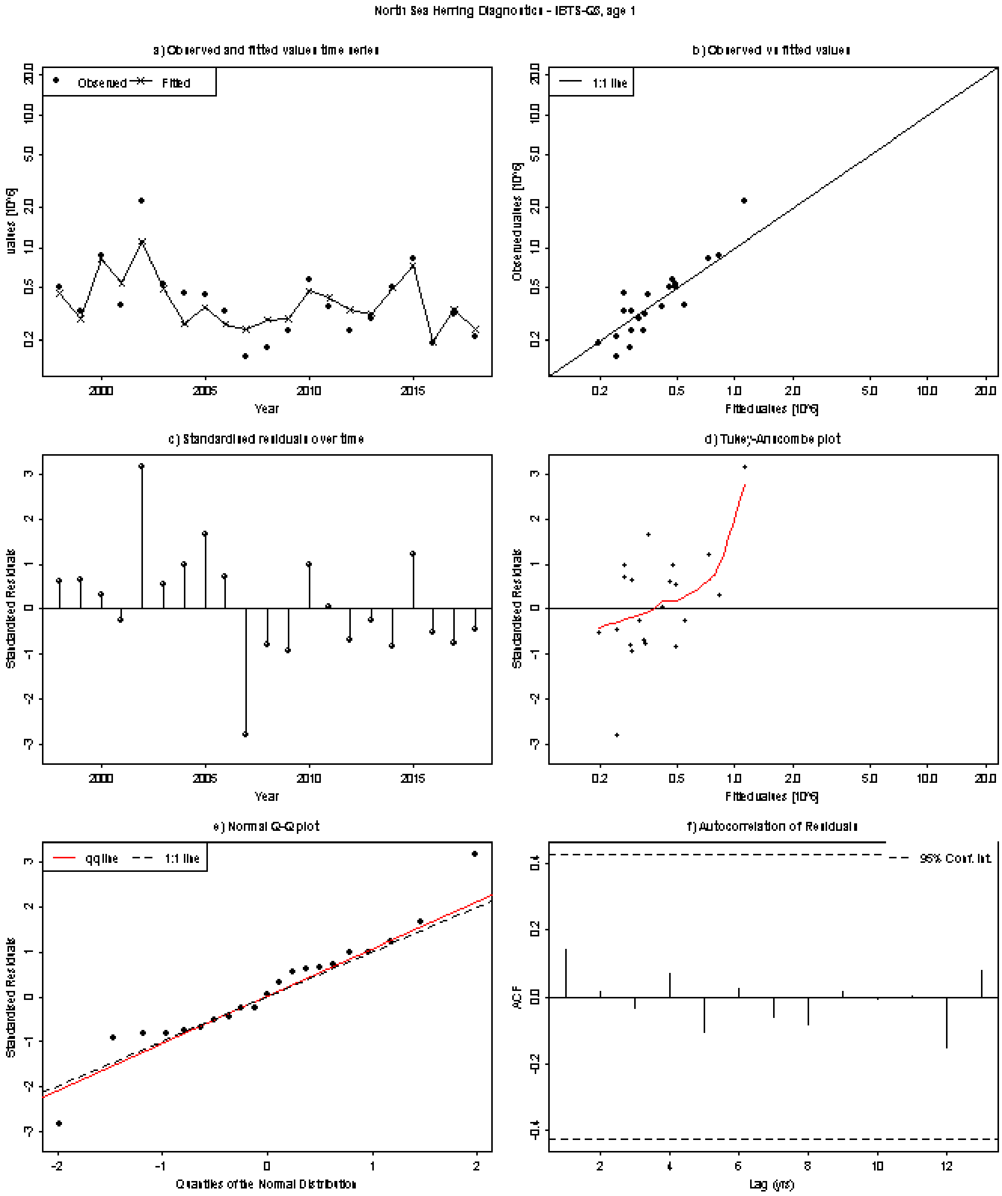

Figure 2.6.1.26. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 1 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

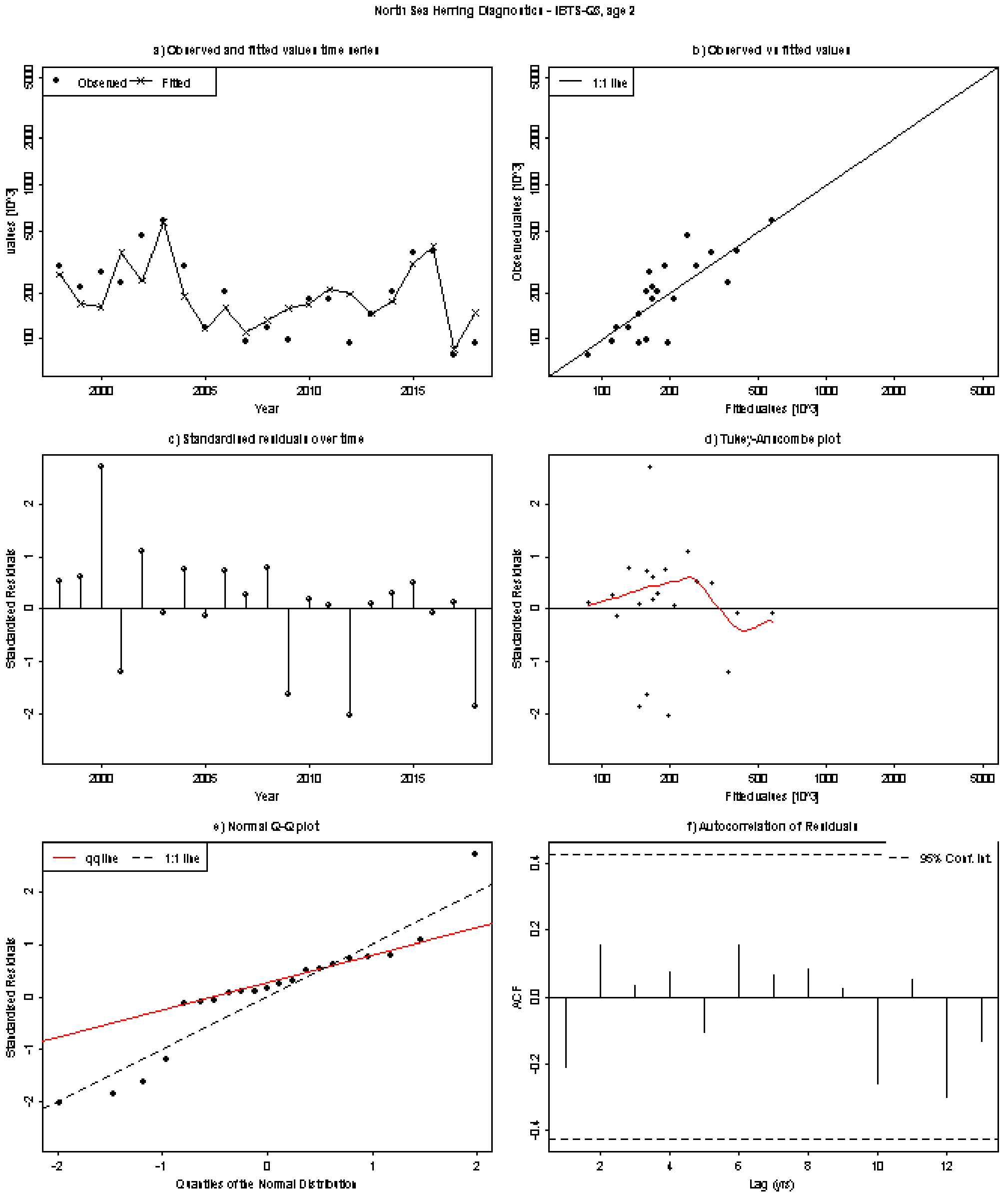

Figure 2.6.1.27. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 2 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

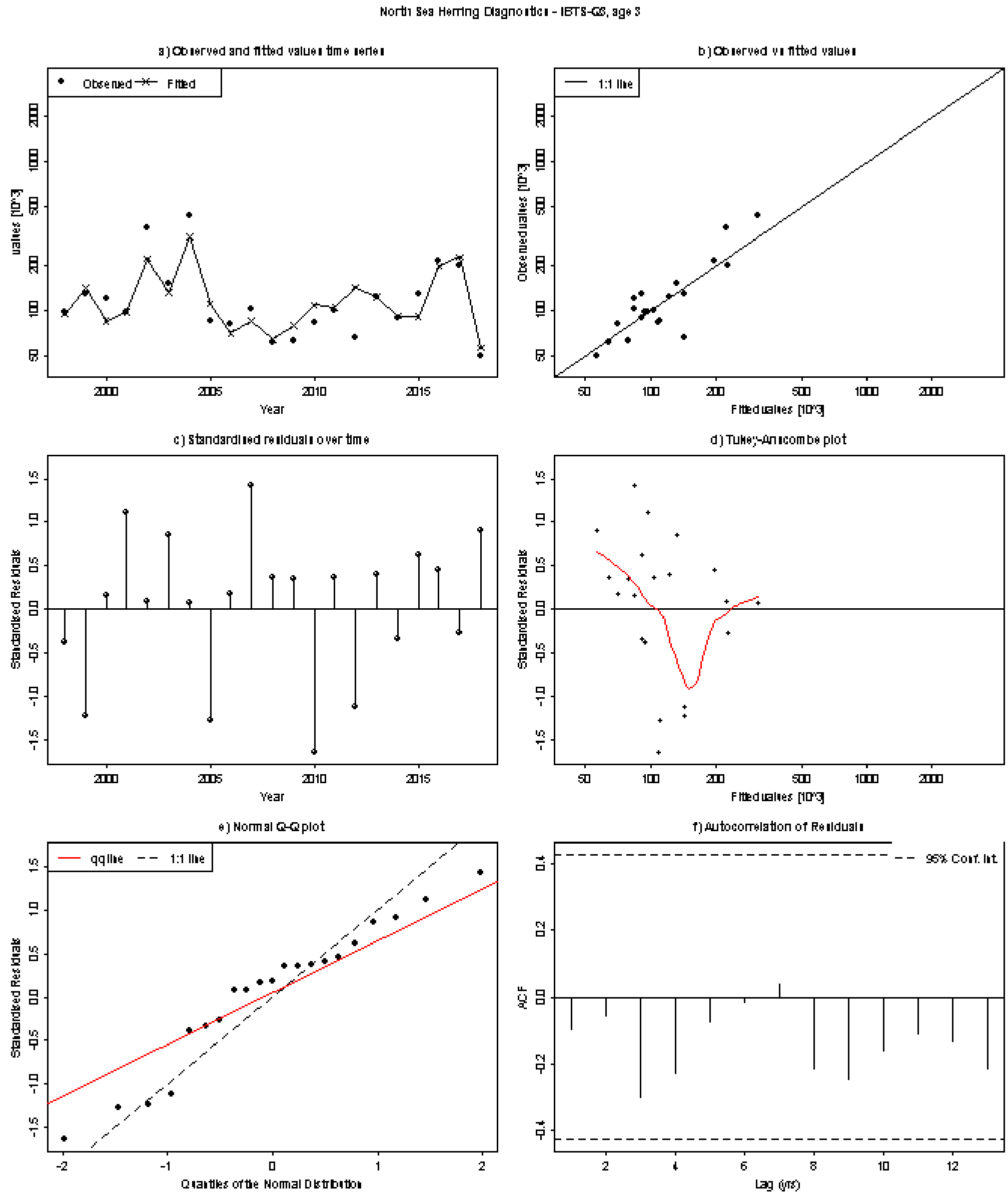

Figure 2.6.1.28. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 3 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

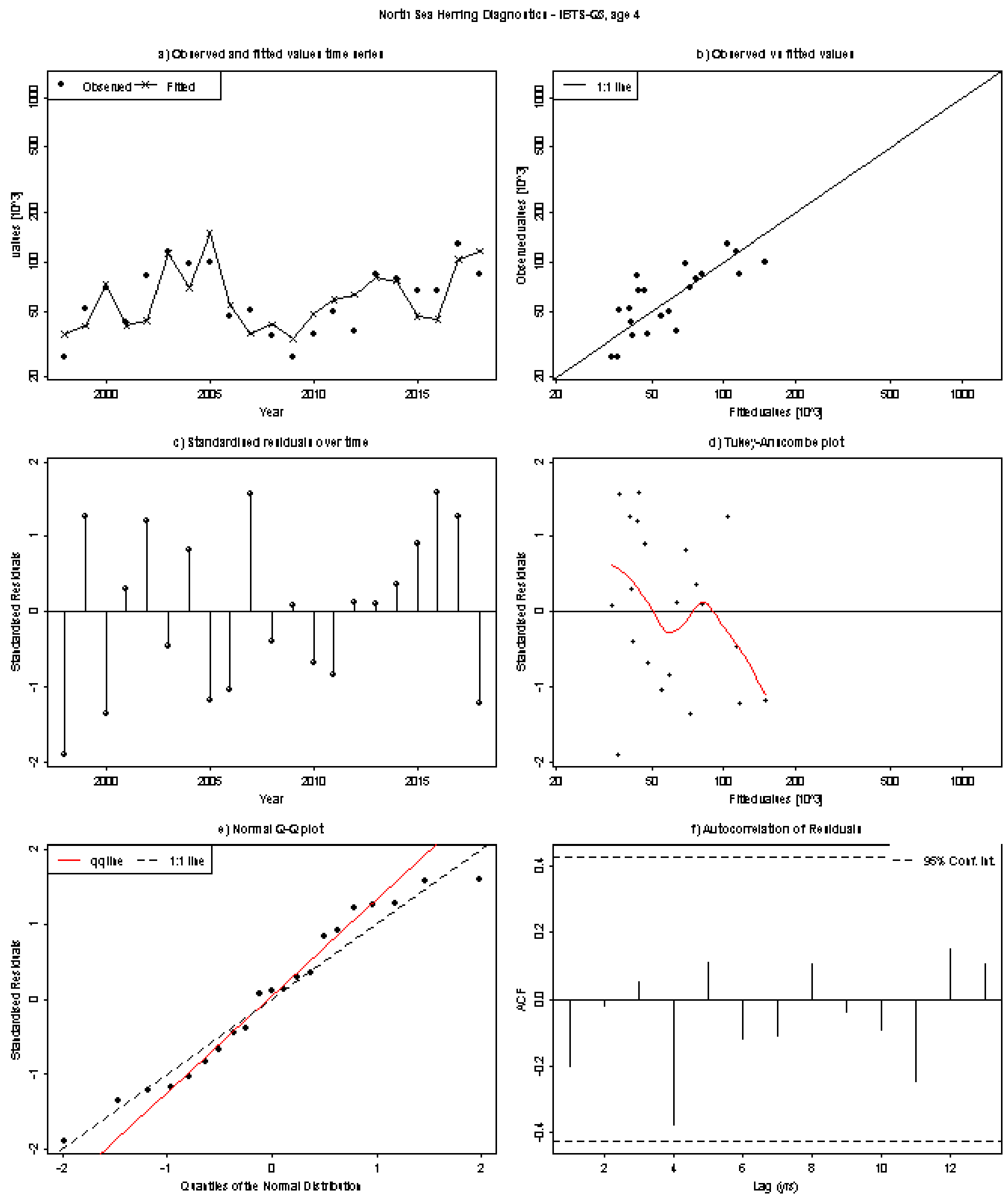

Figure 2.6.1.29. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 4 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

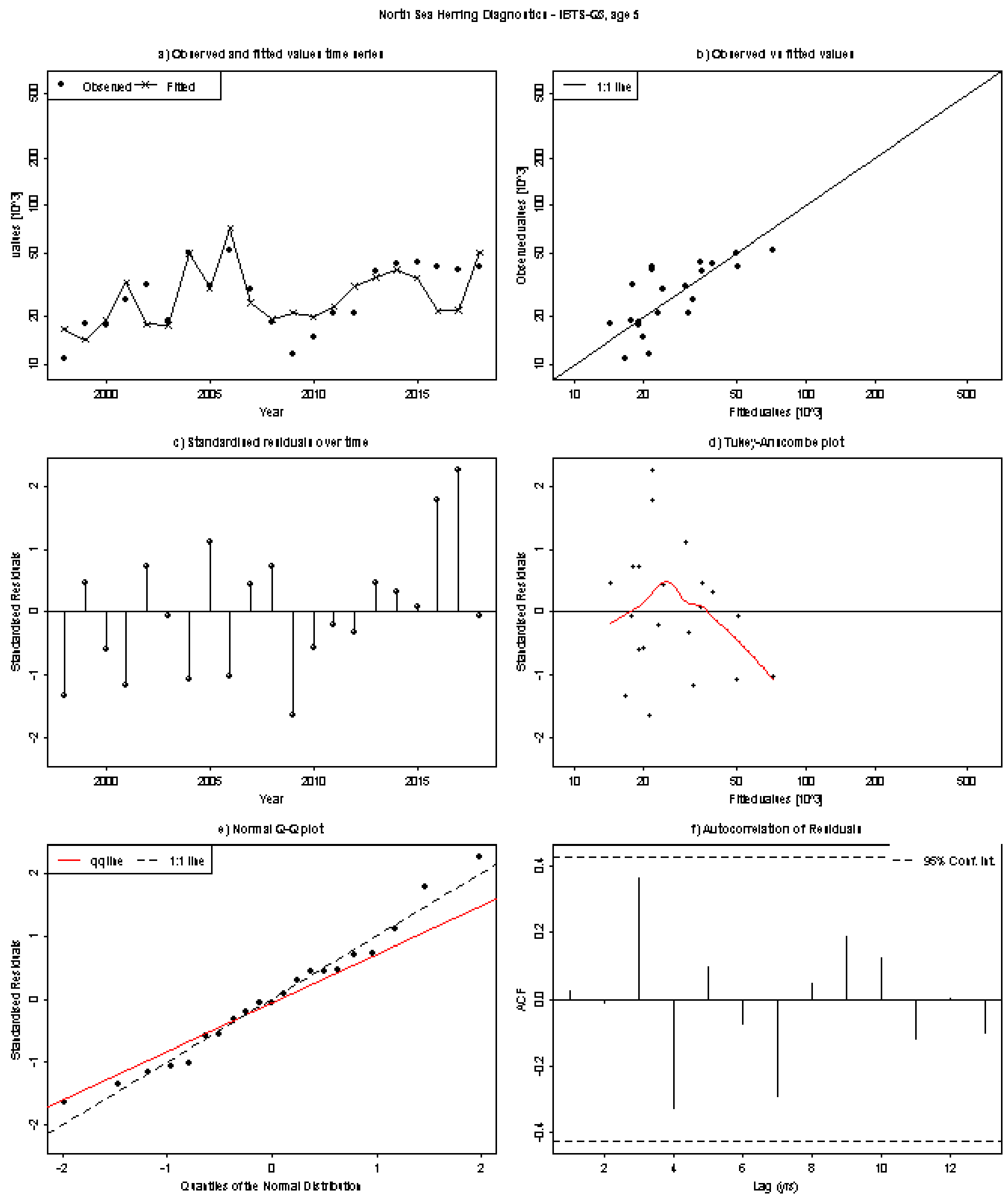

Figure 2.6.1.30. North Sea herring. Diagnostics of the assessment model fit to the IBTS-Q3 index at age 5 wr time series. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

