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

2.1 Introduction

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 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 2022 and 2023

There is currently no agreed EU-Norway management plan (Anon, 2019) although a Working Group has been set up by Norway, UK, and the European Union to recommend a way of optimally and sustainably utilizing the North Sea autumn spawning herring stock. 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 2022 was 435 802 tonnes for Area 4 and Division 7.d, where no more than 47 039 t should be caught in Division 4.c and 7.d. For 2023, the total TAC is 404 272 t (396 556 t for the A-Fleet), including a TAC of 43 621 t for Division 4.c and 7.d.

The bycatch TAC for the B-Fleet in the North Sea (and Division 2.a) was 8 174 t in 2022 and has decreased by 6% to 7 716 t in 2023. As North Sea autumn spawners are also caught in Division 3.a, regulations for the fleets operating in this area have to be considered 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 2022

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 by statistical rectangle. Some catch figures in tables 2.1.1–2.1.5 are 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 467 134 t in 2022. Official catches by the human consumption fishery were 461 007 t, far above the TAC for the human consumption fishery (427 628 t). The effect of quota banking and borrowing is unknown by the WG.

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 41 514 t. The separate TAC for this area was 47 039 t, so the TAC in Division 4.c and 7.d was not fully taken (but due to catch regulations, 50% of the TAC could have been taken in Division 4.b).

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

Landings of herring taken as bycatch in the small-meshed fishery were 6 127 tonnes in 2022. The bycatch ceiling for the B-Fleet was 8 174 t. Since the introduction of yearly bycatch ceilings in 1996, these ceilings have fully been taken in 2014, 2016, 2020 and 2021.

The total North Sea TAC and catch estimates for the years 2017 to 2022 are shown in the table below (adapted from Table 2.1.6).

Year	2017	2018	2019	2020	2021	2022
TAC HC (‘000 t)	482	601	385	385	356	428
“Official” landings HC (‘000 t) *	485	594	439	415	356	458
Working Group catch HC (‘000 t)	485	594	440	417	356	461
Excess of landings over TAC HC (‘000 t)	3	-7	55	32	0	33
Bycatch ceiling (‘000 t) **	11	10	13	9	8	8
Reported bycatches (‘000 t) ***	7	8	5	10	9	6
Working Group catch North Sea (‘000 t)	492	602	446	427	365	467

HC = human consumption fishery

*** Working Group catches may differ from official catches and cannot be used for management purposes. Norwegian bycatches included in this figure.**

**** bycatch ceiling for EU industrial fleets only, Norwegian bycatches included in the HC figure.**

***** prior to 2019 provided by Denmark only. Since 2019 by Denmark and Sweden.**

2.1.3 Regulations and their effects

In 2023, the TAC in Division 3.a (HER/03A) is 23 250 tonnes. However, catches in 3.a are limited to 969 tonnes for the Union fleets. Norway stated to transfer at least 90% of their herring quota for Skagerrak into the North Sea.

Half of the EU quota for Division 3a (HER/03A.) can be taken in UK waters of the North Sea (HER/*04-UK) and 50% of the EU quota can be taken in 4b (HER/*4B-EU). In total, the transfer of 3.a quota into the North Sea can be up to 100% for Norway and the EU, depending on access restrictions.

In the North Sea, Norway is currently not allowed to fish in EU or UK waters in Division 4.a and 4.b (Her/*4AB-C). There is currently also no quantity put into place for EU vessels to fish herring in Norwegian waters south of 62°N (HER/*4N-S62).

Half of the EU and UK quotas for divisions 4.c and 7.d can be taken in Division 4.b (HER/*04B.).

Also 50% of the EU bycatch quota in the small-meshed fishery in 3.a can be fished in EU waters in 4 (HER/*4-EU-BC).

In 2014, an agreed record between EU and Norway was applied, enabling an interannual quota flexibility of 10% of the TAC. Each party could transfer non-utilized 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 interannual flexibility was changed in 2015 due to the Russian embargo on EU fishing products, so that 25% of the TAC could be transferred into the next year, while up to 10% could be borrowed. Subsequent year, the quota flexibility has been set to 10% again. Since 2021, this interannual quota flexibility is in place also for UK herring quotas.

At HAWG 2023, the effect of quota swaps and banking and borrowing could not be assessed by the WG.

Since 2015, a landing obligation is in place for the European pelagic fleets operating in the North Sea and the Baltic. All catches of (quota) regulated species have to be landed into port. Since 2020, the landing obligation also applies to all demersal fisheries although some exemptions have been agreed in the regional discard plans.

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. In 2022 in the Norwegian fleet, more pelagic trawlers and less purse-seiners have been engaged in fishing.

As in preceding years, the herring 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 are taken in Subdivision 4.a.w, in the order of 52% of the total. Subdivision 4.a.e provided 25% of the catches in 2022 and catches in Division 4.b contributed 14%.

In 2022, catches in the transfer area (specific rectangles in Subdivision 4.a.e and 4.b) increased considerably. They amount to 90 861 tonnes, compared to levels of 2 000 - 18 000 tonnes in the preceding 10 years. Reasons for this strong increase may can be the distribution of the fish, the 100% transfer of catches from 3.a into 4.a and, with regards to the Brexit in 2020, a tendency of EU vessels to fish in EU waters.

The bycatch ceiling for the small-meshed fishery (B-Fleet) has not fully been taken in 2022. Reported catches were distributed in 4.a.w (24%) and 4.b (76%).

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

2.2 Biological composition

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.a.e), 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 3.2 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 2007–2022 (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 2012–2022.

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 3.58 billion fish and NSAS amounts to 3.55 billion fish in 2022. The proportion of 0- and 1-ringers of herring taken in the North Sea is 24.5% of the total catch in numbers (Table 2.2.5), in the same order of magnitude as in 2021. Most of these young herring are still taken in the B-Fleet in Division 4.b. Here, 0- and 1-ringers amount to 67% of the total catch in numbers in 4.b.

The proportion of 3+ winter ring herring is 51% of the total catch in numbers taken in the North Sea (compared to 62% in 2021).

In terms of biomass, the 2- and 3-ringers contributed most to the catches of North Sea herring (25% and 20%, respectively).

Western Baltic (WBSS) and local Division 3.a spring spawners are taken in the eastern North Sea during summer feeding migration (see Stock Annex and Section 3.2.2). 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 2007–2022. After splitting the herring caught in the North Sea and 3.a between stocks, the total catch of North Sea Autumn spawners amounts to 462 246 tonnes.

Area	Allocated	Unallocated	BMS/Discard	Total
4.a West	242 180		1 177	243 357
4.a East	116 567			116 567
4.b	65 696			65 696
4.c/7.d	39 253		2 261	41 514
	Total catch in the North Sea			467 134
	Autumn spawners caught in Division 3.a (SOP)			515
	Baltic spring spawners caught in the North Sea (SOP)			-5 402
	Total catch NSAS used for the assessment			462 247

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.e 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. In 2021 and 2022, they have been reported to be zero.

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. The TAC 2022 was set at 10 tonnes and reported catches amount to only 0.055 tonnes.

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 unallocation of catches are regarded as a minor issue in the North Sea herring fishery. In 2022, no unallocated catches were reported.

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 fish lost or damaged during processing procedures) were 13 tonnes in 2022. 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 2022 North Sea herring fishery. However, discards occurred in other fisheries not targeting on herring, mainly in the crustacean fishery. These raised discards sum to 3 438 tonnes in 2022.

The sampling of commercial landings covers 84% of the total catch.

More important than a sufficient overall sampling level is an appropriate spread of sampling effort over the different métiers (here defined as each combination of fleet/nation/area and

quarter). Of 128 different reported métiers, 40 were sampled in 2022. The sampling level of more than 1 sample per 1000 t catch has been met for 21 métiers. With regards to age readings, 24 métiers appear to be sampled sufficiently (>25 fish aged per 1000 t catch).

However, some of the métiers yielded very little catch. In 78 métiers, the catch is below 1000 t. The total catch in these métiers sums to 14 649t, so the remaining 50 métiers represent 452 485 t of the working group catch (97%). Of these 50 métiers, 32 were sampled. 20 métiers have more than 1 sample per 1000 t catch and 22 métiers more than 25 age readings per 1000 t catch.

According to the DCF regulations, some catches were landed into and sampled by other nations.

The WG recommends that all métiers with substantial catch should be sampled (including by-catches in the industrial fisheries), and that catches landed abroad should be sampled and their biological data 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 2022

Six national 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 2023). 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 for the assessment (Table 2.3.1.2).

The estimate of North Sea Autumn Spawning herring spawning stock biomass is higher than in the previous year at 1.96 million tonnes (2021: 1.50 million tonnes) with an increase in the number of mature fish from 8 170 million fish in 2021 to 10 348 million fish in 2022. The mean weight of mature fish is only slightly higher than last year at 189.7g, and the increase in biomass of mature fish is due to higher abundance rather than change in condition of individual fish. The 2012- and 2013- year classes continue to be stronger than the long-term average (especially the 2013- year class). The 2014- year class is also emerging as a stronger than average size year class. These stronger year classes still contribute 17% to the overall biomass in 2022 and it should be noted that all year classes since 2015 are well below the average level since 2010 (and the long-term average). The 2016- year class is particularly weak with abundance at only 56% of the average level since 2010.

Distribution of herring in the North Sea area (Figure 2.3.1.2) is similar to that seen since 2017 and does not extend as far south as was the norm in the years prior to 2017. Abundance of NSAS herring was slightly higher compared to recent surveys in the North Sea area.

The abundance of immature fish in the stock has decreased by 15% from 23 311 million in 2021 to 19 780 million in 2022. While prior to 2020 2 winter ring fish contributed substantially to the abundance of immature fish, the maturity level in this age group was as in the previous year comparatively high (59% mature in 2019, 75% mature in 2020, 74% mature in 2021).

At 70%, the proportion mature at 2 winter rings in 2022 is again at the high end in the time series – compared to e.g., the all-time low of 37% in 2018. Maturities for ages 3 and above were

comparable to the long-term average with 95% maturity of 3 winter ringers, 97% of 4-wr and 99% of 5-wr and 100% maturity for all ages 5 and above. Since 2015, actual observed maturities are reported for all age groups. Prior to 2015 maturity was fixed at 100% for ages above 4 wr.

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

Five survey areas were covered within the framework of the International Herring Larval Surveys in the North Sea during the sampling period 2022–2023. 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 September and in the southern North Sea (SNS) in December 2022 and January 2023 (Figures 2.3.2.1–2.3.2.3). While four survey were conducted as scheduled, the survey in the English Channel in January 2023 struggled with technical problems of the vessel and unfavourable weather condition. Thus, only 50% of the planned stations have been sampled in January 2023.

The survey around the Orkneys revealed lower quantities of newly hatched larvae, and their distribution was different from previous years. Most larvae were not found close to the Orkneys, but much more easterly than usual, on the outer edge of the survey area. These larvae may have drifted here down from the Shetlands, but the actual reason is unknown.

In the Buchan and the central North Sea, newly larvae hatched in two areas, while the remaining stations contributed only very low numbers of larvae (Figure 2.3.2.1).

The distribution of larvae on the southern North Sea in the December survey was unusual in that manner that highest concentration of larvae was observed in the inner part of the English Channel (around Sandettie Bank), and not at the most westerly stations as in other years. Higher abundance of larvae around Sandettie Bank were also observed during the survey in January, but due to heavy wind speeds and high waves, the western parts of the area were out of reach and could not be sampled.

No survey was planned for the second half of January 2023. Instead, an additional MIK sampling is scheduled for April 2023 in the German Bight and Skagerrak/Kattegat area. This sampling should shade light on the foraging and recruitment of herring larvae originating in the Downs stock component. This survey is described in section 2.11.

At the last 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.

In almost all observed area in the North Sea, newly hatched herring larvae at the spawning grounds were less abundant compared to recent years. It is necessary to underpin and verify these findings in the upcoming sampling period.

2.3.3 International Bottom Trawl Survey (IBTS-Q1)

During the International Bottom Trawl Survey in the first quarter (Q1 IBTS), night-time catches are conducted with the MIK net, a fine meshed (1600 μm) 2-m-midwater ring net (ICES 2017) providing abundance estimates for large herring larvae (0-ringers) of the autumn spawning stock components. In addition, the Q1 IBTS also provides the time series for the 1-ringer herring abundance index in the North Sea from GOV catches carried out during daytime. For more details on the times series, the reader is referred to the previous reports of the working group.

2.3.3.1 The 0-ringer abundance (IBTS0 survey)

The total abundance of 0-ringers in the survey area from the MIK sampling is used as a recruitment index for the stock. Since 2017, this 0-ringer index (also called MIK index) time series is calculated with a new algorithm, which excludes larvae of Downs origin more rigorously. This is done by excluding the smaller larvae – presumably of Downs origin – from the analyses in certain parts of the survey area. Index values are calculated as described in detail in the Stock Annex. (Note that this new time-series based on the new algorithm only dates back to 1992, and that all French data before 2008 are excluded because of data quality issues). The results of the calculation can be found in Table 2.3.3.1. The index from the 2023 survey (corresponding to the 2022 year-class) is 90.8. This corresponds to an average index value and is a bit below the long-term average of 100.7 (in the time-series since 1992).

The previous MIK-IBTS survey in 2022 had been faced with numerous challenges which resulted in poor sampling coverage (see previous HAWG report for details). The 2023 survey was again faced with several challenges, but fortunately considerably fewer than in 2022. Due to technical issues with the steering gear and the trawl winches on RV Walther Herwig III, Germany lost approximately 1.5 weeks of survey time. Scotland also had technical problems with the engine as well as a Covid-19 infection onboard of RV Scotia, resulting in a loss of approximately 1 week of survey time. In addition, several participants had issues with severe weather conditions during parts of the survey period.

A total of 586 MIK hauls were conducted in 2023, which is 153 more than in 2022 but 97 less than in 2021. For the 2023 MIK 0-ringer index (corresponding to the 2022 year-class), all hauls north of 51° N were used, in total 569 hauls (for comparison: 2022 = 410 hauls and 2021 = 663 hauls).

A total of 716 MIK hauls were planned according to the 2023 NSIBTS Q1 program (the target is 4 hauls per ICES rectangle) and 586 were conducted, i.e., 82% of the planned MIK-stations were sampled in 2023. However, there has been a general increase in the number of MIK hauls throughout the time-series, and the 586 MIK hauls achieved in 2023 are above the long-term average of 505 hauls (time-series since 1992). Besides, thanks to coordination between participants during the survey, almost all ICES squares in the survey area were covered. Furthermore, the main distribution area of the herring larvae in the central and southern North Sea was well covered with at least 3 and mostly 4 MIK hauls per ICES square. Thus, the "missing" hauls in relation to the number of planned hauls and the resulting lower coverage with only 1 or 2 hauls per ICES square did mainly occur in the northern part of the survey area, which usually only yields relatively few herring larvae. Overall, the coverage achieved during the 2023 MIK survey was good and can be regarded to provide a representative 0-ringer index.

Figure 2.3.3.1.1 shows the size distribution of MIK larvae in 2023. Herring larvae measured between 6 and 40 mm standard length (SL). Again, and as in most years, the smallest larvae <12

mm were numerous, with a peak at 10 mm. However, while these small larvae <12 mm often accounted for around 50 to 60% of the total number of larvae in other years, they only made up 33% of the total number of larvae in 2023. Instead, larvae in the size range between 13 and 17 mm were also numerous in the 2023 survey, with another peak at 15 mm. This interesting feature in the 2023 length distribution is similar to the length distribution in 2022, which also showed a peak at 15 mm. Larger larvae >18 mm SL were rarer, but their relative share was 20% and thus higher than in the two previous years 2022 and 2021, where the share of these larger larvae >18 mm was only 11 and 12%, respectively.

Figure 2.3.3.1.2 illustrates the spatial distribution of 0-ringers (>18 mm) in 2021, 2022 and 2023. As in previous years, the smallest larvae in 2023 were again chiefly caught in 7.d and in the Southern Bight. The 2023 distribution is partly similar to 2021, with higher abundances east of Scotland and along the UK coast. However, in the south-eastern and eastern part of the North Sea, the potential nurseries, abundance of larger herring larvae in 2023 was lower than in the two previous years. An interesting feature of the 2023 spatial distribution are the few stations with very high abundances in the English channel / Southern Bight area, which have a relatively strong impact on the index value.

As in previous years, sardine larvae were again found in the samples of the 2023 MIK survey. Most sardine larvae occurred in the southern and south-eastern North Sea as well as in the Skagerrak. However, in contrast to previous years, some sardine larvae were also found relatively far north and north-west.

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 1991 to 2021 is shown in Table 2.3.3.2. The index from the 2023 survey (corresponding to the 2021 year-class) is 5016. This is a record high value in the time series and more than 2.5 times higher than the long-term average of 1969, and considerably higher than the previous 3 highest year-classes in 1986, 1995 and 2013 with index values of 4394, 4403 and 3918, respectively.

Figure 2.3.3.2.1 illustrates the spatial distribution of 1-ringers as estimated by trawling in January/February 2021, 2022, and 2023, corresponding to year-classes 2019, 2020 and 2021. As in previous years, a large part of the 1-ringers of the 2021 year-class were found in the Kattegat/Skagerrak area. However, very high abundances were also found in the entire eastern North Sea, in the area east of 4° East and south of 58° North.

After a longer period where the trajectories of 1-ringer abundance and 0-ringer index seemed to be uncoupled (year-classes 2003-2012), the two trajectories corresponded better again for the year-classes 2013 – 2018 but weakened for the 2019 year-class (Fig. 2.3.3.2.2). The 0-ringer and 1-ringer data for the 2020 year-class correspond better than for the 2019 year-class, but the 1-ringer value seemed rather low compared to the 0-ringer value, which may have been related to the severe challenges during the 2022 survey and associated potential catchability issues (see previous HAWG report for details). For the 2021 year-class, the two time-series seem to be highly uncoupled, as the 0-ringer index of 48.0 is one of the lowest in the time series, while the 1-ringer abundance is record high. This may be related to unusually good recruitment of the Downs component, which is not reflected in the 0-ringer index but is included in the 1-ringer abundance (see also section 2.5.1 on the "Relationship between 0-ringer and 1-ringer recruitment indices" for further details).

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 third 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 2000 to 2022 for comparison. The data for 2022 were sourced from tables 2.3.1.2. and 2.2.2. In the third quarter (timing of the HERAS survey), most fish are approaching their peak weights just prior to spawning.

The general trend towards smaller mean weights-at-age observed in recent years in the acoustic survey and, but less pronounced, in the catch in the third quarter (Figure 2.4.1.1), seems to have been turned since 2020. This is especially the case for winter ringers 2 and 3. Almost all ages, in both the acoustic survey and the catch, had higher or equal mean weights-at-age compared to 2021, with the only exception of 1-wr fish in both the catch and the survey, and 9+ group in the survey.

2.4.2 Maturity ogive

The percentages at age of North Sea autumn spawning herring that were considered mature in 2022 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 were described fully in ICES (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.

In 2022, 2 winter ringers were to 70% mature. This is in line with previous years, while in 2018 and 2019, maturity of 2 ringers was only 37% and 59%, respectively. Maturity of winter ringers 3 (95%) and 4 (97%) are also comparable to the long-term average. 100% maturity was achieved by winter ringers 6.

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, 2021).

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. However, for the profiling performed during WKPELA2018, a benchmark interim model specification was used. In practice, the assessment profiling should have been performed using the WKPELA2018 final model configuration to ensure consistency in the derivation of additive rescaling. This discrepancy was only discovered at HAWG2021 and has consequence in the scaling of the assessment. In order to correct this discrepancy but also update the natural mortality for the NSAS assessment with the latest SMS model key run (ICES WGSAM, 2021), a dedicated inter-benchmark was held (IBPNSherring2021, ICES, 2021).

The latest natural mortality vector from WGSAM (ICES WGSAM, 2021) spans the 1974-2019 period. Values outside this year range is computed using a three-year moving average.

2.5 Recruitment

Information on the development in North Sea herring recruitment comes from the International Bottom Trawl Surveys, from which IBTS0 and 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. Of importance is the fact that IBTS0 allows the assessment model to estimate recruitment levels in the assessment year. This is subsequently used in the short-term forecast for the intermediate year. 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 herring stock increased and of the autumn spawning components decreased, the relationship between the two indices started to erode. This was particularly true during the first decade of the 21st century (for the year-classes 2003 - 2012), but also already for the 1995 year-class, when the predicted trends in recruitment deviated between the two indices.

Since 2017, the MIK index time series is calculated with a 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 (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 the 2014 MIK survey, the 2013 year-class 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-classes until the 2018 year-class (Figure 2.3.3.2.2). For the 2019 year-class, the relationship between the MIK 0-ringer and the IBTS 1-ringer index decreased again. For the 2020 year-class, the two indices corresponded better, but the 1-ringer value seemed rather low compared to the 0-ringer value, which may have been related to the severe challenges during the 2022 survey and associated potential catchability issues (see previous HAWG report for details).

The most recent data that can be compared between 0-ringers and 1-ringers are for the 2021 year-class, corresponding to the 0-ringers from the 2022 MIK survey and the 1-ringers from the 2023 GOV survey. For this year-class the two time-series seem to be highly uncoupled, as the 0-ringer index of 48.0 is one of the lowest in the time series, while the 1-ringer abundance is record high. This is also reflected in the explained variability of the correlation between 0- and 1-ringers, which was 26% until the last 2020 year-class, but with the large discrepancy between the 0-ringer and 1-ringer indices for the most recent 2021 year-class, this value has now further diminished to 15% (Figure 2.5.1.1).

The high discrepancy may be related to unusually good recruitment of the Downs component, as this component is not reflected in the 0-ringer index but is represented in the 1-ringer index. This is also supported by the index of small (<13 cm) 1-ringers, which are assumed to be of Downs origin and also showed a record high value of 2699 for the 2021 year-class (Table 2.3.3.2). The variable correspondence in the 0-ringer and 1-ringer indices in the later part of the time-series may in general be related to variable but generally increasing contributions of the Downs component. This also corresponds to recent results of genetic studies (Bekkevold et al. 2023), which show high shares of individuals of Downs origin amongst in particular juvenile herring in the eastern North Sea area.

2.6 Assessment of North Sea Herring

2.6.1 Data exploration and preliminary results

The tool for the assessment of North Sea herring is FLSAM, an implementation of the State-space assessment model (www.stockassessment.org, Nielsen and Berg 2014), 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 70%, 95%, and 97% respectively. The historical proportion mature at age are given in Table 2.6.1.2 and plotted in Figure 2.6.1.1. The maturity for age 2 is substantially higher compared to the lowest point in 2018. This is following

a consistent decrease of proportion mature at this age since 2015. Other biological inputs to the assessment are presented in Figures 2.6.1.2-2.6.1.4 and Tables 2.6.1.3-2.6.1.5. Catch at age are given in Table 2.6.1.6 and the proportions plotted in Figure 2.6.1.5.

The numbers-at-age over all ages in the HERAS acoustic survey are given in Table 2.6.1.7 and the proportions are plotted in Figure 2.6.1.6. Overall, the age composition of the stock sampled by the HERAS acoustic survey in 2022 is similar to previous years. For this survey, the internal consistency of the index remains high, as it has been for a long period (Figure 2.6.1.7). However, as explored at HAWG 2020 (ICES 2020h), the index consistency has decreased in recent years. Other survey indices are presented in Tables 2.6.1.8-2.6.1.14. The internal consistency of the IBTSQ3 (the other multi-age index) is shown in Figure 2.6.1.8 and presents good cohort tracking.

2.6.2 NS herring assessment

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 are presented in Table 2.6.1.2-2.6.1.14 and model settings are given in Table 2.6.2.7. Estimated parameters and model outputs are given in Table 2.6.2.1-2.6.2.6.

A summary of assessment outputs is shown in Figure 2.6.2.1 (SSB, F averaged over age 2-6 and recruitment). The spawning stock at spawning time in 2022 is estimated at approximately 1.65 million tonnes, a slight increase to 2021. As for recruitment, the 2023 estimates are at similar levels than estimated during 2022. Recruitment of the 2021- and 2022-year classes are estimated to be the highest since 2013. Mean F2–6 in 2022 is estimated at approximately 0.22.

The SAM model fits the catch and the surveys well and residuals are random and small for all ages (figures 2.6.2.2–2.6.2.5). Only 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 2.6.2.2). 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. However, this survey is the only one able to provide information on the strength of the different spawning components. Given the low impact of this survey on the overall assessment, this is not considered an issue.

The estimated observation variances and survey catchabilities are given in Tables 2.6.2.1-2.6.2.2 and plotted in Figures 2.6.2.6-2.6.2.8. Overall, the assessment is informed best by catch data and HERAS over the core ages of the stock (ages 2-6). With the updated assessment model from the latest inter-benchmark (ICES 2021i), the catchability of the HERAS survey is close to 1, in line with the expectation for this survey that covers the stock in its entirety.

A feature of the assessment model is the estimation of an observation variance parameter for each dataset (Table 2.6.2.1, Figure 2.6.2.6). 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 uncertainty associated with the parameter estimated is low for most data sources where only the CV of the catch-at-age

0 is some- what high (Figure 2.6.2.7). However, the CV quantities do not indicate a lack of convergence of the assessment model.

The analytical retrospective analysis (Table 2.6.2.5, Figure 2.6.2.9) has mean Mohn's rho values with a 5-year peel of: -10.4% (Fbar), -3.5% (rec), and 8.6% (SSB). Figure 2.6.2.10 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 (Figures 2.6.1.7-2.6.1.8 and Figure 2.6.2.11).

The fishing selectivity at age is presented in Figure 2.6.2.12. Whilst dome shape selectivity was observed at the end of the 2000's, linearly increasing selectivity has been taking place since 2005, due to a large part of the biomass at old fish ages. In the last years, these linearly increasing selectivity shapes were dampened, potentially trending toward dome shapes.

2.6.3 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 (Figure 2.6.3.1). The fleets B and D are combined because of their similarity and to ease model convergence. More details on the model configuration exploration are provided in the 2018 benchmark report (ICES WKPELA, 2018) and 2021 inter-benchmark (ICES 2021i). The latest configuration with 2023 data did not allow the model to converge. This was due to the low catches for the B-D fleets, with years associated with 0 catches for some ages. Consequently, model tuning was necessary. A small adaptation of the 2021 inter-benchmark configuration was used and is given in Table 2.6.3.8. The main change is the reduction of ages considered for catches for the fleets B and D (0-6 initially, now ages 0-3).

Tables for the multifleet assessment and results (including fleet wise fishing mortalities) are given in Table 2.6.3.1-2.6.3.7. Figure 2.6.3.2 shows a comparison between the single fleet and multi-fleet stock trajectory results, and these are very consistent.

Of particular relevance when running the SAM model using a multifleet configuration is the fishing mortality-at-age that is outputted for each fleet. The subsequent catch residuals for each fleet are shown in Figure 2.6.3.3 to Figure 2.6.3.5. The observation variance is shown in Figure 2.6.3.6, with high levels for fleet B and D and C. Expectedly, the model is driven by catch data from the fleet A which represents most of the overall catches. The model uncertainty and the correlation coefficients between the estimated parameters are shown in Figure 2.6.3.7 and 2.6.3.8 respectively.

Whilst the 2023 model converged with the new configuration (Table 2.6.3.8), it failed for all the peels. Consequently, the analytical retrospective could not be performed. The issue in the multi-fleet model convergence requires further investigation at HAWG 2024.

The fishing selectivity for the A fleet are shown in Figure 2.6.3.9 and present similar patterns to the single fleet model. This is expected as fleet A is the main fleet harvesting the stock. The development of selectivity patterns for the other fleets (C and B and D combined) are presented in Figure 2.6.3.10 and 2.6.3.11.

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 FMSY (0.31).

The SSB in autumn 2022 was estimated at 1.65 million tonnes, which is above Bpa (0.96 million t) and MSY Btrigger(1.23 million t).

Since the strong 2013-year class, recruitment of herring has been low, but the latest two years are higher than the 10-year rolling average. The 2021-year class is estimated at 123% and the 2022-year class at 124% of the 10-year geometric mean recruitment.

Contrary to recent years' assessments, fishing mortality on older ages is now estimated lower.

2.7 Short-term predictions

Short-term predictions for the years 2023, 2024, and 2025 were done with a code developed in the R programming language. During HAWG 2019, a modification to the code was 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. During HAWG 2020 a further modification to the code was made to allow for a combined scaling of the A and B fleets (see below).

The various assumptions for the short-term predictions for both the stock and the four different fleets are given in tables 2.7.1 and 2.7.2 respectively. The reference points are presented in Table 2.7.3.

In the short-term predictions, recruitment is assumed constant at 23 billion for the years 2024 and 2025 following the same recruitment regime since 2002 (weighted mean of the past 10 year classes, weighted by the uncertainty in the estimate). The recruitment estimates of the 2022 year class, obtained from the assessment (informed by the 2023 IBTS0 survey) served as the estimate for 2023.

For the intermediate year (2023). No overshoot for the A fleet was assumed. Negotiations between the EU, Norway, and UK for 2023 resulted in the allowance of 21 970 t of the C-fleet and 50% D-fleet TACs in the Kattegat-Skagerrak area to be taken in the North Sea. The arrangement is very different to the previous year's arrangements. The expected catches of NSAS herring during 2023 were estimated as follows:

- A-fleet: 413 245 t. Fleet TAC (396 556 t) + C-fleet TAC transfer to the North Sea (21 971 t), scaled by the 3-year average proportion of NSAS in A-fleet catch (98.7%, 2020-2022)
- B-fleet: 8279 t. Fleet TAC (7716 t) + D-fleet TAC transfer (50%) to the North Sea (3330 t), scaled with the fleet uptake in 2022 (75%)
- C-fleet: 331 t. Fleet catches in 3.a of 770 t (310 t agreed maximum Norwegian catch and 47.5% (proportion of C-fleet EU catches in the total EU catches in 3.a in 2022) of 969 t agreed maximum EU catch), scaled by the 3-year average proportion of NSAS in the C-fleet catch (43%, 2020-2022)
- D-fleet: 355 t. Fleet catches based on 52.5% (proportion of D-fleet catches in the total EU catches in 3.a in 2022) of 969 t agreed maximum EU catch, scaled by the 3-year average proportion of NSAS in the D-fleet catch (70%, 2020-2022)
- The expected catches of Western Baltic Spring-spawning herring caught under the North Sea TAC are deducted from the expected A fleet catches in the intermediate year. In the projected year 2024, for most of the scenarios, the C and D fleet outtake was set to 0 in

agreement with the 0-catch advice for WBSS for 2024. The catch scenarios with a zero-catch advice for WBSS are presented in Table 2.7.4.

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. The catch scenarios assuming a status quo in C-D fleet catches are presented in Table 2.7.5.

Two additional scenarios with the inclusion of the C-fleet TAC rule were calculated at HAWG2023. The corresponding scenarios (with and without a TAC transfer to the North Sea) are given in Table 2.7.6. In practice, managers implement the following TAC rule in order to determine the TAC for the C-fleet:

TAC C = (5.7%* TAC A) + (TAC SD22-24*41%*2)

The final table as presented in the advice is given in Table 2.7.7.

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. With the reference points derived at IBPNSherring 2021 (ICES, 2021i), the MSY AR stipulates a fishing mortality of FMSY = 0.31 when the stock is above MSY Btrigger (1 232 828 tonnes) and a linear decline in F when the stock is below MSY Btrigger. With the forecasted values in 2024, the SSB is calculated above MSY Btrigger which results in a target $F_{(wr)\,2\text{–}6}$ =0.31 (Figure 2.7.1.1).

There is no specific allowance in the ICES MSY AR for multiple fishing mortality targets, such as the fishing mortality for 0 and 1 WR herring, which were previously integral part of the management plans for NSAS herring. In the forecast, the combined selection pattern for the A and B fleets are scaled together to achieve the different targets of the forecast scenarios. Therefore, the fishing mortalities of the A and B fleets are both variable across the scenarios.

The 2024 advice exemplifies a 28.3% increase. The basis for this increase of catch advice is threefold. Firstly, the SSB in 2022 is estimated to be 32.5% larger than that predicted in the previous advice. Secondly, the recruitment in 2022 (2021 year class) is now estimated to be 87.3% larger than that estimated in the previous advice. The contribution of this year class to the SSB in the advice year is 32.6%. Thirdly, the SSB in the advice year is forecasted to be above MSY $B_{trigger}$, leading to a fishing advice at FMSY in 2024, rather than below FMSY which was the situation for 2023.

All predictions are for North Sea autumn spawning herring only.

2.7.1 Exploratory short-term projections

A direct comparison of the forecast results with the last two assessments (2023 and 2022) is given in Figure 2.7.2.1 for the total SSB, Figure 2.7.2.2 for the catches at age and Figure 2.7.2.3 as proportions. Overall, it is predicted that the contribution of old ages will be lessened in 2024 relative to 2023.

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 2023 again carried out and extended short-term projection using the MSY AR projection, using the same recruitment and the same fishing patterns by fleet for the years 2025–2029 (Figure 2.7.2.4). This projection resulted catch of ~477 269 tonnes by 2027. 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.

2.8 Medium-term predictions and HCR simulations

No medium-term prediction or HCR simulations were carried out during the Working Group. A new management strategy evaluation was carried out in 2019 (ICES WKNSMSE, 2019), following an EU-Norway request (EU–Norway, 2018). However, to date there is no agreement of management plan between EU, Norway, and UK.

2.9 Precautionary and Limit Reference Points and FMSY targets

The precautionary reference points for this stock were originally adopted in 1998 and updated in 2012, 2016, 2018 and 2021.

New reference points were calculated during the 2021 interbenchmark meeting (ICES, 2021i) which resulted in a downward estimate of Blim and MSYBtrigger and an upward estimate of Fmsy. Sensitivity testing revealed that the derivation of reference points for herring in the North Sea is very sensitive to the choice of time periods and stock–recruitment models used. Reference points out of the 2018 benchmark and the 2021 interbenchmark are presented in table 2.9.1. The derivation of reference points and the history of the reference points for North Sea herring are further described in the Stock Annex.

Overall, in light of the 2023 assessment, the fishing pressure remains below FMSY while the SSB is above MSY BTrigger.

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 2021 inter-benchmark (ICES, 2021i). 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 changes made during the 2021 inter-benchmark overall improved the assessment model. Sensitivity testing revealed that the derivation of reference points for herring in the North Sea is very sensitive to the choice of time periods and stock–recruitment models used.

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.

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 interannual variability. However, the Downs component may be underrepresented in some years due late spawning and Orkney-Shetland due to a lack of sampling due to vessel constraints in 2016-2019. In recent years, the Downs component is dominating, an aspect that has been confirmed by a dedicated larvae survey conducted in April (Downs Recruitment Survey).

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 <19 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 several 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 despite a spawning-stock biomass that is well above the Blim 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 datasets 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 of 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.

2.14 Tables and Figures

Table 2.1.1. Herring caught in the North Sea. Total catch (tonnes) by country, 2018–2022. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2018	2019	2020	2021	2022
Belgium	32	60	119	47	52
Denmark *	132 231	91 680	95 615	62 943	76 168
Faroe Islands	497	614	804	0	212
France	31 505	25 288	19 768	25 070	28 573
Germany	51 636	37 699	29 439	25 741	28 573
Netherlands	111 302	79 465	75 036	66 402	46 986
Norway	162 594	128 614	115 879	95 061	74 376
Lithuania	0	0	0	466	0
Sweden *	19 408	13 184	13 149	18 765	19 813
Ireland	515	3	235	414	306
UK (England)	19 591	12 685	16 241	13 174	15 590
UK (Scotland)	66 005	50 771	49 692	51 194	63 756
UK (N.Ireland)	6 916	3 938	2 681	5 176	3 866
Unallocated landings	0	0	0	0	0
Total landings	602 232	444 001	424 800	364 453	463 696
Discards/BMS	96	1 630	2 522	162	3 438
Total catch	602 328	445 631	427 321	364 615	467 134
Estimates of the parts of the catches which have been allocated to spring-spawning stocks					
WBSS	2 164	8 832	6 802	3 505	5 402
Thames estuary **	0	-	-	2	0
Norw. Spring Spawners ***	310	5	88	0	0

*** Including any bycatches 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	2018	2019	2020	2021	2022
Denmark *	90 763	54 820	56 676	37 970	43 150
Faroe Islands	496	611	794	0	8
France	14 745	13 344	7 688	13 795	18 055
Germany	35 884	19 851	16 694	16 590	38 182
Lithuania	-	-	2 789	466	-
Netherlands	56 990	44 071	50 363	48 510	49 603
Norway	78 647	53 254	35 674	7 119	14 017
Sweden	14 132	8 557	7 718	11 100	10 412
Ireland	515	3	235	414	306
UK (England)	12 313	5 640	11 439	9 487	10 752
UK (Scotland)	64 424	50 771	42 581	33 416	53 829
UK (N. Ireland)	5 582	3 938	2 681	2 514	3 866
Total Landings	374 491	254 860	235 330	181 381	242 180
Discards/BMS	-	-	284	64	1 177
Total catch	374 491	254 860	235 613	181 445	243 357

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

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	2018	2019	2020	2021	2022
Denmark *	751	0	62	18	618
Faroese	-	-	-	-	204
Netherlands	0	100	0	0	913
Norway	73 452	64 592	58 535	87 756	113 476
Sweden	377	0	0	479	1 356
Total landings	74 580	64 692	58 597	88 253	116 567
Discards/BMS	-	-	-	-	-
Total catch	74 580	64 692	58 597	88 253	116 567
Norw. Spring Spawners **	310	5	88	0	0

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

**** 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	2018	2019	2020	2021	2022
Belgium	0	0	11	1	-
Denmark*	4 067	367 50	38 842	24 903	32 399
Faroe Islands	1	3	10	-	-
France	6 090	1 359	5 092	1 569	1 167
Germany	4 964	8 568	4 197	3 869	838
Netherlands	34 491	20 700	8 814	691	6 124
UK (N. Ireland)	1 334	0	0	2 662	-
Norway	10 495	10 768	21 671	186	6 505
Sweden*	4 899	4 627	5 431	7 166	8 045
UK (England)	3 262	2 750	919	4	695
UK (Scotland)	1 581	-	7 082	17 775	9 923
Unallocated landings	0	0	0	0	0
Total landings	107 794	85 525	95 422	58 826	65 696

Country	2018	2019	2020	2021	2022
Discards	1	800	-	-	-
Total catch	107 795	86 325	95 422	58 826	65696

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

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	2018	2019	2020	2021	2022
Belgium	32	60	108	46	52
Denmark*	40	110	36	53	1
France	10 670	10 585	6 988	9 705	9 351
Germany	10 788	9 280	8 548	5 282	7 966
Netherlands	19 821	14 594	15 859	17 202	17 736
Sweden	0	0	0	21	0
UK (England)	4 016	4 295	3 883	3 682	4143
UK (Scotland)	-	-	30	2	4
Unallocated landings	0	0	0	0	0
Total landings	45 367	38 924	35 451	35 992	39 252
Discards/BMS	95	830	2 238	99	2 261
Total catch	45 462	39 754	37 689	36 091	41 514
Coastal spring spawners included above**	10	-	-	2	-

*** 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	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Agreed Divisions 4.a,b	173.5	360.4	427.7	418.3	396.3	461.2	428.7	534.5	342.7	342.7	321.6	380.6	352.9
Agreed Div. 4.c, 7.d	26.5	44.6	50.3	51.7	49.0	57.0	53.0	66.0	42.4	42.4	34.8	47.0	43.6
Bycatch ceiling in the small mesh fishery *	16.5	17.9	14.4	13.1	15.7	13.4	11.4	9.7	13.2	9.0	7.8	8.2	7.7
National catch Divisions 4.a,b **	191.7	387.2	453.8	465.9	439	514.0	456.5	556.9	405.1	389.3	328.5	424.4	
Unallocated catch Divisions 4.a,b	0.0	-3.0	0.0	3.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Discard/slipping Divisions 4.a,b ***	-	-	-	0.0	-	0.1	-	0.0	0.8	0.3	0.1	1.2	
Total catch Divisions 4.a,b #	191.7	384.2	453.9	469.2	440.5	514.1	456.5	556.9	405.9	389.6	328.5	425.6	
National catch Divisions 4.c, 7.d **	26.7	37.1	44.7	38.2	41.1	45.8	35.2	45.4	38.9	35.5	36.0	41.5	
Unallocated catch Divisions 4.c,7.d	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Discard/slipping Divisions 4.c, 7.d ***	-	-	-	-	-	0.1	-	0.1	0.8	2.2	0.1	0.0	
Total catch Divisions 4.c, 7.d	26.7	40.4	44.7	38.2	41.1	45.8	35.2	45.5	39.8	37.7	36.1	41.5	
Total catch 4 and 7.d as used by ICES #	218.4	424.6	498.5	507.5	481.6	559.9	491.7	602.3	445.6	427.3	364.6	467.1	
CATCH BY FLEET/STOCK (4 and 7.d) ##													
North Sea autumn spawners directed fisheries (Fleet A)	209.2	411.8	489.9	490.5	471.5	543.6	484.1	591.7	440.5	417.5	352.3	455.6	
North Sea autumn spawners industrial (Fleet B)	8.9	10.6	8.1	14.0	7.9	14.5	7.0	8.5	5.2	9.9	8.8	6.1	

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
North Sea autumn spawners in 4 and 7.d total	218.1	422.5	498.1	504.5	479.4	558.1	491.1	600.2	436.8	420.5	361.1	461.7	
Baltic-3.a-type spring spawners in 4	0.3	2.1	0.5	3.0	2.2	1.8	0.6	2.2	8.8	6.8	3.5	5.4	
Coastal-type spring spawners	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Norw. Spring Spawners caught under a separate quota in 4 ###	12.2	9.6	3.2	2.3	2.2	0.2	0.1	0.3	0.0	0.1	0.0	0.0	
Agreed herring TAC	30.0	45.0	55.0	46.8	43.6	51.1	50.7	48.4	29.3	24.5	21.6	25.0	23.3
Bycatch ceiling in the small mesh fishery	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
National catch	20.0	27.7	31.2	28.9	27.8	29.9	26.8	23.3	14.9	17.8	13.3	0.7	
Catch as used by ICES	20.0	27.7	31.2	28.9	27.8	29.9	26.8	23.3	14.9	17.8	13.3	0.7	
Autumn spawners human consumption (Fleet C)	6.6	7.8	11.8	9.5	10.2	4.1	7.4	3.2	5.8	6.0	4.1	0.3	
Autumn spawners mixed clupeoid (Fleet D)	1.8	4.4	1.6	3.3	4.4	1.4	0.2	0.2	0.3	0.4	0.1	0.2	
Autumn spawners in 3.a total	8.4	12.2	13.4	12.8	14.7	5.5	7.6	3.4	6.1	6.4	4.2	0.5	
Spring spawners human consumption (Fleet C)	10.8	14.5	16.6	15.4	11.3	23.3	19.0	19.7	8.8	10.9	9.0	0.2	
Spring spawners mixed clupeoid (Fleet D)	0.8	1.0	1.3	0.6	1.8	1.1	0.2	0.2	0.0	0.5	0.0	0.0	
Spring spawners in 3.a total	11.6	15.5	17.9	16.1	13.1	24.4	19.2	19.9	8.8	11.4	9.1	0.2	
North Sea autumn spawners Total as used by ICES	226.5	434.6	511.4	517.3	494.1	563.6	498.7	603.5	442.9	426.9	365.4	462.2	

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 2022. 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	1.2	0.0	0.0	0.0	118.3	598.3	0.0	0.0	716.6	0.0	**717.8**	**716.6**
1	3.3	24.2	0.1	24.1	46.7	90.0	0.1	0.0	160.8	0.1	**164.2**	**161.0**
2	3.8	590.0	6.2	583.	136.2	147.5	4.2	7.0	867.4	11.2	**882.4**	**884.8**
3	0.2	107.4	6.7	100.	362.1	61.2	42.9	26.1	524.0	69.0	**593.2**	**599.7**
4	0.1	25.4	7.2	18.1	274.7	50.9	31.9	25.5	343.8	57.4	**401.3**	**408.4**
5	0.1	17.6	5.1	12.4	89.4	13.3	21.7	14.4	115.2	36.1	**151.3**	**156.4**
6	0.1	32.2	4.5	27.7	122.3	12.7	21.8	15.6	162.8	37.4	**200.3**	**204.7**
7	0.0	6.1	2.5	3.6	69.8	9.7	12.9	6.8	83.2	19.7	**102.9**	**105.4**
8	0.0	18.6	2.5	16.2	132.9	25.9	12.2	12.2	175.0	24.3	**199.3**	**201.7**
9+	0.0	11.0	0.8	10.2	81.4	22.1	17.9	7.3	113.7	25.2	**139.0**	**139.8**
Sum	8.8	832.6	35.6	797.	1433.	1031.	165.5	114.	3262.5	280.	**3551.6**	**3578.4**
Quarter: 1												
0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	**0.3**	**0.3**
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**
2	2.8	0.0	2.5	0.0	15.4	17.3	0.0	0.0	32.7	0.0	**35.5**	**32.7**
3	0.0	9.4	0.4	9.1	19.2	1.1	5.4	7.3	29.4	12.	**42.2**	**42.5**
4	0.0	1.2	0.3	0.9	15.1	1.0	8.9	12.0	16.9	20.	**37.9**	**38.2**
5	0.0	0.6	0.0	0.6	3.7	0.0	2.3	3.2	4.3	5.5	**9.8**	**9.8**
6	0.0	13.4	0.0	13.4	7.7	0.0	1.8	2.5	21.1	4.3	**25.4**	**25.4**
7	0.0	0.8	0.0	0.8	6.3	0.1	1.5	2.0	7.2	3.5	**10.7**	**10.7**
8	0.0	2.1	0.0	2.1	8.3	0.0	1.0	1.3	10.4	2.3	**12.7**	**12.7**
9+	0.0	2.1	0.0	2.1	5.4	0.0	0.0	0.0	7.5	0.0	**7.5**	**7.5**
Sum	2.9	29.6	3.2	28.9	81.1	19.9	21.0	28.3	129.8	49.	**182.0**	**179.9**
Quarter: 2												
0	0.5	0.0	0.0	0.7	0.0	209.7	0.0	0.0	0.2	0.1	**210.9**	**209.7**
1	1.6	12.3	0.0	12.3	0.0	0.3	0.0	0.0	12.6	0.0	**14.2**	**12.6**
2	0.6	541.0	3.3	537.	57.2	9.5	0.0	0.0	604.5	0.0	**605.0**	**607.7**
3	0.0	85.9	6.0	79.9	42.1	12.3	0.1	0.0	134.4	0.1	**134.5**	**140.4**
4	0.0	15.9	6.1	9.8	50.8	9.9	0.2	0.0	70.6	0.2	**70.7**	**76.8**
5	0.0	8.1	4.7	3.4	11.6	0.7	0.0	0.0	15.8	0.0	**15.8**	**20.5**
6	0.0	7.1	4.0	3.2	9.8	1.3	0.0	0.0	14.3	0.0	**14.3**	**18.3**
7	0.0	4.6	2.5	2.1	6.6	1.4	0.0	0.0	10.1	0.0	**10.1**	**12.6**
8	0.0	7.0	2.2	4.7	10.0	2.7	0.0	0.0	17.5	0.0	**17.5**	**19.7**
9+	0.0	3.6	0.8	2.8	9.0	0.9	0.0	0.0	12.6	0.0	**12.6**	**13.4**
Sum	2.8	685.5	29.5	656.	197.2	248.7	0.4	0.0	892.4	0.5	**1105.8**	**1131.8**
Quarter: 3												
0	0.1	0.0	0.0	0.0	0.4	219.1	0.0	0.0	219.5	0.0	**219.6**	**219.5**
1	0.3	11.9	0.1	0.0	0.0	22.3	0.0	0.0	22.3	0.0	**22.5**	**34.2**
2	0.2	41.9	0.4	0.0	55.8	93.6	0.0	0.0	149.4	0.0	**149.**	**191.3**
3	0.1	9.1	0.4	0.0	281.6	42.5	0.0	0.0	324.1	0.0	**324.2**	**333.2**
4	0.1	6.3	0.7	0.0	183.2	31.9	0.0	0.0	215.1	0.0	**215.2**	**221.4**
5	0.0	7.2	0.4	0.0	60.1	9.4	0.0	0.0	69.5	0.0	**69.5**	**76.7**
6	0.0	9.9	0.5	0.0	91.8	3.7	0.0	0.0	95.5	0.0	**95.6**	**105.4**
7	0.0	0.0	0.0	0.0	53.0	7.4	0.0	0.0	60.4	0.0	**60.4**	**60.4**
8	0.0	2.3	0.2	0.0	101.1	20.4	0.0	0.0	121.5	0.0	**121.5**	**123.8**
9+	0.0	2.1	0.0	0.0	59.1	16.9	0.0	0.0	75.9	0.0	**75.9**	**78.1**
Sum	0.8	90.8	2.8	0.0	886.1	467.0	0.0	0.0	1353.1	0.0	**1353.9**	**1443.9**
Quarter: 4												
0	0.6	0.0	0.0	0.0	117.9	169.3	0.0	0.0	287.1	0.0	**287.7**	**287.1**
1	1.4	0.0	0.0	0.0	46.7	67.5	0.1	0.0	114.2	0.1	**115.6**	**114.2**
2	0.2	7.1	0.0	0.0	7.8	27.1	4.2	7.0	34.9	11.	**46.2**	**53.1**
3	0.1	2.9	0.0	0.0	19.2	5.2	37.4	18.8	24.4	56.2	**80.7**	**83.6**
4	0.1	1.9	0.0	0.0	25.6	8.1	22.8	13.5	33.7	36.3	**70.1**	**71.9**
5	0.0	1.6	0.0	1.6	14.0	3.2	19.3	11.2	18.8	30.5	**49.4**	**49.3**
6	0.0	1.8	0.0	1.8	13.0	7.8	19.9	13.1	22.5	33.1	**55.6**	**55.6**
7	0.0	0.7	0.0	0.7	4.0	0.8	11.4	4.7	5.5	16.	**21.7**	**21.7**
8	0.0	7.4	0.0	7.4	13.4	2.8	11.1	10.	23.6	22.	**45.5**	**45.5**
9+	0.0	3.2	0.0	3.2	8.0	4.3	17.9	7.3	15.6	25.2	**40.8**	**40.8**
Sum	2.3	26.7	0.1	14.7	269.5	296.1	144.1	86.5	580.3	230.	**813.2**	**822.9**

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 2022. 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	0.026	0.000	0.000	0.007	0.007	0.000	0.000	0.007	0.000	**0.007**	**0.007**
1	0.052	0.062	0.068	0.011	0.027	0.094	0.000	0.028	0.094	**0.028**	**0.028**
2	0.061	0.129	0.129	0.133	0.139	0.119	0.122	0.131	0.121	**0.131**	**0.131**
3	0.117	0.140	0.133	0.177	0.164	0.111	0.120	0.168	0.114	**0.162**	**0.162**
4	0.158	0.179	0.144	0.185	0.183	0.121	0.127	0.184	0.124	**0.176**	**0.176**
5	0.170	0.215	0.170	0.194	0.206	0.145	0.163	0.198	0.152	**0.188**	**0.188**
6	0.193	0.250	0.176	0.209	0.196	0.159	0.178	0.216	0.167	**0.208**	**0.207**
7	0.198	0.205	0.192	0.223	0.245	0.173	0.174	0.224	0.173	**0.215**	**0.215**
8	0.205	0.215	0.195	0.229	0.237	0.197	0.202	0.229	0.199	**0.226**	**0.225**
9+	0.000	0.234	0.230	0.242	0.257	0.193	0.211	0.244	0.198	**0.236**	**0.236**
Quarter: 1											
0	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.004	0.000	**0.004**	**0.004**
1	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.023**	**0.000**
2	0.052	0.081	0.082	0.085	0.083	0.000	0.000	0.084	0.000	**0.081**	**0.084**
3	0.073	0.130	0.105	0.123	0.098	0.083	0.083	0.124	0.083	**0.112**	**0.112**
4	0.113	0.142	0.117	0.137	0.109	0.108	0.108	0.135	0.108	**0.120**	**0.120**
5	0.000	0.238	0.169	0.158	0.000	0.135	0.135	0.168	0.135	**0.150**	**0.150**
6	0.000	0.258	0.174	0.234	0.000	0.145	0.145	0.249	0.145	**0.232**	**0.232**
7	0.000	0.263	0.212	0.192	0.207	0.167	0.167	0.200	0.167	**0.189**	**0.189**
8	0.000	0.218	0.192	0.189	0.000	0.196	0.196	0.194	0.196	**0.195**	**0.195**
9+	0.000	0.241	0.229	0.182	0.000	0.000	0.000	0.199	0.000	**0.199**	**0.199**
Quarter: 2											
0	0.026	0.000	0.004	0.000	0.004	0.000	0.000	0.004	0.000	**0.004**	**0.004**
1	0.052	0.053	0.063	0.000	0.065	0.000	0.000	0.053	0.000	**0.053**	**0.053**
2	0.060	0.129	0.127	0.132	0.149	0.000	0.000	0.130	0.000	**0.130**	**0.130**
3	0.073	0.132	0.130	0.144	0.149	0.083	0.083	0.137	0.083	**0.138**	**0.137**
4	0.113	0.153	0.141	0.162	0.154	0.108	0.108	0.159	0.108	**0.161**	**0.159**
5	0.000	0.170	0.169	0.176	0.194	0.135	0.135	0.174	0.135	**0.176**	**0.174**
6	0.000	0.178	0.174	0.183	0.181	0.145	0.145	0.181	0.145	**0.183**	**0.181**
7	0.000	0.185	0.192	0.186	0.174	0.167	0.167	0.185	0.167	**0.183**	**0.185**
8	0.000	0.192	0.192	0.197	0.195	0.196	0.196	0.195	0.196	**0.196**	**0.195**
9+	0.000	0.208	0.229	0.200	0.225	0.000	0.000	0.203	0.000	**0.202**	**0.203**
Quarter: 3											
0	0.026	0.000	0.025	0.007	0.008	0.000	0.000	0.008	0.000	**0.008**	**0.008**
1	0.053	0.071	0.069	0.028	0.063	0.000	0.000	0.066	0.000	**0.066**	**0.066**
2	0.129	0.121	0.147	0.151	0.154	0.000	0.000	0.146	0.000	**0.146**	**0.146**
3	0.133	0.219	0.172	0.186	0.172	0.000	0.000	0.185	0.000	**0.185**	**0.185**
4	0.159	0.248	0.169	0.196	0.196	0.000	0.000	0.197	0.000	**0.197**	**0.197**
5	0.170	0.259	0.186	0.202	0.207	0.000	0.000	0.208	0.000	**0.208**	**0.208**
6	0.193	0.285	0.186	0.211	0.209	0.000	0.000	0.218	0.000	**0.218**	**0.218**
7	0.198	0.204	0.000	0.232	0.261	0.000	0.000	0.235	0.000	**0.235**	**0.235**
8	0.205	0.279	0.220	0.236	0.245	0.000	0.000	0.238	0.000	**0.238**	**0.238**
9+	0.000	0.292	0.256	0.258	0.268	0.000	0.000	0.261	0.000	**0.261**	**0.261**
Quarter: 4											
0	0.026	0.000	0.000	0.007	0.008	0.000	0.000	0.008	0.000	**0.008**	**0.008**
1	0.052	0.000	0.083	0.011	0.015	0.094	0.000	0.013	0.094	**0.014**	**0.014**
2	0.123	0.149	0.142	0.106	0.120	0.119	0.122	0.122	0.121	**0.122**	**0.122**
3	0.133	0.163	0.165	0.173	0.145	0.115	0.134	0.166	0.121	**0.136**	**0.136**
4	0.159	0.187	0.160	0.183	0.175	0.127	0.144	0.181	0.133	**0.157**	**0.157**
5	0.170	0.233	0.118	0.186	0.204	0.146	0.171	0.193	0.155	**0.170**	**0.170**
6	0.193	0.278	0.248	0.204	0.192	0.161	0.184	0.206	0.170	**0.185**	**0.185**
7	0.198	0.261	0.000	0.218	0.230	0.174	0.177	0.226	0.175	**0.188**	**0.188**
8	0.205	0.216	0.000	0.227	0.214	0.197	0.203	0.222	0.200	**0.212**	**0.212**
9+	0.000	0.219	0.000	0.215	0.221	0.193	0.211	0.218	0.198	**0.206**	**0.206**

Table 2.2.3. North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea in 2022. 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.**	**10.0**	**9.2**	**0.0**	**0.0**	**9.3**	**0.0**	**9.3**
1	**n.d.**	**18.8**	**n.d.**	**19.0**	**19.0**	**22.6**	**0.0**	**19.0**	**22.6**	**19.0**
2	**n.d.**	**23.2**	**n.d.**	**24.7**	**24.6**	**24.3**	**24.6**	**23.7**	**24.5**	**23.7**
3	**n.d.**	**23.9**	**n.d.**	**26.9**	**25.8**	**24.6**	**24.8**	**26.2**	**24.7**	**26.0**
4	**n.d.**	**26.2**	**n.d.**	**27.3**	**26.9**	**24.9**	**25.5**	**27.1**	**25.2**	**26.9**
5	**n.d.**	**28.0**	**n.d.**	**27.5**	**28.0**	**26.9**	**27.1**	**27.7**	**27.0**	**27.5**
6	**n.d.**	**29.7**	**n.d.**	**28.1**	**27.7**	**27.3**	**27.7**	**28.4**	**27.5**	**28.2**
7	**n.d.**	**28.2**	**n.d.**	**29.0**	**29.7**	**27.9**	**27.5**	**29.1**	**27.8**	**28.8**
8	**n.d.**	**29.3**	**n.d.**	**29.1**	**29.4**	**28.8**	**28.4**	**29.1**	**28.6**	**29.1**
9+	**n.d.**	**29.9**	**n.d.**	**29.6**	**30.2**	**28.2**	**28.8**	**29.7**	**28.3**	**29.5**
Quarter: 1										
0	n.d.	0.0	n.d.	0.0	7.9	0.0	0.0	7.9	0.0	7.9
1	n.d.	0.0	n.d.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	n.d.	22.0	n.d.	22.2	22.6	0.0	0.0	22.4	0.0	22.4
3	n.d.	23.6	n.d.	25.2	23.7	23.5	23.5	24.6	23.5	24.3
4	n.d.	25.5	n.d.	26.1	24.4	25.1	25.1	26.0	25.1	25.5
5	n.d.	30.4	n.d.	27.2	0.0	26.4	26.4	27.7	26.4	27.0
6	n.d.	30.7	n.d.	29.9	0.0	26.7	26.7	30.4	26.7	29.8
7	n.d.	30.8	n.d.	29.3	29.0	27.9	27.9	29.5	27.9	29.0
8	n.d.	30.1	n.d.	29.4	0.0	28.4	28.4	29.5	28.4	29.3
9+	n.d.	31.8	n.d.	29.0	0.0	0.0	0.0	29.8	0.0	29.8
Quarter: 2										
0	n.d.	0.0	n.d.	0.0	7.9	0.0	0.0	7.9	0.0	7.9
1	n.d.	18.0	n.d.	0.0	19.5	0.0	0.0	18.0	0.0	18.0
2	n.d.	23.2	n.d.	24.3	24.7	0.0	0.0	23.3	0.0	23.3
3	n.d.	23.5	n.d.	24.9	24.4	23.5	23.5	24.0	23.5	24.0
4	n.d.	25.1	n.d.	26.0	24.9	25.1	25.1	25.7	25.1	25.7
5	n.d.	26.3	n.d.	26.7	26.4	26.4	26.4	26.5	26.4	26.5
6	n.d.	26.1	n.d.	27.0	26.8	26.7	26.7	26.7	26.7	26.7
7	n.d.	27.3	n.d.	27.2	26.5	27.9	27.9	27.2	27.9	27.2
8	n.d.	27.8	n.d.	27.5	27.0	28.4	28.4	27.5	28.4	27.5
9+	n.d.	28.2	n.d.	27.8	28.9	0.0	0.0	28.0	0.0	28.0
Quarter: 3										
0	n.d.	0.0	n.d.	9.3	9.5	0.0	0.0	9.5	0.0	9.5
1	n.d.	19.7	n.d.	14.8	19.0	0.0	0.0	19.2	0.0	19.2
2	n.d.	22.8	n.d.	25.7	24.9	0.0	0.0	24.7	0.0	24.7
3	n.d.	27.2	n.d.	27.4	26.3	0.0	0.0	27.2	0.0	27.2
4	n.d.	28.3	n.d.	27.7	27.6	0.0	0.0	27.7	0.0	27.7
5	n.d.	29.5	n.d.	27.9	28.1	0.0	0.0	28.1	0.0	28.1
6	n.d.	30.7	n.d.	28.1	28.3	0.0	0.0	28.4	0.0	28.4
7	n.d.	27.6	n.d.	29.2	30.4	0.0	0.0	29.4	0.0	29.4
8	n.d.	30.0	n.d.	29.2	29.8	0.0	0.0	29.3	0.0	29.3
9+	n.d.	29.3	n.d.	30.0	30.6	0.0	0.0	30.1	0.0	30.1
Quarter: 4										
0	n.d.	0.0	n.d.	10.0	10.3	0.0	0.0	10.2	0.0	10.2
1	n.d.	0.0	n.d.	19.0	19.1	22.6	0.0	19.0	22.6	19.0
2	n.d.	25.8	n.d.	25.8	24.8	24.3	24.6	25.2	24.5	25.0
3	n.d.	27.1	n.d.	27.1	25.5	24.8	25.3	26.8	25.0	25.6
4	n.d.	28.1	n.d.	27.2	26.9	24.9	25.8	27.2	25.2	26.2
5	n.d.	29.4	n.d.	26.8	28.1	26.9	27.3	27.2	27.1	27.1
6	n.d.	31.0	n.d.	27.6	27.5	27.4	27.9	27.8	27.6	27.7
7	n.d.	30.6	n.d.	29.0	29.1	27.9	27.3	29.2	27.7	28.1
8	n.d.	30.4	n.d.	29.1	28.6	28.8	28.4	29.4	28.6	29.0
9+	n.d.	30.9	n.d.	28.8	28.7	28.2	28.8	29.2	28.3	28.7