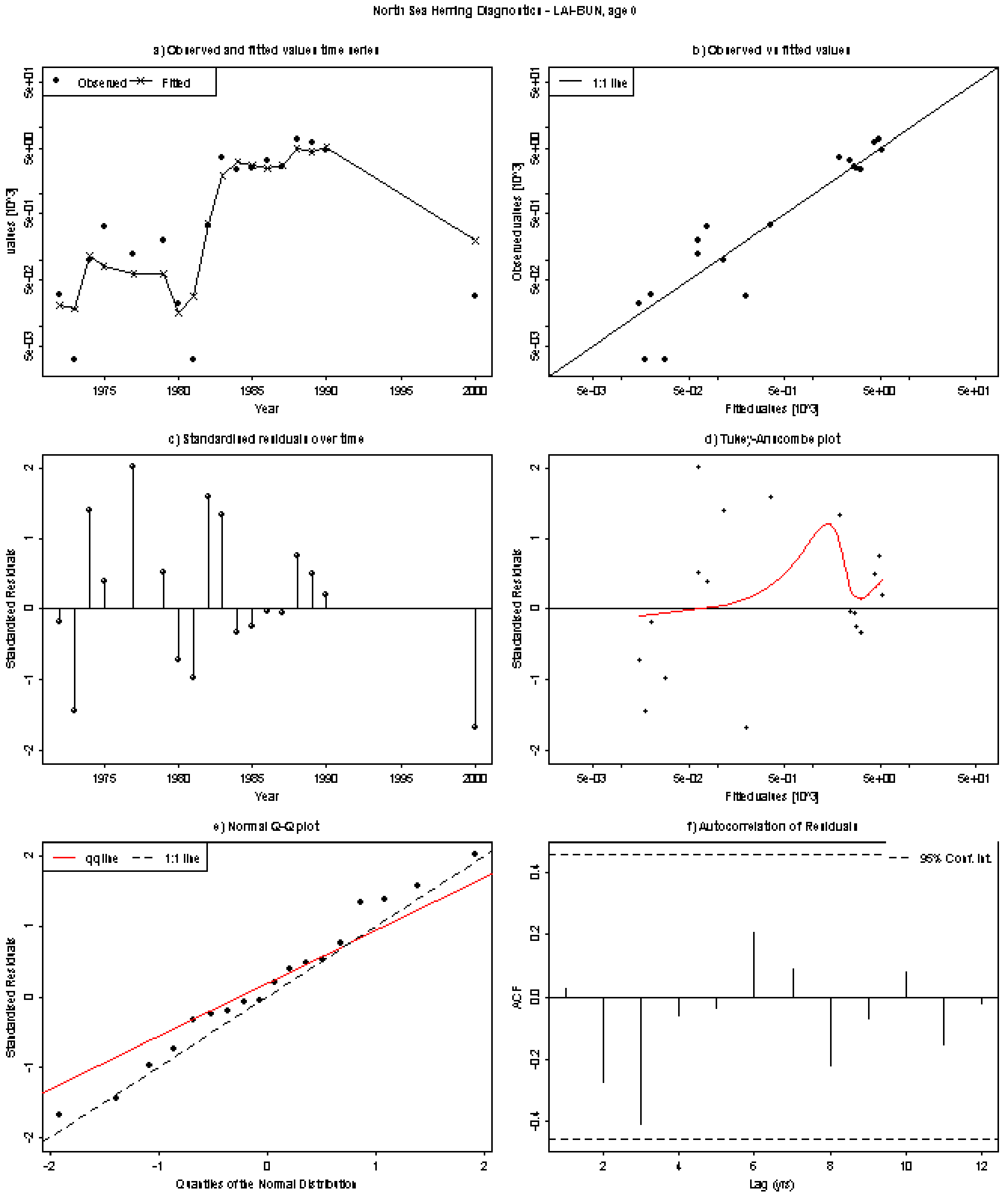

Figure 2.6.1.31. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Buchan area for the first week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

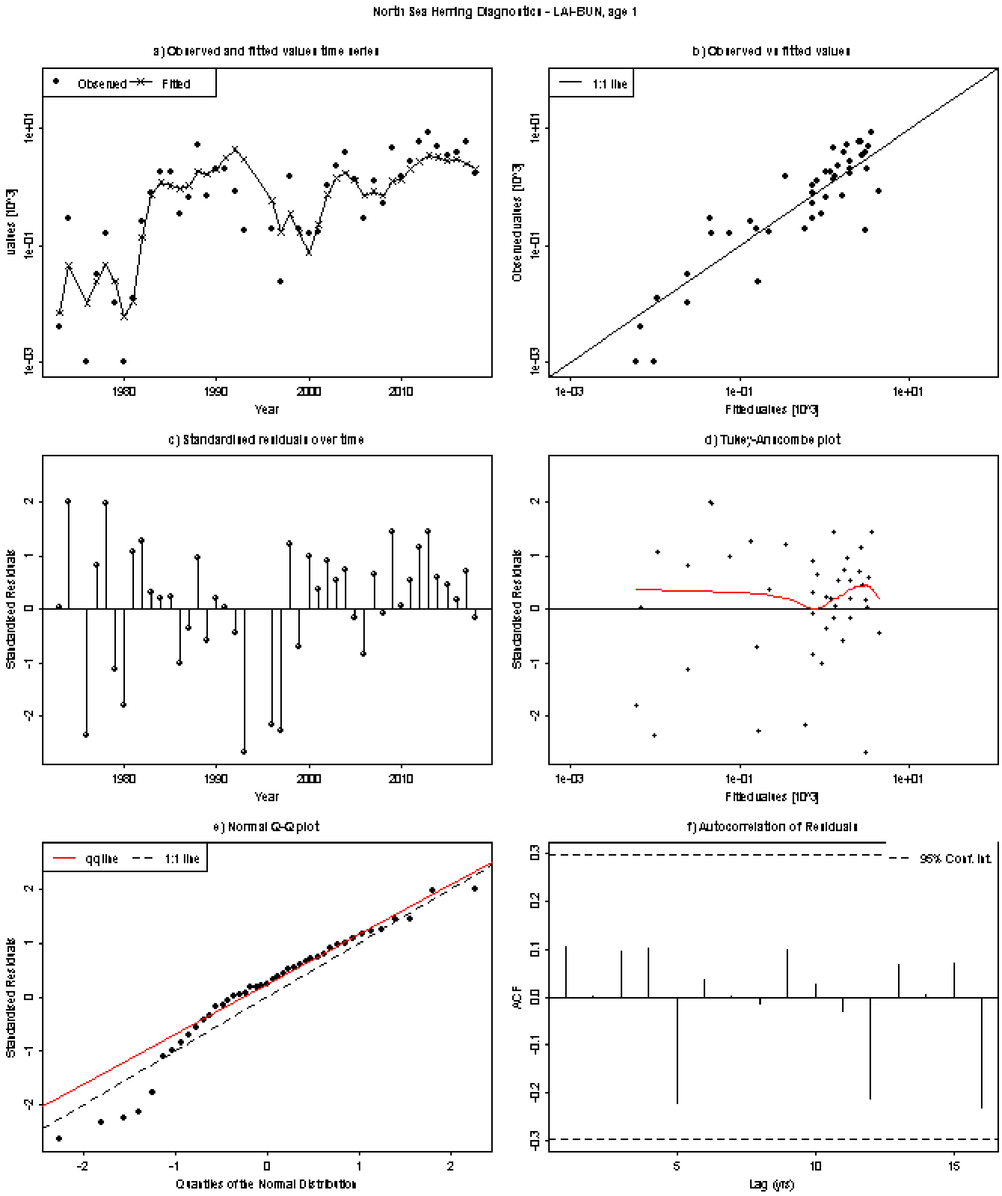

Figure 2.6.1.32. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Buchan area for the second week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

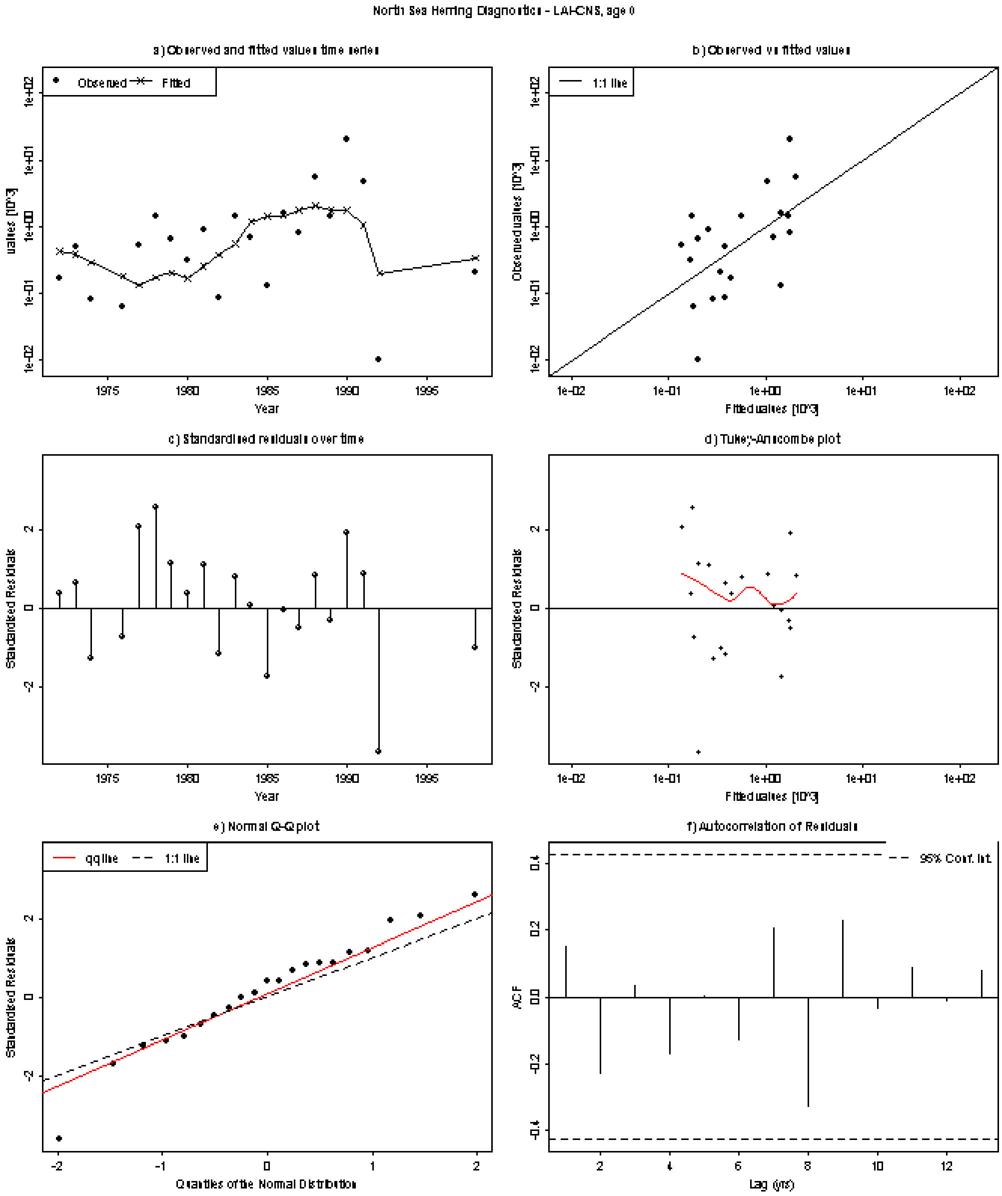

Figure 2.6.1.33. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Banks area for the first week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

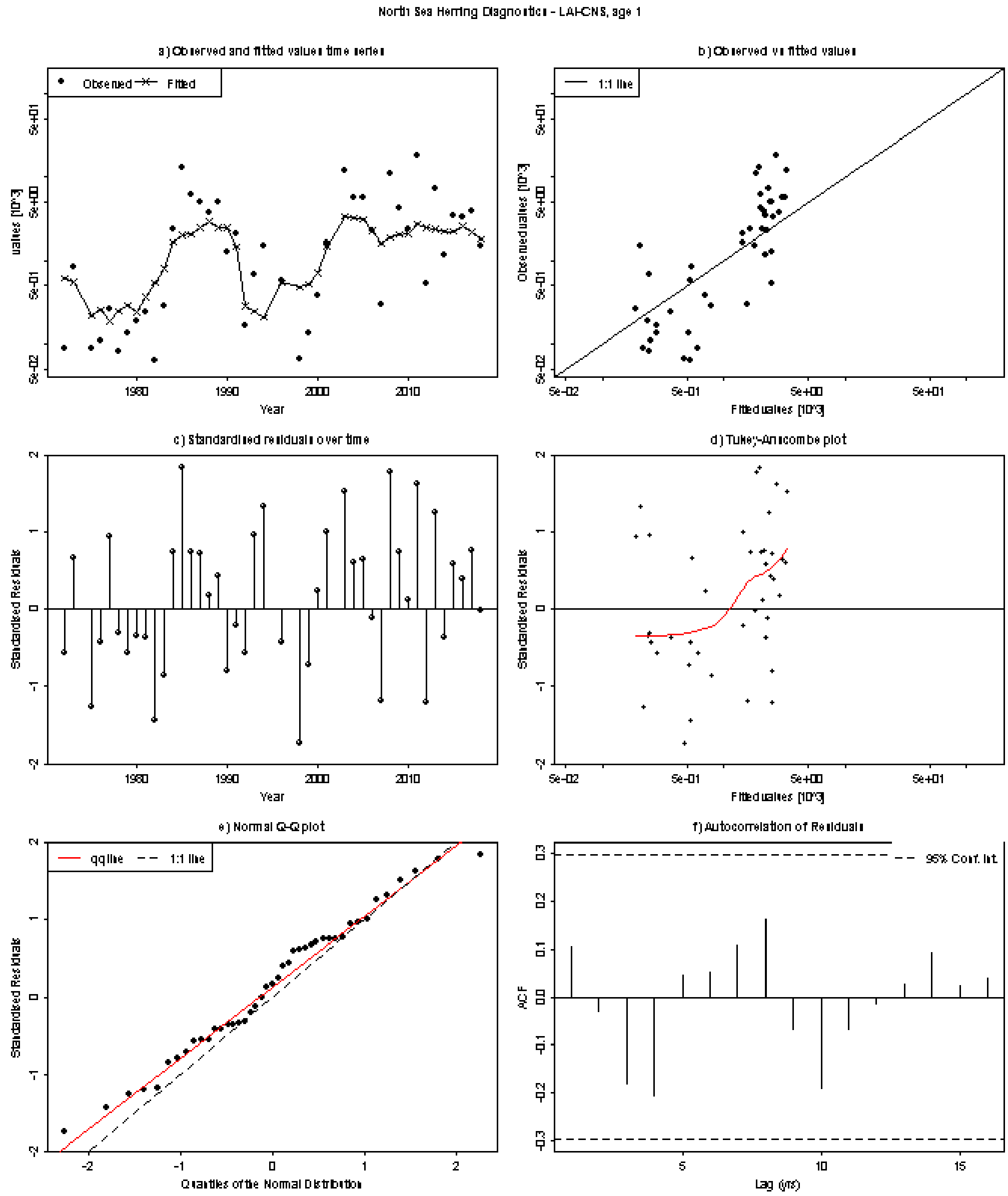

Figure 2.6.1.34. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Banks area for the second week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

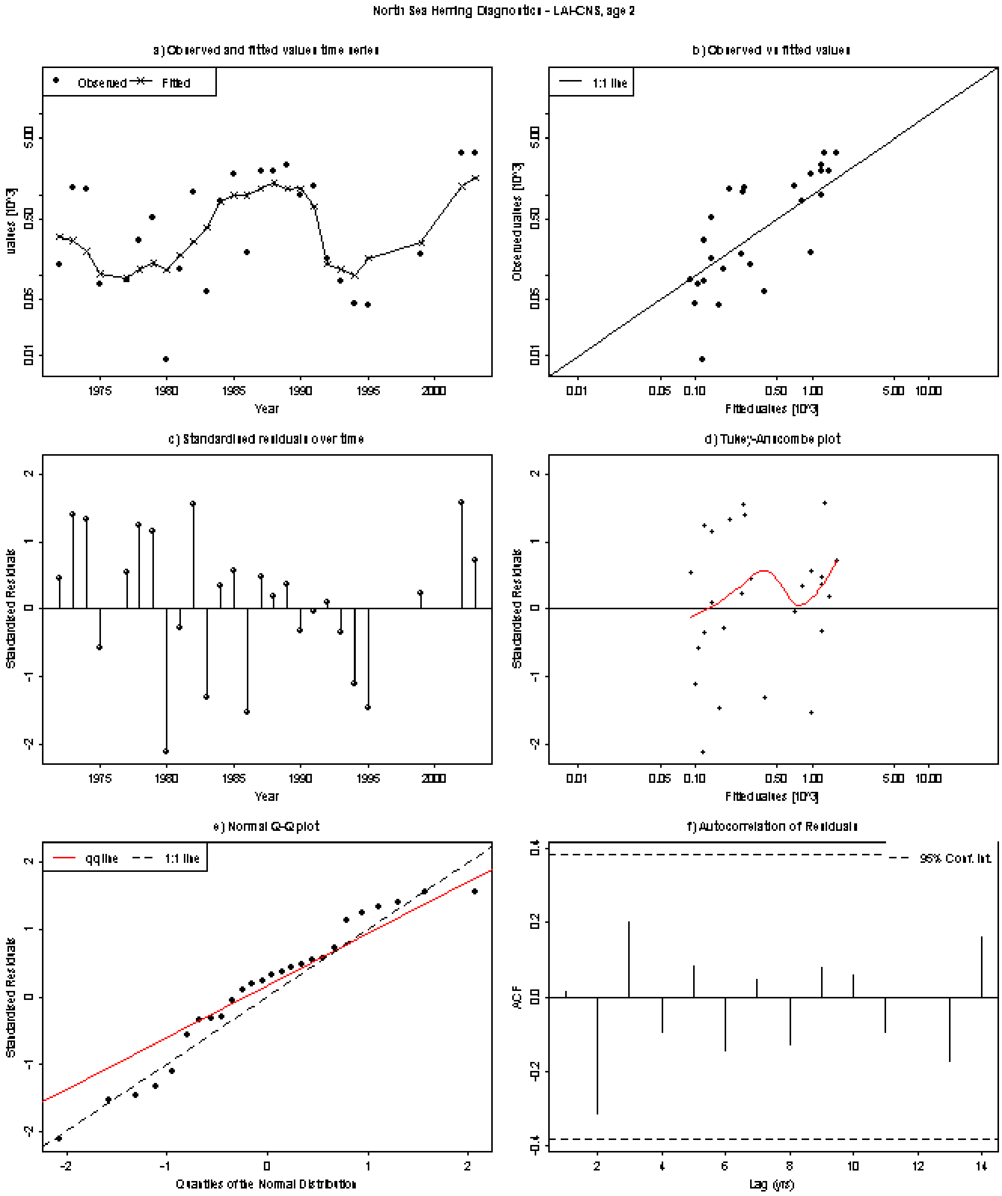

Figure 2.6.1.35. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Banks area for the third week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