Table 2.2.4. North Sea autumn spawning herring (NSAS), & western Baltic spring spawners (WBSS) caught in the North Sea and Division 3.a in 2022. Catches (tonnes) at-age (SOP figures), by quarter & 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	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**3.9**	**0.0**	**0.0**	**4.8**	**0.0**	**4.8**	**4.8**
1	**0.2**	**1.5**	**0.0**	**1.5**	**0.5**	**2.5**	**0.0**	**0.0**	**4.5**	**0.0**	**4.6**	**4.5**
2	**0.2**	**75.9**	**0.8**	**75.1**	**18.1**	**20.5**	**0.5**	**0.9**	**113.7**	**1.3**	**115.3**	**115.9**
3	**0.0**	**15.1**	**0.9**	**14.2**	**64.1**	**10.0**	**4.8**	**3.1**	**88.2**	**7.9**	**96.1**	**97.0**
4	**0.0**	**4.5**	**1.0**	**3.5**	**50.8**	**9.3**	**3.9**	**3.2**	**63.6**	**7.1**	**70.7**	**71.7**
5	**0.0**	**3.8**	**0.9**	**2.9**	**17.4**	**2.7**	**3.1**	**2.3**	**23.0**	**5.5**	**28.5**	**29.4**
6	**0.0**	**8.0**	**0.8**	**7.3**	**25.6**	**2.5**	**3.5**	**2.8**	**35.4**	**6.2**	**41.6**	**42.4**
7	**0.0**	**1.3**	**0.5**	**0.8**	**15.6**	**2.4**	**2.2**	**1.2**	**18.7**	**3.4**	**22.2**	**22.6**
8	**0.0**	**4.0**	**0.5**	**3.5**	**30.5**	**6.1**	**2.4**	**2.5**	**40.1**	**4.8**	**45.0**	**45.4**
9+	**0.0**	**2.6**	**0.2**	**2.4**	**19.7**	**5.7**	**3.4**	**1.6**	**27.8**	**5.0**	**32.8**	**33.0**
Sum	**0.5**	**116.7**	**5.5**	**111.1**	**243.0**	**65.7**	**23.8**	**17.5**	**419.8**	**41.3**	**461.6**	**466.7**
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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.1	0.0	0.2	0.0	1.3	1.4	0.0	0.0	2.7	0.0	0.0	2.7
3	0.0	1.2	0.0	1.2	2.4	0.1	0.4	0.6	3.7	1.1	4.7	4.8
4	0.0	0.2	0.0	0.1	2.1	0.1	1.0	1.3	2.3	2.3	4.6	4.6
5	0.0	0.1	0.0	0.1	0.6	0.0	0.3	0.4	0.7	0.7	1.5	1.5
6	0.0	3.5	0.0	3.5	1.8	0.0	0.3	0.4	5.3	0.6	5.9	5.9
7	0.0	0.2	0.0	0.2	1.2	0.0	0.3	0.3	1.4	0.6	2.0	2.0
8	0.0	0.5	0.0	0.5	1.6	0.0	0.2	0.3	2.0	0.5	2.5	2.5
9+	0.0	0.5	0.0	0.5	1.0	0.0	0.0	0.0	1.5	0.0	1.5	1.5
Sum	0.1	6.2	0.3	6.1	11.9	1.7	2.4	3.3	19.6	5.7	22.6	25.5
Quarter: 2												
0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.0	0.9	0.8
1	0.1	0.7	0.0	0.7	0.0	0.0	0.0	0.0	0.7	0.0	0.8	0.7
2	0.0	69.8	0.4	69.4	7.5	1.4	0.0	0.0	78.3	0.0	78.4	78.7
3	0.0	11.3	0.8	10.6	6.1	1.8	0.0	0.0	18.5	0.0	18.5	19.3
4	0.0	2.4	0.9	1.6	8.2	1.5	0.0	0.0	11.3	0.0	11.3	12.2
5	0.0	1.4	0.8	0.6	2.0	0.1	0.0	0.0	2.8	0.0	2.8	3.6
6	0.0	1.3	0.7	0.6	1.8	0.2	0.0	0.0	2.6	0.0	2.6	3.3
7	0.0	0.8	0.5	0.4	1.2	0.2	0.0	0.0	1.8	0.0	1.8	2.3
8	0.0	1.3	0.4	0.9	2.0	0.5	0.0	0.0	3.4	0.0	3.4	3.8
9+	0.0	0.7	0.2	0.6	1.8	0.2	0.0	0.0	2.5	0.0	2.5	2.7
Sum	0.1	89.8	4.6	85.2	30.7	7.0	0.0	0.0	122.8	0.0	123.0	127.5
Quarter: 3												
0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	1.7	0.0	1.7	1.7
1	0.0	0.8	0.0	0.0	0.0	1.4	0.0	0.0	1.4	0.0	2.3	2.3
2	0.0	5.1	0.1	0.0	8.4	14.4	0.0	0.0	22.8	0.0	27.9	27.9
3	0.0	2.0	0.1	0.0	52.3	7.3	0.0	0.0	59.6	0.0	61.6	61.6
4	0.0	1.6	0.1	0.0	35.8	6.2	0.0	0.0	42.1	0.0	43.5	43.6
5	0.0	1.9	0.1	1.8	12.1	1.9	0.0	0.0	15.9	0.0	15.9	15.9
6	0.0	2.8	0.1	0.0	19.4	0.8	0.0	0.0	20.1	0.0	22.9	22.9
7	0.0	0.0	0.0	0.0	12.3	1.9	0.0	0.0	14.2	0.0	14.2	14.2
8	0.0	0.6	0.0	0.6	23.9	5.0	0.0	0.0	29.4	0.0	29.4	29.5
9+	0.0	0.6	0.0	0.6	15.2	4.5	0.0	0.0	20.4	0.0	20.4	20.4
Sum	0.1	15.4	0.5	3.0	179.4	45.2	0.0	0.0	227.6	0.0	239.7	240.1
Quarter: 4												
0	0.0	0.0	0.0	0.0	0.8	1.4	0.0	0.0	2.2	0.0	2.2	2.2
1	0.1	0.0	0.0	0.0	0.5	1.0	0.0	0.0	1.5	0.0	1.6	1.5
2	0.0	1.1	0.0	0.0	0.8	3.2	0.5	0.9	4.1	1.3	6.5	6.5
3	0.0	0.5	0.0	0.0	3.3	0.8	4.3	2.5	4.1	6.8	11.4	11.4
4	0.0	0.4	0.0	0.4	4.7	1.4	2.9	1.9	6.5	4.8	11.3	11.3
5	0.0	0.4	0.0	0.4	2.6	0.7	2.8	1.9	3.6	4.7	8.4	8.4
6	0.0	0.5	0.0	0.5	2.6	1.5	3.2	2.4	4.6	5.6	10.3	10.3
7	0.0	0.2	0.0	0.2	0.9	0.2	2.0	0.8	1.2	2.8	4.1	4.1
8	0.0	1.6	0.0	1.6	3.1	0.6	2.2	2.2	5.2	4.4	9.6	9.6
9+	0.0	0.7	0.0	0.7	1.7	1.0	3.4	1.6	3.4	5.0	8.4	8.4
Sum	0.1	5.3	0.0	3.7	21.1	11.7	21.3	14.2	36.5	35.6	73.8	73.6

Table 2.2.5. North Sea autumn spawning herring (NSAS), and western Baltic spring spawners (WBSS) caught in the North Sea in 2022. Percentage age composition (based on numbers, 3+ group summarized), 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	**13.4%**	**0.0%**	**0.0%**	**0.0%**	**8.3%**	**58.0%**	**0.0%**	**0.0%**	**22.0%**	**0.0%**	**20.2%**	**20.0%**
1	**37.4%**	**2.9%**	**0.3%**	**3.0%**	**3.3%**	**8.7%**	**0.0%**	**0.0%**	**4.9%**	**0.0%**	**4.6%**	**4.5%**
2	**43.0%**	**70.9%**	**17.5%**	**73.3%**	**9.5%**	**14.3%**	**2.5%**	**6.1%**	**26.6%**	**4.0%**	**24.8%**	**24.7%**
3	**2.6%**	**12.9%**	**18.8%**	**12.6%**	**25.3%**	**5.9%**	**25.9%**	**22.7%**	**16.1%**	**24.6%**	**16.7%**	**16.8%**
4	**1.6%**	**3.0%**	**20.2%**	**2.3%**	**19.2%**	**4.9%**	**19.3%**	**22.2%**	**10.5%**	**20.5%**	**11.3%**	**11.4%**
5	**0.7%**	**2.1%**	**14.4%**	**1.6%**	**6.2%**	**1.3%**	**13.1%**	**12.5%**	**3.5%**	**12.9%**	**4.3%**	**4.4%**
6	**0.7%**	**3.9%**	**12.5%**	**3.5%**	**8.5%**	**1.2%**	**13.2%**	**13.6%**	**5.0%**	**13.3%**	**5.6%**	**5.7%**
7	**0.3%**	**0.7%**	**7.0%**	**0.5%**	**4.9%**	**0.9%**	**7.8%**	**5.9%**	**2.5%**	**7.0%**	**2.9%**	**2.9%**
8	**0.4%**	**2.2%**	**6.9%**	**2.0%**	**9.3%**	**2.5%**	**7.3%**	**10.6**	**5.4%**	**8.7%**	**5.6%**	**5.6%**
9+	**0.0%**	**1.3%**	**2.2%**	**1.3%**	**5.7%**	**2.1%**	**10.8%**	**6.4%**	**3.5%**	**9.0%**	**3.9%**	**3.9%**
Sum 3+	**6.3%**	**26.2%**	**82.2%**	**23.7%**	**79.0%**	**19.0%**	**97.4%**	**93.9%**	**46.5%**	**96.0%**	**50.3%**	**50.7%**
Quarter: 1												
0	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	0.2%	0.0%	0.1%	0.1%
1	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	97.3%	0.0%	78.7%	0.0%	19.0%	87.3%	0.0%	0.0%	25.2%	0.0%	19.5%	18.2%
3	1.4%	31.8%	10.9%	31.4%	23.7%	5.7%	25.8%	25.8%	22.7%	25.8%	23.2%	23.6%
4	0.0%	4.1%	10.4%	3.0%	18.6%	5.1%	42.4%	42.4%	13.1%	42.4%	20.8%	21.2%
5	0.0%	1.9%	0.0%	2.0%	4.6%	0.0%	11.2%	11.2%	3.3%	11.2%	5.4%	5.5%
6	0.0%	45.2%	0.0%	46.3%	9.5%	0.0%	8.7%	8.7%	16.2%	8.7%	14.0%	14.1%
7	0.0%	2.7%	0.0%	2.8%	7.7%	0.6%	7.2%	7.2%	5.5%	7.2%	5.9%	6.0%
8	0.0%	7.0%	0.0%	7.2%	10.3%	0.0%	4.7%	4.7%	8.0%	4.7%	7.0%	7.1%
9+	0.0%	7.2%	0.0%	7.4%	6.6%	0.0%	0.0%	0.0%	5.8%	0.0%	4.1%	4.2%
Sum 3+	**1.4%**	**100.0%**	**21.3%**	**100.0%**	**81.0%**	**11.4%**	**100.0%**	**100.0%**	**74.6%**	**100.0%**	**80.3%**	**81.7%**
Quarter: 2												
0	19.7%	0.0%	0.0%	0.1%	0.0%	84.3%	0.0%	0.0%	0.0%	26.3%	19.1%	18.5%
1	58.6%	1.8%	0.0%	1.9%	0.0%	0.1%	0.0%	0.0%	1.4%	0.0%	1.3%	1.1%
2	20.9%	78.9%	11.1%	81.9%	29.0%	3.8%	0.0%	0.0%	67.7%	0.0%	54.7%	53.7%
3	0.7%	12.5%	20.2%	12.2%	21.4%	5.0%	25.8%	25.8%	15.1%	19.0%	12.2%	12.4%
4	0.1%	2.3%	20.6%	1.5%	25.8%	4.0%	42.4%	42.4%	7.9%	31.3%	6.4%	6.8%
5	0.0%	1.2%	16.0%	0.5%	5.9%	0.3%	11.2%	11.2%	1.8%	8.2%	1.4%	1.8%
6	0.0%	1.0%	13.5%	0.5%	5.0%	0.5%	8.7%	8.7%	1.6%	6.4%	1.3%	1.6%
7	0.0%	0.7%	8.5%	0.3%	3.3%	0.6%	7.2%	7.2%	1.1%	5.3%	0.9%	1.1%
8	0.0%	1.0%	7.6%	0.7%	5.1%	1.1%	4.7%	4.8%	2.0%	3.5%	1.6%	1.7%
9+	0.0%	0.5%	2.6%	0.4%	4.5%	0.4%	0.0%	0.0%	1.4%	0.0%	1.1%	1.2%
Sum 3+	**0.8%**	**19.3%**	**88.8%**	**16.1%**	**71.0%**	**11.8%**	**100.0%**	**100.0%**	**30.8%**	**73.7%**	**24.9%**	**26.7%**
Quarter: 3												
0	9.4%	0.0%	0.0%	0.0%	0.0%	46.9%	0.0%	0.0%	16.2%	0.0%	16.2%	15.2%
1	30.1%	13.1%	3.5%	0.0%	0.0%	4.8%	0.0%	0.0%	1.6%	0.0%	1.7%	2.4%
2	26.5%	46.2%	15.1%	0.0%	6.3%	20.0%	0.0%	0.0%	11.0%	0.0%	11.0%	13.2%
3	11.6%	10.1%	14.2%	0.0%	31.8%	9.1%	0.0%	0.0%	24.0%	0.0%	23.9%	23.1%
4	9.4%	7.0%	26.8%	0.0%	20.7%	6.8%	0.0%	0.0%	15.9%	0.0%	15.9%	15.3%
5	4.6%	8.0%	14.8%	0.0%	6.8%	2.0%	0.0%	0.0%	5.1%	0.0%	5.1%	5.3%
6	4.1%	10.9%	16.8%	0.0%	10.4%	0.8%	0.0%	0.0%	7.1%	0.0%	7.1%	7.3%
7	1.9%	0.0%	0.0%	0.0%	6.0%	1.6%	0.0%	0.0%	4.5%	0.0%	4.5%	4.2%
8	2.4%	2.5%	7.5%	0.0%	11.4%	4.4%	0.0%	0.0%	9.0%	0.0%	9.0%	8.6%
9+	0.0%	2.4%	1.3%	0.0%	6.7%	3.6%	0.0%	0.0%	5.6%	0.0%	5.6%	5.4%
Sum 3+	**34.0%**	**40.7%**	**81.4%**	**0.0%**	**93.7%**	**28.3%**	**0.0%**	**0.0%**	**71.1%**	**0.0%**	**71.1%**	**69.2%**
Quarter: 4												
0	23.8%	0.0%	0.0%	0.0%	43.7%	57.2%	0.0%	0.0%	49.5%	0.0%	35.4%	34.9%
1	59.1%	0.0%	0.0%	0.0%	17.3%	22.8%	0.1%	0.0%	19.7%	0.0%	14.2	13.9
2	8.3%	26.6%	0.0%	0.0%	2.9%	9.1%	2.9%	8.1%	6.0%	4.8%	5.7%	6.5%
3	3.1%	11.0%	0.0%	0.0%	7.1%	1.8%	25.9%	21.7%	4.2%	24.4%	9.9%	10.2%
4	2.5%	7.2%	65.9%	0.0%	9.5%	2.7%	15.8%	15.6%	5.8%	15.7%	8.6%	8.7%
5	1.2%	6.0%	0.0%	10.9%	5.2%	1.1%	13.4%	13.0%	3.2%	13.2%	6.1%	6.0%
6	1.0%	6.8%	34.1	12.3%	4.8%	2.6%	13.8%	15.2%	3.9%	14.3%	6.8%	6.8%
7	0.5%	2.8%	0.0%	5.1%	1.5%	0.3%	7.9%	5.5%	1.0%	7.0%	2.7%	2.6%
8	0.6%	27.6%	0.0%	50.1%	5.0%	0.9%	7.7%	12.5	4.1%	9.5%	5.6%	5.5%
9+	0.0%	11.9%	0.0%	21.7%	3.0%	1.5%	12.4%	8.5%	2.7%	10.9	5.0%	5.0%
Sum 3+	**8.8%**	**73.4%**	**100.0%**	**100.0%**	**36.1%**	**10.9%**	**97.0%**	**91.9%**	**24.8%**	**95.1%0**	**44.7%**	**44.8%**

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. A fleet figure includes unsampled bycatch in the industrial fishery.

2022	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Winter rings	Numbers	Mean weight	Numbers	Mean weight	Numbers	Mean weight	Numbers	Mean weight	Numbers	Mean weight
0	1.7	0.005	701.8	0.007	0.0	0.000	1.2	0.026	704.7	0.007
1	49.2	0.046	110.1	0.011	0.1	0.036	3.2	0.052	162.5	0.023
2	879.9	0.130	6.0	0.039	3.5	0.060	0.2	0.081	889.7	0.129
3	597.9	0.155	0.2	0.113	0.2	0.118	0.0	0.073	598.2	0.155
4	404.4	0.171	0.2	0.113	0.1	0.157	0.0	0.113	404.7	0.171
5	152.5	0.189	0.0	0.000	0.1	0.170	0.0	0.081	152.6	0.189
6	201.9	0.214	0.0	0.000	0.1	0.193	0.0	0.000	202.0	0.214
7	103.8	0.219	0.0	0.000	0.0	0.198	0.0	0.000	103.8	0.219
8	201.0	0.238	0.0	0.000	0.0	0.205	0.0	0.000	201.0	0.238
9+	140.1	0.247	0.0	0.000	0.0	0.000	0.0	0.000	140.1	0.247
TOTAL	2'732.3		818.2		4.1		4.6		3'559.3	
SOP catch		455.6		6.1		0.3		0.2		462.3

Table 2.2.7. Catch-at-age (numbers in millions) of North Sea herring, 2012–2022.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
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
2019	513	35	34	292	197	740	542	140	85	138	2717
2020	2048	86	505	210	290	146	515	349	69	108	4324
2021	527	97	372	420	185	270	120	322	212	81	2606
2022	717	161	885	600	408	156	204	105	202	140	357

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, 2012–2022.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
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
2019	5.3	30.6	53.0	16.2	5.5	2.5	1.4	0.3	0.1	0.0	114.9
2020	0.0	1.8	3.2	5.8	7.5	1.2	10.7	5.3	1.8	2.8	40.2
2021	0.0	0.4	1.1	2.8	7.3	4.5	1.9	1.1	1.8	0.5	21.3
2022	0.0	0.1	6.2	6.7	7.2	5.1	4.5	2.5	2.5	0.8	35.6

Table 2.2.9. Catch-at-age (numbers in millions) of NSAS taken in 3.a, and transferred to the assessment of NSAS, 2012– 2022.

Year/rings	0	1	2	3	4	5	6	7	8+	Total
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
2019	23.7	101.3	19.8	4.6	0.1	0.1	0.1	0.0	0.0	149.8
2020	79.4	26.6	44.2	5.3	2.2	0.3	0.6	0.8	0.0	159.3
2021	6.9	15.7	36.3	2.8	1.5	0.8	0.5	0.1	0.1	64.8
2022	1.2	3.3	3.8	0.2	0.1	0.1	0.1	0.0	0.0	9.0

Table 2.2.10. Catch-at-age (numbers in millions) of the total NSAS stock 2012–2022.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
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
2019	537	137	54	296	197	740	542	140	85	138	2866
2020	2127	112	549	215	292	146	515	349	69	108	4483
2021	534	112	407	420	179	266	118	321	210	81	2649
2022	718	164	882	593	401	151	200	103	199	139	3552

Table 2.2.11. Comparison of mean weight (kg) at age (rings) in the catch of adult North Sea herring and NSAS caught in Division 3.a in 2012–2022

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
3.a	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	-
	2019	0.062	0.085	0.116	0.118	0.164	0.202	0.159	-
	2020	0.066	0.139	0.168	0.175	0.199	0.216	0.000	-
	2021	0.071	0.116	0.159	0.174	0.192	0.206	0.186	-
	2022	0.061	0.117	0.158	0.170	0.193	0.198	0.205	-
4.a(E)	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
	2019	0.134	0.155	0.173	0.212	0.204	0.209	0.220	0.250
	2020	0.126	0.144	0.158	0.169	0.180	0.191	0.197	0.210
	2021	0.126	0.149	0.162	0.178	0.180	0.200	0.203	0.220
	2022	0.129	0.140	0.179	0.215	0.250	0.205	0.215	0.234
4.a(W)	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
	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

		Age (Rings)							
Division	Year	2	3	4	5	6	7	8	9+
	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
	2019	0.134	0.154	0.174	0.205	0.206	0.220	0.246	0.248
	2020	0.138	0.160	0.174	0.195	0.216	0.218	0.239	0.246
	2021	0.138	0.160	0.174	0.195	0.216	0.218	0.239	0.246
	2022	0.138	0.160	0.174	0.195	0.216	0.218	0.239	0.246
4.b	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
	2019	0.148	0.163	0.163	0.210	0.229	0.251	0.244	0.253
	2020	0.150	0.174	0.186	0.212	0.234	0.241	0.252	0.265
	2021	0.133	0.157	0.173	0.199	0.214	0.225	0.226	0.240
	2022	0.133	0.177	0.185	0.194	0.209	0.223	0.229	0.242

Table 2.2.12. Sampling of commercial landings of North Sea herring (Division 4 and 7.d) in 2022 by quarter. Sampled catch means the proportion of the reported catch to which sampling was applied. Métiers are each reported combination of nation/fleet/area/quarter.

Country (fleet)	Q	Métiers (n)	Métiers sampled	Sam. Catch (%)	Official Catch	Samples	Fish aged	Fish meas-ured	>1 sample per 1 kt catch
Belgium	1	2	0	0%	13	0	0	0	13
	2	3	0	0%	0	0	0	0	0
	3	1	0	0%	0	0	0	0	0
	4	2	0	0%	38	0	0	0	38
total		8	0	0%	52	0	0	0	52
Denmark (A)	1	3	2	100%	9281	9	317	1050	n
	2	3	1	76%	4504	3	67	247	n
	3	3	2	100%	47391	60	1851	5299	y
	4	4	2	100%	9473	6	176	657	n
total		13	7	98%	70648	78	2411	7253	y
Denmark (B)	1	2	1	98%	61	2	6	6	y
	2	1	1	100%	755	9	91	308	y
	3	2	1	100%	1417	41	914	2522	y
	4	2	1	57%	3287	11	163	104	y
total		7	4	74%	5520	63	1174	2940	Y
France	1	3	0	0%	2233	0	0	0	n
	2	4	0	0%	3373	0	0	0	n
	3	3	0	0%	13150	0	0	0	n
	4	4	0	0%	9818	0	0	0	n
total		14	0	0%	28573	0	0	0	n
Germany	1	1	0	0%	133	0	0	0	n
	2	2	1	100%	14465	38	228	12991	y
	3	2	1	97%	23346	47	168	10685	y
	4	4	2	88%	9045	30	390	7930	y
total		9	4	96%	46988	115	786	31606	y

Country (fleet)	Q	Métiers (n)	Métiers sampled	Sam. Catch (%)	Official Catch	Samples	Fish aged	Fish meas-ured	>1 sample per 1 kt catch
Ireland	1	1	1	0	0%	74	0	0	n

Country (fleet)	Q	Métiers (n)	Métiers sampled	Sam. Catch (%)	Official Catch	Samples	Fish aged	Fish measured	>1 sample per 1 kt catch
	4	1	1	0	0%	232	0	0	n
total		2	2	0	0%	306	0	0	n
Netherlands	1	3	2	100%	1177	4	100	666	y
	2	3	0	0%	3034	0	0	0	n
	3	2	2	100%	49875	47	1531	6776	n
	4	4	2	82%	20290	2	50	360	n
total		12	6	91%	74375	53	1681	7802	n
Norway	1	2	2	100%	7762	8	326	365	y
	2	3	2	94%	96208	32	1566	2553	n
	3	3	2	98%	17555	3	113	138	n
	4	3	2	94%	12473	5	211	266	n
total		11	8	95%	133997	48	2216	3322	n
UK (Scot)	1	3	0	0%	732	0	0	0	n
	2	3	1	100%	2799	5	164	735	y
	3	2	1	83%	58970	22	1088	3495	n
	4	3	0	0%	1256	0	0	0	n
total		11	2	81%	63756	27	1252	4230	n
Sweden (A)	1	3	1	31%	1228	3	225	225	y
	2	3	1	66%	2340	2	142	142	n
	3	3	2	99%	14022	9	622	622	n
	4	3	1	60%	1616	2	150	150	y
total		12	5	87%	19206	16	1139	1139	n
Sweden (B)	2	1	0	0%	43	0	0	0	n
	3	1	0	0%	158	0	0	0	n
	4	1	1	100%	406	5	103	103	y
total		3	1	67%	607	5	103	103	y
UK (NI)	1	1	0	0%	10	0	0	0	n
	3	1	0	0%	3734	0	0	0	n

	4	1	0	0%	122	0	0	0	n
total		3	0	0%	3866	0	0	0	n
UK (E+W)	1	4	1	54%	491	4	100	551	y
	2	3	0	0%	44	0	0	0	n
	3	3	1	100%	9482	39	973	4061	y
	4	4	1	9%	5575	1	25	155	n
total		14	3	66%	15592	44	1098	4767	Y
Faroese	4	2	0	0%	211	0	0	0	n
total		2	0	0%	211	0	0	0	n
Period total	**1**	30	9	74%	25442	30	1074	2863	y
Period total	**2**	30	7	89%	127564	89	2258	16976	n
Period total	**3**	27	12	88%	240261	268	7260	33598	y
Period total	**4**	41	12	67%	73868	62	1268	9725	n
Total 2022		121	40	85%	463696	449	11860	63162	n
Human Cons. Only		111	35	85%	457569	381	10583	60119	n
Total 2020		117	28	82%	427321	347	8226	66700	n
Total 2021		108	31	81%	364615	274	8531	42072	n
HC 2021		92	29	82%	355827	241	8164	41311	n

2.3.1.1. North Sea herring. Acoustic Surveys in the North Sea (HERAS) in June–July 2022. Vessels, areas and cruise dates.

Vessel	Period	Contributing to Stocks	Strata

Celtic Explorer (IRL) EIGB	5 – 20 July	WoS, MSHAS (6.a.N and 6.a.S)	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	23 June – 15 July	NSAS, WBSS, Sprat NS	11, 141
Tridens (NED) PBVO	28 June – 21 July	NSAS, Sprat NS	81, 91 (south of 58°30'N), 101
Solea (GER) DBFH	1 – 19 July	NSAS, Sprat NS	51, 61, 71, 131
Dana (DEN) OXBH	22 June – 08 July	NSAS, WBSS, Sprat NS, Sprat 3.a	21, 31, 41, 42, 151, 152

Table 2.3.1.2. North Sea herring. Acoustic Surveys in the North Sea (HERAS) in June–July 2022. 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	14746	78	0.00	5.3	9.0
1	3711	149	0.00	40.3	16.9
2	3814	503	0.70	132.0	24.2
3	3043	541	0.95	177.8	26.7
4	1743	340	0.97	194.9	27.3
5	822	172	0.99	209.7	27.9
6	662	154	1.00	232.2	29.0
7	718	176	1.00	244.4	29.3
8	619	151	1.00	243.5	29.2
9+	249	67	1.00	268.8	30.4
Immature	19780	367		18.6	11.5
Mature	10348	1963		189.7	26.8
Total	30127	2330	0.34	77.4	16.8

Table 2.3.1.3. Estimates of North Sea autumn spawners (millions) at age from acoustic surveys, 1986–2022. 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 2019 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 ('000t)
1986	1639	3206	1637	833	135	36	24	6	8	7542	942
1987	13736	4303	955	657	368	77	38	11	20	20165	817
1988	6431	4202	1732	528	349	174	43	23	14	13496	897
1989	6333	3726	3751	1612	488	281	120	44	22	16377	1637
1990	6249	2971	3530	3370	1349	395	211	134	43	18262	2174
1991	3182	2834	1501	2102	1984	748	262	112	56	12781	1874
1992	6351	4179	1633	1397	1510	1311	474	155	163	17173	1545
1993	10399	3710	1855	909	795	788	546	178	116	19326	1216
1994	3646	3280	957	429	363	321	238	220	132	13003	1035
1995	4202	3799	2056	656	272	175	135	110	84	11220	1082
1996	6198	4557	2824	1087	311	99	83	133	206	18786	1446
1997	9416	6363	3287	1696	692	259	79	78	158	22028	1780
1998	4449	5747	2520	1625	982	445	170	45	121	16104	1792
1999	5087	3078	4725	1116	506	314	139	54	87	15107	1534
2000	24735	2922	2156	3139	1006	483	266	120	97	34928	1833
2001	6837	12290	3083	1462	1676	450	170	98	59	26124	2622
2002	23055	4875	8220	1390	795	1031	244	121	150	39881	2948
2003	9829	18949	3081	4189	675	495	568	146	178	38110	2999
2004	5183	3415	9191	2167	2590	317	328	342	186	23722	2584
2005	3113	1890	3436	5609	1211	1172	140	127	107	16805	1868
2006	6823	3772	1997	2098	4175	618	562	84	70	20199	2130
2007	6261	2750	1848	898	806	1323	243	152	65	14346	1203
2008	3714	2853	1709	1485	809	712	1749	185	270	20355	1784
2009	4655	5632	2553	1023	1077	674	638	1142	578	31526	2591
2010	14577	4237	4216	2453	1246	1332	688	1110	1619	43705	3027
2011	10119	4166	2534	2173	1016	651	688	440	1207	25524	2431
Years / Age (rings)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9+**	**Total**	**SSB ('000t)**

2012	7437	4718	4067	1738	1209	593	247	218	478	23641	2269
2013	6388	2683	3031	2895	1546	849	464	250	592	36484	2261
2014	11634	4918	2827	2939	1791	1236	669	211	250	61339	2610
2015	6714	9495	2831	1591	1549	926	520	275	221	24508	2280
2016	9034	12011	5832	1273	822	909	395	220	146	51686	2648
2017	3054	1761	6095	3142	787	365	298	153	140	30055	1943
2018	9938	4254	1692	5150	2440	719	529	293	111	32606	2337
2019	10146	1303	2345	1212	3506	1657	395	252	172	25560	1919
2020	7130	2736	1156	1371	1674	1666	504	164	188	23766	1717
2021	5196	2803	1800	773	877	915	1021	388	208	31481	1501
2022	3711	3814	3043	1743	822	662	718	619	249	30127	1963

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 numbers 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
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

	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.

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
2015		9631		3496		3424		2011	1200	645
2016				3872		3288		20710	1442	1545
2017				5833		3965		10553	5880	
2018		102		1740		1509		1140		
2019	2488		5654	3794		10605		14082	5258	
2020		3208		3418		7663		4077	9704	
2021		6651		1413		3282		8899	8764	
2022		2758		1471		188		3712	743	

Table 2.3.3.2. North Sea herring – International herring larvae surveys summary 2022/2023.

Nation:	Vessel:	Dates
Germany	Walther Herwig 3	16 September – 26 September 2022

Netherlands	Tridens 2	19 September – 29 September 2022
Netherlands	Tridens 2	19 December – 23 December 2022
Germany	Walther Herwig 3	04 January – 13 January 2023

Cruise	North Sea IHLS monitor the abundance and distribution of newly hatched herring larvae at the main spawning grounds of autumn spawning herring along the Scottish and English coast in September and on the Downs spawning ground in the English Channel in December and January.
Gear details:	Gulf-type high speed plankton sampler catches are taken during day and night time. Mesh size of the net is 280 microns. The sampler is equipped with a CTD for measurements of actual sampler depth, salinity and temperature profiles as well as internal and external flowmeters determining the filtered water volume. Samples are taken in a V-shape manner, e.g. from the sea surface down to near the seabed (5m above the bottom) and back to the surface.
Notes from survey (e.g. problems, additional work etc.):	Four survey areas could be sampled as scheduled. The survey in the English Channel in January 2023 had to face severe weather problems. Thus only 50% of the planned stations have been sampled. The resulting larvae index for this area is therefore most likely an underestimate. Larvae distribution around the Orkneys was different from previous years, as most larvae were found more easterly than usual. In the Buchan and the central North Sea, newly hatched larvae concentrated in two areas. In all survey areas, herring larvae were less abundant compare to last year. The distribution of larvae in December was unusual in that manner that highest concentration of herring larvae was observed in the inner part of the English Channel, and not in the most westerly area as in other years. The estimated larvae abundance indices could be used in the assessment of North Sea autumn spawning herring.
Number of fish species recorded and notes on any rare species or unusual catches:	In total, 373 plankton samples were taken during the IHLS surveys between September 2022 and January 2023. They contained 48,834 herring larvae.

ICES Divisions	Strat.	Gear	Tows planned	Valid	Add.	Inv.	% stations fished	comments
4a, 4b	N/A	Gulf	261	261	0	0	100 %	Extra hauls taken when abundance was dense.
4c, 7d	N/A	Gulf	141	112	0	0	79 %	Extra hauls taken when abundance was dense.
total	N/A	Gulf	402	373	0	0	93 %	

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 2022- year classes by areas are density estimates in numbers per square meter 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 1990, calculated with the old algorithm, are stored in the stock annex.

Area	Northwest	Northeast	Central west	Central east	Southwest	Southeast	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 $m^2 \times 10^9$ Year class	**Northwest**	**Northeast**	**Central west**	**Central east**	**Southwest**	**Southeast**	**Division 3.a**	**South'Bight**	**IBTS-0 index**
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
2019	0.017	0.002	0.159	0.141	0.166	0.244	0.065	0.066	62.4
2020	0.015	0.005	0.447	0.070	0.328	0.255	0.019	0.304	93.0
2021	0.010	0.002	0.109	0.050	0.251	0.104	0.031	0.412	48.0
2022	0.004	0.001	0.243	0.031	0.165	0.112	0.008	1.606	90.8

Table 2.3.3.2. North Sea herring. Indices of 1-ringers from the IBTS 1st Quarter for the 1995- to 2021- 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	1543	432	0.28	397	0.26	0.15
2018	2020	1021	168	0.16	150	0.15	0.17
2019	2021	3133	487	0.16	256	0.08	0.51
2020	2022	806	401	0.50	396	0.49	0.08

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
2021	2023	5016	2699	0.54	2470	0.49	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.

age	0		1		2		3		4		5		6		7		8		9+	
Year	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS
2000	0.015	0.006	0.033	0.051	0.113	0.116	0.157	0.184	0.179	0.221	0.201	0.248	0.216	0.279	0.246	0.286	0.273	0.284	0.271	0.280
2001	0.012	0.006	0.048	0.051	0.118	0.122	0.149	0.172	0.177	0.210	0.198	0.233	0.213	0.255	0.238	0.275	0.270	0.274	0.298	0.294
2002	0.012	0.006	0.037	0.047	0.118	0.128	0.153	0.172	0.170	0.205	0.199	0.228	0.214	0.248	0.228	0.270	0.250	0.287	0.298	0.249
2003	0.014	0.007	0.037	0.047	0.104	0.123	0.158	0.173	0.174	0.202	0.184	0.222	0.205	0.242	0.222	0.266	0.237	0.285	0.282	0.307
2004	0.014	0.007	0.036	0.042	0.100	0.119	0.138	0.165	0.183	0.203	0.201	0.223	0.216	0.248	0.228	0.268	0.255	0.280	0.299	0.270
2005	0.011	0.006	0.044	0.041	0.099	0.118	0.153	0.164	0.166	0.198	0.208	0.225	0.223	0.248	0.240	0.265	0.265	0.285	0.270	0.295
2006	0.010	0.007	0.049	0.041	0.117	0.126	0.144	0.155	0.172	0.191	0.181	0.216	0.220	0.242	0.237	0.252	0.246	0.270	0.285	0.2265
2007	0.012	0.006	0.064	0.051	0.121	0.128	0.151	0.161	0.163	0.180	0.193	0.207	0.190	0.224	0.223	0.238	0.237	0.256	0.273	0.233
2008	0.008	0.008	0.054	0.058	0.129	0.130	0.180	0.164	0.181	0.181	0.183	0.195	0.216	0.218	0.216	0.226	0.262	0.256	0.312	0.282
2009	0.009	0.007	0.051	0.061	0.144	0.137	0.181	0.181	0.216	0.197	0.216	0.210	0.239	0.223	0.243	0.234	0.253	0.256	0.292	0.263
2010	0.008	0.007	0.057	0.052	0.129	0.142	0.167	0.190	0.191	0.216	0.220	0.224	0.219	0.234	0.216	0.240	0.238	0.261	0.271	0.251
2011	0.008	0.007	0.041	0.043	0.132	0.146	0.159	0.187	0.183	0.225	0.197	0.240	0.217	0.244	0.221	0.251	0.232	0.257	0.267	0.275
2012	0.011	0.006	0.046	0.040	0.124	0.138	0.171	0.182	0.185	0.211	0.206	0.233	0.222	0.241	0.239	0.243	0.243	0.253	0.268	0.243
2013	0.008	0.006	0.047	0.040	0.116	0.136	0.156	0.175	0.198	0.209	0.198	0.221	0.215	0.242	0.233	0.249	0.238	0.252	0.265	0.252
2014	0.008	0.006	0.052	0.043	0.124	0.129	0.172	0.177	0.186	0.204	0.215	0.216	0.212	0.229	0.226	0.241	0.243	0.247	0.266	0.246

age	0		1		2		3		4		5		6		7		8		9+	
Year	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS	catch	HERAS
2015	0.009	0.005	0.026	0.044	0.114	0.127	0.154	0.161	0.188	0.200	0.200	0.212	0.221	0.225	0.217	0.229	0.235	0.239	0.276	0.229
2016	0.007	0.005	0.027	0.043	0.127	0.121	0.155	0.160	0.180	0.189	0.206	0.216	0.215	0.224	0.231	0.224	0.230	0.234	0.263	0.236
2017	0.009	0.004	0.038	0.043	0.099	0.111	0.156	0.153	0.173	0.183	0.188	0.207	0.215	0.227	0.220	0.227	0.231	0.229	0.252	0.230
2018	0.005	0.005	0.039	0.040	0.109	0.101	0.145	0.153	0.184	0.186	0.191	0.215	0.215	0.229	0.234	0.239	0.246	0.247	0.270	.0273
2019	0.006	0.004	0.040	0.040	0.121	0.099	0.147	0.148	0.169	0.177	0.204	0.209	0.208	0.226	0.220	0.238	0.243	0.254	0.263	0.256
2020	0.004	0.004	0.071	0.041	0.130	0.107	0.155	0.150	0.171	0.182	0.189	0.217	0.214	0.229	0.219	0.242	0.243	0.264	0.270	0.268
2021	0.008	0.004	0.040	0.043	0.128	0.117	0.155	0.156	0.166	0.181	0.189	0.210	0.203	0.227	0.219	0.240	0.224	0.255	0.250	0.272
2022	0.007	0.005	0.043	0.040	0.143	0.132	0.171	0.178	0.187	0.195	0.216	0.210	0.234	0.232	0.237	0.244	0.249	0.244	0.272	0.267

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 2022. 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
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	98.0	100	100	100
2019	59.0	97.0	99.0	100	100	100
2020	75.0	98.0	100	100	100	100
2021	75.0	99.0	100	100	100	100
2022	70.0	95.0	97.0	99.0	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	1972–2022	1973–2022
IBTS 1st Quarter (Trawl survey)	1 wr	1971–2023	1984–2023
IBTS 3rd Quarter (Trawl survey)	0-5 wr	1991–2022	1998–2022
Acoustic (+trawl)	1 wr	1995–2022	1997–2022
	2-9+ wr	1984–2022	1989–2022
IBTS0	0wr	1977–2023	1992–2023

Table 2.6.1.2 North Sea herring input data. Maturity at age.

Year	0	1	2	3	4	5	6	7	8
1947	0	0	1	1	1	1	1	1	1
1948	0	0	1	1	1	1	1	1	1
1949	0	0	1	1	1	1	1	1	1
1950	0	0	1	1	1	1	1	1	1
1951	0	0	1	1	1	1	1	1	1
1952	0	0	1	1	1	1	1	1	1
1953	0	0	1	1	1	1	1	1	1
1954	0	0	1	1	1	1	1	1	1
1955	0	0	1	1	1	1	1	1	1
1956	0	0	1	1	1	1	1	1	1
1957	0	0	1	1	1	1	1	1	1
1958	0	0	1	1	1	1	1	1	1
1959	0	0	1	1	1	1	1	1	1
1960	0	0	1	1	1	1	1	1	1
1961	0	0	1	1	1	1	1	1	1
1962	0	0	1	1	1	1	1	1	1
1963	0	0	1	1	1	1	1	1	1
1964	0	0	1	1	1	1	1	1	1
1965	0	0	1	1	1	1	1	1	1
1966	0	0	1	1	1	1	1	1	1
1967	0	0	1	1	1	1	1	1	1
1968	0	0	1	1	1	1	1	1	1
1969	0	0	1	1	1	1	1	1	1
1970	0	0	1	1	1	1	1	1	1
1971	0	0	1	1	1	1	1	1	1
1972	0	0	0.82	1	1	1	1	1	1
1973	0	0	0.82	1	1	1	1	1	1
1974	0	0	0.82	1	1	1	1	1	1
1975	0	0	0.82	1	1	1	1	1	1
1976	0	0	0.82	1	1	1	1	1	1
1977	0	0	0.82	1	1	1	1	1	1
1978	0	0	0.82	1	1	1	1	1	1
1979	0	0	0.82	1	1	1	1	1	1
1980	0	0	0.82	1	1	1	1	1	1
1981	0	0	0.82	1	1	1	1	1	1
1982	0	0	0.82	1	1	1	1	1	1
1983	0	0	0.82	1	1	1	1	1	1
1984	0	0	0.82	1	1	1	1	1	1
1985	0	0	0.7	1	1	1	1	1	1
1986	0	0	0.75	1	1	1	1	1	1

1987	0	0	0.8	1	1	1	1	1	1
1988	0	0	0.85	0.93	1	1	1	1	1
1989	0	0	0.82	0.94	1	1	1	1	1
1990	0	0	0.91	0.97	1	1	1	1	1
1991	0	0	0.86	0.99	1	1	1	1	1
1992	0	0	0.5	0.99	1	1	1	1	1
1993	0	0	0.47	0.61	1	1	1	1	1
1994	0	0	0.73	0.93	1	1	1	1	1
1995	0	0	0.67	0.95	1	1	1	1	1
1996	0	0	0.61	0.98	1	1	1	1	1
1997	0	0	0.64	0.94	1	1	1	1	1
1998	0	0	0.64	0.89	1	1	1	1	1
1999	0	0	0.69	0.91	1	1	1	1	1
2000	0	0	0.67	0.96	1	1	1	1	1
2001	0	0	0.77	0.92	1	1	1	1	1
2002	0	0	0.87	0.97	1	1	1	1	1
2003	0	0	0.43	0.93	1	1	1	1	1
2004	0	0	0.7	0.65	1	1	1	1	1
2005	0	0	0.76	0.96	0.96	1	1	1	1
2006	0	0	0.66	0.88	0.98	1	1	1	1
2007	0	0	0.71	0.92	0.93	1	1	1	1
2008	0	0	0.86	0.98	0.99	1	1	1	1
2009	0	0	0.89	1	1	1	1	1	1
2010	0	0	0.45	0.9	1	1	1	1	1
2011	0	0	0.87	0.84	1	1	1	1	1
2012	0	0	0.91	0.99	1	1	1	1	1
2013	0	0	0.83	0.96	0.98	1	1	1	1
2014	0	0	0.85	1	1	1	1	1	1
2015	0	0	0.7	0.9	0.96	1	1	1	1
2016	0	0	0.71	0.89	0.95	1	1	1	1
2017	0	0	0.55	0.96	0.97	1	1	1	1
2018	0	0	0.37	0.91	0.98	1	1	1	1
2019	0	0	0.59	0.97	0.99	1	1	1	1
2020	0	0	0.75	0.98	1	1	1	1	1
2021	0	0	0.74	0.99	1	1	1	1	1
2022	0	0	0.7	0.95	0.97	1	1	1	1

Table 2.6.1.3 North Sea herring input data. Natural mortality at age.

Year	0	1	2	3	4	5	6	7	8
1947	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1948	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1949	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1950	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1951	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1952	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1953	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1954	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1955	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1956	0.7123	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1957	0.7123	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1958	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1959	0.7124	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1960	0.7124	0.4973	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1961	0.7123	0.4973	0.3026	0.2727	0.252	0.2323	0.2219	0.2158	0.2159
1962	0.7123	0.4974	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1963	0.7124	0.4978	0.3027	0.2728	0.2519	0.2322	0.2218	0.2156	0.2158
1964	0.7124	0.4973	0.3026	0.2727	0.252	0.2323	0.2218	0.2157	0.2159
1965	0.7123	0.4969	0.3025	0.2727	0.252	0.2323	0.2219	0.2159	0.216
1966	0.7122	0.497	0.3025	0.2727	0.252	0.2323	0.2219	0.2158	0.216
1967	0.7123	0.4979	0.3028	0.2728	0.2519	0.2322	0.2217	0.2156	0.2158
1968	0.7128	0.4997	0.3032	0.273	0.2517	0.2319	0.2213	0.2151	0.2152
1969	0.7123	0.4951	0.302	0.2724	0.2522	0.2325	0.2223	0.2163	0.2165
1970	0.7119	0.4947	0.302	0.2724	0.2523	0.2326	0.2224	0.2164	0.2167
1971	0.7119	0.4975	0.3027	0.2729	0.2521	0.2323	0.2219	0.2158	0.216
1972	0.7129	0.5025	0.3039	0.2734	0.2514	0.2317	0.2208	0.2145	0.2145
1973	0.7149	0.5089	0.3052	0.2739	0.2503	0.2306	0.2193	0.2126	0.2124
1974	0.7099	0.4717	0.2964	0.2694	0.2548	0.2352	0.2268	0.222	0.2229
1975	0.7098	0.493	0.3018	0.2727	0.253	0.2332	0.2231	0.2172	0.2176
1976	0.7121	0.5116	0.3063	0.2749	0.2508	0.231	0.2194	0.2125	0.2124
1977	0.7176	0.5274	0.3096	0.2761	0.248	0.2283	0.2156	0.2079	0.2072
1978	0.725	0.5406	0.3121	0.2763	0.2449	0.2253	0.2118	0.2035	0.202
1979	0.7336	0.5514	0.3135	0.2757	0.2415	0.2221	0.208	0.1992	0.197
1980	0.7446	0.5596	0.3139	0.2742	0.2379	0.2187	0.2043	0.195	0.1921
1981	0.7581	0.5651	0.3133	0.2717	0.2339	0.2151	0.2006	0.1911	0.1873
1982	0.7713	0.5685	0.3119	0.2685	0.2299	0.2113	0.1969	0.1873	0.1827
1983	0.7914	0.5689	0.3094	0.2642	0.2252	0.2071	0.1932	0.1836	0.178
1984	0.8183	0.5662	0.3058	0.2585	0.2198	0.2023	0.1894	0.1801	0.1732
1985	0.8387	0.562	0.3015	0.2525	0.2146	0.1975	0.1854	0.1765	0.1686
1986	0.8493	0.5533	0.294	0.2437	0.2085	0.1915	0.1801	0.1723	0.1638
1987	0.8559	0.5406	0.2841	0.2327	0.2013	0.1844	0.174	0.1679	0.1587
1988	0.8584	0.53	0.2772	0.2249	0.1963	0.1794	0.1693	0.1642	0.1547
1989	0.8531	0.5217	0.274	0.2216	0.1952	0.178	0.1666	0.1615	0.1524
1990	0.8416	0.5131	0.2718	0.2199	0.1961	0.1783	0.1646	0.1594	0.1511
1991	0.8321	0.5061	0.271	0.2193	0.1967	0.1784	0.1631	0.1576	0.15
1992	0.8203	0.4994	0.2728	0.2211	0.197	0.1789	0.1622	0.1565	0.1495
1993	0.8033	0.4926	0.2767	0.2251	0.1982	0.1804	0.1619	0.1558	0.1496
1994	0.791	0.4883	0.28	0.228	0.199	0.1813	0.1617	0.1553	0.1497
1995	0.7803	0.4826	0.282	0.2284	0.1973	0.1799	0.1605	0.1541	0.1493
1996	0.772	0.4795	0.2848	0.2295	0.196	0.179	0.1599	0.1535	0.1493
1997	0.7734	0.4853	0.2888	0.232	0.1966	0.1785	0.1603	0.1534	0.1497
1998	0.7794	0.4948	0.2934	0.2348	0.1972	0.1776	0.1608	0.1535	0.1502
1999	0.7874	0.506	0.2988	0.2391	0.2	0.1788	0.1629	0.1551	0.1519
2000	0.8003	0.5269	0.3075	0.2464	0.2069	0.1835	0.1676	0.1588	0.1553
2001	0.818	0.5556	0.3182	0.2555	0.2164	0.19	0.1738	0.1636	0.1595
2002	0.8327	0.5748	0.3259	0.2626	0.2244	0.1962	0.18	0.1689	0.164
2003	0.846	0.5848	0.3318	0.2699	0.2338	0.2048	0.1884	0.1765	0.1704
2004	0.8616	0.594	0.3383	0.2786	0.2455	0.216	0.1993	0.1863	0.1783
2005	0.8745	0.598	0.3419	0.2839	0.253	0.2239	0.2071	0.1937	0.1844
2006	0.887	0.5914	0.3407	0.2838	0.2547	0.2275	0.2113	0.1987	0.1888
2007	0.9004	0.5777	0.3368	0.2814	0.2542	0.2299	0.2147	0.2036	0.1931
2008	0.9082	0.5656	0.3327	0.2788	0.2531	0.2313	0.217	0.2073	0.1966
2009	0.9104	0.5549	0.3273	0.2747	0.25	0.2305	0.217	0.2087	0.1983
2010	0.9099	0.542	0.3203	0.2687	0.2448	0.2279	0.2154	0.2087	0.1991
2011	0.9046	0.5311	0.3147	0.2647	0.2415	0.2266	0.2147	0.2093	0.2003
2012	0.8947	0.5218	0.3105	0.2623	0.2397	0.2262	0.2147	0.2102	0.2017
2013	0.8812	0.512	0.3058	0.2597	0.2375	0.2253	0.2141	0.2106	0.2026
2014	0.863	0.5031	0.3017	0.2578	0.2358	0.2246	0.2136	0.2108	0.2034
2015	0.84	0.4952	0.298	0.2566	0.2347	0.2242	0.2131	0.2109	0.204
2016	0.8128	0.4876	0.2945	0.2558	0.2337	0.2237	0.2123	0.2106	0.2043
2017	0.7812	0.4806	0.2912	0.2555	0.2332	0.2233	0.2116	0.2101	0.2045
2018	0.745	0.4746	0.2886	0.2563	0.2336	0.2235	0.2112	0.2098	0.2047
2019	0.7043	0.4691	0.2864	0.2578	0.2346	0.224	0.2109	0.2093	0.2049
2020	0.7767	0.4814	0.2918	0.2564	0.234	0.2237	0.2118	0.2101	0.2045
2021	0.7608	0.478	0.2902	0.2564	0.2338	0.2236	0.2115	0.2099	0.2046
2022	0.7435	0.4748	0.2888	0.2566	0.2338	0.2236	0.2113	0.2097	0.2047

Table 2.6.1.4 North Sea herring input data. Stock weight at age.

Year	0	1	2	3	4	5	6	7	8
1947	0.015	0.05	0.122	0.14	0.156	0.171	0.185	0.197	0.2625
1948	0.015	0.05	0.122	0.14	0.156	0.171	0.185	0.197	0.2625
1949	0.015	0.05	0.124	0.1417	0.1577	0.1727	0.1863	0.1983	0.263
1950	0.015	0.05	0.126	0.1453	0.161	0.1757	0.189	0.2007	0.264
1951	0.015	0.05	0.13	0.151	0.1677	0.1817	0.1943	0.2053	0.2658
1952	0.015	0.05	0.133	0.1577	0.175	0.1893	0.2013	0.2113	0.2683
1953	0.015	0.05	0.136	0.163	0.183	0.1977	0.2097	0.2187	0.2713
1954	0.015	0.05	0.1377	0.167	0.1887	0.205	0.217	0.226	0.2743
1955	0.015	0.05	0.1387	0.1687	0.1927	0.21	0.223	0.2323	0.2772
1956	0.015	0.05	0.1397	0.1703	0.195	0.2137	0.2273	0.2377	0.2795
1957	0.015	0.05	0.1403	0.1717	0.1967	0.216	0.2307	0.2413	0.2815
1958	0.015	0.05	0.1407	0.173	0.198	0.2177	0.2327	0.2437	0.2828
1959	0.015	0.05	0.1417	0.1743	0.1993	0.2193	0.2343	0.2453	0.284
1960	0.015	0.05	0.1463	0.179	0.2077	0.2263	0.2487	0.2637	0.2936
1961	0.015	0.05	0.151	0.1833	0.2157	0.233	0.2627	0.2817	0.3034
1962	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.309
1963	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3093
1964	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3101
1965	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.307
1966	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3103
1967	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3101
1968	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3112
1969	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3089
1970	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.309
1971	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.312
1972	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3076
1973	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3078
1974	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3081
1975	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3078
1976	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3077
1977	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.306
1978	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3096
1979	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3069
1980	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3072
1981	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.307
1982	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3074
1983	0.015	0.05	0.155	0.187	0.223	0.239	0.276	0.299	0.3091
1984	0.01733	0.05667	0.1503	0.1903	0.2297	0.2433	0.282	0.3107	0.3435
1985	0.01567	0.05633	0.138	0.187	0.2323	0.2467	0.2747	0.321	0.3544
1986	0.014	0.061	0.13	0.1833	0.2317	0.252	0.273	0.3147	0.3628
1987	0.009	0.05033	0.1217	0.17	0.2123	0.23	0.242	0.2747	0.3056
1988	0.008	0.04833	0.123	0.1663	0.2083	0.229	0.2483	0.2587	0.2854
1989	0.008667	0.04367	0.1223	0.1653	0.2047	0.2283	0.2523	0.2613	0.2886
1990	0.01233	0.052	0.1257	0.1743	0.2117	0.2437	0.2707	0.2837	0.3079
1991	0.01133	0.059	0.139	0.1837	0.212	0.2387	0.2653	0.2797	0.3095
1992	0.01033	0.06367	0.1367	0.194	0.214	0.2343	0.253	0.2717	0.2987
1993	0.005667	0.061	0.134	0.1843	0.213	0.2343	0.2617	0.2727	0.3079
1994	0.007333	0.06	0.1263	0.1917	0.2143	0.2397	0.2747	0.2913	0.3205
1995	0.006	0.05733	0.1293	0.1857	0.2107	0.2243	0.268	0.2933	0.3261
1996	0.006	0.054	0.1297	0.1993	0.2273	0.2343	0.2737	0.3007	0.3271
1997	0.005	0.04867	0.1233	0.1833	0.2303	0.2373	0.2567	0.2803	0.31
1998	0.005667	0.04733	0.116	0.1873	0.2413	0.2643	0.2837	0.2867	0.3083
1999	0.006	0.05067	0.116	0.1793	0.2263	0.256	0.2733	0.276	0.2781
2000	0.005667	0.05133	0.1157	0.1837	0.2213	0.2483	0.2787	0.286	0.2842
2001	0.006	0.05067	0.1217	0.1717	0.21	0.2327	0.2553	0.2747	0.2745
2002	0.006333	0.04733	0.128	0.1717	0.2053	0.2283	0.2483	0.2703	0.2865
2003	0.006667	0.047	0.123	0.173	0.2023	0.222	0.2423	0.2657	0.2849
2004	0.006667	0.042	0.1193	0.1653	0.2027	0.223	0.2477	0.2677	0.2805
2005	0.005667	0.04133	0.118	0.1643	0.198	0.2247	0.248	0.265	0.2849
2006	0.006667	0.041	0.1257	0.1553	0.191	0.216	0.242	0.2523	0.2702
2007	0.006	0.05133	0.128	0.1607	0.1797	0.207	0.2237	0.238	0.2564
2008	0.008	0.05767	0.1303	0.1643	0.1807	0.1953	0.2177	0.226	0.2556
2009	0.007333	0.06133	0.1373	0.181	0.1967	0.21	0.2227	0.2337	0.2557
2010	0.007333	0.052	0.1423	0.1903	0.216	0.2237	0.2343	0.24	0.2607
2011	0.006667	0.043	0.1457	0.1873	0.225	0.2397	0.2437	0.2507	0.2573
2012	0.006	0.04033	0.138	0.182	0.2113	0.233	0.241	0.2427	0.2525
2013	0.006	0.04033	0.1357	0.1747	0.2087	0.2213	0.242	0.2493	0.2518
2014	0.005667	0.04333	0.1287	0.1767	0.2037	0.2157	0.2287	0.2413	0.2466
2015	0.005333	0.04367	0.1273	0.1613	0.2	0.2117	0.2247	0.229	0.2394
2016	0.005	0.04333	0.121	0.1603	0.1887	0.216	0.2243	0.2243	0.2337
2017	0.004167	0.04287	0.1109	0.1532	0.183	0.2071	0.2265	0.2271	0.2292
2018	0.004567	0.03997	0.1013	0.153	0.1858	0.215	0.2292	0.2388	0.2468
2019	0.004	0.04023	0.099	0.1485	0.1774	0.209	0.2261	0.2379	0.2541
2020	0.0041	0.04073	0.1072	0.1495	0.1816	0.2168	0.2291	0.2424	0.2642
2021	0.003833	0.0432	0.1169	0.1563	0.1812	0.21	0.2267	0.2401	0.2551
2022	0.0045	0.04403	0.1259	0.1674	0.1922	0.2117	0.2288	0.2414	0.256

Table 2.6.1.5 North Sea herring input data. Catch weight at age.

Year	0	1	2	3	4	5	6	7	8
1947	0.015	0.05	0.122	0.14	0.156	0.171	0.185	0.197	0.242
1948	0.015	0.05	0.122	0.14	0.156	0.171	0.185	0.197	0.242
1949	0.015	0.05	0.128	0.145	0.161	0.176	0.189	0.201	0.2435
1950	0.015	0.05	0.128	0.151	0.166	0.18	0.193	0.204	0.245
1951	0.015	0.05	0.134	0.157	0.176	0.189	0.201	0.211	0.2475
1952	0.015	0.05	0.137	0.165	0.183	0.199	0.21	0.219	0.251
1953	0.015	0.05	0.137	0.167	0.19	0.205	0.218	0.226	0.254
1954	0.015	0.05	0.139	0.169	0.193	0.211	0.223	0.233	0.2565
1955	0.015	0.05	0.14	0.17	0.195	0.214	0.228	0.238	0.2595
1956	0.015	0.05	0.14	0.172	0.197	0.216	0.231	0.242	0.261
1957	0.015	0.05	0.141	0.173	0.198	0.218	0.233	0.244	0.2625
1958	0.015	0.05	0.141	0.174	0.199	0.219	0.234	0.245	0.2635
1959	0.015	0.05	0.143	0.176	0.201	0.221	0.236	0.247	0.2645
1960	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1961	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1962	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1963	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1964	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1965	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1966	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1967	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1968	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1969	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1970	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1971	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1972	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1973	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1974	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1975	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1976	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1977	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1978	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1979	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1980	0.015	0.05	0.126	0.176	0.211	0.243	0.251	0.267	0.271
1981	0.007	0.049	0.118	0.142	0.189	0.211	0.222	0.267	0.271
1982	0.01	0.059	0.118	0.149	0.179	0.217	0.238	0.265	0.2742
1983	0.01	0.059	0.118	0.149	0.179	0.217	0.238	0.265	0.2745
1984	0.01	0.059	0.118	0.149	0.179	0.217	0.238	0.265	0.2746
1985	0.009	0.036	0.128	0.164	0.194	0.211	0.22	0.258	0.2821
1986	0.006	0.067	0.121	0.153	0.182	0.208	0.221	0.238	0.2572
1987	0.011	0.035	0.099	0.15	0.18	0.211	0.234	0.258	0.2881
1988	0.011	0.055	0.111	0.145	0.174	0.197	0.216	0.237	0.2566
1989	0.017	0.043	0.115	0.153	0.173	0.208	0.231	0.247	0.2631
1990	0.019	0.055	0.114	0.149	0.177	0.193	0.229	0.236	0.2608
1991	0.017	0.058	0.13	0.166	0.184	0.203	0.217	0.235	0.263
1992	0.01	0.053	0.102	0.175	0.189	0.207	0.223	0.237	0.2632
1993	0.01	0.033	0.115	0.145	0.189	0.204	0.228	0.244	0.2735
1994	0.006	0.056	0.13	0.159	0.181	0.214	0.24	0.255	0.2762
1995	0.009	0.042	0.13	0.169	0.198	0.207	0.243	0.247	0.2809
1996	0.015	0.018	0.112	0.156	0.188	0.204	0.212	0.261	0.2815
1997	0.015	0.044	0.108	0.148	0.195	0.227	0.226	0.235	0.2549
1998	0.021	0.051	0.114	0.145	0.183	0.219	0.238	0.247	0.2879
1999	0.009	0.045	0.115	0.151	0.171	0.207	0.233	0.245	0.2677
2000	0.015	0.033	0.113	0.157	0.179	0.201	0.216	0.246	0.2731
2001	0.012	0.048	0.118	0.149	0.177	0.198	0.213	0.238	0.2697
2002	0.012	0.037	0.118	0.153	0.17	0.199	0.214	0.228	0.2504
2003	0.014	0.037	0.104	0.158	0.174	0.184	0.205	0.222	0.2366
2004	0.014	0.036	0.1	0.138	0.183	0.201	0.216	0.228	0.2545
2005	0.011	0.044	0.099	0.153	0.166	0.208	0.223	0.24	0.2654
2006	0.01	0.049	0.117	0.144	0.172	0.181	0.22	0.237	0.246
2007	0.0124	0.0638	0.1214	0.1513	0.1634	0.1933	0.19	0.2232	0.2375
2008	0.0079	0.0535	0.1288	0.1796	0.1812	0.1832	0.2157	0.2161	0.2621
2009	0.0094	0.0514	0.144	0.1811	0.2158	0.2162	0.239	0.2428	0.2533
2010	0.0075	0.0571	0.1292	0.1669	0.1912	0.2203	0.2193	0.216	0.2384
2011	0.008	0.0413	0.1317	0.1593	0.1831	0.197	0.2167	0.2211	0.2319
2012	0.0106	0.0463	0.1243	0.1706	0.1854	0.2058	0.2215	0.2387	0.2427
2013	0.0077	0.0468	0.1162	0.1563	0.1977	0.198	0.2154	0.2334	0.2378
2014	0.0075	0.0522	0.124	0.1719	0.1861	0.2148	0.2118	0.2264	0.2427
2015	0.0087	0.0261	0.1135	0.1538	0.1883	0.2001	0.2212	0.217	0.2347
2016	0.0071	0.0265	0.1267	0.1549	0.1803	0.2059	0.2151	0.2313	0.2299
2017	0.009	0.038	0.099	0.156	0.173	0.188	0.215	0.22	0.2305
2018	0.0054	0.0394	0.1085	0.1451	0.1838	0.1914	0.2151	0.2342	0.2456
2019	0.0064	0.0395	0.121	0.1465	0.1688	0.2036	0.2081	0.2195	0.2435
2020	0.004	0.0706	0.1303	0.1553	0.1707	0.1888	0.2135	0.219	0.2435
2021	0.008	0.0398	0.1284	0.1547	0.1659	0.1892	0.2032	0.2187	0.2241
2022	0.0067	0.0283	0.1308	0.1621	0.1762	0.1883	0.2078	0.2154	0.2298

Table 2.6.1.6 North Sea herring input data. Catch at age.