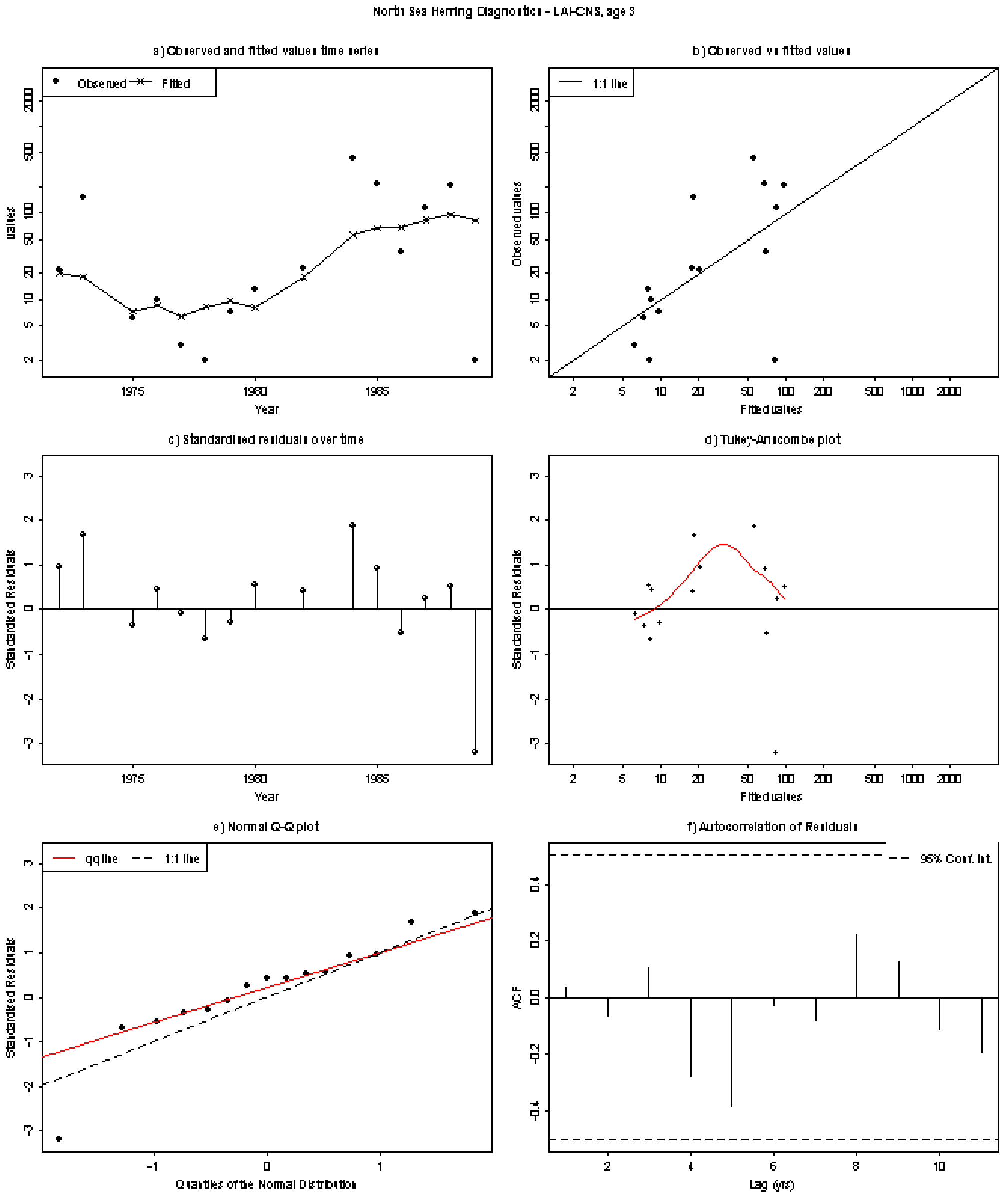

Figure 2.6.1.36. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Banks area for the fourth week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

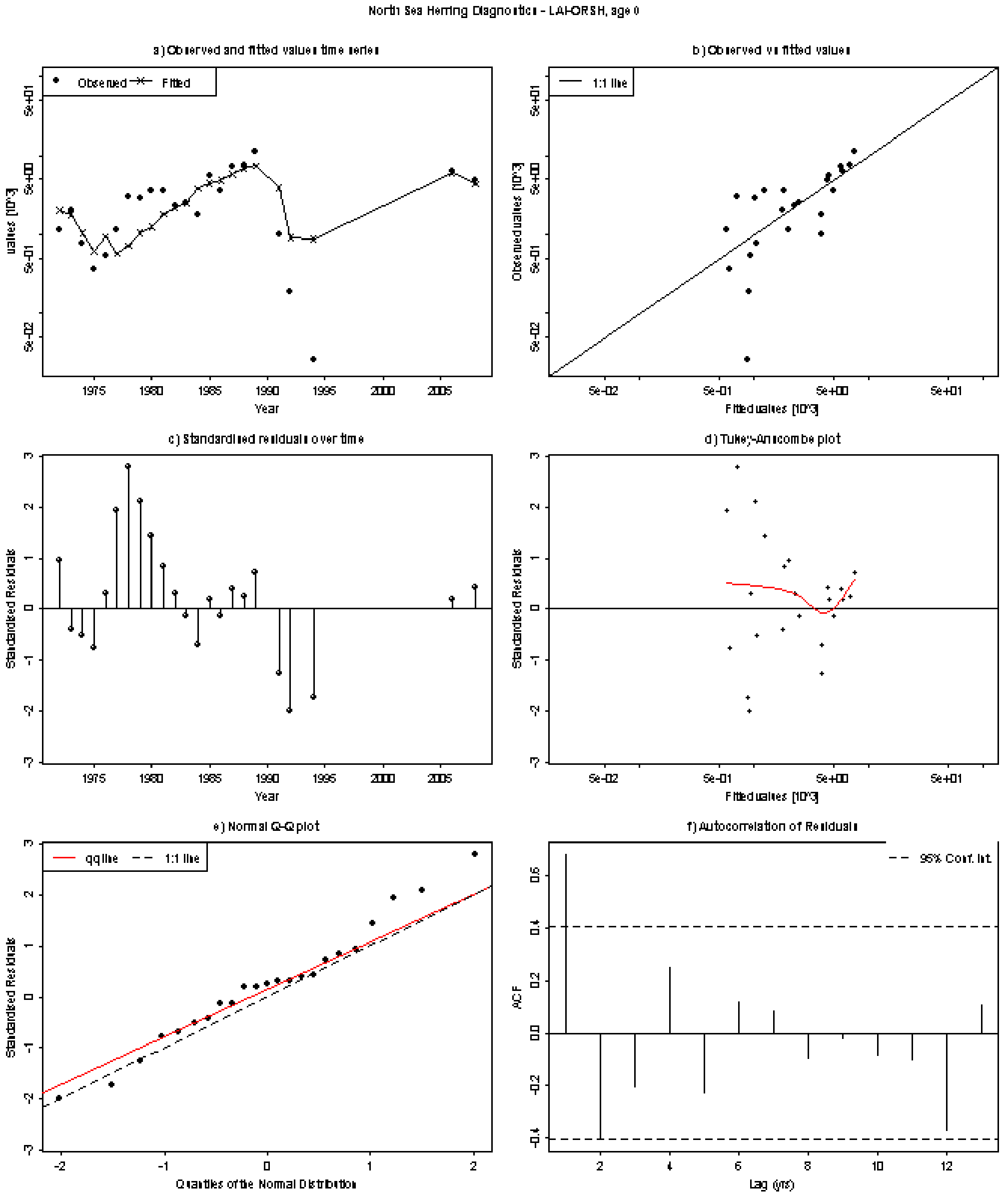

Figure 2.6.1.37. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Orkney/Shetland area for the first week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

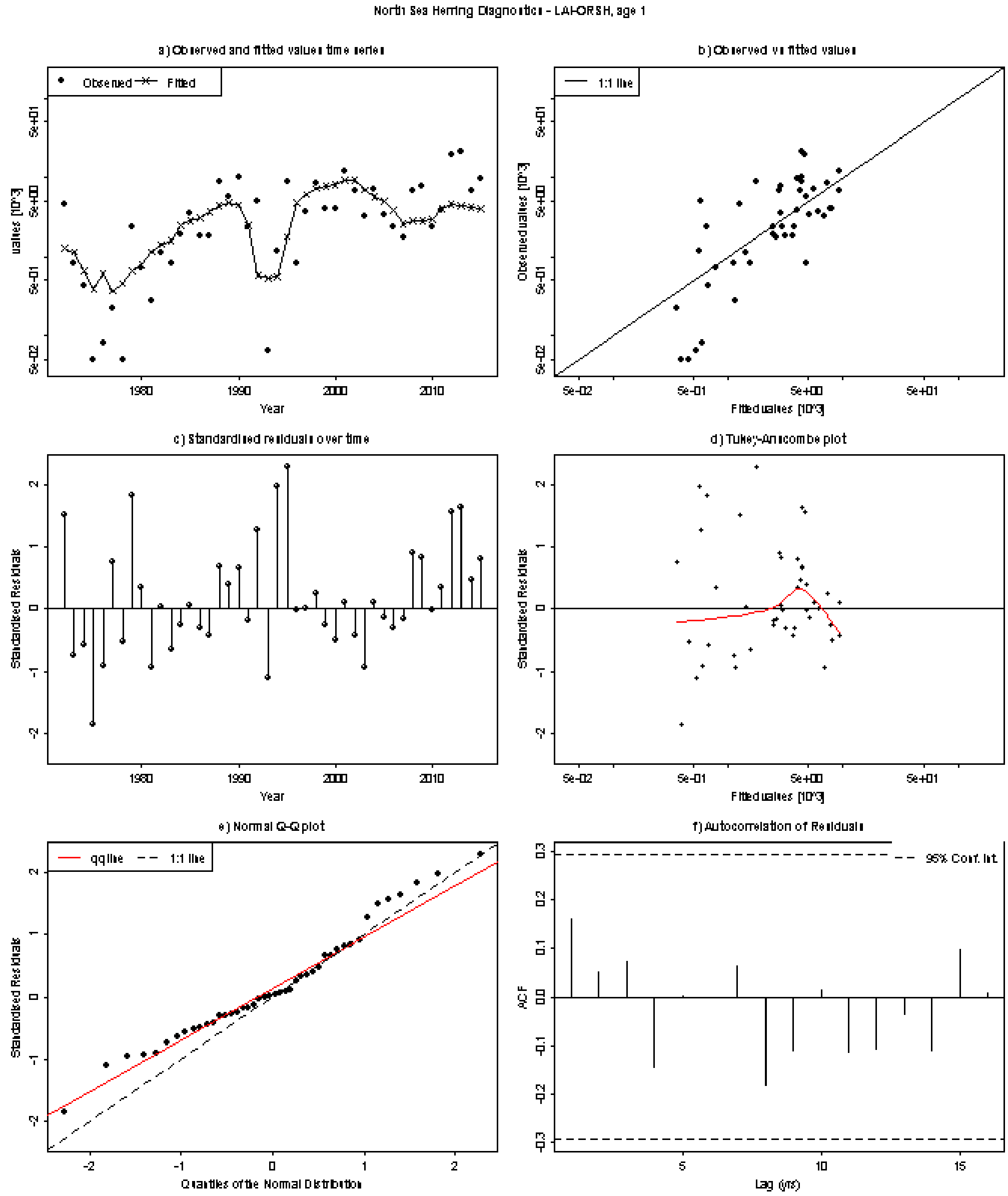

Figure 2.6.1.38. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Orkney/Shetland area for the second week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

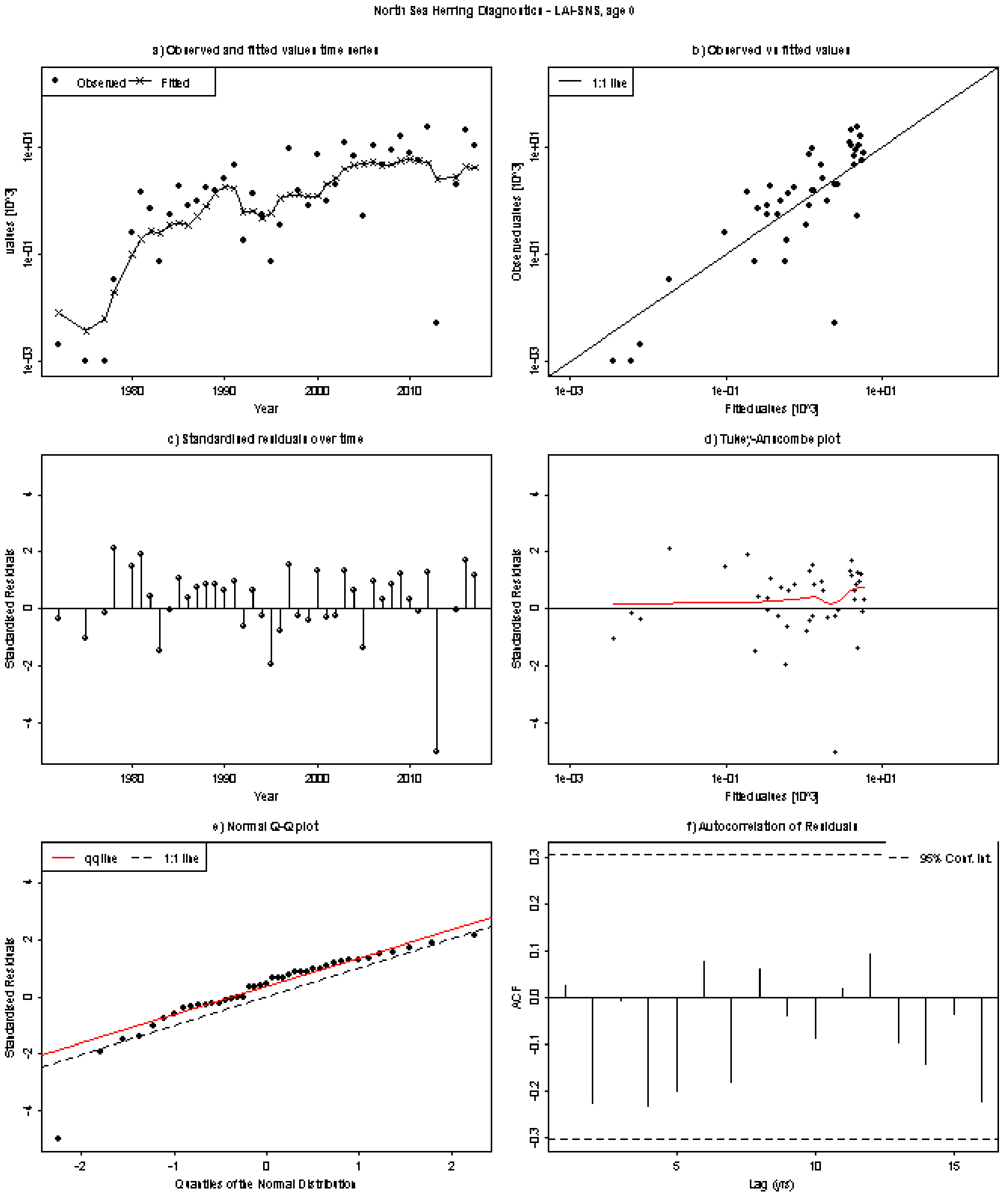

Figure 2.6.1.39. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Downs area for the first week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

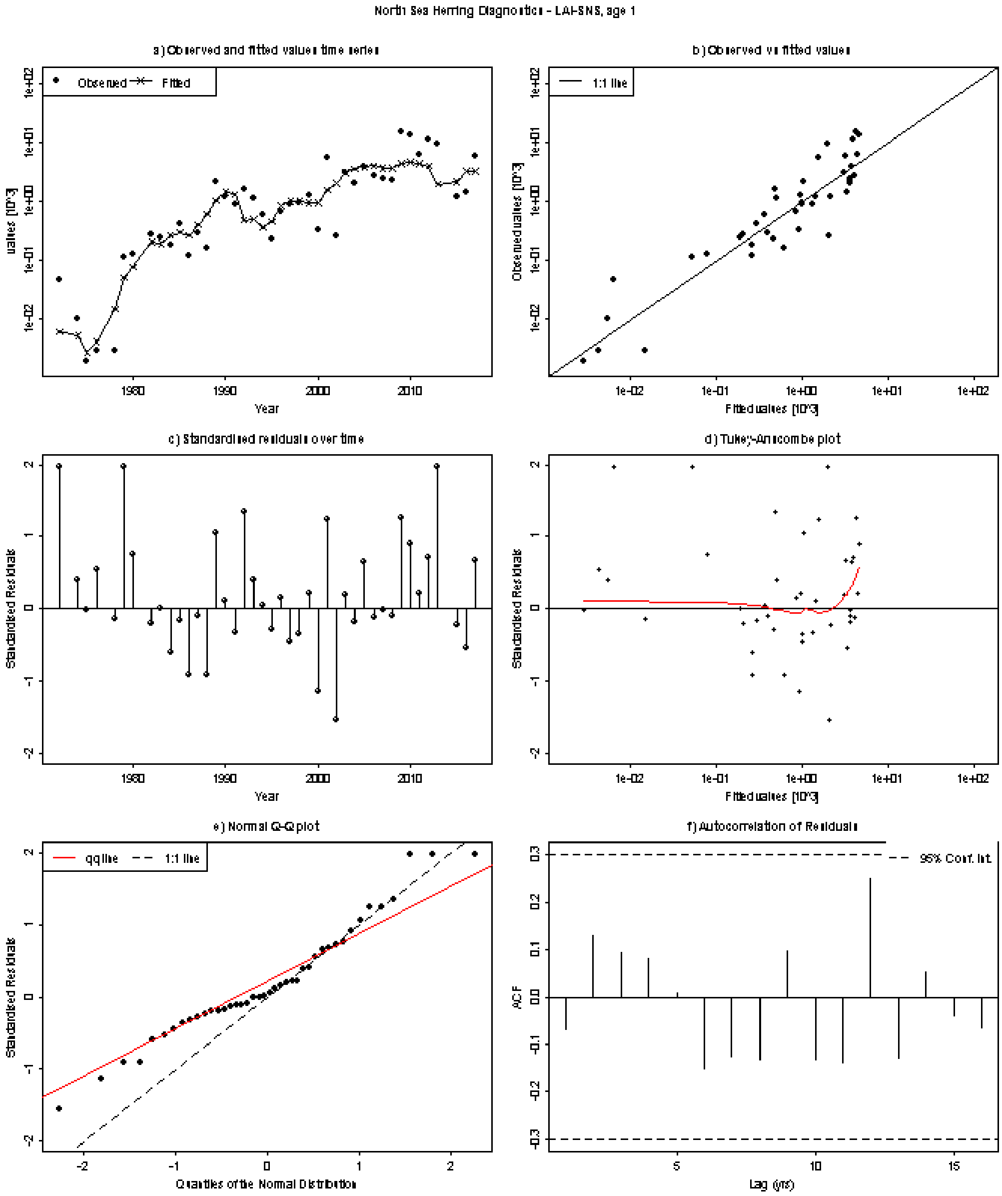

Figure 2.6.1.40. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Downs area for the second week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

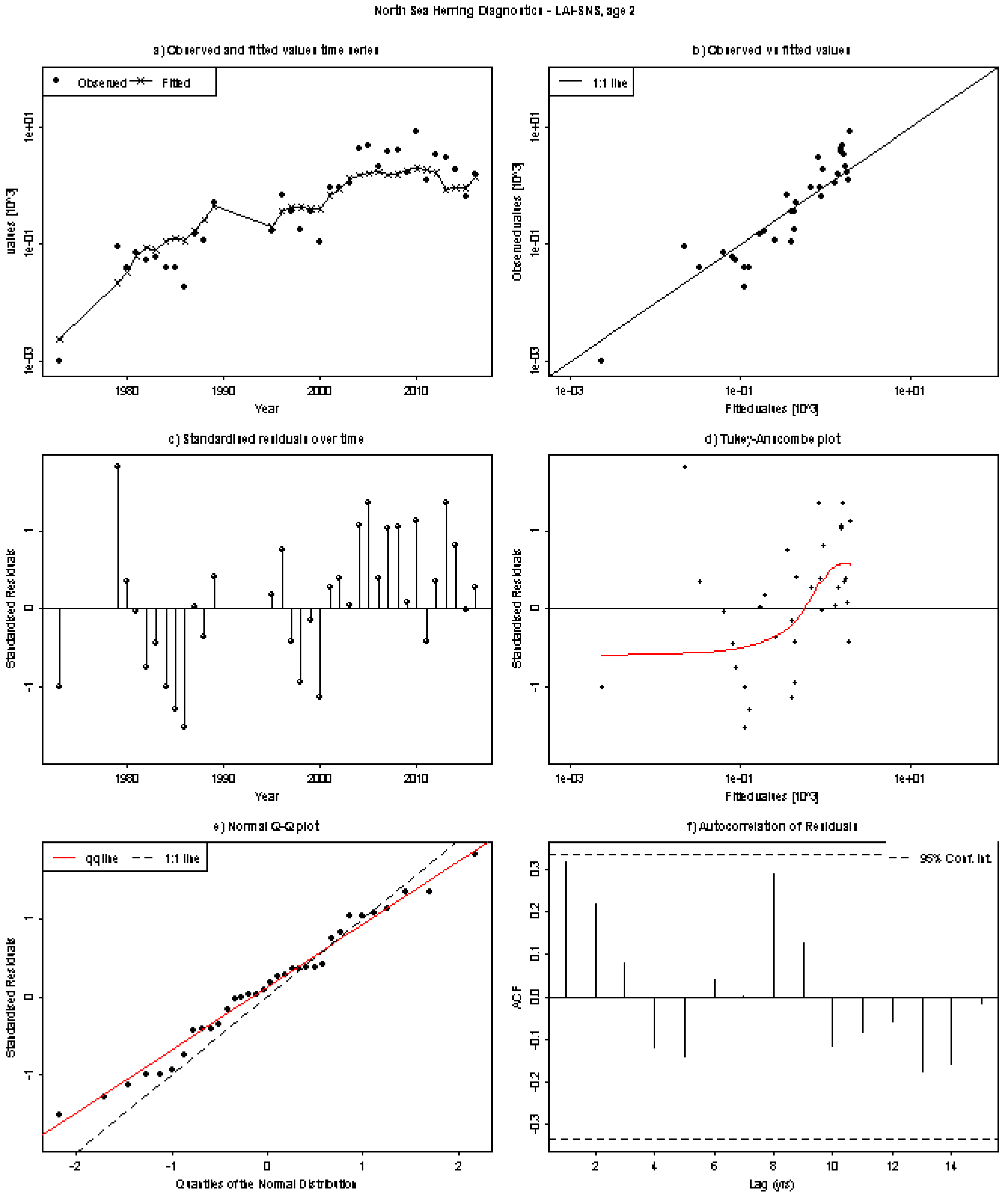

Figure 2.6.1.41. North Sea herring. Diagnostics of the assessment model fit to the LAI index in the Downs area for the third week time series available for this component. Top left: Estimates of numbers at 0 wr (line) and numbers predicted from index abundance at 0 wr. Top right: scatterplot of index observations versus assessment model estimates of numbers at 0 wr with the best-fit catchability model (linear function). Middle right: index observation versus standardized residuals at 0 wr. Middle left: Time series of standardized residuals of the index at 0 wr. Bottom left: normal Q-Q plot of standardized residuals. Bottom right: Autocorrelation plot.