Year	0	1	2	3	4	5	6	7	8+
1947	0	0	494000	415000	638000	526000	756000	431000	1311000
1948	0	3000	247000	672000	328000	601000	487000	4e+05	917000
1949	0	0	478000	644000	396000	287000	652000	462000	1037000
1950	0	0	535000	1039000	617000	290000	254000	331000	597000
1951	0	462000	660000	959000	1255000	630000	262000	142000	445000
1952	0	722000	1346000	576000	610000	652000	464000	236000	554000
1953	150000	1023000	1322000	1003000	474000	386000	473000	278000	392000
1954	219000	1451000	1493000	1111000	591000	361000	330000	379000	511000
1955	164000	2072000	1931000	1032000	479000	337000	232000	120000	215000
1956	96000	1697000	1860000	1221000	516000	249000	194000	104000	292000
1957	279000	1483000	1644000	736000	644000	344000	207000	147000	253000
1958	97000	4279000	1029000	999000	322000	461000	147000	73000	118000
1959	0	1609000	4934000	488000	497000	233000	249000	120000	301000
1960	194600	2392700	1142300	1966700	165900	167700	112900	125800	270600
1961	1269200	336000	1889400	479900	1455900	124000	157900	61400	143500
1962	141800	2146900	269600	797400	335100	1081800	126900	145100	173100
1963	442800	1262200	2961200	177200	158300	80600	229700	22400	93000
1964	496900	2971700	1547500	2243100	148400	149000	95000	256300	84000
1965	157100	3209300	2217600	1324600	2039400	145100	151900	117600	491400
1966	374500	1383100	2569700	741200	450100	889800	45300	64800	331800
1967	645400	1674300	1171500	1364700	371500	297800	393100	67900	254400
1968	839300	2425000	1795200	1494300	621400	157100	145000	163400	105500
1969	112000	2503300	1883000	296300	133100	190800	49900	42700	52500
1970	898100	1196200	2002800	883600	125200	50300	61000	7900	24200
1971	684000	4378500	1146800	662500	208300	26900	30500	26800	12500
1972	750400	3340600	1440500	343800	130600	32900	5000	200	1500
1973	289400	2368000	1344200	659200	150200	59300	30600	3700	2000
1974	996100	846100	772600	362000	126000	56100	22300	5000	3100
1975	263800	2460500	541700	259600	140500	57200	16100	9100	4800
1976	238200	126600	901500	117300	52000	34500	6100	4400	1400
1977	256800	144300	44700	186400	10800	7000	4100	1500	700
1978	.	.	.	.	.	.	.	.	.
1979	.	.	.	.	.	.	.	.	.
1980	1262700	245100	134000	91800	32200	21700	2300	1400	500
1981	9519700	872000	284300	56900	39500	28500	22700	18700	6600
1982	11956700	1116400	299400	230100	33700	14400	6800	7800	4700
1983	13296900	2448600	573800	216400	105100	26200	22800	12800	23100
1984	6973300	1818400	1146200	441400	201500	81100	22600	25200	29700
1985	4211000	3253000	1326300	1182400	368500	124500	43600	20200	29200
1986	3724700	4801400	1266700	840800	465900	129800	62100	20500	28400
1987	8229200	6836300	2137200	667900	467100	245800	74700	23800	16200
1988	3164800	7867000	2232500	1090700	383700	255800	128100	38000	23800
1989	3057800	3145900	1593700	1363800	809300	211800	123700	61000	28200
1990	1302800	3020000	899300	779100	861000	387500	80200	54400	40700
1991	2386600	2138900	1132800	556700	548900	501200	205300	39300	38600
1992	10331300	2303100	1284900	442700	361500	360500	375600	152400	62500
1993	10265400	3826800	1176300	609000	305500	215600	226000	188000	129000
1994	4498900	1785200	1783200	489100	347600	109000	91800	76400	116600
1995	7438469	1664874	1444061	816703	231794	118536	55128	41409	98200
1996	2311226	1606393	642084	525601	172099	57586	22534	9264	21143
1997	431175	479702	687920	446909	284920	109178	31389	11832	24467
1998	259526	977680	1220105	537932	276333	175817	88927	15232	20550
1999	1566349	303520	616354	1058716	294066	135648	69299	27998	12228
2000	1105085	1171677	622853	463170	646814	213466	82481	35706	17087
2001	1832691	614469	842635	485628	278884	321743	90918	38252	20602
2002	730279	837557	579592	970577	292205	140701	174570	48908	43322
2003	369074	617021	1221992	529386	835552	244780	107751	123291	46715
2004	715597	206648	447918	1366155	543376	753231	169324	104945	97142
2005	1015554	715547	355453	485746	1318647	479961	576154	115212	146808
2006	878637	222111	401087	310602	464620	997782	252150	247042	106412
2007	621005	235553	219115	417452	285746	309454	629187	147830	156750
2008	798284	235022	331772	184771	199069	137529	118349	215542	117258
2009	650043	175923	259434	106738	93321	86137	37951	53130	143131
2010	574895	280728	293887	236804	126241	83893	61542	33305	113675
2011	778927	159504	367820	275016	218711	130127	62938	52081	125734
2012	773241	284906	455259	673465	404265	306234	152577	104461	205427
2013	461571	413000	324920	485185	571269	422765	327213	145330	313638
2014	1388685	370590	382990	386131	616563	487582	284562	191729	214513
2015	538228	394878	551802	247555	282813	461041	432034	271280	337811
2016	1583568	109135	625483	818585	293372	280451	367844	307347	359076
2017	462148	209356	108706	1079854	837770	222790	145511	175533	221296
2018	1337404	73260	206232	200527	1178604	848961	223637	144999	332482
2019	649197	172202	105505	307520	198443	730016	528327	133409	217686
2020	2127371	112088	549256	215250	291883	145821	515402	349435	176646
2021	534073	112447	407388	419770	179190	265946	118167	320792	291104
2022	717789	164187	882367	593215	401291	151310	200265	102906	338289

Table 2.6.1.7 North Sea herring input data. HERAS survey index at age.

Year	1	2	3	4	5	6	7	8+
1989	-1	4090000	3903000	1633000	492000	283000	120000	66000
1990	-1	3306000	3521000	3414000	1366000	392000	210000	176000
1991	-1	2634000	1700000	1959000	1849000	644000	228000	145000
1992	-1	3734000	1378000	1147000	1134000	1246000	395000	218000
1993	-1	2984000	1637000	902000	741000	777000	551000	296000
1994	-1	3185000	839000	399000	381000	321000	326000	350000
1995	-1	3849000	2041000	672000	299000	203000	138000	212000
1996	-1	4497000	2824000	1087000	311000	99000	83000	339000
1997	9361000	5960000	2935000	1441000	601000	215000	46000	237000
1998	4449000	5747000	2520000	1625000	982000	445000	170000	166000
1999	5087000	3078000	4725000	1116000	506000	314000	139000	141000
2000	24736000	2923000	2156000	3140000	1007000	483000	266000	217000
2001	6837000	12290000	3083000	1462000	1676000	450000	170000	157000
2002	23055000	4875000	8220000	1390000	794600	1031000	244400	270500
2003	9829400	18949400	3081000	4188900	675100	494800	568300	323200
2004	5183700	3415900	9191800	2167300	2590700	317100	327600	527650
2005	3114100	2055100	3648500	5789600	1212900	1174900	139900	233200
2006	6822800	3772300	1997200	2097500	4175100	618200	562100	154700
2007	6261000	2750000	1848000	898000	806000	1323000	243000	217000
2008	3714000	2853000	1709000	1485000	809000	712000	1749000	455000
2009	4655000	5632000	2553000	1023000	1077000	674000	638000	1720000
2010	14577000	4237000	4216000	2453000	1246000	1332000	688000	2729000
2011	10119000	4166000	2534000	2173000	1016000	651000	688000	1737000
2012	7437000	4719000	4067000	1738000	1209000	593000	247000	696000
2013	6388000	2683000	3031000	2895000	1546000	849000	464000	842000
2014	11634000	4918000	2827000	2939000	1791000	1236000	669000	461000
2015	6714000	9495000	2831000	1591000	1549000	926000	520000	496000
2016	9034000	12011000	5832000	1273000	822000	909000	395000	366000
2017	3054000	1761000	6095000	3142000	787000	365000	298000	293000
2018	9938000	4254000	1692000	5150000	2440000	719000	529000	404000
2019	10146000	1303000	2345000	1212000	3506000	1657000	395000	424000
2020	7130000	2736000	1156000	1371000	1674000	1666000	504000	352000
2021	5196000	2803000	1800000	773000	877000	915000	1021000	596000
2022	3711000	3814000	3043000	1743000	822000	662000	718000	868000

Table 2.6.1.8 North Sea herring input data. IBTS0 survey index at age.

Year	Value
1992	163
1993	195.8
1994	155.7
1995	171.2
1996	105.6
1997	133.5
1998	51.72
1999	255.2
2000	110.6
2001	341.5
2002	150.7
2003	72.44
2004	43.11
2005	68.73
2006	67.28
2007	50.76
2008	39.49
2009	92.36
2010	56.53

2011	77.62
2012	65.1
2013	61.55
2014	113.7
2015	21.76
2016	81.71
2017	27.83
2018	102.2
2019	51.63
2020	62.39
2021	92.97
2022	48.02
2023	90.84

Table 2.6.1.9 North Sea herring input data. IBTSQ1 survey index at age. This index is normalized Using the data from DATRAS following the method described in the stock annex.

Year	Value
1984	1070765
1985	1465723
1986	1688359
1987	3199710
1988	1505430
1989	1612781
1990	763223
1991	1094232
1992	1142297
1993	1866527
1994	2748908
1995	2150928
1996	1263540
1997	834462
1998	1482508
1999	722082
2000	2085204
2001	1598455
2002	1770396
2003	1357941
2004	783840
2005	925980
2006	745247
2007	883566
2008	731055
2009	725168
2010	878615
2011	1528358
2012	798515
2013	502558
2014	1658630
2015	1941522
2016	556770
2017	1373951

2018	678384
2019	979984
2020	1145966
2021	1230685
2022	646976
2023	1525725

Table 2.6.1.10 North Sea herring input data. IBTSQ3 survey index at age. This index is normalized Using the data from DATRAS following the method described in the stock annex

Year	0	1	2	3	4	5
1998	746142	456306	323785	93858	27033	12102
1999	4655800	308088	210339	122567	54784	18836
2000	1769976	741709	295223	120313	73409	17233
2001	1848091	324999	218553	110440	47372	27506
2002	2320620	1921639	476202	340570	83910	32760
2003	912394	473070	571541	152372	117861	19044
2004	2257961	398418	306517	429607	99940	52391
2005	1162862	410220	113336	83132	108262	32967
2006	1056562	297333	192760	77967	47028	52404
2007	2347335	137823	94556	102228	51624	32785
2008	626833	161049	116339	60891	37259	19462
2009	2849593	208455	95989	65858	28517	12250
2010	1513359	495574	171320	85040	38557	16069
2011	896673	348861	177067	104548	52800	22322
2012	801530	210381	92341	70235	40268	23400
2013	1989165	279817	137884	125379	88486	41603
2014	7386892	443236	203907	89768	79279	45667
2015	529316	732079	361702	122806	69235	47888
2016	1797028	178869	374205	213339	74220	43534
2017	880165	280217	78546	2e+05	134319	42174
2018	1867214	321320	119121	51005	89418	40305
2019	1472846	136778	63345	42443	23123	36180
2020	1052911	318606	268824	72360	67119	25947
2021	787374	281442	107626	70668	25161	17101
2022	7455503	201645	263672	136851	86432	18326

Table 2.6.1.11 North Sea herring input data. LAI index from the IHLS larvae survey for the Southern North Sea component (Downs). The columns correspond to survey time windows: 0=16-31Dec, 1=01-15Jan, 2=16-31Jan.

Year	0	1	2
1972	2	46	0
1973	-1	-1	1
1974	-1	10	-1
1975	1	2	0
1976	-1	3	-1
1977	1	0	-1
1978	33	3	-1
1979	-1	111	89
1980	247	129	40
1981	1456	-1	70
1982	710	275	54
1983	71	243	58
1984	523	185	39
1985	1851	407	38
1986	780	123	18
1987	934	297	146

1988	1679	162	112
1989	1514	2120	512
1990	2552	1204	-1
1991	4400	873	-1
1992	176	1616	-1
1993	1358	1103	-1
1994	537	595	-1
1995	74	230	164
1996	337	675	691
1997	9374	918	355
1998	1522	953	170
1999	804	1260	344
2000	7346	338	106
2001	971	5531	909
2002	2008	260	925
2003	12048	3109	1116
2004	6528	2052	4175
2005	498	3999	4822
2006	10858	2700	2106
2007	4443	2439	3854
2008	8426	2317	4008
2009	15295	14712	1689
2010	7493	13230	8073
2011	5461	6160	1215
2012	22768	11103	3285
2013	5	9314	2957
2014	-1	-1	1851
2015	2011	1200	645
2016	20710	1442	1545
2017	10553	5880	-1
2018	1140	-1	-1
2019	14082	5258	-1
2020	4077	9704	-1
2021	8899	8764	-1
2022	3712	743	-1

Table 2.6.1.12 North Sea herring input data. LAI index from the IHLS larvae survey for the Central North Sea component (Banks). The columns correspond to survey time windows in: 0=01-15Sep, 1=16-30Sep, 2=01-15Oct, 3=16-31Oct.

Year	0	1	2	3
1972	165	88	134	22
1973	492	830	1213	152
1974	81	-1	1184	-1
1975	-1	90	77	6
1976	64	108	0	10
1977	520	262	89	3
1978	1406	81	269	2
1979	662	131	507	7
1980	317	188	9	13
1981	903	235	119	0
1982	86	64	1077	23
1983	1459	281	63	-1
1984	688	2404	824	433
1985	130	13039	1794	215
1986	1611	6112	188	36
1987	799	4927	1992	113
1988	5533	3808	1960	206
1989	1442	5010	2364	2
1990	19965	1239	975	-1
1991	4823	2110	1249	-1
1992	10	165	163	-1
1993	-1	685	85	-1
1994	-1	1464	44	-1
1995	-1	-1	43	-1
1996	-1	564	-1	-1
1997	-1	-1	-1	-1
1998	205	66	-1	-1
1999	-1	134	181	-1
2000	-1	376	-1	-1
2001	-1	1604	-1	-1
2002	-1	-1	3291	-1
2003	-1	12018	3277	-1
2004	-1	5545	-1	-1
2005	-1	5614	-1	-1
2006	-1	2259	-1	-1
2007	-1	291	-1	-1
2008	-1	11201	-1	-1
2009	-1	4219	-1	-1
2010	-1	2317	-1	-1
2011	-1	17766	-1	-1

2012	-1	517	-1	-1
2013	-1	7354	-1	-1
2014	-1	1149	-1	-1
2015	-1	3424	-1	-1
2016	-1	3288	-1	-1
2017	-1	3965	-1	-1
2018	-1	1509	-1	-1
2019	-1	10605	-1	-1
2020	-1	7663	-1	-1
2021	-1	3282	-1	-1
2022	-1	188	-1	-1

Table 2.6.1.13 North Sea herring input data. LAI index from the IHLS larvae survey for the Bunchan component. The columns correspond to survey time windows in: 0=01-15Sep, 1=16-30Sep.

Year	0	1
1972	30	0
1973	3	4
1974	101	284
1975	312	-1
1976	0	1
1977	124	32
1978	-1	162
1979	197	10
1980	21	1
1981	3	12
1982	340	257
1983	3647	768
1984	2327	1853
1985	2521	1812
1986	3278	341
1987	2551	670
1988	6812	5248
1989	5879	692
1990	4590	2045
1991	-1	2032
1992	-1	822
1993	-1	174
1994	-1	-1
1995	-1	-1
1996	-1	184
1997	-1	23
1998	-1	1490
1999	-1	185
2000	28	155
2001	-1	164
2002	-1	1038
2003	-1	2263
2004	-1	3884
2005	-1	1364
2006	-1	280
2007	-1	1304
2008	-1	533
2009	-1	4629
2010	-1	1493
2011	-1	2839
2012	-1	5856
2013	-1	8618
2014	-1	5033
2015	-1	3496
2016	-1	3872
2017	-1	5833
2018	-1	1740
2019	5654	3794
2020	-1	3418
2021	-1	1413
2022	-1	1471

Table 2.6.1.14 North Sea herring input data. LAI index from the IHLS larvae survey for the Orkney/Shetland component. The columns correspond to survey time windows in: 0=01-15Sep, 1=16-30Sep.

Year	0	1
1972	1133	4583
1973	2029	822
1974	758	421
1975	371	50
1976	545	81
1977	1133	221
1978	3047	50
1979	2882	2362
1980	3534	720
1981	3667	277
1982	2353	1116
1983	2579	812
1984	1795	1912
1985	5632	3432
1986	3529	1842
1987	7409	1848
1988	7538	8832
1989	11477	5725
1990	-1	10144
1991	1021	2397
1992	189	4917
1993	-1	66
1994	26	1179
1995	-1	8688
1996	-1	809
1997	-1	3611
1998	-1	8528
1999	-1	4064
2000	-1	3972
2001	-1	11918
2002	-1	6669
2003	-1	3199
2004	-1	7055
2005	-1	3380
2006	6311	2312
2007	-1	1753
2008	4978	6875
2009	-1	7543
2010	-1	2362
2011	-1	3831
2012	-1	19552
2013	-1	21282
2014	-1	6604
2015	-1	9631
2016	-1	-1
2017	-1	-1
2018	-1	102
2019	2488	-1
2020	-1	3208
2021	-1	6651
2022	-1	2785

Table 2.6.2.1 North Sea herring single fleet assessment. Observation variance per data source and at age.

fleet	age	value	CV	lbnd	ubnd
catch unique	0	0.4282	0.1272	0.3338	0.5494
catch unique	1	0.4282	0.1272	0.3338	0.5494
catch unique	2	0.1213	0.1755	0.08601	0.1711
catch unique	3	0.1213	0.1755	0.08601	0.1711
catch unique	4	0.1213	0.1755	0.08601	0.1711
catch unique	5	0.1213	0.1755	0.08601	0.1711
catch unique	6	0.1213	0.1755	0.08601	0.1711
catch unique	7	0.1875	0.1958	0.1278	0.2753
catch unique	8	0.1875	0.1958	0.1278	0.2753
HERAS	1	0.464	0.1491	0.3464	0.6215
HERAS	2	0.2641	0.1464	0.1982	0.3519
HERAS	3	0.1643	0.177	0.1161	0.2325
HERAS	4	0.2191	0.09772	0.1809	0.2653
HERAS	5	0.2191	0.09772	0.1809	0.2653

HERAS	6	0.2191	0.09772	0.1809	0.2653
HERAS	7	0.3101	0.1219	0.2442	0.3938
HERAS	8	0.3101	0.1219	0.2442	0.3938
IBTS-Q1	1	0.2718	0.1502	0.2025	0.3648
IBTS0	0	0.3697	0.1575	0.2715	0.5035
IBTS-Q3	0	0.5318	0.1302	0.412	0.6865
IBTS-Q3	1	0.5318	0.1302	0.412	0.6865
IBTS-Q3	2	0.3244	0.09377	0.2699	0.3898
IBTS-Q3	3	0.3244	0.09377	0.2699	0.3898
IBTS-Q3	4	0.3244	0.09377	0.2699	0.3898
IBTS-Q3	5	0.3244	0.09377	0.2699	0.3898
LAI-ORSH	0	1.184	0.04326	1.088	1.289
LAI-BUN	0	1.184	0.04326	1.088	1.289
LAI-CNS	0	1.184	0.04326	1.088	1.289
LAI-SNS	0	1.184	0.04326	1.088	1.289

Table 2.6.2.2 North Sea herring single fleet assessment. Catchabilities at age.

fleet	age	value	CV	lbnd	ubnd
HERAS	1	0.9401	0.06666	0.825	1.071
HERAS	2	0.9401	0.06666	0.825	1.071
HERAS	3	1.075	0.05826	0.9588	1.205
HERAS	4	1.075	0.05826	0.9588	1.205
HERAS	5	1.075	0.05826	0.9588	1.205
HERAS	6	1.075	0.05826	0.9588	1.205
HERAS	7	1.075	0.05826	0.9588	1.205
HERAS	8	1.075	0.05826	0.9588	1.205
IBTS-Q1	1	0.1059	0.06679	0.09294	0.1208
IBTS0	0	3.215e-06	0.09015	2.695e-06	3.837e-06
IBTS-Q3	0	0.1036	0.1257	0.08096	0.1325
IBTS-Q3	1	0.04618	0.1219	0.03637	0.05865
IBTS-Q3	2	0.04158	0.08631	0.03511	0.04924
IBTS-Q3	3	0.03802	0.08584	0.03213	0.04499
IBTS-Q3	4	0.03314	0.08726	0.02793	0.03932
IBTS-Q3	5	0.02481	0.08846	0.02086	0.02951
LAI-ORSH	0	0.01605	0.1069	0.01302	0.01979
LAI-BUN	0	0.01605	0.1069	0.01302	0.01979
LAI-CNS	0	0.01605	0.1069	0.01302	0.01979
LAI-SNS	0	0.01605	0.1069	0.01302	0.01979

Table 2.6.2.3 North Sea herring single fleet assessment. Numbers at age.

Year	0	1	2	3	4	5	6	7	8
1947	34843107	16666475	14592167	5407277	7264055	4440840	3912769	2070123	6313607
1948	33204210	16181501	9534969	8641669	3644784	5082805	2940188	2225271	4877291
1949	27923624	15556349	11572065	7226025	4189711	2287343	3243787	1869730	4258186
1950	39551269	12151793	9016049	9345946	5172845	2343749	1449778	1811015	3233889
1951	38374251	19062997	6516386	6049017	6824903	3620847	1475044	841314	2790755
1952	38187357	17642954	10476730	3868830	3576857	3787503	2163612	938806	2269147
1953	43252063	17327703	9216360	5731555	2633236	2114685	2222853	1230487	1764972
1954	40358247	20073032	8858672	5251386	3105424	1713838	1244473	1282427	1706998
1955	34301248	18147174	10527667	5109197	2667527	1790192	1056402	665524	1410434
1956	25467628	16043223	8612241	6055419	2885102	1465175	1045282	582999	1388766
1957	57469609	10830071	8068881	3750345	3535689	1680692	931593	650633	1174883
1958	24929483	32548124	4742779	4542914	1881776	2247417	925005	544476	1011344
1959	28331717	11058168	19138195	2165014	2339195	1102401	1161108	565319	1192960

1960	12552193	14357573	4976624	10533764	1060183	1145048	605690	616115	1088727
1961	52690620	4189313	7282570	2362379	7108365	669800	792664	344557	870697
1962	28485201	27146529	1593856	3196087	1370648	4375518	425469	513429	709615
1963	34232664	13053389	1.6e+07	1009042	1251328	676174	2245795	203160	694024
1964	34357568	14833057	6528560	9346700	663798	734821	506991	1536778	545435
1965	17213841	16503748	6210085	3394650	5403668	389402	425386	320424	1376536
1966	18496083	7916703	7508159	2139560	1362746	2326868	168111	188226	843516
1967	25581791	7847534	3586795	3136850	848279	651293	865360	101071	465311
1968	21939615	11633435	3119983	1877985	1147459	290563	245917	277535	164658
1969	12755372	9855830	4266113	657039	301326	349858	78381	65531	95308
1970	21817686	5820121	4117988	1522153	209995	99146	108168	16300	42983
1971	17158471	10059921	2331552	1206349	371720	51002	31704	30027	17496
1972	12615750	7662338	3287013	757479	313864	95366	13993	1048	6526
1973	6893962	5388537	2652784	1130204	291904	120791	47477	7466	4451
1974	10772641	2769838	1557462	729076	262978	97700	40070	11364	5282
1975	2573246	5323148	926740	432825	232066	81000	26827	11716	5880
1976	3337077	839575	1810962	210300	92974	61398	13516	6298	2457
1977	4403786	1400413	284034	614874	49501	24670	18470	4529	2106
1978	4327905	1874080	706379	222473	249314	30532	11435	10019	3132
1979	7877575	1702345	909388	409014	177215	122259	20572	7006	7224
1980	12639916	3236472	755357	477690	229131	156441	62616	16887	8038
1981	27375323	4678193	1611037	325089	220224	138833	120748	54414	20160
1982	46445060	8097894	1852062	1038911	200208	120572	77139	71073	39265
1983	46151118	14958233	3237207	1057091	504695	126008	103126	52508	82927
1984	46549410	13369781	6158052	1800147	673839	273632	79644	67411	81224
1985	55251332	14932130	5732565	3596705	998515	359510	124580	47172	75364
1986	67358005	19966442	5483377	3e+06	1553044	428929	170027	54620	61493
1987	57782205	26604848	8780676	2620261	1555769	781973	224084	77220	50927
1988	38074870	1.9e+07	10151654	4631942	1345940	813796	393271	113160	67756
1989	29846582	13069401	7000889	5630792	2695651	703681	407168	196541	91457
1990	27756832	9933260	4551829	3978370	3690257	1582458	378498	220919	165033
1991	30285372	10653373	4210989	2376418	2343819	2186812	898056	216844	201851
1992	52786702	10436718	4556140	1810444	1351823	1359405	1319257	533983	248839
1993	55579837	16956715	3799139	2033638	953901	744961	754039	650360	415655
1994	43072895	17190801	5938054	1468651	878873	409834	351952	346030	480817
1995	44203697	14122824	6144059	2644449	737630	379229	203340	176959	386789
1996	35958398	14144266	5262496	3113922	1113623	349902	156709	100130	272117
1997	29160338	13684735	6488721	3011194	1698795	679978	215130	92620	228866
1998	19186559	12120068	9050944	3230497	1512894	913733	447341	132793	179022
1999	55290404	8450077	5600327	5497992	1709313	769806	445855	234442	153849
2000	40457232	22372745	5640786	2949695	3244267	1051521	485515	277632	199837
2001	67636349	16181229	11224247	3648421	1727929	1812566	566391	289903	231348
2002	36318539	28835906	8144674	8156460	1947917	938102	1106339	331337	318713
2003	20507520	14165115	17428976	4571631	5022135	1089305	578736	668465	344760
2004	23685950	7774620	6349044	11062895	3014318	3041947	560153	374060	504464
2005	20842279	9866033	3871523	3880085	6603614	1787980	1633187	278102	415082
2006	21487048	7353034	5030411	2485836	2426252	4169287	874841	736774	293145
2007	24668134	7845506	3238396	2967106	1559892	1395166	2329652	456914	481137
2008	22373022	8853438	4418327	2132420	1730092	1007208	881200	1482315	585283
2009	35013307	8839130	5419499	2634055	1438386	1146203	682761	638555	1632197
2010	28340638	12782070	5563693	3952552	1938063	1072294	1008832	520973	1755764
2011	2.5e+07	11629346	6695592	3615958	2489693	1256525	733720	656509	1494262
2012	23319964	9155391	5954580	5076416	2643228	1742794	812873	482172	1206751
2013	31738726	8655039	4565820	4143107	3465560	1992047	1206047	510235	1045677
2014	47612886	14212065	5440446	3178706	3349911	2330910	1256996	706045	770620
2015	13682022	19235940	9872013	2987687	1961800	2100071	1393879	726823	825980
2016	23844071	5263968	11917987	7014466	1862158	1241790	1182613	706561	733057
2017	14401346	8968411	2560729	8537038	4885576	1234303	638779	561715	612120
2018	24778622	5817443	4300133	1947482	6048389	3472513	813117	425979	713360
2019	22146722	9937479	2453366	2785121	1447492	3817701	2106628	440071	590512
2020	25562864	9216496	5911435	1637139	1910373	1067328	2328132	1111574	533453
2021	18159371	10981001	4816593	3035662	1131440	1329787	737273	1311779	929005
2022	31135028	6329198	7028822	3464781	2158853	782291	876069	477309	1232610
2023	31349395	13787347	3597468	4300806	2023410	1267202	457046	504511	929677

Table 2.6.2.4 North Sea herring single fleet assessment. Harvest at age.