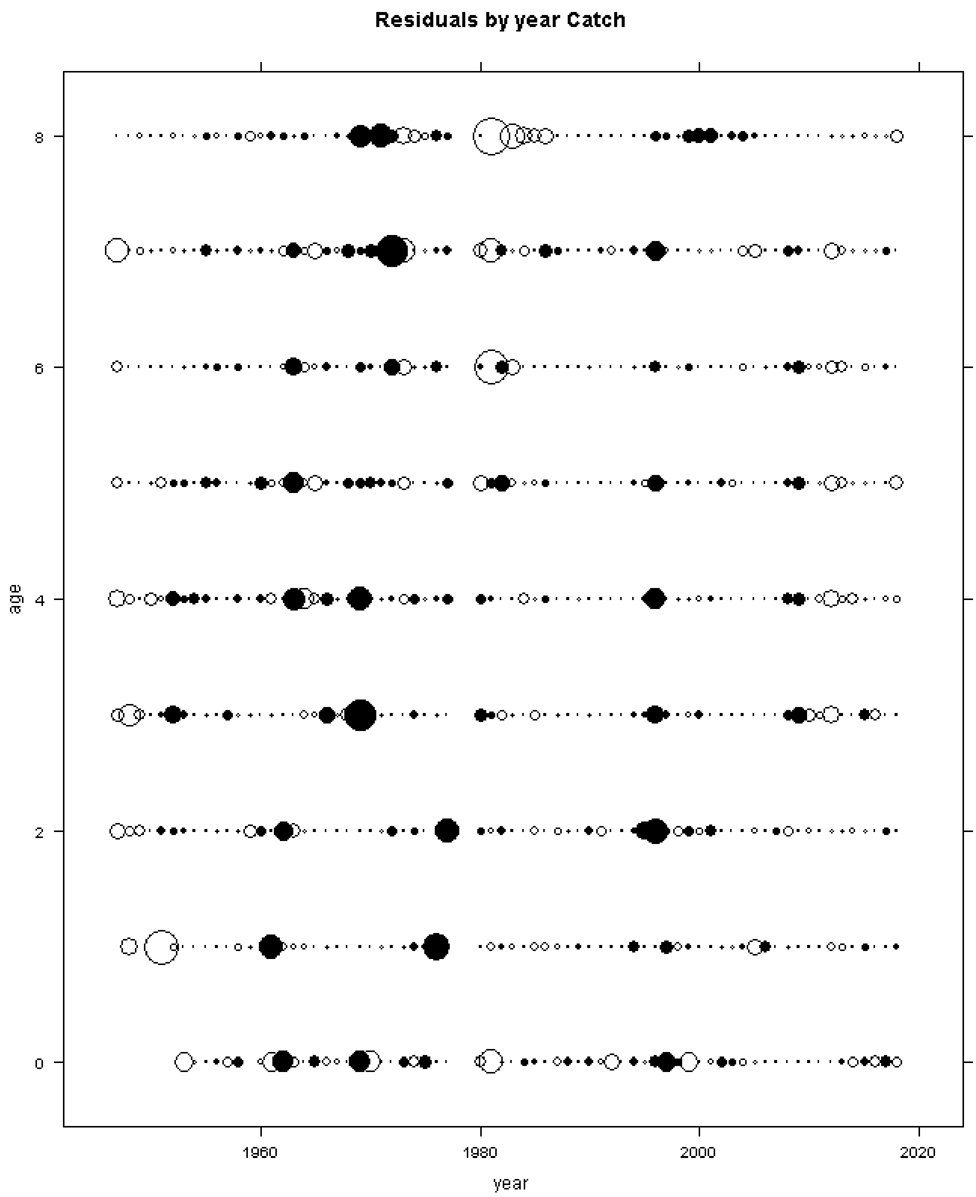

Figure 2.6.1.42. North Sea herring. Bubble plot of standardised catch residual.

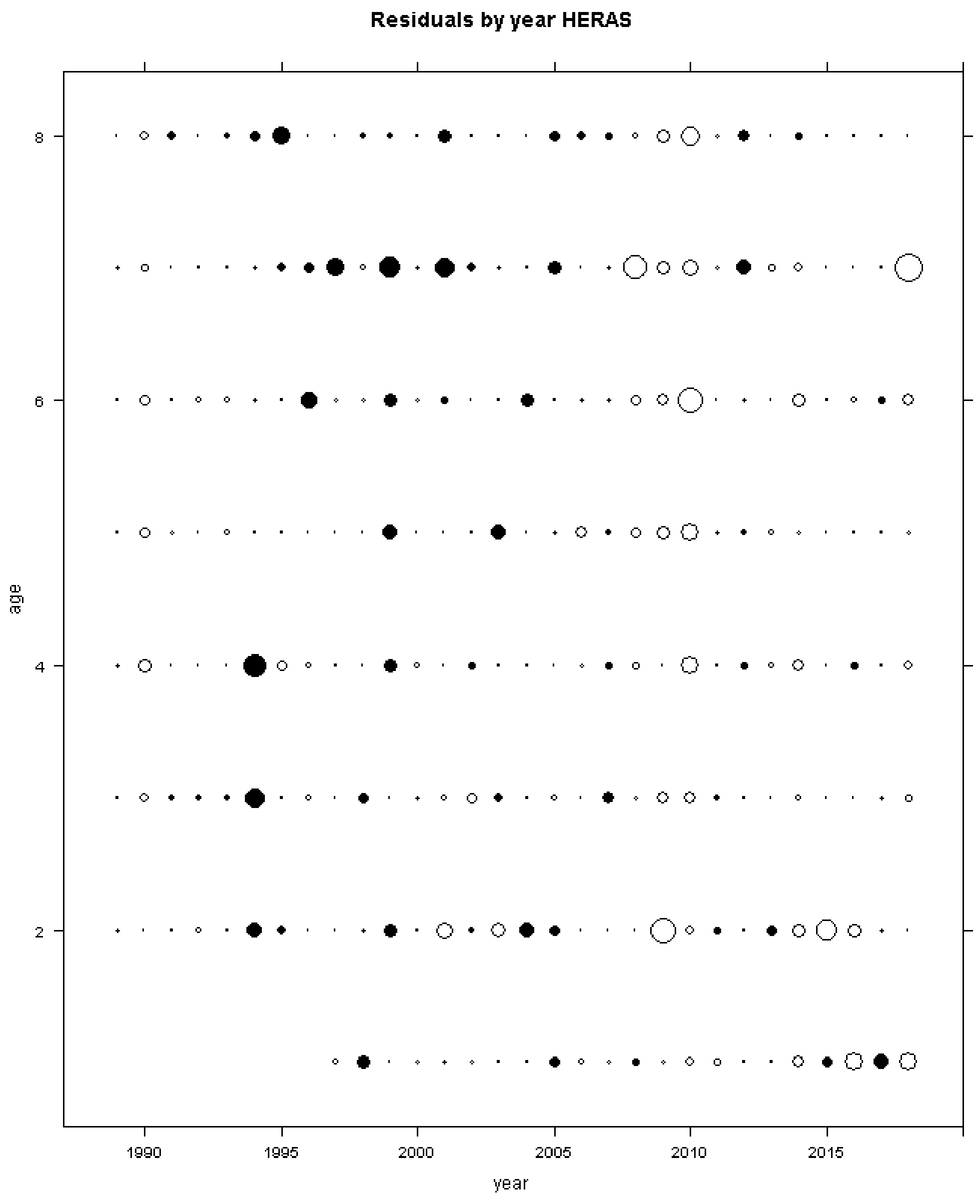

Figure 2.6.1.43. North Sea herring. Bubble plot of standardised acoustic survey residuals.

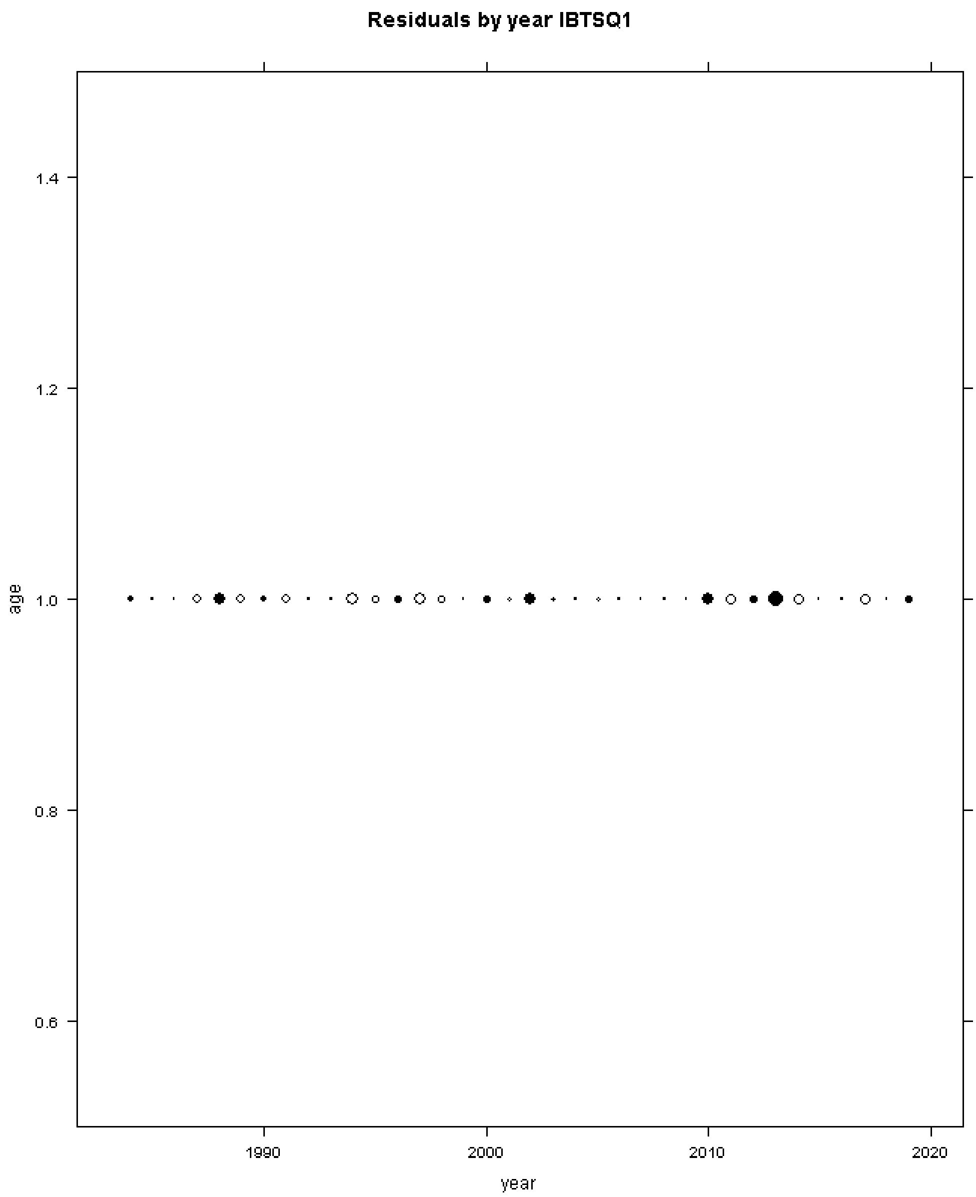

Figure 2.6.1.44. North Sea herring. Bubble plot of standardised IBTSQ1 residuals.

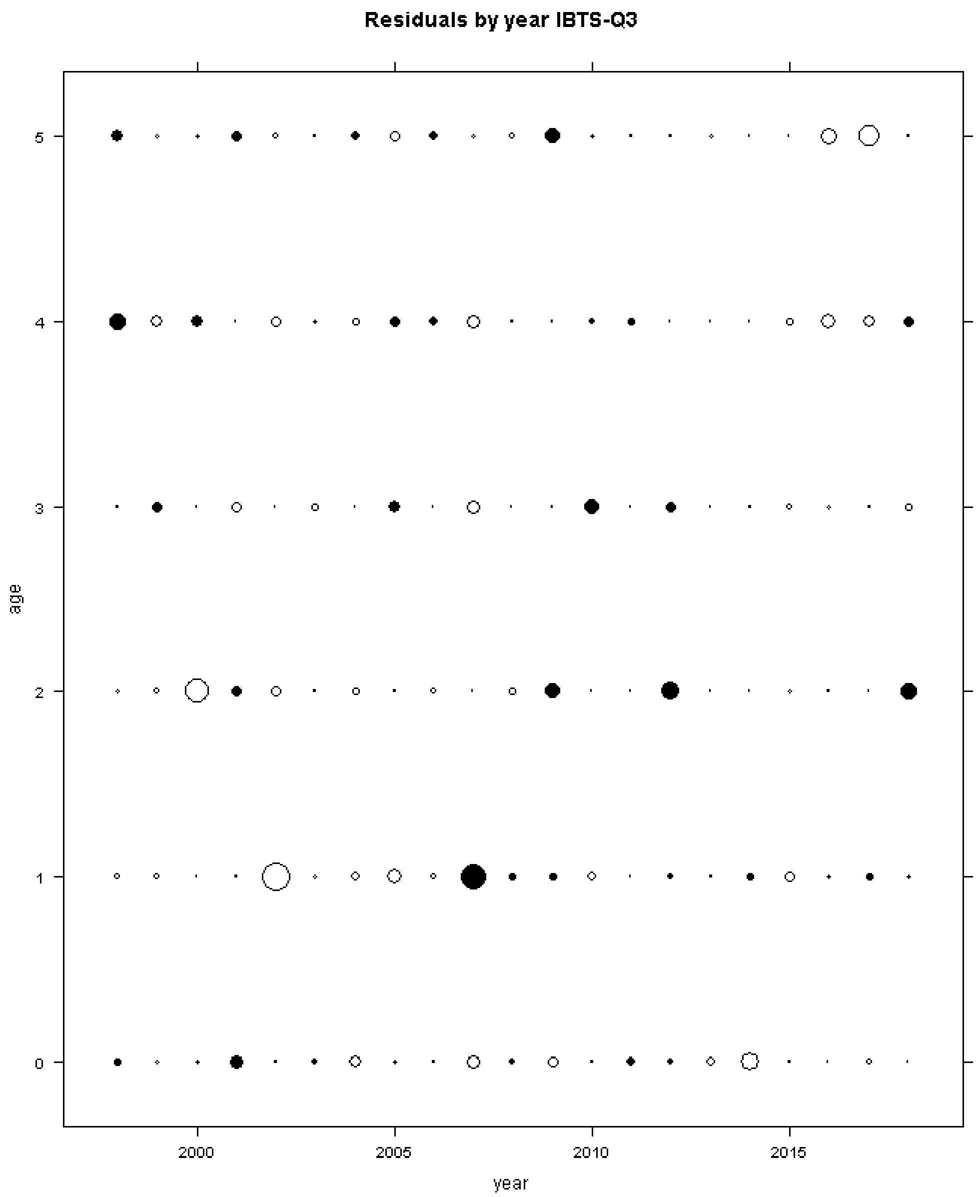

Figure 2.6.1.45. North Sea herring. Bubble plot of standardised IBTSQ3 residuals.

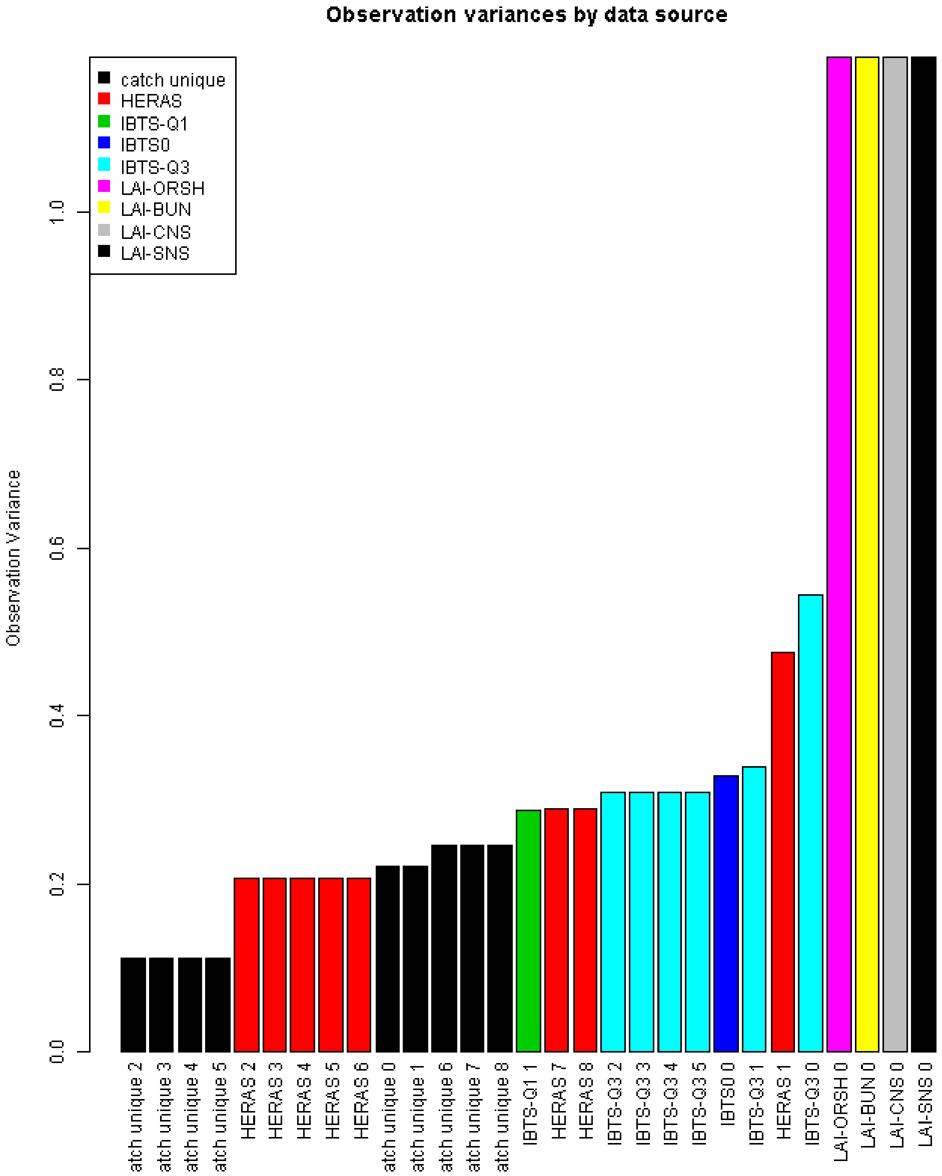

Figure 2.6.1.46. North Sea herring. Observation variance by data source as estimated by the assessment model. Observation variance is ordered from least (left) to most (right). Colours indicate the different data sources. Observation variance is not individually estimated for each data source thereby reducing the parameters needed to be estimated in the assessment model. In these cases of parameter bindings, observation variances have equal values.

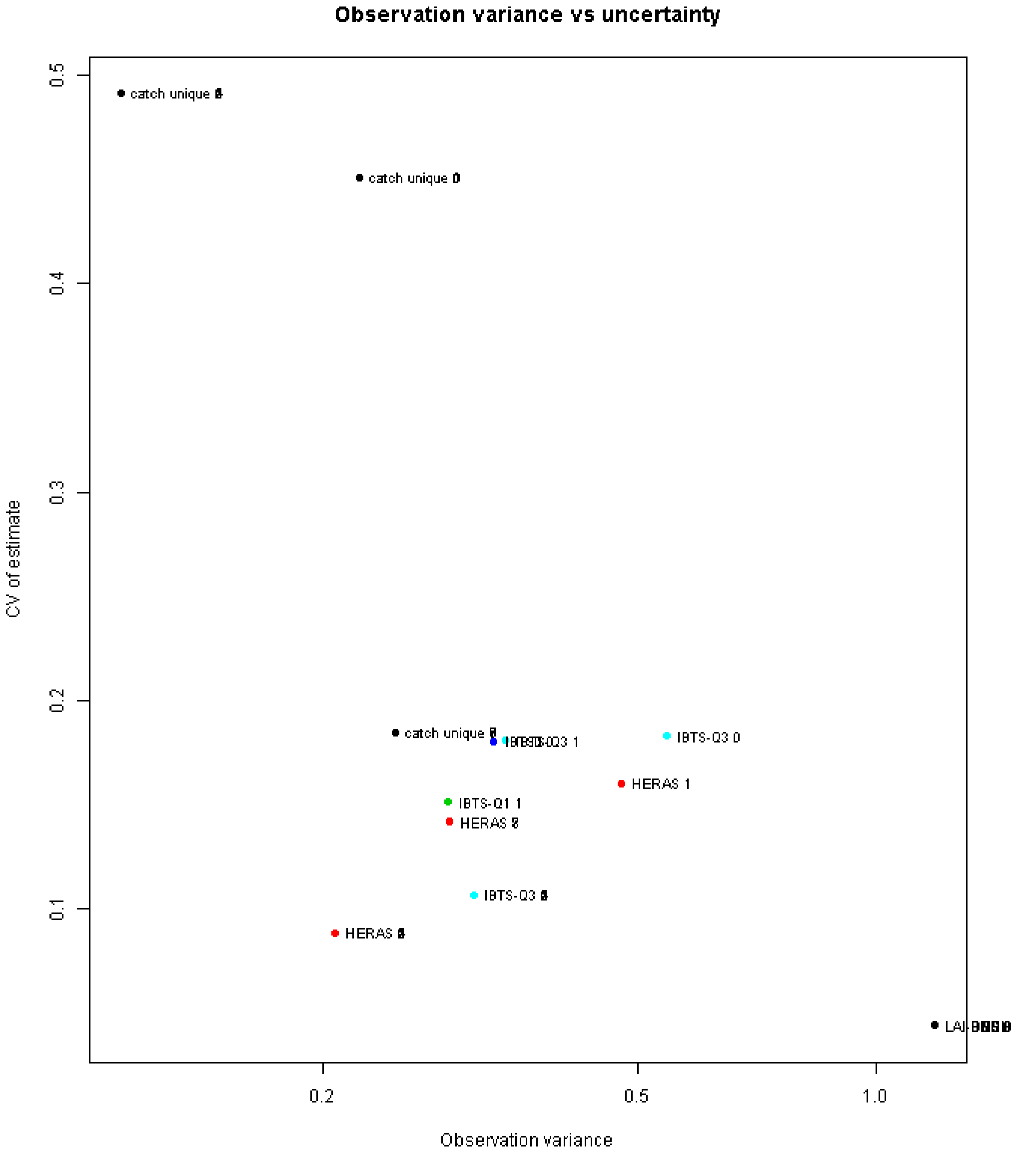

Figure 2.6.1.47. North Sea herring. Observation variance by data source as estimated by the assessment model plotted against the CV estimate of the observation variance parameter.

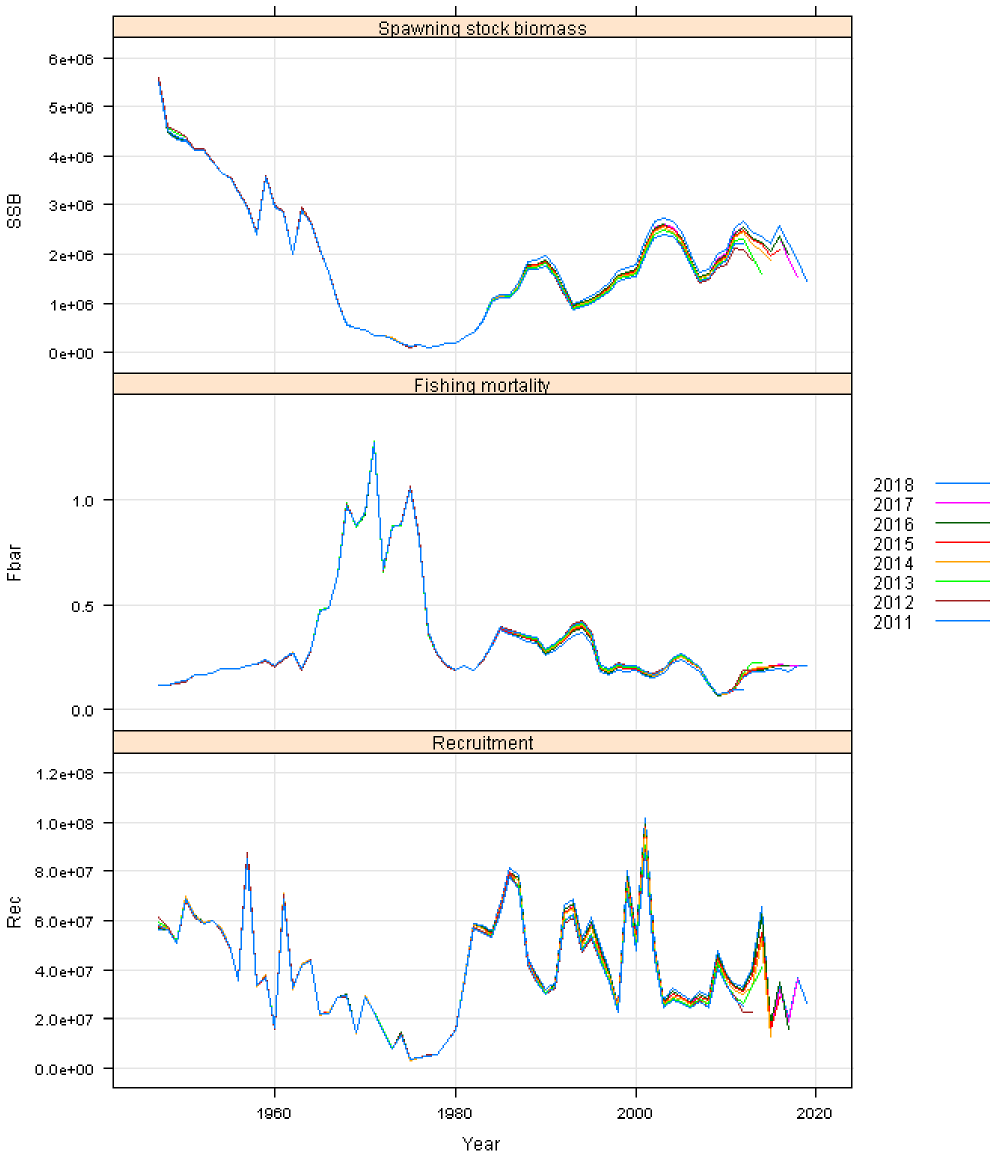

Figure 2.6.1.48. North Sea herring. Assessments retrospective pattern of SSB (top panel) F (middle panel) and recruitment (bottom panel) from 2011 to 2018.

Figure 2.6.1.49. North Sea herring. Model uncertainty; distribution and quantiles of estimated SSB and $F_{2\text{-}6}$ in the terminal year of the assessment. Estimates of precision are based on a parametric bootstrap from the FLSAM estimated variance / covariance estimates from the model.

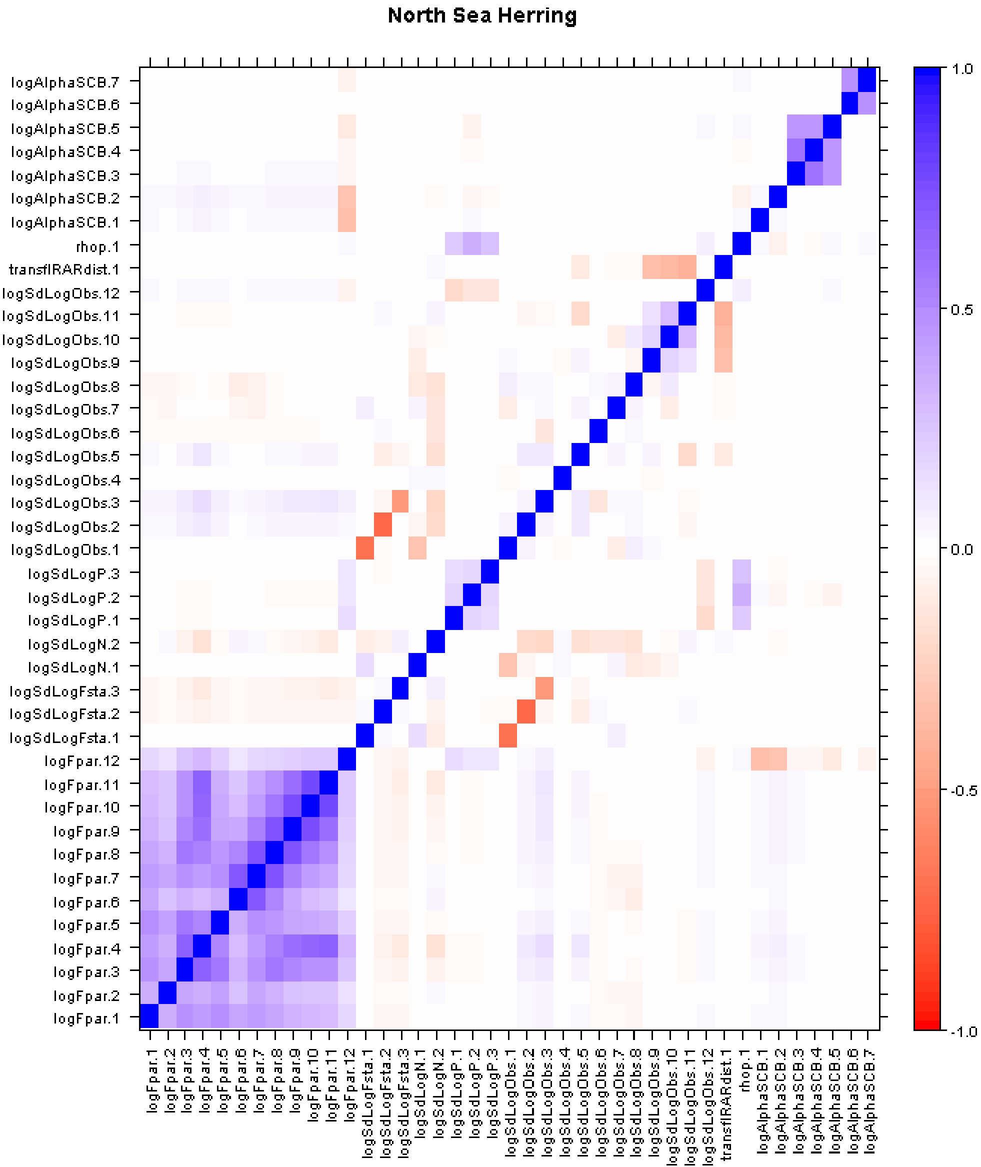

Figure 2.6.1.50. North Sea herring. Correlation plot of the FLSAM assessment model with the final set of parameters estimated in the model. The diagonal represents the correlation with the data source itself.

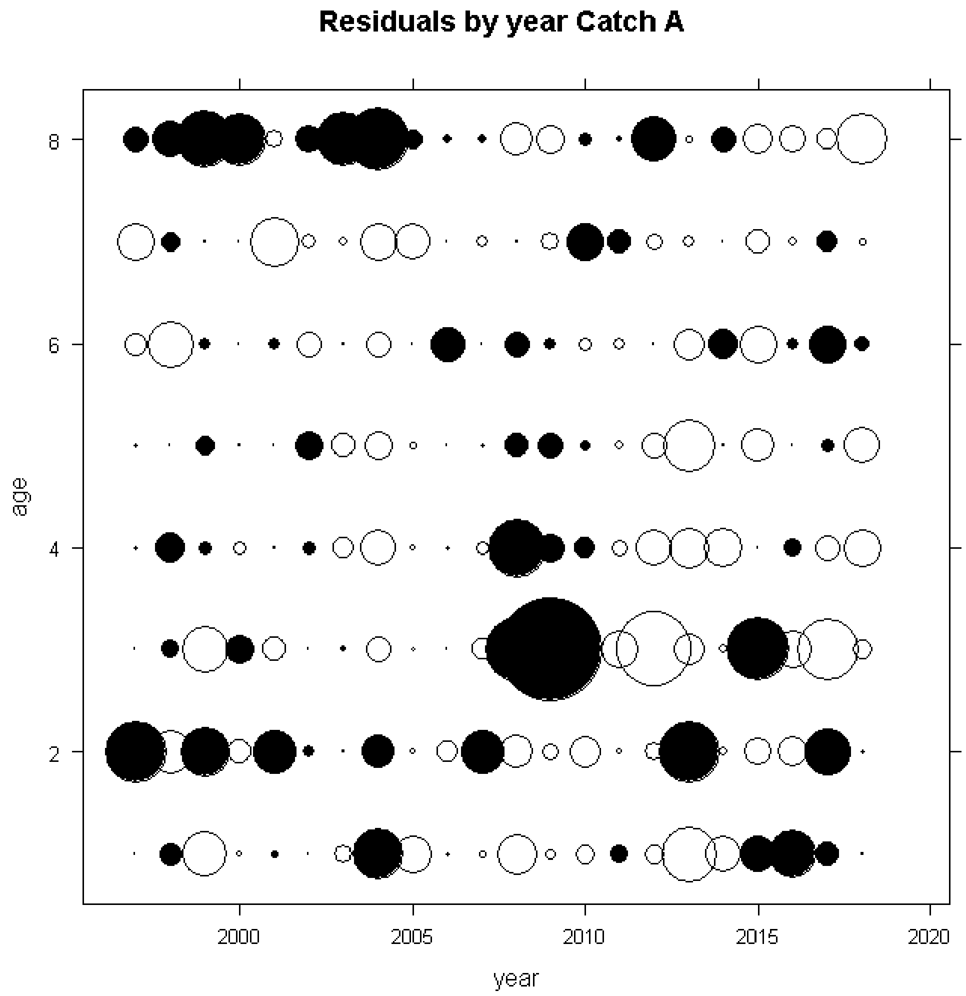

Figure 2.6.2.1. North Sea herring multi-fleet assessment model. Bubble plot of standardised residuals for catches of fleet A.

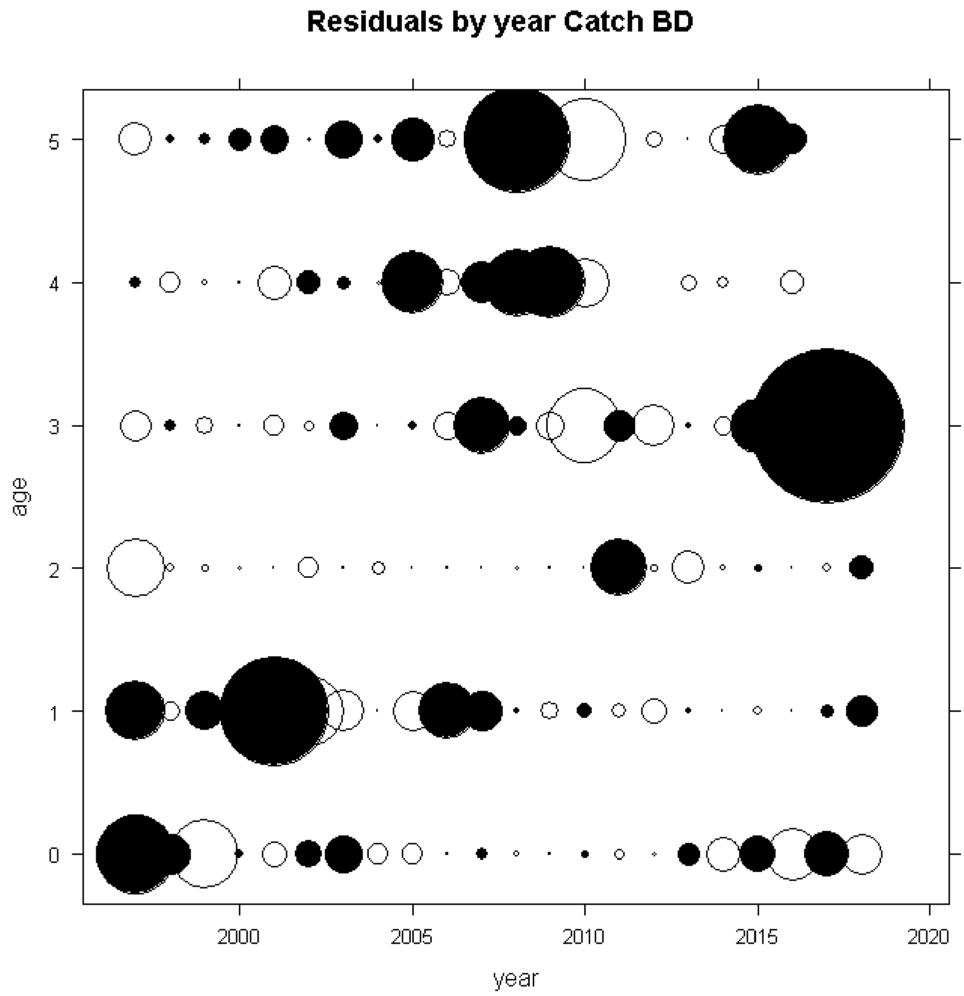

Figure 2.6.2.2. North Sea herring multi-fleet assessment model. Bubble plot of standardised residuals for catches of fleet B&D.