Year	0	1	2	3	4	5	6	7	8
1947	0.0001244	0.001054	0.03888	0.09584	0.111	0.1483	0.2442	0.2706	0.2706
1948	0.0001008	0.0008296	0.0331	0.08772	0.1061	0.1403	0.2109	0.2403	0.2403
1949	0.0002486	0.002326	0.04986	0.1098	0.1255	0.159	0.2567	0.3062	0.3062
1950	0.0006014	0.00638	0.07401	0.1365	0.1485	0.164	0.2188	0.2379	0.2379
1951	0.001813	0.0225	0.1301	0.2021	0.2142	0.2099	0.235	0.227	0.227
1952	0.003102	0.04154	0.1604	0.21	0.2195	0.2253	0.2822	0.3078	0.3078
1953	0.00464	0.06581	0.1902	0.2325	0.228	0.2336	0.2821	0.2987	0.2987
1954	0.006552	0.1004	0.2334	0.2746	0.2572	0.2718	0.3639	0.3794	0.3794
1955	0.007046	0.1201	0.2508	0.2663	0.235	0.2402	0.2703	0.2338	0.2338
1956	0.007254	0.1355	0.2761	0.2687	0.2287	0.2307	0.2452	0.2387	0.2387
1957	0.008009	0.1481	0.2856	0.2756	0.2411	0.2612	0.2861	0.2726	0.2726
1958	0.008719	0.1506	0.2953	0.2772	0.231	0.238	0.2041	0.1725	0.1725
1959	0.01467	0.2123	0.3508	0.3146	0.2705	0.271	0.2906	0.2881	0.2881
1960	0.01668	0.1906	0.3088	0.2561	0.2138	0.2104	0.2381	0.2693	0.2693
1961	0.01921	0.1968	0.3276	0.2933	0.2547	0.2401	0.2533	0.2372	0.2372
1962	0.01233	0.1305	0.273	0.3159	0.3023	0.3072	0.3798	0.3501	0.3501

1963	0.01241	0.1173	0.2349	0.225	0.1792	0.1677	0.1307	0.1441	0.1441
1964	0.01853	0.1941	0.3401	0.3394	0.2875	0.2727	0.226	0.2171	0.2171
1965	0.02424	0.2888	0.524	0.584	0.5254	0.5228	0.505	0.5122	0.5122
1966	0.02453	0.2535	0.4915	0.5598	0.4962	0.5137	0.4106	0.5124	0.5124
1967	0.02906	0.2867	0.5643	0.7335	0.6701	0.7111	0.7629	0.9563	0.9563
1968	0.04945	0.5354	0.9964	1.3	1.004	0.9682	1.147	1.215	1.215
1969	0.02798	0.2977	0.6926	0.8799	0.8018	0.8542	1.192	1.07	1.07
1970	0.04705	0.4242	0.8182	1.024	0.9383	0.8547	1.174	0.91	0.91
1971	0.06852	0.561	0.8828	1.082	1.072	1.128	2.928	1.723	1.723
1972	0.06918	0.459	0.6991	0.7286	0.6017	0.5283	0.5394	0.3174	0.3174
1973	0.1017	0.6325	0.9104	1.021	0.8639	0.8634	1.08	0.705	0.705
1974	0.1147	0.543	0.842	0.938	0.8407	0.9428	0.9573	0.8424	0.8424
1975	0.1746	0.6742	1.01	1.242	1.117	1.298	1.284	1.621	1.621
1976	0.1487	0.4456	0.7299	1.015	0.8819	0.9554	0.807	1.156	1.156
1977	0.06793	0.1271	0.2601	0.3879	0.3309	0.4032	0.275	0.4638	0.4638
1978	0.0779	0.1136	0.2139	0.2808	0.2351	0.266	0.1409	0.2563	0.2563
1979	0.1103	0.1309	0.2101	0.2493	0.1942	0.2005	0.08289	0.1542	0.1542
1980	0.1633	0.158	0.215	0.235	0.1729	0.1562	0.05041	0.09152	0.09152
1981	0.324	0.2647	0.2482	0.2776	0.2481	0.2631	0.2122	0.3799	0.3799
1982	0.2982	0.2375	0.2202	0.2509	0.2043	0.1733	0.1065	0.1533	0.1533
1983	0.3022	0.27	0.2411	0.2883	0.2846	0.2756	0.257	0.3379	0.3379
1984	0.2193	0.2611	0.2595	0.3428	0.3876	0.3853	0.3895	0.4928	0.4928
1985	0.1889	0.3262	0.3224	0.4361	0.4986	0.4787	0.5196	0.5842	0.5842
1986	0.1461	0.3018	0.3076	0.3788	0.4341	0.4402	0.5142	0.5787	0.5787
1987	0.1795	0.38	0.3239	0.3559	0.4128	0.4242	0.4527	0.4532	0.4532
1988	0.1656	0.3824	0.3088	0.3234	0.3922	0.4184	0.4506	0.4639	0.4639
1989	0.1619	0.3813	0.3166	0.3198	0.3864	0.4005	0.4115	0.4182	0.4182
1990	0.1179	0.2769	0.2751	0.2611	0.3011	0.3086	0.2822	0.3005	0.3005
1991	0.1581	0.3363	0.3409	0.3041	0.3171	0.3033	0.2806	0.2547	0.2547
1992	0.2267	0.4094	0.3902	0.3536	0.372	0.351	0.3709	0.35	0.35
1993	0.2617	0.4468	0.4397	0.4377	0.4588	0.3968	0.4163	0.3988	0.3988
1994	0.2131	0.3549	0.4104	0.4722	0.4992	0.3926	0.3627	0.3159	0.3159
1995	0.1857	0.2866	0.3365	0.4233	0.4408	0.3958	0.3842	0.3083	0.3083
1996	0.06954	0.1052	0.1693	0.2146	0.2149	0.208	0.1647	0.1121	0.1121
1997	0.03376	0.05958	0.1356	0.1899	0.2048	0.2063	0.182	0.1319	0.1319
1998	0.03784	0.07458	0.1589	0.2263	0.2409	0.2462	0.2368	0.1451	0.1451
1999	0.03814	0.06523	0.1428	0.2203	0.2292	0.228	0.1938	0.1192	0.1192
2000	0.04278	0.06718	0.1347	0.2109	0.2443	0.2494	0.2124	0.1312	0.1312
2001	0.03519	0.04822	0.101	0.1654	0.205	0.2225	0.1952	0.1355	0.1355
2002	0.03184	0.04097	0.08896	0.1453	0.1885	0.2122	0.1961	0.1654	0.1654
2003	0.03563	0.04398	0.08976	0.1478	0.2111	0.264	0.248	0.2058	0.2058
2004	0.04322	0.04728	0.09328	0.1542	0.2357	0.3213	0.3934	0.3339	0.3339
2005	0.06674	0.06854	0.1135	0.173	0.2664	0.363	0.515	0.5497	0.5497
2006	0.05612	0.05289	0.1016	0.1601	0.2434	0.3152	0.41	0.4883	0.4883
2007	0.0498	0.04605	0.09696	0.1564	0.2285	0.2848	0.3575	0.4325	0.4325
2008	0.04827	0.04047	0.08668	0.1084	0.1441	0.1715	0.165	0.2086	0.2086
2009	0.02878	0.02165	0.05555	0.05928	0.07702	0.09295	0.06812	0.09476	0.09476
2010	0.03345	0.02494	0.06244	0.07114	0.08315	0.09695	0.06994	0.07937	0.07937
2011	0.03705	0.02662	0.06844	0.0912	0.1089	0.1268	0.1012	0.1041	0.1041
2012	0.05348	0.04305	0.09659	0.1504	0.1893	0.2226	0.2411	0.2504	0.2504
2013	0.045	0.03744	0.08914	0.1491	0.2109	0.2689	0.3461	0.389	0.389
2014	0.0516	0.03518	0.08418	0.1464	0.2148	0.2678	0.3141	0.3797	0.3797
2015	0.0525	0.02697	0.06629	0.1191	0.1902	0.2758	0.4059	0.5522	0.5522
2016	0.06706	0.02864	0.06705	0.1393	0.2123	0.2925	0.4385	0.6611	0.6611
2017	0.05585	0.02192	0.05869	0.1368	0.2049	0.249	0.3075	0.4624	0.4624
2018	0.05692	0.02009	0.06121	0.1394	0.2244	0.287	0.3777	0.5398	0.5398
2019	0.04706	0.01665	0.06145	0.1299	0.1818	0.2335	0.3173	0.4634	0.4634
2020	0.06963	0.02589	0.09899	0.1672	0.1927	0.2107	0.274	0.4293	0.4293
2021	0.04844	0.02127	0.1048	0.1748	0.1997	0.2213	0.2253	0.3482	0.3482
2022	0.05517	0.03018	0.1425	0.2213	0.239	0.2538	0.2806	0.3433	0.3433
2023	0.05511	0.03015	0.1424	0.2212	0.2389	0.2537	0.2804	0.3431	0.3431

Table 2.6.2.5 North Sea herring single fleet assessment. Analytical retrospective (Mohn's Rho).

year	ssb	fbar	rec
2012	23.54	-30.66	28.75
2013	21.77	-28.17	19.35
2014	14.27	-17.07	3.354
2015	12.97	-14.06	7.284
2016	11.5	-11.83	-19.05
2017	19.77	-27.14	-3.2
2018	12.68	-14.47	-8.542
2019	7.085	-9.155	-9.249
2020	3.874	-4.588	-0.445
2021	8.449	-7.089	0.2181
2022	0	0	0
av_5y	8.643	-10.41	-3.536

Table 2.6.2.6 North Sea herring single fleet assessment. Assessment summary.

Year	Rec	Rec_lo	Rec_hi	TSB	TSB_lo	TSB_hi	SSB	SSB_lo	SSB_hi	Catch	Catch_lo	Catch_hi	Fbar	Fbar_lo	Fbar_hi	Landings	SOP
1947	34843107	19625911	61859146	8574808	6502051	11308329	5288144	3807178	7345197	851339	733014	988764	0.1276	0.08941	0.1822	581760	1.461
1948	33204210	19739073	55854679	7380586	5638212	9661405	4492545	3263477	6184496	661659	578545	756713	0.1156	0.08219	0.1626	502100	1.333
1949	27923624	16775841	46479266	6805979	5272421	8785593	4064846	2986678	5532224	724586	634097	827988	0.1402	0.1008	0.1949	508500	1.45
1950	39551269	24226625	64569573	6430870	5060781	8171879	3813382	2857190	5089575	648221	578906	725836	0.1484	0.1094	0.2012	491700	1.307
1951	38374251	23697892	62139838	6292667	5035285	7864034	3377236	2562141	4451638	777630	699507	864479	0.1983	0.15	0.262	600400	1.324
1952	38187357	23755266	61387410	6044295	4871907	7498809	3195395	2442845	4179780	834373	753448	923989	0.2195	0.1668	0.2888	664400	1.272
1953	43252063	27734115	67452702	5816740	4709363	7184508	2963000	2269315	3868730	835485	754263	925453	0.2333	0.1781	0.3056	698500	1.198
1954	40358247	25972075	62713054	5670943	4606212	6981787	2706632	2060095	3556076	947906	850337	1056671	0.2802	0.2125	0.3695	762900	1.251
1955	34301248	22209401	52976466	5414475	4393798	6672256	2714584	2076479	3548780	843588	750365	948393	0.2525	0.1921	0.332	806400	1.06
1956	25467628	16476565	39365008	5058459	4117056	6215123	2625637	2012614	3425382	833911	742261	936878	0.2499	0.1911	0.3267	675200	1.271
1957	57469609	36856427	89611398	4940708	4034776	6050049	2376964	1821725	3101434	783937	702409	874928	0.2699	0.2061	0.3535	682900	1.158
1958	24929483	16269580	38198842	4950133	4025573	6087038	2018983	1548726	2632028	734843	626486	861941	0.2491	0.1919	0.3233	670500	1.167
1959	28331717	1.8e+07	44585230	5524214	4543279	6716942	2919711	2255993	3778696	1168520	1010934	1350671	0.2995	0.2313	0.3879	784500	1.519
1960	12552193	8045015	19584493	4632019	3808683	5633337	2516069	1949494	3247306	805199	703933	921032	0.2454	0.1911	0.3152		

696200 1.183
1961 52690620 33900753 81894979 4791135 3976780 5772252 2536810 1993861 3227610 769038 683324 865504 0.2738 0.2167 0.3459
696700 1.135
1962 28485201 18709038 43369771 4470946 3711533 5385741 1771243 1374247 2282924 729409 634130 839003 0.3156 0.2488 0.4004
627800 1.171
1963 34232664 22614627 51819349 5171471 4325637 6182700 2789711 2234012 3483637 595633 512805 691840 0.1875 0.1515 0.2321
716000 0.8602
1964 34357568 22833652 51697489 5109002 4418790 5907026 2516773 2081799 3042632 901056 786199 1032692 0.2931 0.2441 0.3521
871200 1.066
1965 17213841 11433746 25915944 4614594 4076081 5224252 1991409 1676813 2365029 1304893 1149893 1480785 0.5322 0.4504 0.6289
1168800 1.15
1966 18496083 12366304 27664295 3461551 3071762 3900802 1594303 1353527 1877911 934170 833423 1047095 0.4944 0.4219 0.5793
895500 1.071
1967 25581791 17011961 38468702 2676814 2387504 3001181 958349 822953 1116021 833295 742976 934593 0.6884 0.5963 0.7947
695500 1.176
1968 21939615 14715523 32710133 2272975 1996632 2587567 523395 448244 611144 912963 782205 1065580 1.083 0.9554 1.228
717800 1.255
1969 12755372 8440622 19275774 1689713 1460542 1954842 479343 393632 583718 503072 428676 590379 0.884 0.7725 1.012
546700 0.9674
1970 21817686 14441150 32962154 1659738 1441908 1910475 454924 373326 554358 549818 472863 639296 0.9617 0.8456 1.094
563100 0.9657
1971 17158471 11483704 25637470 1465620 1246999 1722570 286581 236803 346824 522484 423282 644937 1.418 1.256 1.602
520100 1.075
1972 12615750 8384612 18982051 1322456 1136433 1538928 329390 271962 398946 393429 319757 484075 0.6194 0.5364 0.7153
497500 0.9197
1973 6893962 4594665 10343889 1106036 968285 1263383 278827 232904 333804 444142 373580 528032 0.9477 0.833 1.078
484000 0.9575
1974 10772641 7059737 16438261 775904 675195 891635 191402 160829 227786 271159 232904 315698 0.9042 0.7923 1.032
275100 0.968
1975 2573246 1673465 3956817 613166 512770 733219 105746 87467 127846 269222 214272 338264 1.19 1.028 1.379
312800 0.9343
1976 3337077 2103457 5294181 453837 379519 542708 144849 109932 190856 159761 135360 188560 0.8779 0.6883 1.12
174800 0.953
1977 4403786 2712103 7150661 319115 251445 404998 110114 80073 151426 52031 44158 61307 0.3314 0.2417 0.4545

46000 1.198
1978 4327905 2637275 7102317 379729 290545 496290 137100 100537 186960 45717 26427 79087 0.2273 0.1427 0.3623
11000 .
1979 7877575 4974700 12474357 499450 396269 629498 187117 143407 244149 59567 33833 104874 0.1874 0.1163 0.3018
25100 .
1980 12639916 8462656 18879117 671117 550652 817935 210879 168208 264376 80826 63339 103140 0.1659 0.1315 0.2094
70764 1.094
1981 27375323 18407702 40711671 1093119 892603 1338678 271738 217530 339455 146018 112352 189773 0.2498 0.1993 0.3131
174879 1.008
1982 46445060 31294830 68929712 1710991 1387949 2109220 385735 312760 475737 239532 174365 329056 0.191 0.155 0.2354
275079 0.9786
1983 46151118 31823595 66929135 2352083 1951954 2834236 550510 449858 673682 382595 284543 514435 0.2693 0.2221 0.3267
387202 1.077
1984 46549410 32176197 67343185 3125511 2658237 3674925 906030 739986 1109331 476442 387057 586470 0.3529 0.2939 0.4239
428631 1.054
1985 55251332 38100936 80121644 3567194 3064525 4152314 994586 820715 1205293 639243 545942 748490 0.4511 0.3764 0.5405
613780 1.042
1986 67358005 46278848 98038328 3977599 3396368 4658298 1035062 859198 1246921 717786 579116 889660 0.415 0.3459 0.4979
671488 1.137
1987 57782205 39767737 83957085 3974109 3420178 4617754 1217539 1011865 1465019 766792 630330 932798 0.3939 0.3299 0.4703
792058 1.017
1988 38074870 26264795 55195395 3854891 3356763 4426938 1559333 1300386 1869845 876266 723126 1061837 0.3787 0.319 0.4496
887686 1.164
1989 29846582 20595560 43252937 3509650 3110228 3960366 1620487 1387617 1892439 809747 700747 935701 0.367 0.3128 0.4305
787899 1.034
1990 27756832 19095063 40347692 3507061 3106330 3959489 1773102 1522345 2065162 632348 552039 724340 0.2856 0.2423 0.3367
645229 1.052
1991 30285372 20864782 43959422 3373797 2993222 3802761 1574572 1357488 1826371 686173 590963 796723 0.3092 0.2629 0.3637
658008 1.02
1992 52786702 37776372 73761342 3344843 2959050 3780935 1198109 1029482 1394357 708256 605516 828428 0.3675 0.3121 0.4328
716799 0.995
1993 55579837 39582580 78042369 3113648 2720203 3564000 853988 725955 1004601 708668 597184 840964 0.4298 0.3636 0.5082
671397 1.023
1994 43072895 30558956 60711312 3017170 2602045 3498523 910441 772659 1072792 717553 578711 889705 0.4274 0.3614 0.5056

568234 1.05
1995 44203697 31280700 62465573 2833567 2449279 3278149 942466 793627 1119219 612450 520482 720669 0.3961 0.3318 0.4729
579371 1.008
1996 35958398 25499673 50706783 2779770 2387286 3236780 1103450 930869 1308028 266588 232951 305082 0.1943 0.1615 0.2337
275098 0.9987

Table 2.6.2.7 North Sea herring single fleet assessment. SAM model control object.

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

Slot "desc":
[1] "Imported from a VPA file. ( ./bootstrap/data/index.txt ).  Mon Mar 20 08:09:58 2023"

Slot "range":
      min       max plusgroup   minyear   maxyear   minfbar   maxfbar
        0         8         8      1947      2023         2         6

Slot "fleets":
catch unique        HERAS      IBTS-Q1        IBTS0      IBTS-Q3     LAI-ORSH
           0            2            2            2            2            6
     LAI-BUN      LAI-CNS      LAI-SNS
           6            6            6

Slot "plus.group":
plusgroup
     TRUE

Slot "states":
             age
fleet          0  1  2  3  4  5  6  7  8
  catch unique  0  1  2  3  4  5  6  7  7
  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

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 unique -1 -1 -1 -1 -1 -1 -1 -1 -1
  HERAS        -1  1  1  2  2  2  2  2  2
  IBTS-Q1      -1  3 -1 -1 -1 -1 -1 -1 -1
  IBTS0         0 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3       4  5  6  7  8  9 -1 -1 -1
  LAI-ORSH     10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN      10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS      10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS      10 -1 -1 -1 -1 -1 -1 -1 -1

Slot "power.law.exps":
             age
fleet          0  1  2  3  4  5  6  7  8
  catch unique -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
  LAI-SNS      -1 -1 -1 -1 -1 -1 -1 -1 -1

Slot "f.vars":
             age
fleet          0  1  2  3  4  5  6  7  8
  catch unique  0  0  1  1  1  1  2  2  2
  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

Slot "obs.vars":
             age
fleet          0  1  2  3  4  5  6  7  8
```

```
  catch unique  0  0  1  1  1  1  1  2  2
  HERAS        -1  3  4  5  6  6  6  7  7
  IBTS-Q1      -1  8 -1 -1 -1 -1 -1 -1 -1
  IBTS0         9 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3      10 10 11 11 11 11 -1 -1 -1
  LAI-ORSH     12 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN      12 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS      12 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS      12 -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

Slot "cor.obs":
             age
fleet         0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8
  catch unique  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