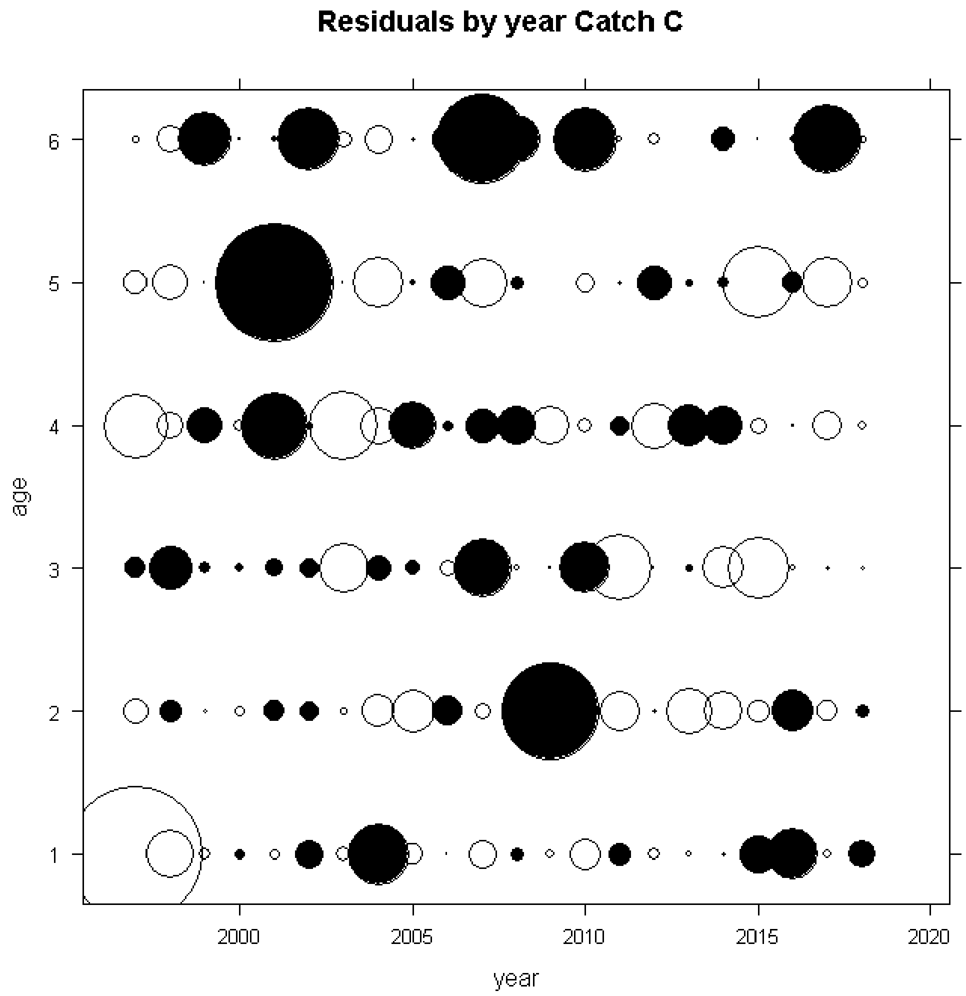

Figure 2.6.2.3. North Sea herring multi-fleet assessment model. Bubble plot of standardised residuals for catches of fleet C.

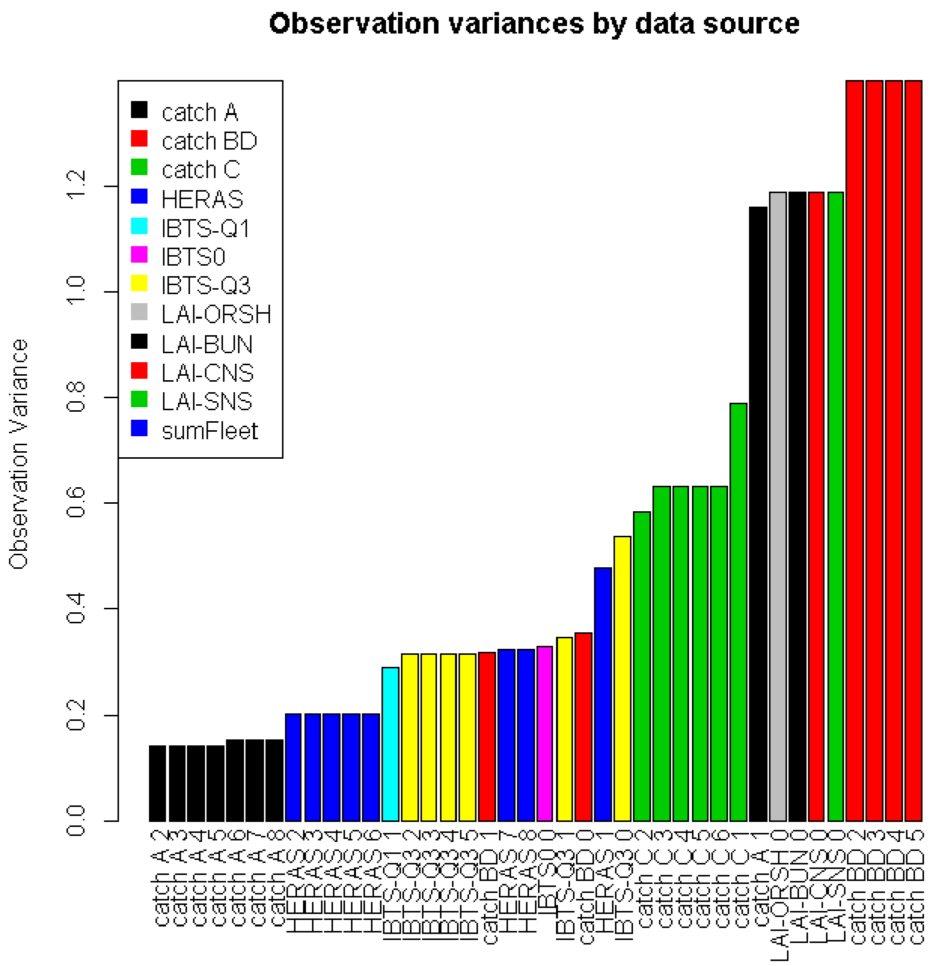

Figure 2.6.2.4. North Sea herring multi-fleet assessment model. Observation variance by data source as estimated by the assessment model. Observation variance is ordered from least (left) to most (right). Colours indicate the different data sources. Observation variance is not individually estimated for each data source thereby reducing the parameters needed to be estimated in the assessment model. In these cases of parameter bindings, observation variances have equal values.

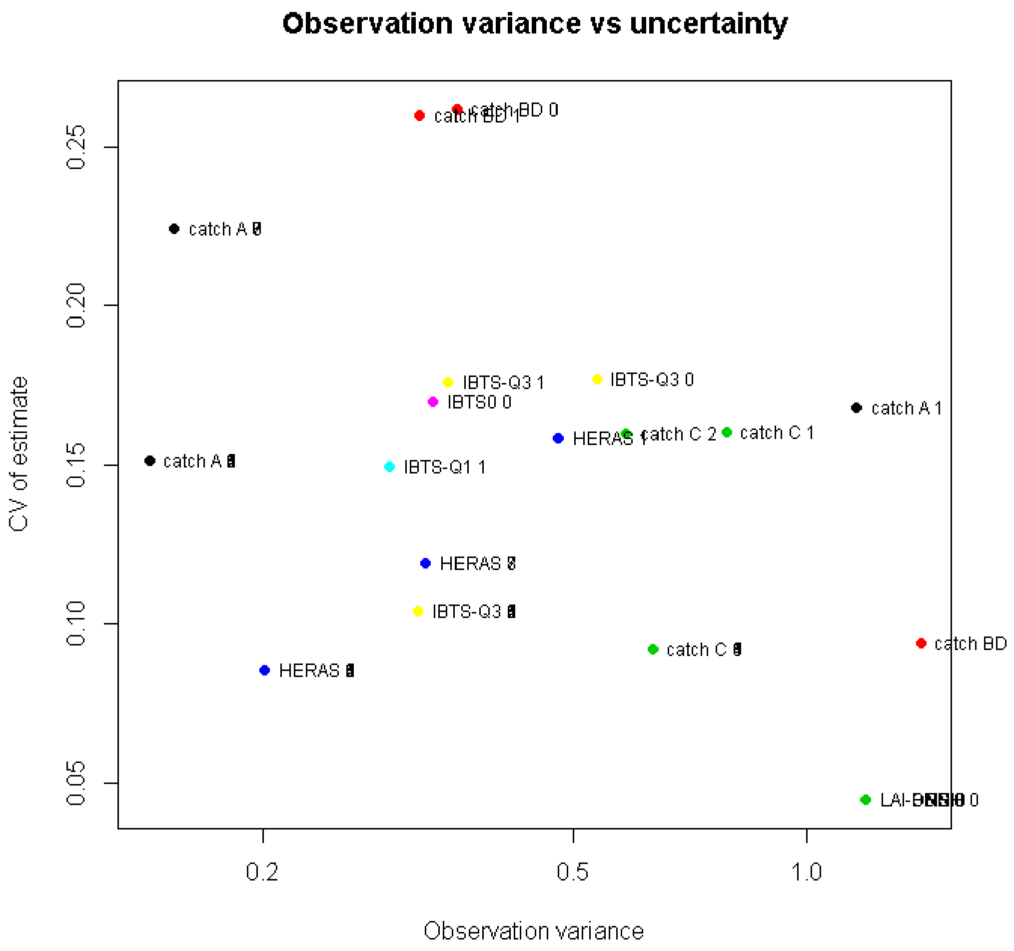

Figure 2.6.2.5. North Sea herring multi-fleet assessment model. Observation variance by data source as estimated by the assessment model plotted against the CV estimate of the observation variance parameter.

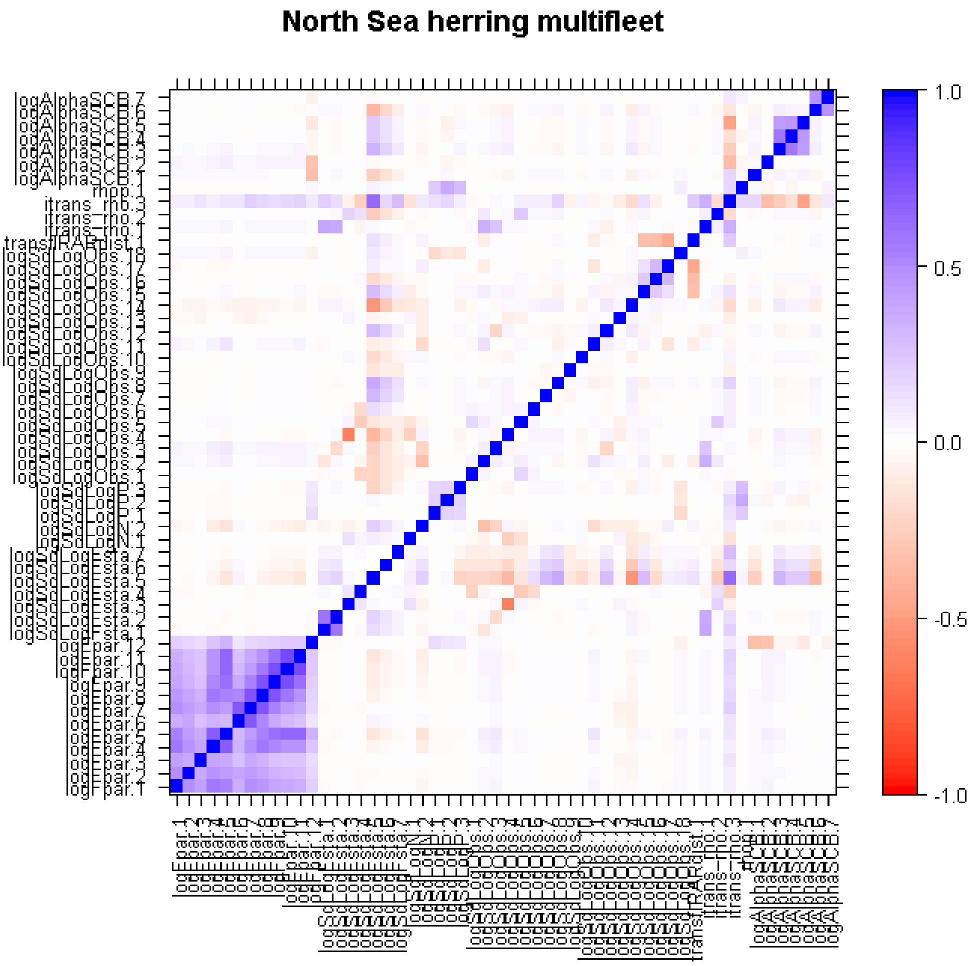

Figure 2.6.2.6. North Sea multi-fleet assessment model. Correlation plot of the FLSAM assessment model with the final set of parameters estimated in the model. The diagonal represents the correlation with the data source itself.

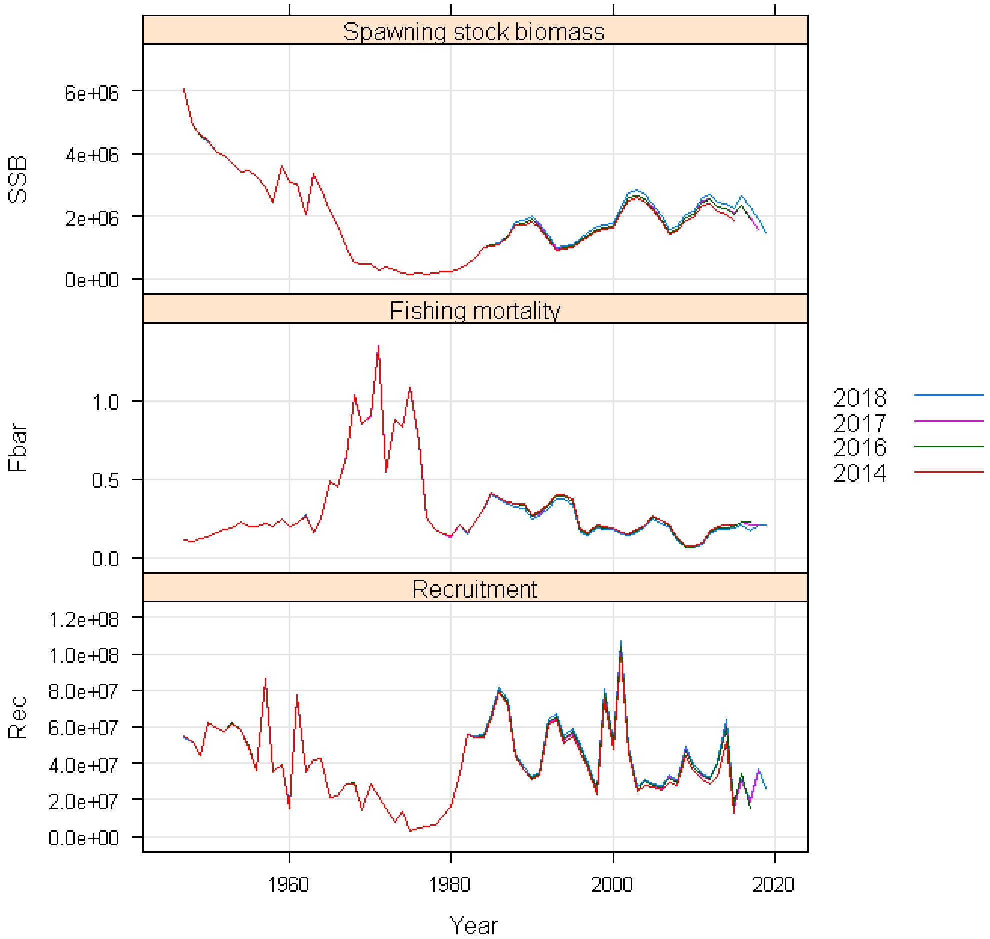

Figure 2.6.2.7. North Sea herring multi-fleet assessment model. Assessments retrospective pattern of SSB (top panel) F (middle panel) and recruitment (bottom panel) from 2006 to 2018.

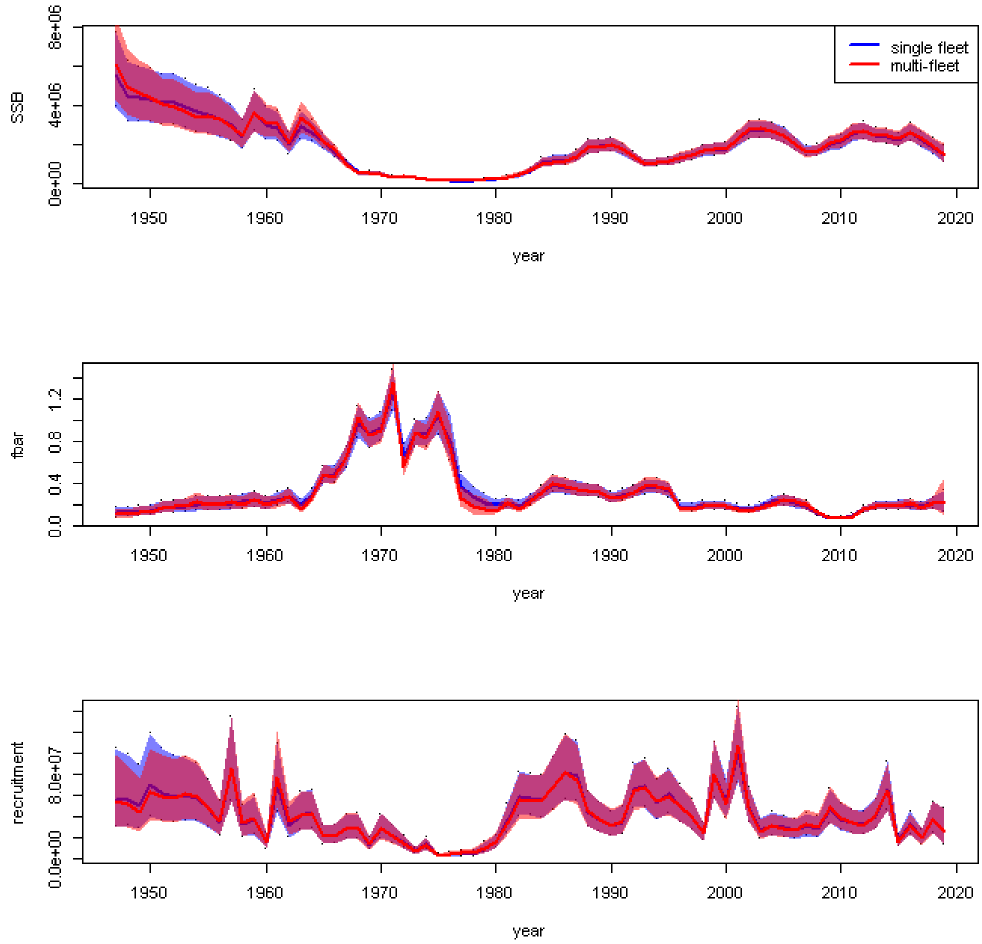

Figure 2.6.2.8. North Sea herring multi-fleet assessment model. Comparison SSB, F_{bar} and recruitment trajectories for multi-fleet and single fleet assessment model outputs.

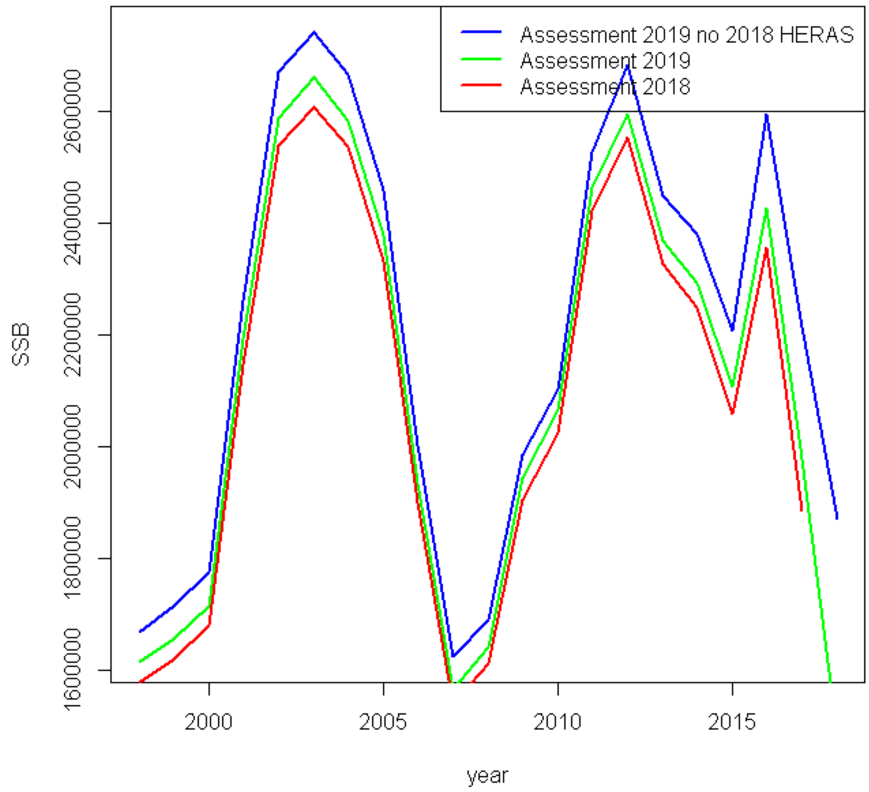

Figure 2.6.2.9. North Sea herring. SSB trajectory for the 2018 and 2019 assessments and the 2019 assessment without including the 2018 from HERAS.

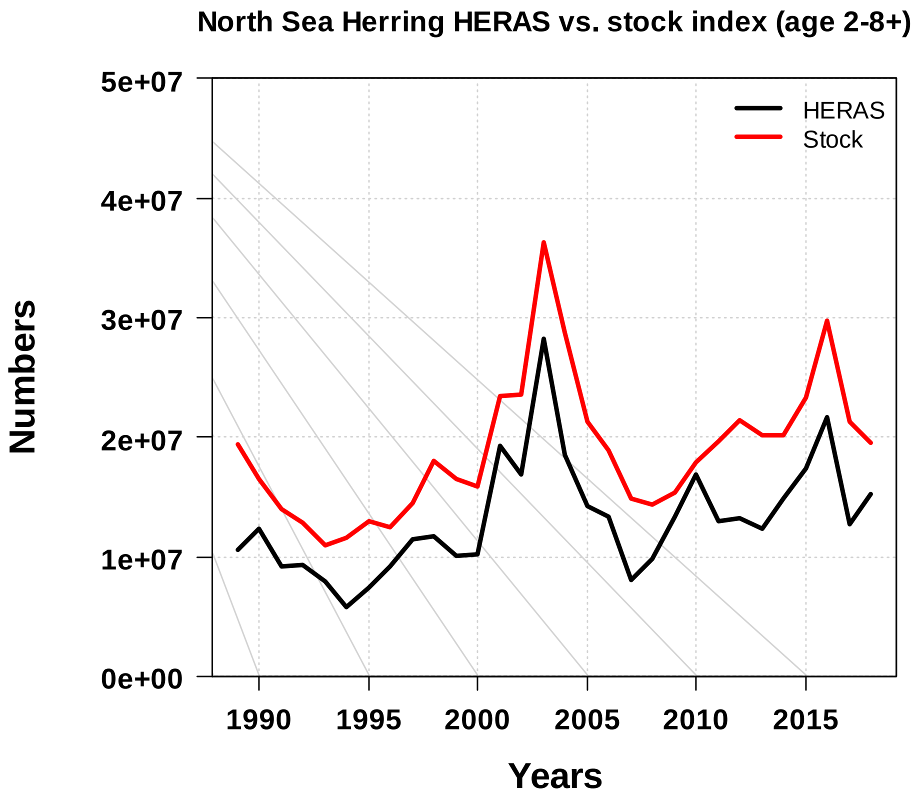

Figure 2.6.2.10. North Sea herring. SSB trajectory (age 2–8+ winter rings) for the 2019 assessments and the HERAS SSB index.

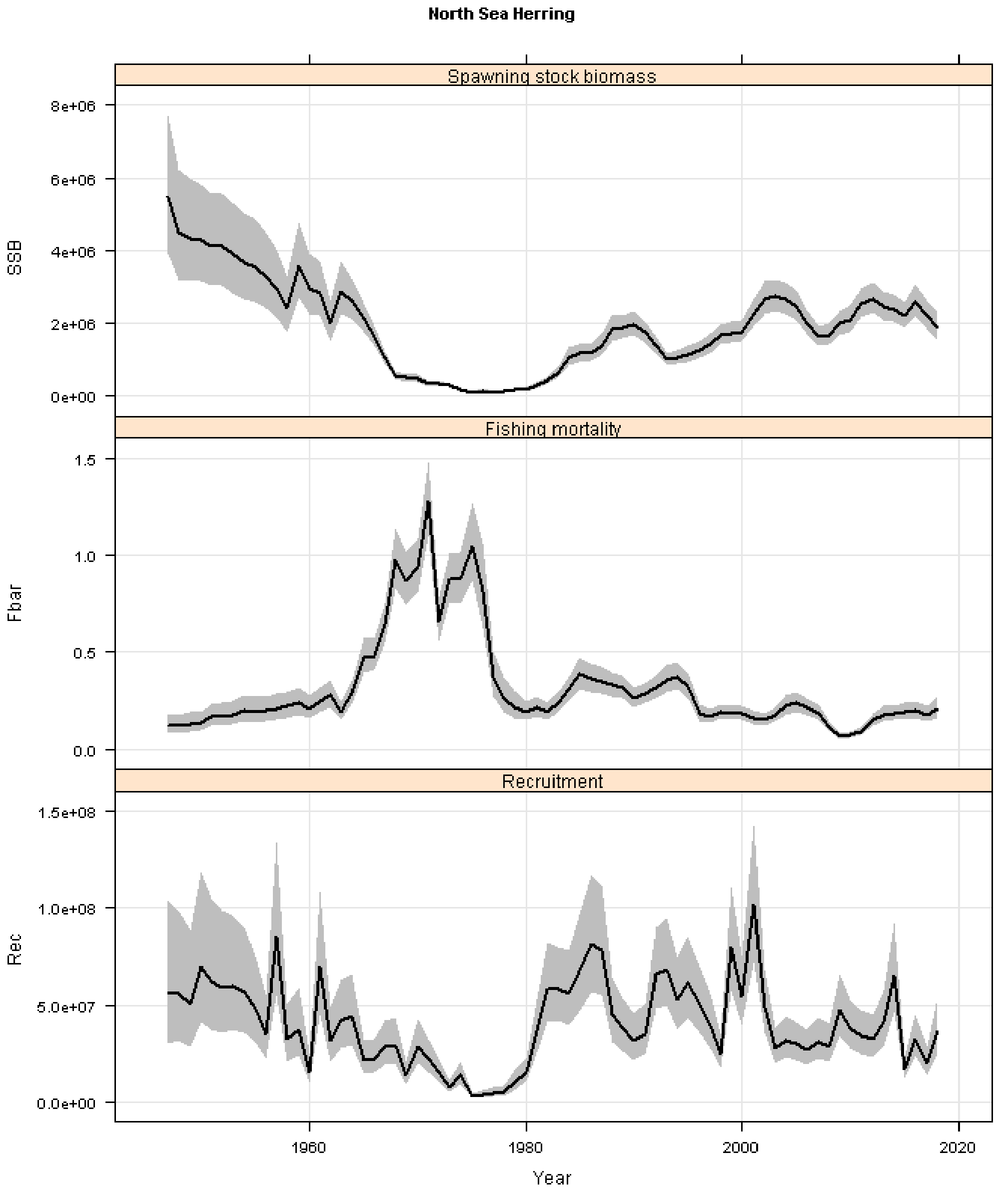

Figure 2.6.3.1 North Sea herring. Stock summary plot of North Sea herring with associated uncertainty for SSB (top panel), F ages 2–6 (middle panel) and recruitment (bottom panel).

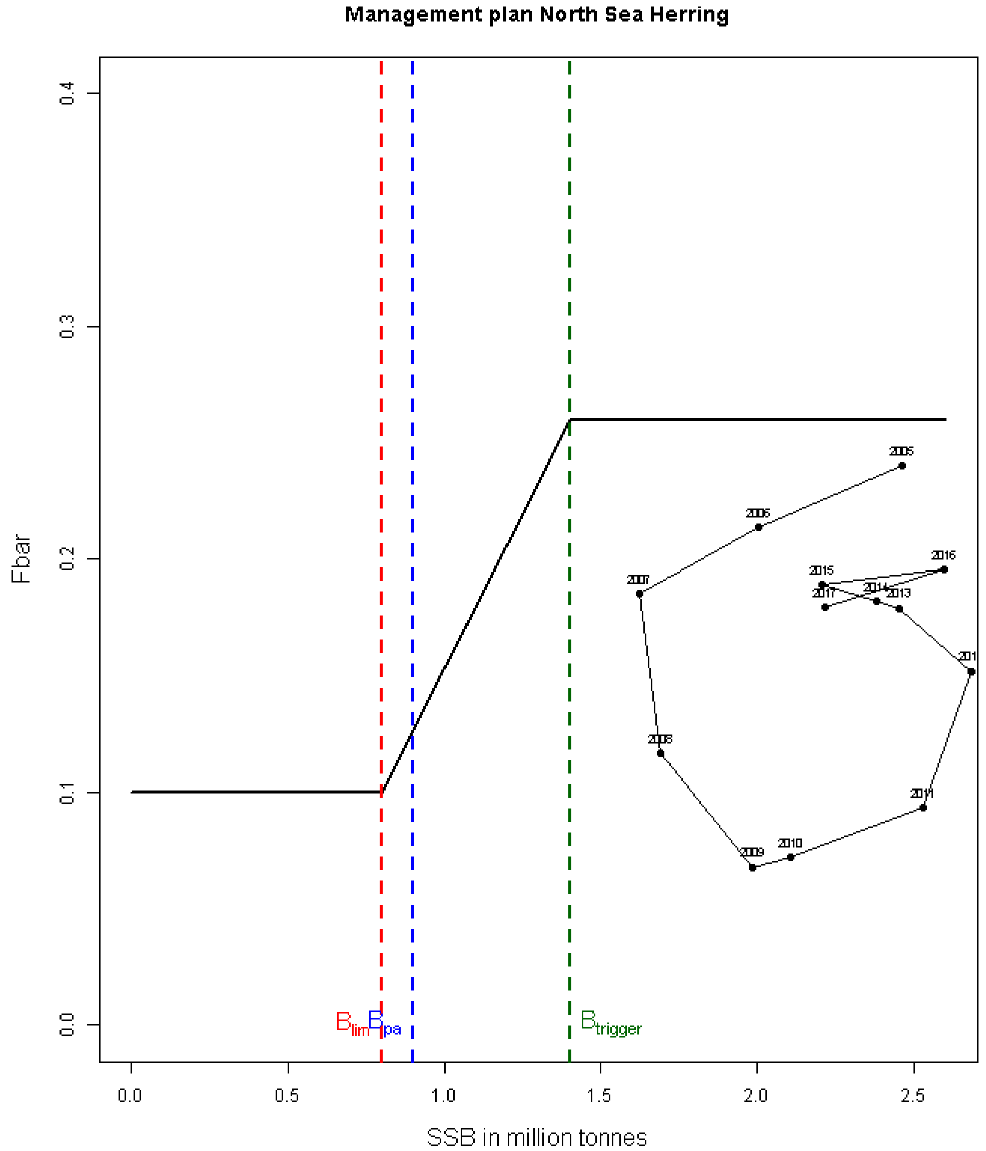

Figure 2.6.3.2. North Sea herring. Agreed management plan for North Sea herring including the most recent 10 years of SSB and F as estimated within the assessment in relation with the management plan.

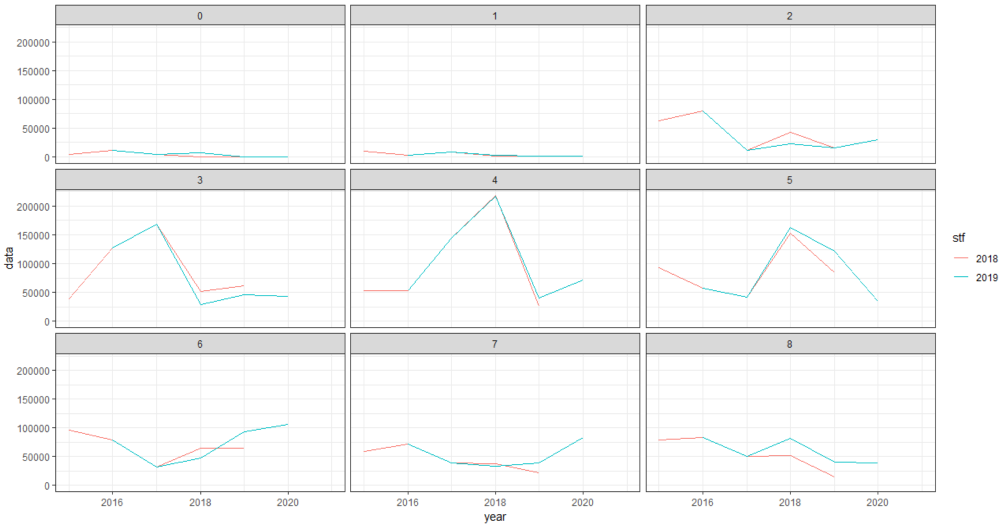

Figure 2.7.2.1. North Sea Herring. Predicted and projected catch (in weight) between 2018 assessment (2019 as forecast year) and 2019 assessment (2020 as forecast year).

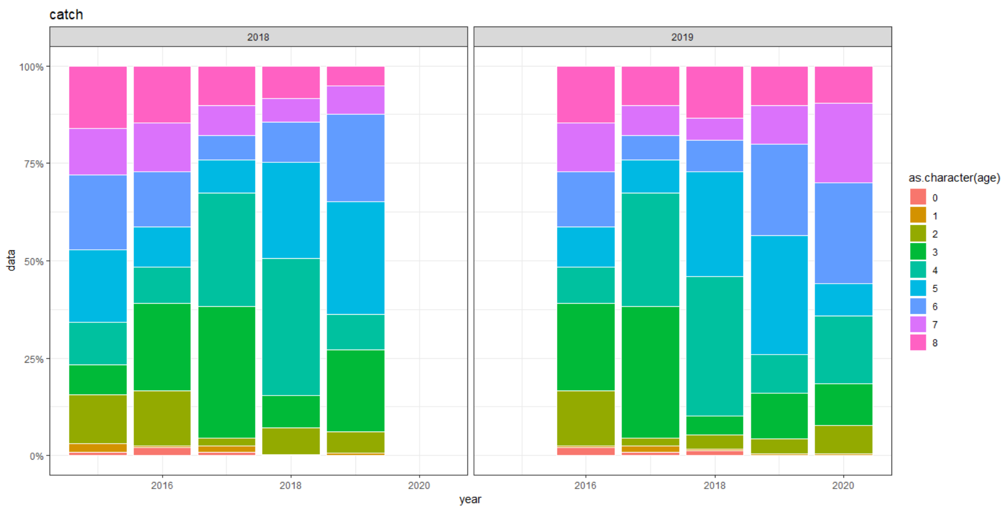

Figure 2.7.2.2. North Sea Herring. Catch proportions for the different ages between the 2018 short term forecast (2019 as forecast year) and the 2019 short term forecast (2020 as forecast year).

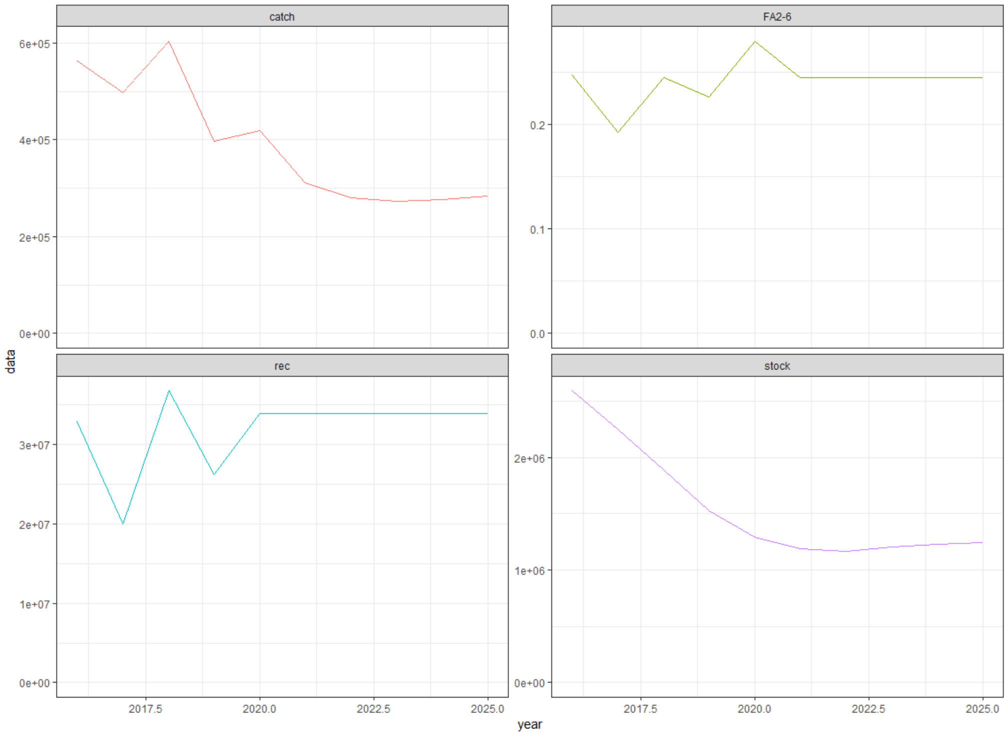

Figure 2.7.2.3. North Sea Herring. Short term projections using an F status quo from TAC year (i.e. advice year). Intermediate year is in 2019 and the TAC year is 2020.