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

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

Slot "timeout":
[1] 3600

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

Slot "fixVarToWeight":
[1] FALSE

Slot "simulate":
[1] FALSE

Slot "residuals":
[1] TRUE

Slot "sumFleets":
logical(0)
```

Table 2.6.3.1 North Sea herring multi fleet assessment. observation variance per data source and at age.

fleet	age	value	CV	lbnd	ubnd
catch A	1	0.8392	0.1992	0.568	1.24
catch A	2	0.17	0.097	0.1406	0.2056
catch A	3	0.17	0.097	0.1406	0.2056
catch A	4	0.17	0.097	0.1406	0.2056
catch A	5	0.17	0.097	0.1406	0.2056
catch A	6	0.17	0.097	0.1406	0.2056
catch A	7	0.1848	0.2068	0.1232	0.2772
catch A	8	0.1848	0.2068	0.1232	0.2772
catch BD	0	0.5018	0.1449	0.3778	0.6666

catch BD	1	0.4689	0.2038	0.3145	0.6991
catch BD	2	0.6477	0.186	0.4498	0.9327
catch C	1	0.5295	0.1453	0.3983	0.7039
catch C	2	0.5295	0.1453	0.3983	0.7039
catch C	3	0.6488	0.09998	0.5333	0.7892
catch C	4	0.6488	0.09998	0.5333	0.7892
catch C	5	0.6488	0.09998	0.5333	0.7892
catch C	6	0.6488	0.09998	0.5333	0.7892
HERAS	1	0.4625	0.1482	0.3459	0.6184
HERAS	2	0.2616	0.147	0.1961	0.349
HERAS	3	0.1719	0.1744	0.1221	0.2419
HERAS	4	0.2284	0.09712	0.1888	0.2763
HERAS	5	0.2284	0.09712	0.1888	0.2763
HERAS	6	0.2284	0.09712	0.1888	0.2763
HERAS	7	0.326	0.1174	0.259	0.4103
HERAS	8	0.326	0.1174	0.259	0.4103
IBTS-Q1	1	0.2769	0.1445	0.2086	0.3675
IBTS0	0	0.3801	0.1537	0.2812	0.5138
IBTS-Q3	0	0.5335	0.129	0.4143	0.687
IBTS-Q3	1	0.5335	0.129	0.4143	0.687
IBTS-Q3	2	0.3174	0.09437	0.2638	0.3819
IBTS-Q3	3	0.3174	0.09437	0.2638	0.3819
IBTS-Q3	4	0.3174	0.09437	0.2638	0.3819
IBTS-Q3	5	0.3174	0.09437	0.2638	0.3819
LAI-ORSH	0	1.186	0.04331	1.089	1.291
LAI-BUN	0	1.186	0.04331	1.089	1.291
LAI-CNS	0	1.186	0.04331	1.089	1.291
LAI-SNS	0	1.186	0.04331	1.089	1.291

Table 2.6.3.2 North Sea herring multi fleet assessment. Catchabilities at age.

fleet	age	value	CV	lbnd	ubnd
HERAS	1	0.9534	0.06378	0.8414	1.08
HERAS	2	0.9534	0.06378	0.8414	1.08
HERAS	3	1.094	0.05562	0.9808	1.22
HERAS	4	1.094	0.05562	0.9808	1.22
HERAS	5	1.094	0.05562	0.9808	1.22
HERAS	6	1.094	0.05562	0.9808	1.22
HERAS	7	1.094	0.05562	0.9808	1.22
HERAS	8	1.094	0.05562	0.9808	1.22
IBTS-Q1	1	0.1074	0.06469	0.09463	0.1219
IBTS0	0	3.29e-06	0.08892	2.764e-06	3.917e-06
IBTS-Q3	0	0.1052	0.1238	0.08251	0.134
IBTS-Q3	1	0.04682	0.1205	0.03697	0.0593
IBTS-Q3	2	0.04215	0.08297	0.03583	0.0496
IBTS-Q3	3	0.0385	0.08262	0.03275	0.04527
IBTS-Q3	4	0.03345	0.08397	0.02838	0.03944
IBTS-Q3	5	0.02526	0.0853	0.02137	0.02985
LAI-ORSH	0	0.01614	0.1062	0.0131	0.01987
LAI-BUN	0	0.01614	0.1062	0.0131	0.01987
LAI-CNS	0	0.01614	0.1062	0.0131	0.01987
LAI-SNS	0	0.01614	0.1062	0.0131	0.01987

Table 2.6.3.3 North Sea herring multi fleet assessment. Numbers at age.

Year	0	1	2	3	4	5	6	7	8
1947	38197927	14641994	12015645	4995046	6902845	4352893	3838035	2040706	6214738
1948	34933781	17742794	8381938	7352973	3309286	4724442	2873317	2187131	4768084
1949	29878200	16190897	11434149	6589573	3954521	2129154	3043957	1808542	4127397
1950	40090649	13135221	9324594	9076675	4862142	2303192	1349014	1703695	3106775
1951	38623757	19070983	7153012	6274830	6585572	3429229	1451737	786158	2671313
1952	38964890	17676329	10662074	4240472	3681540	3779365	2091316	910461	2169050
1953	42922409	17749061	9482710	5959074	2726420	2149079	2216831	1192762	1710737
1954	38548856	20337162	9304444	5338642	3228564	1728807	1263002	1271102	1665467
1955	34863082	17205520	10899906	5277763	2752236	1837281	1052141	673521	1412897
1956	26292124	16221484	8165716	6177904	2923154	1527548	1075669	590583	1386962
1957	61098438	11014894	8093055	3775900	3536055	1693625	947105	662546	1185371
1958	26427650	33531398	4784688	4448630	1919797	2183644	944472	552576	1031879
1959	27447382	11596365	19308773	2237130	2339138	1108759	1180868	576507	1196039
1960	13060781	13572768	5218478	10841438	1105548	1206347	612383	633747	1099712
1961	53135861	4597428	6755374	2533253	7089264	684081	816557	352239	901997
1962	28741141	27481660	1801614	3080260	1392125	4322257	428557	527045	734600
1963	30866220	13189549	16104483	1059350	1305846	710399	2306489	213327	718555
1964	33675086	13744286	6654159	9534315	676223	760109	509106	1576034	572540
1965	18371597	16195300	5870486	3417911	5287883	393840	429660	321757	1400337
1966	17830172	8268156	7428615	2143497	1381455	2260173	175913	191084	846275
1967	23864634	7645339	3664384	3184956	838056	656388	880757	101258	469558
1968	22813125	10800188	3058655	1689222	1155859	290548	253097	277024	167467
1969	13368585	10220199	4248770	693502	307223	346231	78360	63731	95612
1970	21897578	5976525	4118851	1468889	205133	96351	112709	16370	42855
1971	18626897	10033224	2423644	1250014	379102	55733	29358	29913	17476
1972	12798736	8349590	3280015	758388	306414	95106	14358	1105	6429
1973	7149343	5502704	2647503	1142989	295589	123558	45400	7549	4420
1974	10039938	2854987	1534087	756673	266945	97284	40179	11490	5220
1975	2704422	4770185	918203	439474	229901	79644	28705	11865	5906
1976	3487261	927386	1731820	214889	89981	60646	15020	6454	2598
1977	4046796	1467568	341461	583247	54310	25786	19048	5075	2377
1978	4656229	1687863	725551	246029	247903	33043	12266	10534	3778
1979	8559482	1740441	845939	414453	183850	126259	22295	7579	8194
1980	13221185	3301388	794216	475596	233750	151702	67785	18059	9075
1981	26064880	4851154	1672368	365151	233440	140673	115529	57436	21683
1982	44214530	8030282	2010555	1029667	210213	130838	79212	71315	42279
1983	43417286	14443218	3281277	1128738	521500	131113	103751	54297	84917
1984	45202724	12989492	6041175	1812545	676849	275392	81777	68123	83021
1985	57387293	14537845	5618668	3440901	981763	357972	127952	47599	76044
1986	70354209	20478183	5367269	2901032	1545506	436671	169226	55693	60862
1987	58504757	26878611	8755832	2613701	1521534	774359	223684	77141	51095
1988	38457571	19599420	10290347	4631421	1347807	800051	393725	113486	67486
1989	29986887	13087646	6949915	5612706	2641515	699644	404577	196829	91173
1990	28067349	10031371	4524889	3916084	3587993	1531089	374194	217267	161864
1991	29743046	10425248	4006264	2345387	2305906	2134131	871332	212119	200357
1992	49471609	10091561	4446591	1813361	1331103	1320385	1267293	520793	244721
1993	51161183	16109547	3759266	1997333	942409	719752	722490	626553	404940
1994	41358269	16160366	5900548	1474746	837360	411714	340027	326762	463512
1995	41230862	13882497	6269712	2610068	725358	364098	201620	167735	372566
1996	33551944	13727023	5492475	3043453	1118197	343777	156995	98317	260412
1997	27887113	12931850	6160539	3041647	1601757	653225	207241	97377	213510
1998	19347856	11648351	8527390	3174092	1511069	862880	432595	133032	177020
1999	53808573	8455041	5552495	5154756	1693647	781630	435232	236053	158958
2000	38547655	22296204	5515080	2982279	3032821	978958	483052	266231	223251
2001	67519175	15064836	11246743	3579791	1692238	1658791	508947	277459	290615
2002	35428470	29331568	7922440	7804426	1928269	945425	1012916	307279	318739
2003	19130795	13954259	17317226	4568295	4984963	1073097	584511	627324	334885
2004	23222546	7082507	6262889	10855391	3006721	3034843	573364	368836	491750
2005	20239769	9771276	3655576	3914742	6553921	1794942	1655461	288720	421067
2006	21168571	7177967	4982047	2453239	2435985	4065341	886584	746146	302904
2007	24926578	7761839	3238854	2865989	1544093	1418080	2234474	455547	489525
2008	22857234	8940906	4355279	2123707	1695096	992986	859457	1413101	575202
2009	34427466	9031770	5226837	2641478	1417531	1096096	662545	621939	1529319
2010	28284153	12843961	5573271	3734467	1901478	1041004	894614	495551	1636255
2011	24804130	11300133	6614619	3668813	2446251	1243695	721030	604732	1409145
2012	23680038	9206738	5974199	4889534	2676535	1712527	812801	479820	1167161
2013	32906186	8777507	4485630	4117034	3384893	1960185	1172057	505208	1021232
2014	46804732	14257942	5395495	3118948	3216947	2280079	1237811	686807	763555
2015	13300233	18753339	9660994	3075412	1962960	2092379	1375524	719620	818294
2016	22681856	5056940	11936109	6926735	1935906	1224160	1179266	710993	737836
2017	13952021	8682592	2592439	8307136	4884893	1298831	629779	566556	621861
2018	24172777	5544475	4256154	1971815	5818890	3367895	824952	411643	712687
2019	21678404	9964093	2360141	2763059	1463386	3595230	2034791	445844	582169
2020	25571817	9084027	5835639	1646848	1906961	1082360	2184635	1100365	526074
2021	17223642	11134766	4896007	3062489	1139964	1261075	731259	1250398	906435
2022	31077671	6013021	6791340	3383565	2099472	775725	831622	454891	1181007
2023	30861278	13608120	3439308	4192887	1956564	1221113	449524	473508	866418

Table 2.6.3.4 North Sea herring multi fleet assessment. Harvest at age fleet A.

Year	0	1	2	3	4	5	6	7	8
1947	0	0.0001263	0.04439	0.1055	0.1202	0.1547	0.2426	0.2748	0.2748
1948	0	0.000107	0.04086	0.1004	0.1164	0.1482	0.2153	0.2465	0.2465
1949	0	0.0001828	0.05123	0.119	0.1368	0.1711	0.2686	0.3169	0.3169
1950	0	0.0003139	0.06454	0.1369	0.1505	0.1714	0.2292	0.2526	0.2526
1951	0	0.0007193	0.09364	0.1808	0.1906	0.1997	0.2375	0.2431	0.2431
1952	0	0.001111	0.1125	0.1959	0.2018	0.2165	0.2825	0.3183	0.3183
1953	0	0.001636	0.1321	0.2142	0.2071	0.2187	0.2739	0.3057	0.3057
1954	0	0.002885	0.1694	0.261	0.2416	0.256	0.3496	0.3853	0.3853
1955	0	0.002984	0.168	0.2391	0.2097	0.2144	0.2383	0.2318	0.2318
1956	0	0.003978	0.1886	0.2504	0.2124	0.2143	0.2288	0.237	0.237
1957	0	0.005121	0.2081	0.2707	0.231	0.2396	0.2629	0.2674	0.2674
1958	0	0.005287	0.2068	0.2589	0.2124	0.2107	0.1855	0.1716	0.1716
1959	0	0.007414	0.2383	0.2963	0.2517	0.2524	0.275	0.2855	0.2855
1960	0	0.005166	0.196	0.2388	0.2043	0.2075	0.2244	0.2586	0.2586
1961	0	0.006324	0.212	0.2644	0.2289	0.2247	0.2265	0.23	0.23
1962	0	0.008144	0.2348	0.3212	0.2897	0.2939	0.3415	0.3416	0.3416
1963	0	0.003907	0.1613	0.2038	0.1712	0.1668	0.1229	0.1367	0.1367
1964	0	0.009683	0.2454	0.3108	0.2648	0.2549	0.2034	0.2077	0.2077
1965	0	0.03578	0.4541	0.5848	0.5059	0.4889	0.4913	0.5129	0.5129
1966	0	0.03169	0.4212	0.553	0.4809	0.4785	0.4231	0.5023	0.5023
1967	0	0.05278	0.5313	0.7392	0.6623	0.6775	0.7858	0.9314	0.9314
1968	0	0.1595	0.9008	1.218	0.9828	0.9381	1.202	1.227	1.227
1969	0	0.09523	0.6861	0.9252	0.8219	0.8411	1.185	1.059	1.059
1970	0	0.1118	0.7267	0.9767	0.8747	0.8486	1.191	0.9184	0.9184
1971	0	0.1585	0.8338	1.138	1.094	1.182	2.78	1.754	1.754
1972	0	0.06406	0.5252	0.6504	0.5504	0.5209	0.5047	0.3154	0.3154
1973	0	0.1547	0.7879	0.9986	0.8467	0.8467	1.02	0.7116	0.7116
1974	0	0.1457	0.7537	0.952	0.8327	0.8796	0.9253	0.8313	0.8313
1975	0	0.247	0.96	1.273	1.105	1.19	1.321	1.576	1.576
1976	0	0.1273	0.689	0.9845	0.8428	0.8799	0.8124	1.082	1.082
1977	0	0.01454	0.237	0.3706	0.3258	0.373	0.251	0.3891	0.3891
1978	0	0.008424	0.1795	0.2646	0.2279	0.2464	0.1288	0.21	0.21
1979	0	0.006851	0.1603	0.2254	0.1846	0.1861	0.0785	0.13	0.13
1980	0	0.006458	0.154	0.2076	0.1624	0.149	0.0518	0.08427	0.08427
1981	0	0.01054	0.1924	0.2757	0.251	0.2623	0.2006	0.3439	0.3439
1982	0	0.006445	0.1499	0.2148	0.1877	0.1734	0.1004	0.1469	0.1469
1983	0	0.01019	0.1851	0.2737	0.2724	0.2708	0.233	0.3222	0.3222
1984	0	0.0157	0.2257	0.3435	0.3698	0.372	0.3722	0.4842	0.4842
1985	0	0.02578	0.2835	0.4295	0.47	0.4613	0.5082	0.5898	0.5898
1986	0	0.02289	0.266	0.3859	0.4322	0.4383	0.5045	0.5792	0.5792
1987	0	0.01924	0.2432	0.3404	0.3915	0.402	0.4276	0.454	0.454
1988	0	0.01677	0.2266	0.3117	0.372	0.3937	0.4285	0.4634	0.4634
1989	0	0.0171	0.2281	0.3047	0.3608	0.3748	0.3939	0.4201	0.4201
1990	0	0.01321	0.2012	0.2578	0.2942	0.2999	0.2795	0.3045	0.3045
1991	0	0.01805	0.2342	0.29	0.3088	0.2961	0.2678	0.2595	0.2595
1992	0	0.02508	0.2746	0.3495	0.372	0.3515	0.3655	0.3569	0.3569
1993	0	0.03578	0.3265	0.4381	0.4587	0.4073	0.4379	0.4181	0.4181
1994	0	0.03395	0.3198	0.4615	0.4796	0.4002	0.3905	0.3411	0.3411
1995	0	0.0222	0.2588	0.4086	0.4318	0.3894	0.3956	0.3299	0.3299
1996	0	0.004572	0.1196	0.1974	0.2083	0.1978	0.1467	0.1123	0.1123
1997	0	0.003259	0.1011	0.1754	0.1886	0.1832	0.1402	0.1077	0.1077
1998	0	0.005428	0.1259	0.222	0.2381	0.236	0.211	0.1387	0.1387
1999	0	0.005196	0.1155	0.2133	0.2278	0.2234	0.1829	0.1143	0.1143
2000	0	0.004942	0.106	0.2028	0.2305	0.2318	0.19	0.1238	0.1238
2001	0	0.003221	0.08161	0.1637	0.2016	0.2202	0.1939	0.1604	0.1604
2002	0	0.002514	0.06852	0.1404	0.1839	0.2103	0.1912	0.167	0.167
2003	0	0.002641	0.06744	0.1441	0.2035	0.2499	0.2454	0.2113	0.2113
2004	0	0.002135	0.06052	0.1397	0.2164	0.29	0.3557	0.3198	0.3198
2005	0	0.00364	0.07347	0.1638	0.2577	0.3492	0.5108	0.5369	0.5369
2006	0	0.004445	0.07757	0.1628	0.2452	0.3184	0.4352	0.4961	0.4961
2007	0	0.00466	0.07455	0.1502	0.2177	0.2754	0.3567	0.4248	0.4248
2008	0	0.004325	0.06691	0.1111	0.1463	0.1758	0.1717	0.2148	0.2148
2009	0	0.002147	0.04632	0.06822	0.08584	0.1031	0.07622	0.1028	0.1028
2010	0	0.002424	0.04848	0.07285	0.08683	0.1012	0.07178	0.08542	0.08542
2011	0	0.002954	0.05436	0.08945	0.1095	0.1281	0.1006	0.1107	0.1107
2012	0	0.006801	0.08007	0.1457	0.1856	0.2194	0.2361	0.2558	0.2558
2013	0	0.006259	0.07537	0.15	0.2099	0.2643	0.3393	0.3926	0.3926
2014	0	0.004657	0.0687	0.144	0.2081	0.2619	0.3222	0.3899	0.3899
2015	0	0.002388	0.05432	0.1232	0.193	0.2694	0.3939	0.5383	0.5383
2016	0	0.002021	0.05371	0.135	0.2104	0.29	0.4447	0.6507	0.6507
2017	0	0.001393	0.04564	0.1228	0.1888	0.2428	0.3129	0.4556	0.4556
2018	0	0.00176	0.05247	0.1373	0.2135	0.2777	0.381	0.5466	0.5466
2019	0	0.001435	0.0491	0.1218	0.1771	0.234	0.317	0.47	0.47
2020	0	0.003909	0.08063	0.1631	0.198	0.2292	0.2902	0.4362	0.4362
2021	0	0.004445	0.09035	0.1722	0.1982	0.2227	0.2391	0.3553	0.3553
2022	0	0.009723	0.1313	0.2311	0.248	0.2619	0.2918	0.3695	0.3695
2023	0	0.009717	0.1313	0.231	0.248	0.2618	0.2917	0.3694	0.3694

Table 2.6.3.5 North Sea herring multi fleet assessment. Harvest at age combined fleet B-D.

Year	0	1	2	3	4	5	6	7	8
1947	0.003506	6.666e-05	2.801e-05	0	0	0	0	0	0
1948	0.003446	6.45e-05	2.721e-05	0	0	0	0	0	0
1949	0.003826	7.863e-05	3.24e-05	0	0	0	0	0	0
1950	0.004209	9.423e-05	3.802e-05	0	0	0	0	0	0
1951	0.004619	0.0001124	4.442e-05	0	0	0	0	0	0
1952	0.005063	0.0001337	5.178e-05	0	0	0	0	0	0
1953	0.005543	0.0001588	6.027e-05	0	0	0	0	0	0
1954	0.006305	0.0001994	7.368e-05	0	0	0	0	0	0
1955	0.006477	0.0002155	7.89e-05	0	0	0	0	0	0
1956	0.006539	0.000227	8.26e-05	0	0	0	0	0	0
1957	0.007167	0.0002698	9.62e-05	0	0	0	0	0	0
1958	0.008159	0.0003391	0.0001177	0	0	0	0	0	0
1959	0.01097	0.0005447	0.0001787	0	0	0	0	0	0
1960	0.01479	0.0008781	0.0002723	0	0	0	0	0	0
1961	0.01699	0.001117	0.0003366	0	0	0	0	0	0
1962	0.01496	0.0009606	0.0002944	0	0	0	0	0	0
1963	0.01757	0.001264	0.0003751	0	0	0	0	0	0
1964	0.01931	0.001507	0.0004378	0	0	0	0	0	0
1965	0.02046	0.0017	0.0004869	0	0	0	0	0	0
1966	0.02626	0.002544	0.0006945	0	0	0	0	0	0
1967	0.03162	0.003465	0.0009113	0	0	0	0	0	0
1968	0.03502	0.004165	0.001072	0	0	0	0	0	0
1969	0.03292	0.003933	0.001019	0	0	0	0	0	0
1970	0.0452	0.006484	0.001583	0	0	0	0	0	0
1971	0.05605	0.009205	0.002156	0	0	0	0	0	0
1972	0.07074	0.01339	0.003001	0	0	0	0	0	0
1973	0.08206	0.01716	0.00373	0	0	0	0	0	0
1974	0.1043	0.02509	0.005206	0	0	0	0	0	0
1975	0.1209	0.03192	0.006419	0	0	0	0	0	0
1976	0.1195	0.032	0.0064	0	0	0	0	0	0
1977	0.1256	0.03508	0.006885	0	0	0	0	0	0
1978	0.1516	0.04767	0.009243	0	0	0	0	0	0
1979	0.1768	0.06139	0.01183	0	0	0	0	0	0
1980	0.2048	0.07769	0.01492	0	0	0	0	0	0
1981	0.3007	0.1469	0.02583	0	0	0	0	0	0
1982	0.2999	0.1519	0.02685	0	0	0	0	0	0
1983	0.289	0.1551	0.02794	0	0	0	0	0	0
1984	0.2214	0.1148	0.02208	0	0	0	0	0	0
1985	0.1755	0.09365	0.01934	0	0	0	0	0	0
1986	0.1526	0.08485	0.01871	0	0	0	0	0	0
1987	0.1688	0.1085	0.02446	0	0	0	0	0	0
1988	0.161	0.1101	0.02593	0	0	0	0	0	0
1989	0.1583	0.1151	0.02858	0	0	0	0	0	0
1990	0.1469	0.1093	0.02911	0	0	0	0	0	0
1991	0.1725	0.1442	0.04015	0	0	0	0	0	0
1992	0.2154	0.2058	0.05659	0	0	0	0	0	0
1993	0.2192	0.2153	0.06009	0	0	0	0	0	0
1994	0.1681	0.1431	0.04214	0	0	0	0	0	0
1995	0.1429	0.1182	0.03512	0	0	0	0	0	0
1996	0.09484	0.06951	0.02185	0	0	0	0	0	0
1997	0.05509	0.03242	0.01147	0	0	0	0	0	0
1998	0.04565	0.02595	0.009194	0	0	0	0	0	0
1999	0.04155	0.02153	0.007748	0	0	0	0	0	0
2000	0.04143	0.02127	0.00746	0	0	0	0	0	0
2001	0.03035	0.01173	0.00438	0	0	0	0	0	0
2002	0.04163	0.02225	0.007903	0	0	0	0	0	0
2003	0.04746	0.02883	0.009468	0	0	0	0	0	0
2004	0.0554	0.0364	0.01138	0	0	0	0	0	0
2005	0.06522	0.04509	0.01299	0	0	0	0	0	0
2006	0.05103	0.02666	0.007573	0	0	0	0	0	0
2007	0.04108	0.01732	0.004826	0	0	0	0	0	0
2008	0.04106	0.01666	0.004136	0	0	0	0	0	0
2009	0.03771	0.01407	0.003026	0	0	0	0	0	0
2010	0.03634	0.01237	0.002284	0	0	0	0	0	0
2011	0.03677	0.01186	0.001855	0	0	0	0	0	0
2012	0.04748	0.01898	0.003044	0	0	0	0	0	0
2013	0.04913	0.02026	0.003489	0	0	0	0	0	0
2014	0.05277	0.02019	0.003205	0	0	0	0	0	0
2015	0.06007	0.0216	0.002966	0	0	0	0	0	0
2016	0.0686	0.02355	0.002864	0	0	0	0	0	0
2017	0.063	0.01824	0.002042	0	0	0	0	0	0
2018	0.05153	0.01097	0.001072	0	0	0	0	0	0
2019	0.04063	0.00665	0.0006133	0	0	0	0	0	0
2020	0.0441	0.007269	0.00072	0	0	0	0	0	0
2021	0.05022	0.01023	0.0009639	0	0	0	0	0	0
2022	0.05659	0.01411	0.001262	0	0	0	0	0	0
2023	0.05657	0.0141	0.001262	0	0	0	0	0	0

Table 2.6.3.6 North Sea herring multi fleet assessment. Harvest at age fleet C.

Year	0	1	2	3	4	5	6	7	8
1947	0	0.0002427	0.001588	0.0001085	0.0004687	0.0004687	0.0004687	0	0
1948	0	0.0002351	0.001541	0.0001042	0.0004536	0.0004536	0.0004536	0	0
1949	0	0.0009431	0.003465	0.0003104	0.001107	0.001107	0.001107	0	0
1950	0	0.00432	0.008554	0.00105	0.003005	0.003005	0.003005	0	0
1951	0	0.02176	0.02266	0.003898	0.008808	0.008808	0.008808	0	0
1952	0	0.04658	0.03536	0.006417	0.01197	0.01197	0.01197	0	0
1953	0	0.07012	0.04407	0.008203	0.01335	0.01335	0.01335	0	0
1954	0	0.09087	0.05068	0.009435	0.01376	0.01376	0.01376	0	0
1955	0	0.1434	0.06888	0.01375	0.01782	0.01782	0.01782	0	0
1956	0	0.1568	0.07622	0.01411	0.01608	0.01608	0.01608	0	0
1957	0	0.1741	0.07907	0.01452	0.0161	0.0161	0.0161	0	0
1958	0	0.1609	0.07997	0.01485	0.01608	0.01608	0.01608	0	0
1959	0	0.1901	0.08724	0.01516	0.01496	0.01496	0.01496	0	0
1960	0	0.1875	0.08518	0.01295	0.01148	0.01148	0.01148	0	0
1961	0	0.1714	0.08414	0.01326	0.01194	0.01194	0.01194	0	0
1962	0	0.1012	0.05207	0.007253	0.007146	0.007146	0.007146	0	0
1963	0	0.135	0.05791	0.008006	0.007073	0.007073	0.007073	0	0
1964	0	0.2395	0.07845	0.01314	0.01141	0.01141	0.01141	0	0
1965	0	0.2375	0.07743	0.01362	0.01203	0.01203	0.01203	0	0
1966	0	0.2229	0.06886	0.01182	0.01048	0.01048	0.01048	0	0
1967	0	0.2425	0.06659	0.0117	0.01037	0.01037	0.01037	0	0
1968	0	0.2383	0.06693	0.01214	0.01045	0.01045	0.01045	0	0
1969	0	0.2511	0.06602	0.01212	0.01035	0.01035	0.01035	0	0
1970	0	0.2569	0.06566	0.01243	0.01038	0.01038	0.01038	0	0
1971	0	0.3947	0.08052	0.0166	0.01282	0.01282	0.01282	0	0
1972	0	0.5193	0.09655	0.02218	0.01604	0.01604	0.01604	0	0
1973	0	0.5244	0.09347	0.02236	0.01619	0.01619	0.01619	0	0
1974	0	0.3914	0.07477	0.01683	0.01276	0.01276	0.01276	0	0
1975	0	0.2548	0.05445	0.01129	0.008963	0.008963	0.008963	0	0
1976	0	0.1429	0.03543	0.006519	0.005552	0.005552	0.005552	0	0
1977	0	0.07771	0.02195	0.00349	0.003216	0.003216	0.003216	0	0
1978	0	0.06279	0.01951	0.003	0.002761	0.002761	0.002761	0	0
1979	0	0.05738	0.01862	0.002835	0.002534	0.002534	0.002534	0	0
1980	0	0.05114	0.01752	0.002616	0.002276	0.002276	0.002276	0	0
1981	0	0.068	0.02005	0.003362	0.002988	0.002988	0.002988	0	0
1982	0	0.07486	0.02127	0.003999	0.003635	0.003635	0.003635	0	0
1983	0	0.0886	0.0236	0.005035	0.004855	0.004855	0.004855	0	0
1984	0	0.105	0.02637	0.006417	0.006459	0.006459	0.006459	0	0
1985	0	0.1862	0.03803	0.0114	0.01102	0.01102	0.01102	0	0
1986	0	0.2054	0.04148	0.01312	0.01267	0.01267	0.01267	0	0
1987	0	0.2531	0.04843	0.01676	0.01616	0.01616	0.01616	0	0
1988	0	0.3339	0.05723	0.02116	0.0196	0.0196	0.0196	0	0
1989	0	0.2837	0.05569	0.02086	0.0188	0.0188	0.0188	0	0
1990	0	0.2397	0.05459	0.02023	0.01679	0.01679	0.01679	0	0
1991	0	0.1776	0.05423	0.0218	0.01687	0.01687	0.01687	0	0
1992	0	0.1478	0.05206	0.02235	0.01634	0.01634	0.01634	0	0
1993	0	0.1217	0.04977	0.02398	0.01647	0.01647	0.01647	0	0
1994	0	0.07712	0.04016	0.02088	0.01418	0.01418	0.01418	0	0
1995	0	0.06875	0.03783	0.02204	0.01421	0.01421	0.01421	0	0
1996	0	0.06087	0.03477	0.02124	0.01281	0.01281	0.01281	0	0
1997	0	0.04118	0.02945	0.01789	0.01021	0.01021	0.01021	0	0
1998	0	0.04676	0.02849	0.0141	0.008171	0.008171	0.008171	0	0
1999	0	0.03511	0.0261	0.01198	0.006798	0.006798	0.006798	0	0
2000	0	0.03418	0.02576	0.01074	0.005789	0.005789	0.005789	0	0
2001	0	0.02115	0.01587	0.003149	0.0009853	0.0009853	0.0009853	0	0
2002	0	0.008822	0.008746	0.0009943	0.0003716	0.0003716	0.0003716	0	0
2003	0	0.01381	0.01537	0.003182	0.002013	0.002013	0.002013	0	0
2004	0	0.009437	0.01486	0.002709	0.00207	0.00207	0.00207	0	0
2005	0	0.02048	0.02238	0.00361	0.001564	0.001564	0.001564	0	0
2006	0	0.01878	0.01795	0.002327	0.0008255	0.0008255	0.0008255	0	0
2007	0	0.01907	0.01548	0.0012	0.0003534	0.0003534	0.0003534	0	0
2008	0	0.01099	0.009976	0.0005904	0.000168	0.000168	0.000168	0	0
2009	0	0.005809	0.005299	0.0002223	9.288e-05	9.288e-05	9.288e-05	0	0
2010	0	0.006637	0.006258	0.0002147	7.302e-05	7.302e-05	7.302e-05	0	0
2011	0	0.00538	0.007986	0.0004994	0.0001627	0.0001627	0.0001627	0	0
2012	0	0.00761	0.009996	0.0007136	0.0002349	0.0002349	0.0002349	0	0
2013	0	0.007761	0.01126	0.0008549	0.0002053	0.0002053	0.0002053	0	0
2014	0	0.005568	0.01067	0.001226	0.000295	0.000295	0.000295	0	0
2015	0	0.005255	0.01149	0.002339	0.0008804	0.0008804	0.0008804	0	0
2016	0	0.003348	0.007032	0.0009424	0.0003172	0.0003172	0.0003172	0	0
2017	0	0.007062	0.01088	0.001527	0.0004604	0.0004604	0.0004604	0	0
2018	0	0.005088	0.008928	0.001126	0.0002837	0.0002837	0.0002837	0	0
2019	0	0.005346	0.009009	0.001008	0.0001304	0.0001304	0.0001304	0	0
2020	0	0.003404	0.009675	0.002155	0.0005325	0.0005325	0.0005325	0	0
2021	0	0.00116	0.005965	0.001431	0.0007752	0.0007752	0.0007752	0	0
2022	0	6.45e-05	0.000946	0.0001086	0.0001083	0.0001083	0.0001083	0	0
2023	0	6.45e-05	0.000946	0.0001086	0.0001083	0.0001083	0.0001083	0	0

Table 2.6.3.7 North Sea herring multi fleet assessment. Assessment summary.

Year	Rec	Rec_lo	Rec_hi	TSB	TSB_lo	TSB_hi	SSB	SSB_lo	SSB_hi	Catch	Catch_lo	Catch_hi	Fbar	Fbar_lo	Fbar_hi	Landings
1947	38197927	22290221	65458374	8034897	6296349	10253491	4899103	3648033	6579220	852432	727307	999083	0.1341	0.09737	0.1847	581760
1948	34933781	21421026	56970616	7001338	5523445	8874667	4104753	3082907	5465296	661917	572286	765585	0.1248	0.09173	0.1699	502100
1949	29878200	18468536	48336633	6611595	5269343	8295758	3854908	2930988	5070072	727966	629704	841561	0.1508	0.1117	0.2036	508500