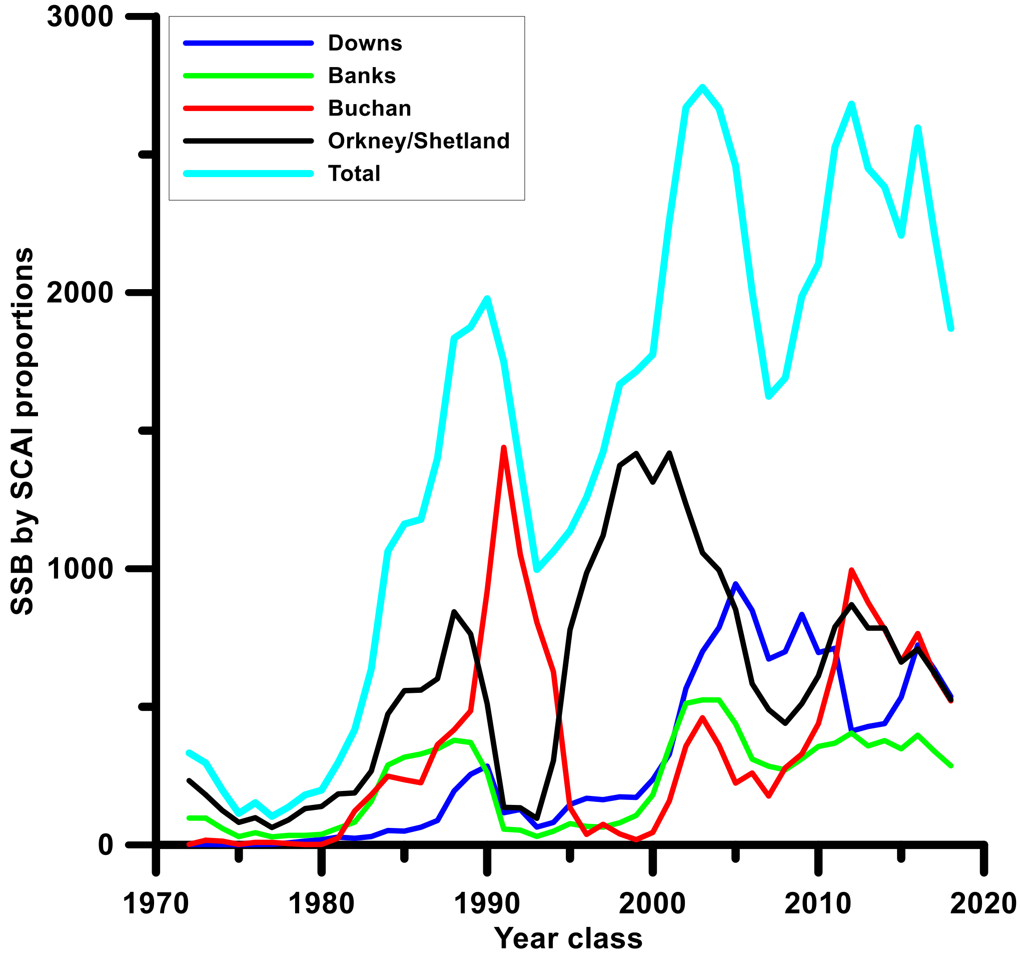

Figure 2.11.1. North Sea herring. Time-series of spawning stock biomass of each component, as estimated from the LAI index. Areas are arranged from top to bottom according to the south-to-north arrangement of the components.

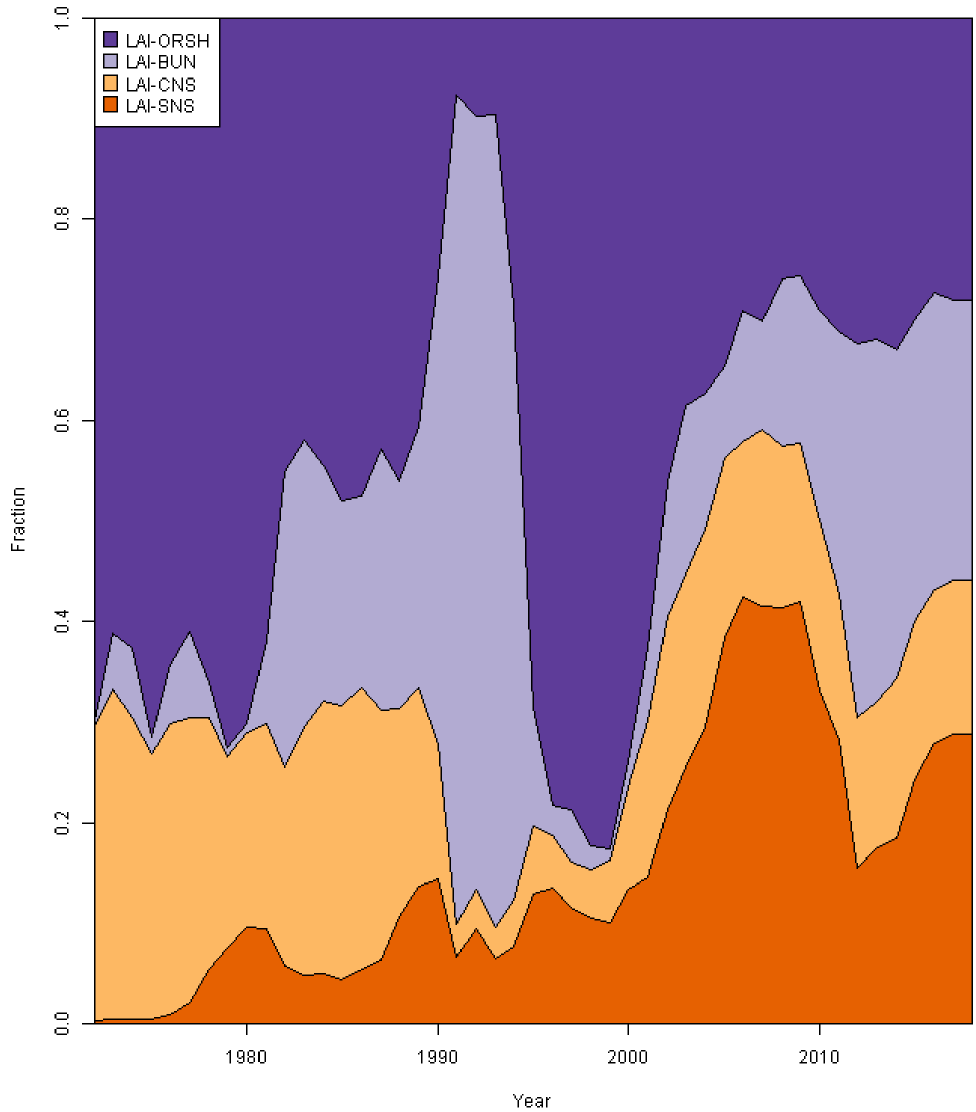

Figure 2.11.2. North Sea herring. Time-series of the contribution of each spawning component to the total stock, as estimated from the LAI index (Payne, 2010). Areas are arranged from top to bottom according to the north-to-south arrangement of the components.

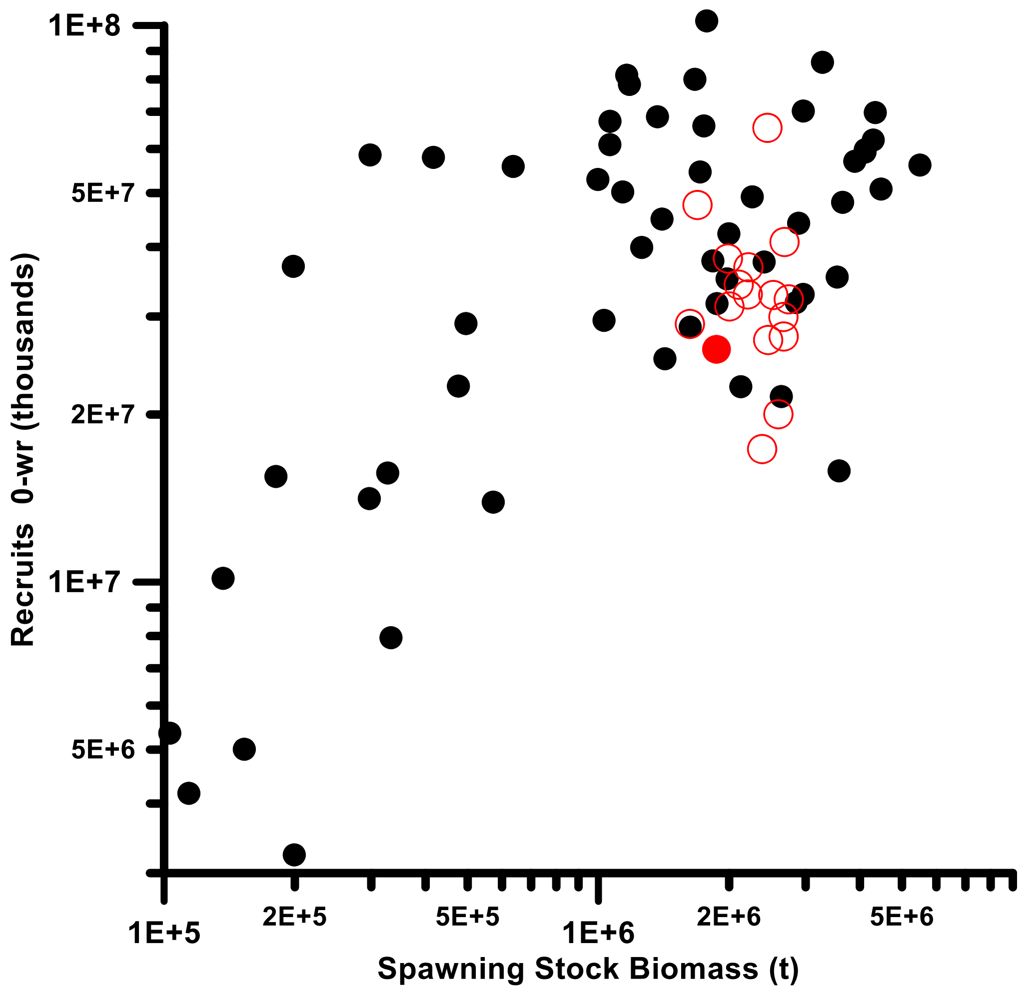

Figure 2.13.1. North Sea Autumn Spawning Herring stock recruitment curve, plotting estimated spawning stock biomass against the resulting recruitment. Year classes spawned after 2001 are plotted with open red circles, to highlight the years of recent poor recruitment. The most recent year class is plotted in solid red. Note the logarithmic scaling on both axes.

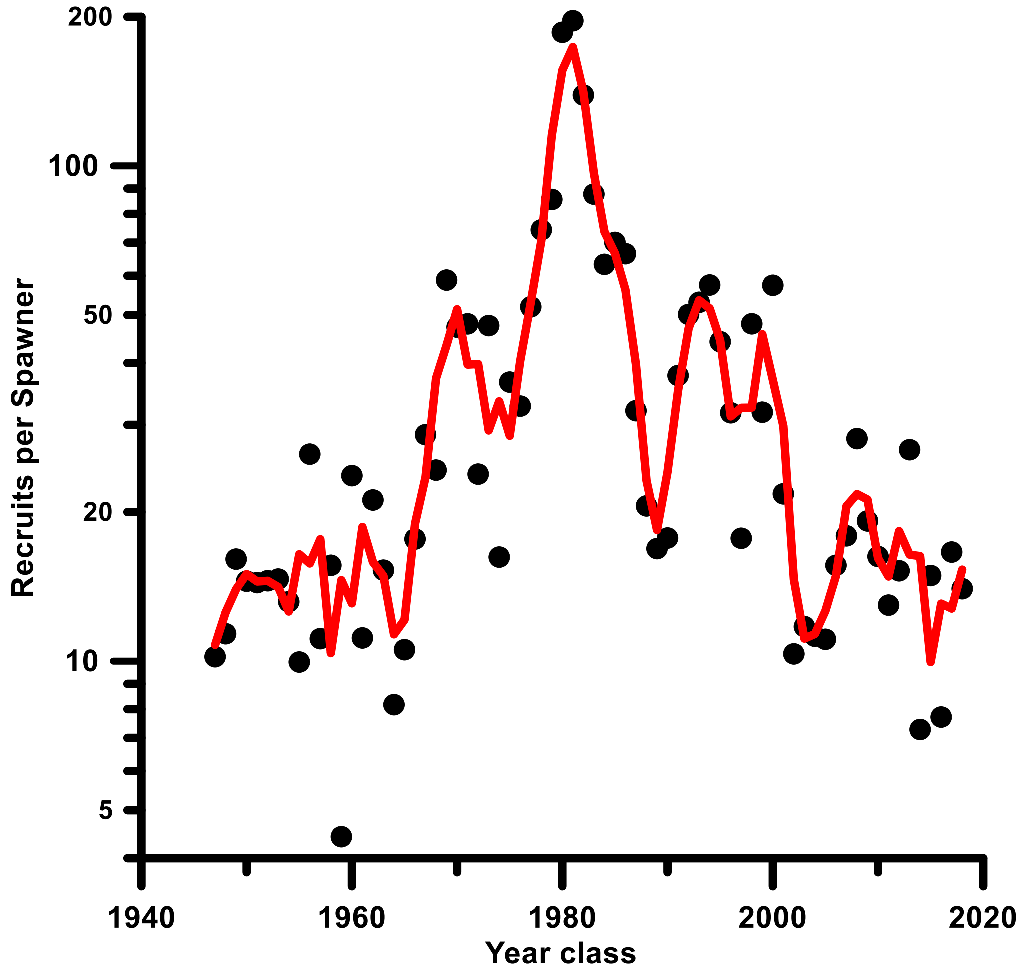

Figure 2.13.2. North Sea Autumn Spawning Herring time series of recruits per spawner (RPS). RPS is calculated as the estimated number of recruits from the assessment divided by the estimated number of mature fish at the time of spawning and is plotted against the year in which spawning occurred. Black points: RPS in a given year. Red line: Smoother to aid visual interpretation. Note the logarithmic scale on the vertical axis.

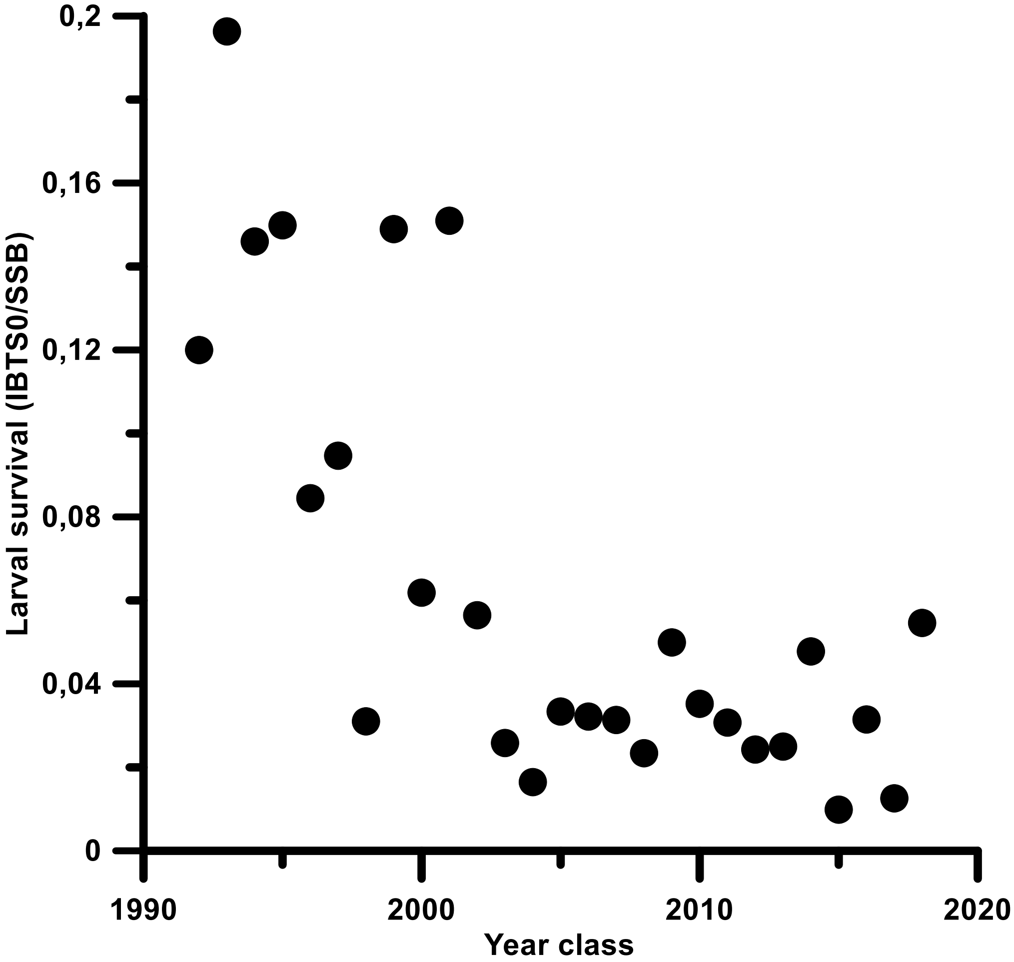

Figure 2.13.3. North Sea Autumn Spawning Herring time series of larval survival ratio (Dickey-Collas & Nash, 2005; Payne *et al.,* 2009), defined as the ratio of the SSB larval index (representing larvae less than 10–11 mm) and the IBTS0 index (representing the late larvae, > 18 mm). Survival ratio is plotted against the year in which the larvae are spawned.

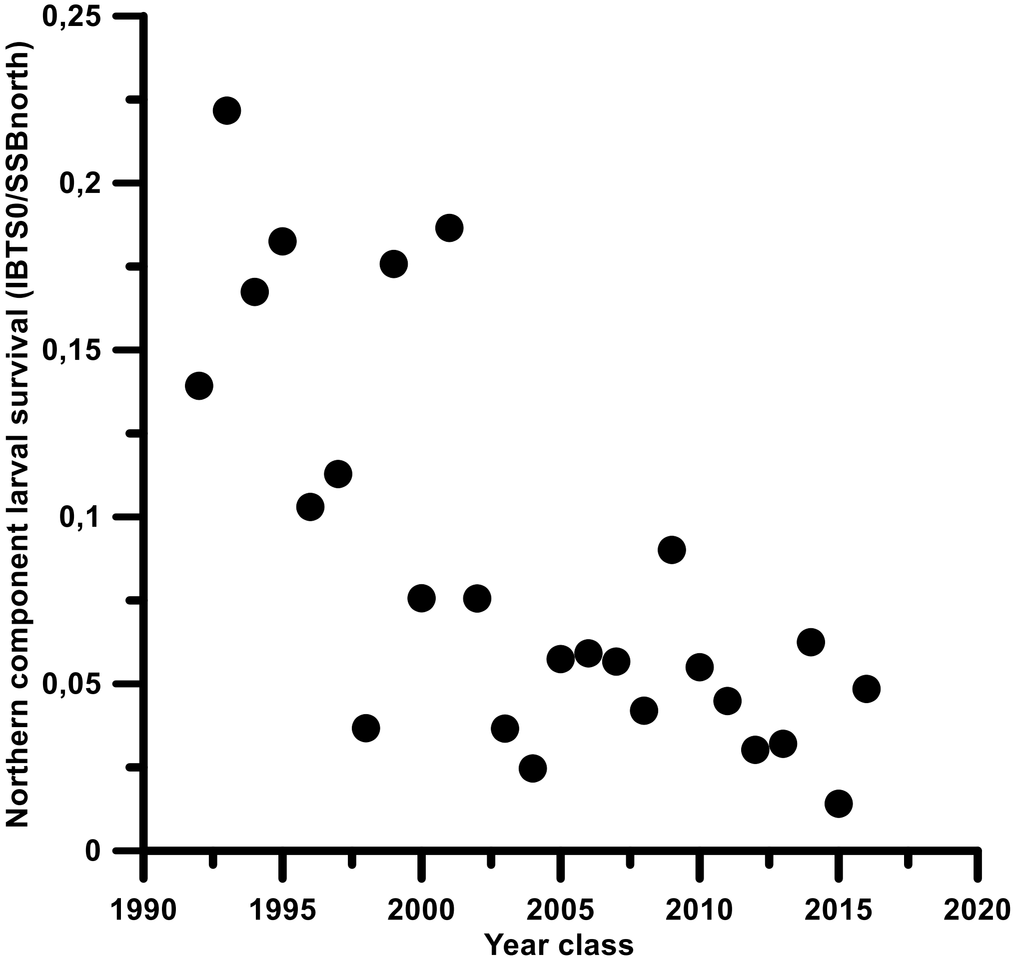

Figure 2.13.4. North Sea Autumn Spawning Herring time series of larval survival ratio (Dickey-Collas & Nash, 2005; Payne *et al.,* 2009) for the northern-most spawning components (Banks, Buchan, Orkney-Shetland), defined as the ratio of the sum of the larvae indices for these components (representing larvae less than 10–11 mm) and the IBTS0 index (representing the late larvae, > 18 mm). Survival ratio is plotted against the year in which the larvae are spawned.