1950	40090649	25038849	64190654	6356589	5121550	7889453	3705057	2859801	4800141	647341	568034	737721	0.1542	0.1163	0.2046	491700
1951	38623757	24376187	61198850	6291123	5127981	7718092	3387421	2640911	4344949	748816	657942	852240	0.191	0.1462	0.2496	600400
1952	38964890	24769335	61296059	6110247	4998387	7469433	3238549	2527921	4148943	835297	736586	947236	0.2174	0.1666	0.2837	664400
1953	42922409	27904152	66023621	5905796	4845015	7198828	3025144	2357292	3882207	833875	732606	949142	0.2277	0.1747	0.2967	698500
1954	38548856	25138435	59113239	5749318	4724798	6995993	2777460	2143930	3598198	947785	828607	1084106	0.2758	0.2105	0.3615	762900
1955	34863082	22900348	53074936	5483668	4498347	6684815	2807308	2172802	3627104	845290	718506	994446	0.2411	0.184	0.3161	806400
1956	26292124	17217892	40148688	5067191	4173473	6152294	2627430	2041990	3380717	833188	710745	976725	0.2466	0.1886	0.3225	675200
1957	61098438	39548353	94391268	5024432	4146796	6087812	2387840	1851868	3078933	804427	692091	934996	0.2709	0.2081	0.3526	682900
1958	26427650	17379874	40185601	5017311	4113817	6119235	2023479	1570565	2607002	745896	594926	935176	0.2435	0.1876	0.316	670500
1959	27447382	17323329	43488106	5584229	4583571	6803344	2980596	2309205	3847190	1131372	925090	1383652	0.2922	0.2251	0.3794	784500
1960	13060781	8394726	20320378	4723706	3905200	5713765	2612996	2037095	3351708	805883	679040	956420	0.2408	0.1867	0.3104	696200
1961	53135861	34406688	82060200	4787085	3994558	5736850	2548959	2023484	3210894	722496	612181	852689	0.258	0.2022	0.3294	696700
1962	28741141	19114042	43217086	4506788	3771016	5386118	1782993	1403816	2264587	711510	601223	842027	0.3124	0.2477	0.3941	627800
1963	30866220	20699327	46026790	5200371	4337355	6235103	2861440	2283979	3584901	592984	484099	726360	0.1827	0.147	0.2271	716000
1964	33675086	22588478	50203090	5128420	4440676	5922678	2595917	2154631	3127584	904084	755922	1081287	0.2811	0.2328	0.3395	871200
1965	18371597	12348602	27332292	4552374	4020000	5155251	1953934	1652422	2310461	1277858	1096903	1488665	0.5305	0.4468	0.6299	1168800
1966	17830172	12023307	26441563	3449638	3051734	3899422	1589454	1350279	1870993	923567	800944	1064962	0.4939	0.4188	0.5825	895500
1967	23864634	16012493	35567276	2666529	2372930	2996455	960748	823851	1120393	855839	743320	985389	0.7013	0.6032	0.8153	695500
1968	22813125	15368327	33864368	2204184	1927391	2520727	517845	442744	605685	828357	700269	979873	1.071	0.9381	1.222	717800
1969	13368585	8925614	20023168	1721258	1477736	2004910	465516	380660	569287	542279	444041	662250	0.9139	0.7951	1.051	546700
1970	21897578	14541840	32974090	1658412	1427061	1927269	458385	373524	562527	529832	442872	633866	0.9457	0.8252	1.084	563100
1971	18626897	12270474	28276110	1510840	1273806	1791982	288045	237056	350002	542112	428167	686380	1.433	1.266	1.622	520100
1972	12798736	8426899	19438662	1357012	1143024	1611062	342103	279836	418226	411840	308804	549255	0.5843	0.4998	0.6831	497500
1973	7149343	4744947	10772115	1118072	963306	1297703	282555	234943	339817	450670	365282	556019	0.9335	0.8143	1.07	484000
1974	10039938	6568380	15346305	771543	666023	893781	192262	160920	229709	273958	228583	328340	0.8957	0.7787	1.03	275100
1975	2704422	1775554	4119222	587169	490511	702874	104971	86732	127046	243113	191752	308232	1.19	1.025	1.381	312800
1976	3487261	2230808	5451384	448730	371319	542279	140977	105949	187586	151594	124793	184152	0.8547	0.6697	1.091	174800
1977	4046796	2563529	6388286	321850	257662	402028	113105	82175	155678	53681	44584	64633	0.3199	0.2332	0.4387	46000
1978	4656229	2919232	7426772	383589	301580	487898	143074	106784	191697	49035	32147	74796	0.2174	0.1336	0.354	11000
1979	8559482	5563545	13168715	506146	408958	626430	186906	145413	240238	61722	40896	93153	0.1752	0.1072	0.2863	25100
1980	13221185	8993259	19436751	690706	571941	834133	218157	175336	271436	81451	63128	105091	0.1534	0.1205	0.1951	70764
1981	26064880	17666667	38455356	1102425	909512	1336257	285288	229988	353886	139511	109581	177615	0.248	0.1981	0.3107	174879
1982	44214530	30061343	65031184	1703246	1398864	2073859	408535	332859	501415	230246	168012	315532	0.1778	0.1438	0.22	275079
1983	43417286	30149787	62523186	2311844	1940981	2753567	570126	468535	693745	362278	276098	475356	0.2612	0.2147	0.3178	387202
1984	45202724	31622388	64615177	3067968	2626583	3583526	895110	735136	1089897	464611	384141	561937	0.3515	0.2922	0.4229	428631
1985	57387293	40048780	82232252	3530626	3044841	4093915	964491	801919	1160021	624116	531577	732764	0.4509	0.376	0.5407	613780
1986	70354209	48975641	101064828	4017615	3446204	4683771	1005533	840566	1202877	744647	595541	931085	0.4276	0.3561	0.5135	671488
1987	58504757	40780529	83932373	3981166	3439738	4607817	1213457	1014004	1452143	757712	619514	926739	0.3886	0.3244	0.4654	792058
1988	38457571	26842187	55099263	3901431	3404785	4470521	1564139	1311992	1864744	934304	754164	1157473	0.3791	0.3183	0.4515	887686
1989	29986887	20981039	42858384	3489774	3100760	3927594	1608047	1384327	1867922	813006	692481	954508	0.3648	0.3086	0.4312	787899
1990	28067349	19648947	40092535	3464410	3084180	3891515	1724688	1489799	1996611	676926	579439	790814	0.2974	0.2505	0.3531	645229
1991	29743046	20867426	42393766	3290550	2933531	3691019	1530703	1327500	1765011	678150	583337	788374	0.3127	0.2631	0.3718	658008
1992	49471609	35712524	68531704	3242668	2882143	3648292	1164147	1006226	1346851	686332	590992	797051	0.3786	0.3191	0.4493	716799
1993	51161183	36612485	71491095	2998495	2635642	3411302	821854	702246	961834	664956	569295	776691	0.4503	0.3781	0.5364	671397
1994	41358269	29596119	57794957	2916317	2529679	3362051	889508	758185	1043577	640183	537208	762897	0.4395	0.3679	0.525	568234
1995	41230862	29429656	57764317	2798034	2423879	3229944	933010	788052	1104631	572251	490903	667081	0.4044	0.3352	0.4878	579371
1996	33551944	24194371	46528713	2753882	2381715	3184205	1099387	930557	1298848	284036	243770	330953	0.1972	0.1621	0.24	275098
1997	27887113	20045424	38796440	2756877	2401794	3164456	1233691	1052083	1446647	265295	231140	304497	0.1756	0.145	0.2126	248023
1998	19347856	14101311	26546435	3052974	2675684	3483463	1408671	1211785	1637547	368039	320559	422551	0.2219	0.1838	0.2677	385577
1999	53808573	39239721	73786522	3131498	2755999	3558159	1507586	1296606	1752896	351524	306620	403003	0.2058	0.1712	0.2474	370877
2000	38547655	28211338	52671083	3737198	3266186	4276133	1543229	1329211	1791706	366240	320484	418529	0.2045	0.1699	0.2461	382794
2001	67519175	48821895	93376937	4178532	3654097	4778234	1930621	1663850	2240165	352723	309970	401374	0.1775	0.1472	0.214	358657
2002	35428470	25883559	48493194	5004317	4362693	5740306	2365262	2038593	2744277	370568	324691	422927	0.1626	0.135	0.1959	371955
2003	19130795	1.4e+07	26134193	5354304	4683599	6121056	2382492	2066349	2747003	476090	418812	541201	0.1889	0.1574	0.2267	480107
2004	23222546	16990702	31740104	4659203	4113607	5277163	2371021	2060926	2727775	552168	485626	627829	0.2195	0.1823	0.2643	570865

2005	20239769	14866839	27554494	3901199	3465642	4391497	2143504	1854310	2477799	653245	574146	743242	0.2797	0.2334	0.3353	666404
2006	21168571	15496944	28915918	3270615	2905884	3681124	1728072	1496200	1995877	514904	453671	584402	0.2539	0.2116	0.3047	524366
2007	24926578	18148081	34236912	2727715	2416379	3079165	1373153	1185796	1590114	385872	339938	438013	0.2194	0.1823	0.2641	408528
2008	22857234	16600099	31472892	2768730	2431914	3152195	1449870	1252177	1678774	251905	223312	284160	0.1374	0.1141	0.1655	259031
2009	34427466	25068755	47279987	3195256	2793518	3654769	1767489	1524041	2049825	172375	152645	194655	0.0777	0.0642	0.09404	172685
2010	28284153	20654624	38731922	3777977	3307389	4315523	1848853	1592262	2146792	178887	158512	201881	0.07803	0.06468	0.09414	187508
2011	24804130	18156267	33886088	3840375	3387223	4354152	2242477	1954046	2573482	222920	197353	251800	0.09858	0.08216	0.1183	224148
2012	23680038	17302246	32408751	3799456	3371223	4282084	2315696	2020289	2654298	417562	369534	471833	0.1762	0.1472	0.211	437236
2013	32906186	23914029	45279576	3686035	3283523	4137888	2103198	1837057	2407896	494334	438097	557791	0.211	0.1765	0.2522	511733
2014	46804732	33806903	64799871	3912295	3477873	4400980	2068339	1805659	2369232	492385	436956	554846	0.2042	0.1706	0.2443	517593
2015	13300233	9639245	18351664	4121335	3632454	4676013	1963949	1711503	2253632	483942	428912	546033	0.2107	0.1755	0.2528	494072
2016	22681856	16576092	31036664	4113554	3613087	4683344	2275739	1969702	2629325	541156	479227	611088	0.2291	0.1904	0.2757	564880
2017	13952021	10143527	19190453	3566742	3139124	4052612	2109847	1818123	2448380	446797	391768	509557	0.1858	0.1547	0.2231	499145
2018	24172777	17629825	33144011	3333144	2946739	3770219	1855787	1597714	2155546	530445	462625	608206	0.2148	0.179	0.2578	604449
2019	21678404	15777301	29786667	2856438	2530060	3224920	1584861	1368585	1835314	418402	365765	478613	0.182	0.1511	0.2193	451542
2020	25571817	18512155	35323703	2834104	2503448	3208434	1535359	1325882	1777932	408261	358776	464572	0.1951	0.1621	0.2347	434000
2021	17223642	12095937	24525081	2766752	2424741	3157004	1459950	1252989	1701096	358702	315845	407375	0.1867	0.1542	0.2259	373167
2022	31077671	20751960	46541225	2996059	2576018	3484590	1591864	1331754	1902777	440436	386742	501585	0.2333	0.1878	0.2899	462596
2023	30861278	16414816	58021878	2946475	2378506	3650069	1404532	1061059	1859189	394927	213998	728827	0.2333	0.1145	0.4752	.

Table 2.6.3.8 North Sea herring multi fleet assessment. SAM model control object.

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

Slot "desc":
[1] "Imported from a VPA file. ( ./bootstrap/data/index.txt ).  Mon Mar 20 08:09:58 2023"

Slot "range":
      min       max plusgroup   minyear   maxyear   minfbar   maxfbar
        0         8         8      1947      2023         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 -1 -1 -1 -1 -1 -1
  catch C  -1 10 11 12 13 13 13 -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  1  1  2  2  2  2  2  2
  IBTS-Q1  -1  3 -1 -1 -1 -1 -1 -1 -1
  IBTS0     0 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3   4  5  6  7  8  9 -1 -1 -1
  LAI-ORSH 10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-BUN  10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-CNS  10 -1 -1 -1 -1 -1 -1 -1 -1
  LAI-SNS  10 -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
  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  1  1  1  1  2  2  2
  catch BD  3  4  4 -1 -1 -1 -1 -1 -1
```

```
  catch C  -1  5  6  7  7  7  7 -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  1  2  2
  catch BD  3  4  5 -1 -1 -1 -1 -1 -1
  catch C  -1  6  6  7  7  7  7 -1 -1
  HERAS    -1  8  9 10 11 11 11 12 12
  IBTS-Q1  -1 13 -1 -1 -1 -1 -1 -1 -1
  IBTS0    14 -1 -1 -1 -1 -1 -1 -1 -1
  IBTS-Q3  15 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

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] TRUE

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

Table 2.7.1. North Sea herring. Intermediate year (2023) assumptions for the stock.

Variable	Value	Notes
Fages (wr) 2–6 (2023)	0.238	Based on estimated catch 2022
SSB (2023)	1 480 607	Calculated based on catch constraint (in tonnes)
Rage (wr) 0 (2023)	31 349 395	Estimated by assessment model (in thousands)
Rage (wr) 0 (2024)	23 566 820	Weighted mean over 2012–2021 (in thousands)
Total catch (2023)	422 211	Estimated realized catch of autumn spawning herring derived from agreed TACs for A-D fleets, the proportion of NSAS herring in the catch (for A, C and D fleets), the transfer of TAC to the North Sea (C fleet) and the uptake of the by-catch quota (for B and D fleets).

Table 2.7.2. North Sea herring. Intermediate year (2023), fleet wise assumptions for the catches and the fishing mortality. Weights are in tonnes

	Field	Value	Note
TACs	A-fleet TAC	396 556	
	B-fleet TAC	7716	
	C-fleet TAC	23 250	Total TAC in IIIa (including WBSS and NSAS)
	D-fleet TAC	6 659	Total TAC in IIIa (including WBSS and NSAS)
TACs to catches variables	C-fleet transfer FcY	0.944	Taken from ImY as % of C-fleet TAC
	C-fleet transfer ImY	21 971	Value for the Intermediate year in tonnes
	D-fleet transfer	0.5	Value for the Intermediate year in %
	WBSS/NSAS split in the North Sea	0.0126	Value from terminal year
	B-fleet uptake	0.75	Average over the last 3 years (2019-2021)
	C-fleet NSAS/WBSS split	0.43	Average over the last 3 years (2019-2021)
	D-fleet NSAS/WBSS split	0.7	Average over the last 3 years (2019-2021)
	D-fleet uptake	0.038	Average over the last 3 years (2019-2021)
F by fleet and total	$F_{(wr)\ 2–6}$ A-fleet	0.237	
	$F_{(wr)\ 0–1}$ B-fleet	0.024	
	$F_{(wr)\ 1–3}$ C-fleet	0	
	$F_{(wr)\ 0–1}$ D-fleet	0.001	
	$F_{(wr)\ 2–6}$	0.238	

	$F_{(wr)\ 0–1}$	0.03	
NSAS catches by fleet	Catches A-fleet	413 245	Fleet TAC (396 556 t) + C-fleet TAC transfer to the North Sea (21 971 t), scaled by the 3-year average proportion of NSAS in A-fleet catch (98.7%, 2020-2022)
	Catches B-fleet	8279	Fleet TAC (7716 t) + D-fleet TAC transfer (50%) to the North Sea (3330 t), scaled with the fleet uptake in 2022 (75%)
	Catches C-fleet	331	Fleet catches in 3.a of 770 t (310 t agreed maximum Norwegian catch and 47.5% (proportion of C-fleet EU catches in the total EU catches in 3.a in 2022) of 969 t agreed maximum EU catch), scaled by the 3-year average proportion of NSAS in the C-fleet catch (43%, 2020-2022)
	Catches D-fleet	335	Fleet catches based on 52.5% (proportion of D-fleet catches in the total EU catches in 3.a in 2022) of 969 t agreed maximum EU catch, scaled by the 3-year average proportion of NSAS in the D-fleet catch (70%, 2020-2022)

Table 2.7.3. North Sea herring. reference points.

wg	fmsy	Fsq	Flim	Fpa	Blim	Bpa	msyBtrigger
IBPNSherring2023	0.31	.	0.4	0.31	874198	956483	1232828
WKPELA2018	0.26	.	0.34	0.3	8e+05	9e+05	1400000

Table 2.7.4. North Sea herring. All scenarios following WBSS TAC advice.

TACs to catches variables.

value	description	basis
0.945	C-fleet transfer forecast year	Value for the forecast year
21971	C-fleet transfer intermediate year	Value for the Intermediate year
0.5	D-fleet transfer intermediate year	Value for the Intermediate year
0.4303	C-fleet NSAS/WBSS split	Average over the last 3 years
0.6976	D-fleet NSAS/WBSS split	Average over the last 3 years
0.01262	WBSS/NSAS split in the north sea	Value from terminal year
0.7496	B-fleet uptake	Average over the last 3 years
0.03774	D-fleet uptake	Average over the last 3 years
0.4745	C-fleet share of EU in 3a	Average over the last 3 years
0.5255	D-fleet share of EU in 3a	Average over the last 3 years

Basis	Fbar26A	Fbar01B	Fbar13C	Fbar01D	Fbar26	Fbar01	CatchA	CatchB	CatchC	CatchD	SSB1	SSB2
intermediate year	0.2373	0.02412	0.0004108	0.001035	0.2378	0.03014	413245	8279	331.3	355.2	1480607	.
fmsyAR_transfer	0.3098	0.03149	1.807e-09	3.373e-07	0.31	0.03795	522833	9334	0.002367	0.1	1482555	1549993
fmsyAR_transfer_Btarget	0.3097	0.04354	1.807e-09	8.927e-09	0.31	0.05	522657	12838	0.002367	0.002632	1482489	1547420
fmsyAR_no_transfer	0.3098	0.03149	3.284e-08	8.879e-09	0.31	0.03795	522832	9334	0.04303	0.002632	1482555	1549993
fmsyAR_transfer_TACrule	0.3094	0.02953	0.0005326	1.176e-07	0.31	0.03604	522179	8762	697.6	0.03488	1482392	1549823
fmsyAR_transfer_TACrule_notransfer	0.3098	0.03149	4.108e-20	2.353e-07	0.31	0.03795	522832	9334	5.383e-14	0.06976	1482555	1549993
fmsyAR_no_transfer_Btarget	0.3097	0.04354	3.285e-08	8.927e-09	0.31	0.05	522657	12838	0.04303	0.002632	1482489	1547420
mpA	0.2297	0.0452	0	0	0.23	0.04999	401862	13345	0	0	1560589	1710328
mpAC	0.2297	0.0452	0	0	0.23	0.04999	401862	13345	0	0	1560589	1710328
mpAD	0.2297	0.0452	0	0	0.23	0.04999	401862	13345	0	0	1560589	1710328
mpB	0.2198	0.04534	0	0	0.2201	0.04993	386288	13388	0	0	1570565	1731995
fmsy	0.3098	0.03149	3.284e-08	8.879e-09	0.31	0.03795	522832	9334	0.04303	0.002632	1482555	1549993
nf	0	0	0	0	0	0	0	0	0	0	1812157	2329793
tacro	0.2262	0.023	3.206e-08	8.828e-09	0.2264	0.02772	396556	6857	0.04303	0.002632	1564316	1723062
-15%	0.189	0.01922	3.172e-08	8.805e-09	0.1892	0.02316	337073	5745	0.04303	0.002632	1602331	1807945
+15%	0.2648	0.02691	3.242e-08	8.852e-09	0.265	0.03244	456039	8004	0.04303	0.002632	1525984	1640331
fsq	0.2376	0.02415	3.217e-08	8.835e-09	0.2378	0.02911	414291	7195	0.04303	0.002632	1552921	1698171
fpa	0.3098	0.03149	3.284e-08	8.879e-09	0.31	0.03795	522832	9334	0.04303	0.002632	1482555	1549993

flim	0.3997	0.04063	3.369e-08	8.935e-09	0.4	0.04897	648316	11969	0.04303	0.002632	1399814	1387573
bpa	1.012	0.1028	3.968e-08	9.311e-09	1.013	0.124	1281303	29074	0.04303	0.002632	956483	711127
blim	1.161	0.118	4.119e-08	9.402e-09	1.161	0.1422	1391641	33025	0.04303	0.002632	874198	616998
MSYBtrigger	0.6008	0.06107	3.561e-08	9.059e-09	0.6012	0.07361	894497	17745	0.04303	0.002632	1232828	1096403

Table 2.7.5. North Sea herring. All scenarios with status quo in C-D fleet catches.

Basis	Fbar26A	Fbar01B	Fbar13C	Fbar01D	Fbar26	Fbar01	CatchA	CatchB	CatchC	CatchD	SSB1	SSB2
intermediate year	0.2373	0.02412	0.0004108	0.001035	0.2378	0.03014	413245	8279	331.3	355.2	1480607	.
fmsyAR_transfer	0.3183	0.04234	0.0004213	3.39e-07	0.3189	0.04902	534986	12489	550.4	0.1	1473968	1530359
fmsyAR_transfer_Btarget	0.3181	0.04437	0.0004214	0.000595	0.3188	0.05164	534809	13071	550.4	175.3	1474045	1529986
fmsyAR_no_transfer	0.3041	0.03091	0.007677	0.0005917	0.31	0.03851	513007	9157	10004	175.3	1480085	1541607
fmsyAR_no_transfer_Btarget	0.304	0.0424	0.007679	0.0005947	0.31	0.05	512838	12496	10004	175.3	1480024	1539182
mpA	0.2438	0.03372	0.0004124	0.00103	0.2443	0.03987	401820	13338	550.3	305.3	1546178	1681319
mpAC	0.2438	0.03372	0.0004124	0.00103	0.2443	0.03987	401820	13338	550.3	305.3	1546178	1681319
mpAD	0.2438	0.03372	0.0004124	0.00103	0.2443	0.03987	401820	13338	550.3	305.3	1546178	1681319
mpB	0.2337	0.03384	0.0004124	0.00103	0.2343	0.03978	386159	13388	551.9	305.4	1556239	1702904
fmsy	0.3041	0.03091	0.007677	0.0005917	0.31	0.03851	513007	9157	10004	175.3	1480085	1541607
nf	0	0	0	0	0	0	0	0	0	0	1812157	2329793
tacro	0.227	0.02307	0.007508	0.0005885	0.2327	0.02905	396556	6872	10004	175.3	1555602	1700867
-15%	0.1897	0.01928	0.007427	0.000587	0.1953	0.02446	337073	5757	10004	175.3	1593700	1785409
+15%	0.2657	0.027	0.007593	0.0005901	0.2715	0.0338	456039	8022	10004	175.3	1517185	1618484
fsq	0.232	0.02358	0.007519	0.0005887	0.2378	0.02967	404428	7022	10004	175.3	1550537	1689840
fpa	0.3041	0.03091	0.007677	0.0005917	0.31	0.03851	513007	9157	10004	175.3	1480085	1541607
flim	0.3939	0.04003	0.007876	0.0005954	0.4	0.04953	638516	11787	10004	175.3	1397246	1379183
bpa	0.9997	0.1016	0.009271	0.0006203	1.007	0.1239	1267111	28717	10004	175.3	956483	707361
blim	1.148	0.1166	0.009624	0.0006263	1.155	0.1421	1377288	32645	10004	175.3	874198	613333
MSYBtrigger	0.5911	0.06008	0.00832	0.0006035	0.5977	0.07374	880693	17450	10004	175.3	1232828	1092620

Table 2.7.6. North Sea herring. All scenarios with the implementation of the C fleet TAC rule for C fleet catches.

Basis	Fbar26A	Fbar01B	Fbar13C	Fbar01D	Fbar26	Fbar01	CatchA	CatchB	CatchC	CatchD	SSB1	SSB2
fmsyAR_transfer_TACrule	0.3093	0.04107	0.0005325	0.007896	0.31	0.05546	521896	12080	697.3	2323	1482286	1545680
fmsyAR_transfer_TACrule_notransfer	0.3022	0.03081	0.01004	0.01579	0.31	0.05377	509768	9064	13059	4645	1479260	1535900

Table 2.7.7. North Sea herring. Final scenario table.

Basis	Fbar26A	Fbar01B	Fbar13C	Fbar01D	Fbar26	Fbar01	CatchA	CatchB	CatchC	CatchD	total_catch	SSB1	SSB2	SSB_change	TAC_change	advice_change	
fmsyAR_no_transfer	0.31	0.031	0	0	0.31	0.038	522832	9334	0	0	532166	1482555	1549993	0.1	31.8	28.3	
fmsy	0.31	0.031	0	0	0.31	0.038	522832	9334	0	0	532166	1482555	1549993	0.1	31.8	28.3	
nf	0	0	0	0	0	0	0	0	0	0	0	1812157	2329793	22.4	-100	-100	
tacro	0.227	0.023	0.008	0.001	0.233	0.029	396556	6872	10004	175	413607	1555602	1700867	5.1	0	-0.3	
fsq	0.238	0.024	0	0	0.238	0.029	414291	7195	0	0	421486	1552921	1698171	4.9	4.5	1.6	
fpa	0.31	0.031	0	0	0.31	0.038	522832	9334	0	0	532166	1482555	1549993	0.1	31.8	28.3	
flim	0.4	0.041	0	0	0.4	0.049	648316	11969	0	0	660285	1399814	1387573	-5.5	63.5	59.1	
bpa	1.012	0.103	0	0	1.013	0.124	1281303	29074	0	0	1310377	956483	711127	-35.4	223.1	215.8	
blim	1.161	0.118	0	0	1.161	0.142	1391641	33025	0	0	1424666	874198	616998	-41	250.9	243.4	
MSYBtrigger	0.601	0.061	0	0	0.601	0.074	894497	17745	0	0	912242	1232828	1096403	-16.7	125.6	119.9	
fmsyAR_no_transfer_Btarget	0.31	0.044	0	0	0.31	0.05	522657	12838	0	0	535495	1482489	1547420	0.1	31.8	29.1	
fmsyAR_transfer_TACrule	0.309	0.041	0.001	0.008	0.31	0.055	521896	12080	697	2323	536996	1482286	1545680	0.1	31.6	29.4	
fmsyAR_transfer_TACrule_notransfer	0.302	0.031	0.01	0.016	0.31	0.054	509768	9064	13059	4645	536536	1479260	1535900	-0.1	28.5	29.3	

Table 2.9.1. North Sea herring. Old and new reference points following WKNSHERRING 2021.

Framework ^	Reference point	Old Value	Old Technical basis	Old Source	New value	New basis
MSY approach	MSY $B_{trigger}$	1 400 000	5th percentile of B_{FMSY}	ICES (2018b)	1 232 828	unchanged
	F_{MSY}	0.26	Stochastic simulations with a segmented regression and Ricker stock–recruitment curve from the short time-series (2002–2016).	ICES (2018b)	0.31	Same rationale with extended time series (2002–2020)
Precautionary approach	B_{lim}	800 000	Breakpoint in the segmented regression of the stock–recruitment time-series (1947–2016).	ICES (2018b)	874 198	Breakpoint in the segmented regression of the stock–recruitment time-series (1947–2020, excluding the recovery period 1979-1990).
	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 (2018b)	956 483	$B_{pa} = B_{lim} \times \exp(1.645 \times \sigma)$ with $\sigma \approx 0.06$, based on the σ from the terminal assessment year.
	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 (2018b)	0.39	The F that on average leads to Blim
	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 (2018b)	0.31	The F that provides a 95% probability for SSB to be above Blim (FP05 with AR)

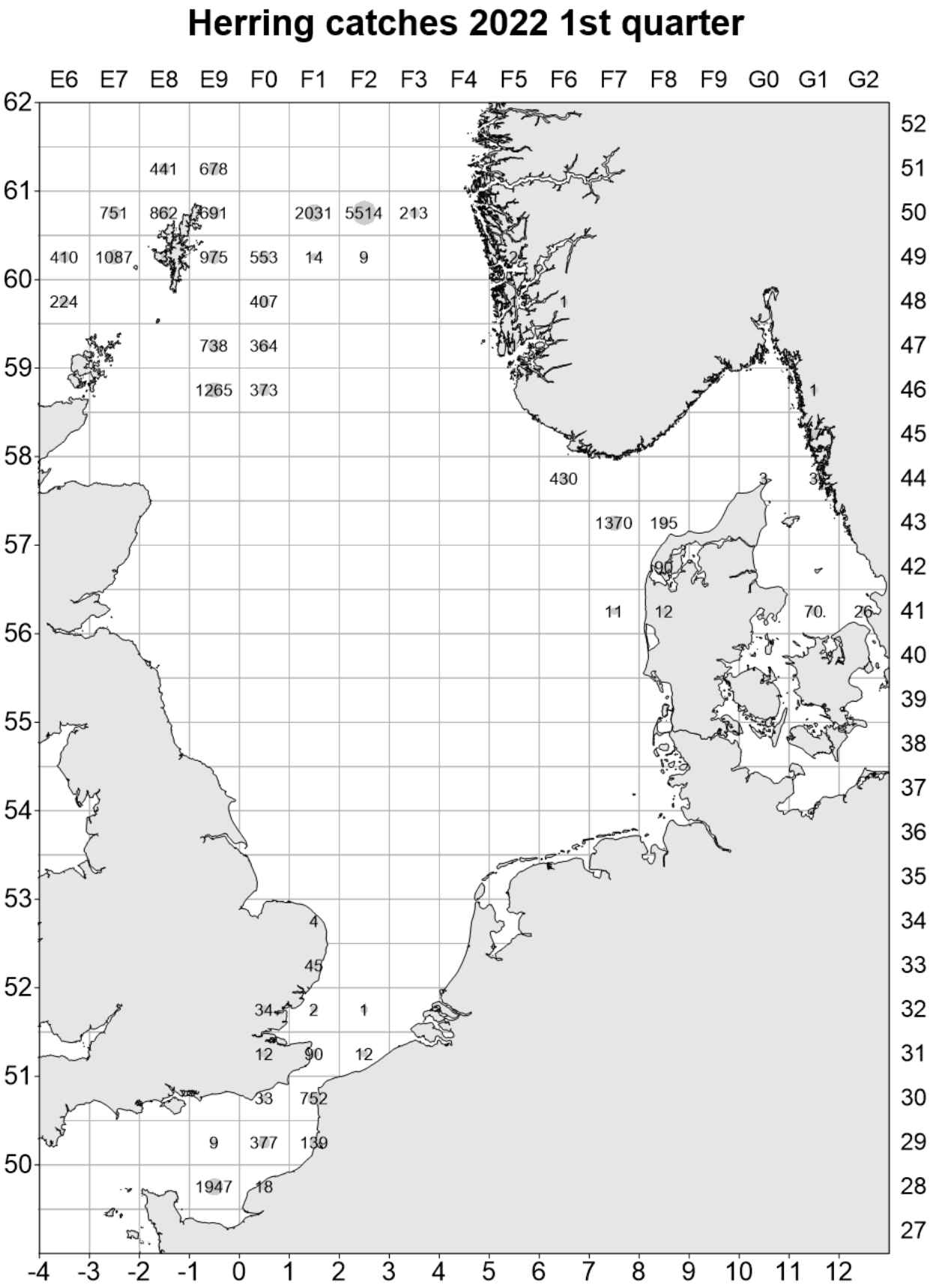


Figure 2.1.1a. Herring catches in the North Sea in the 1st quarter of 2022 (in tonnes) by statistical rectangle.

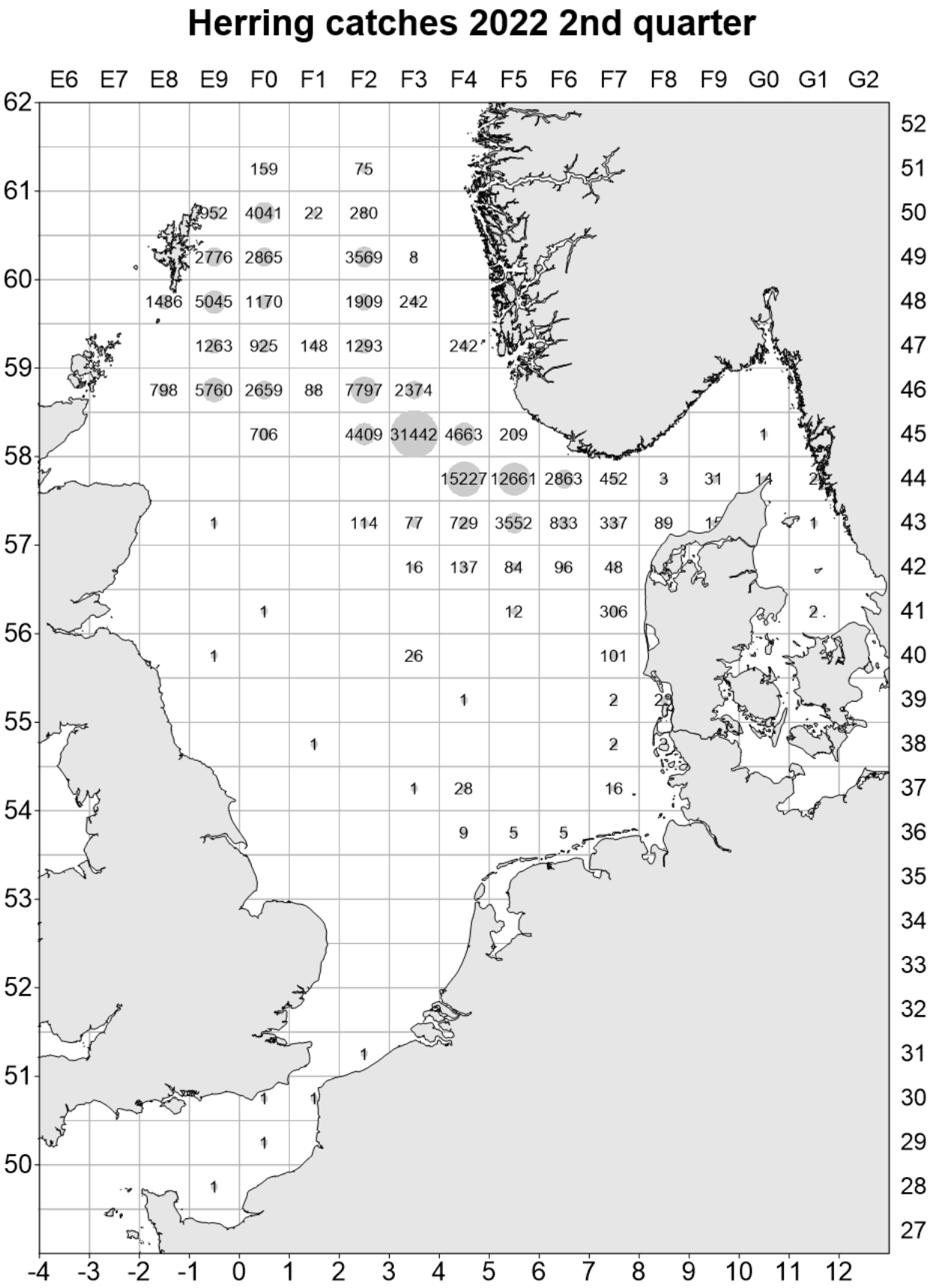


Figure 2.1.1b. Herring catches in the North Sea in the second quarter of 2022 (in tonnes) by statistical rectangle.

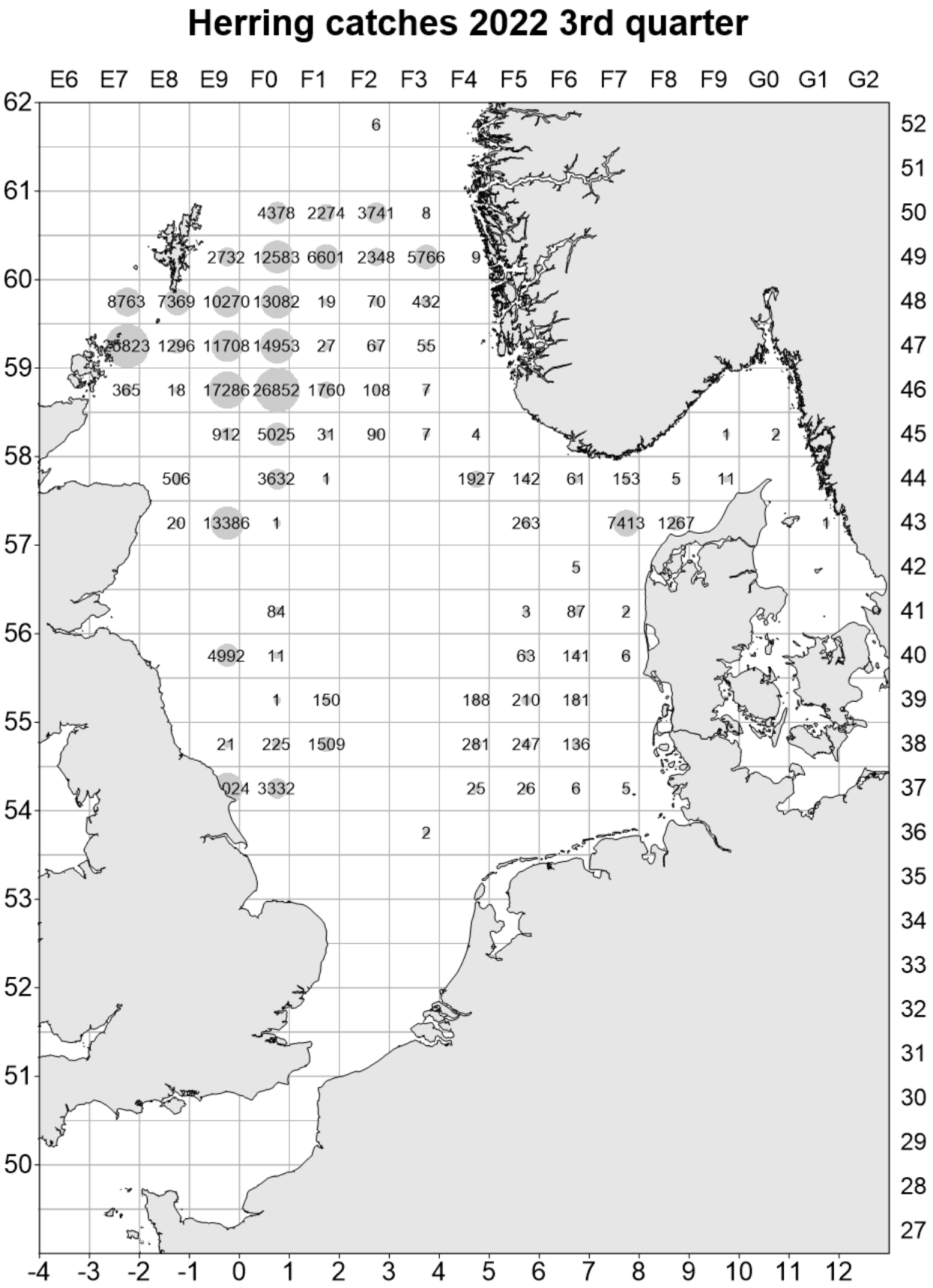


Figure 2.1.1c. Herring catches in the North Sea in the 3rd quarter of 2022 (in tonnes) by statistical rectangle.

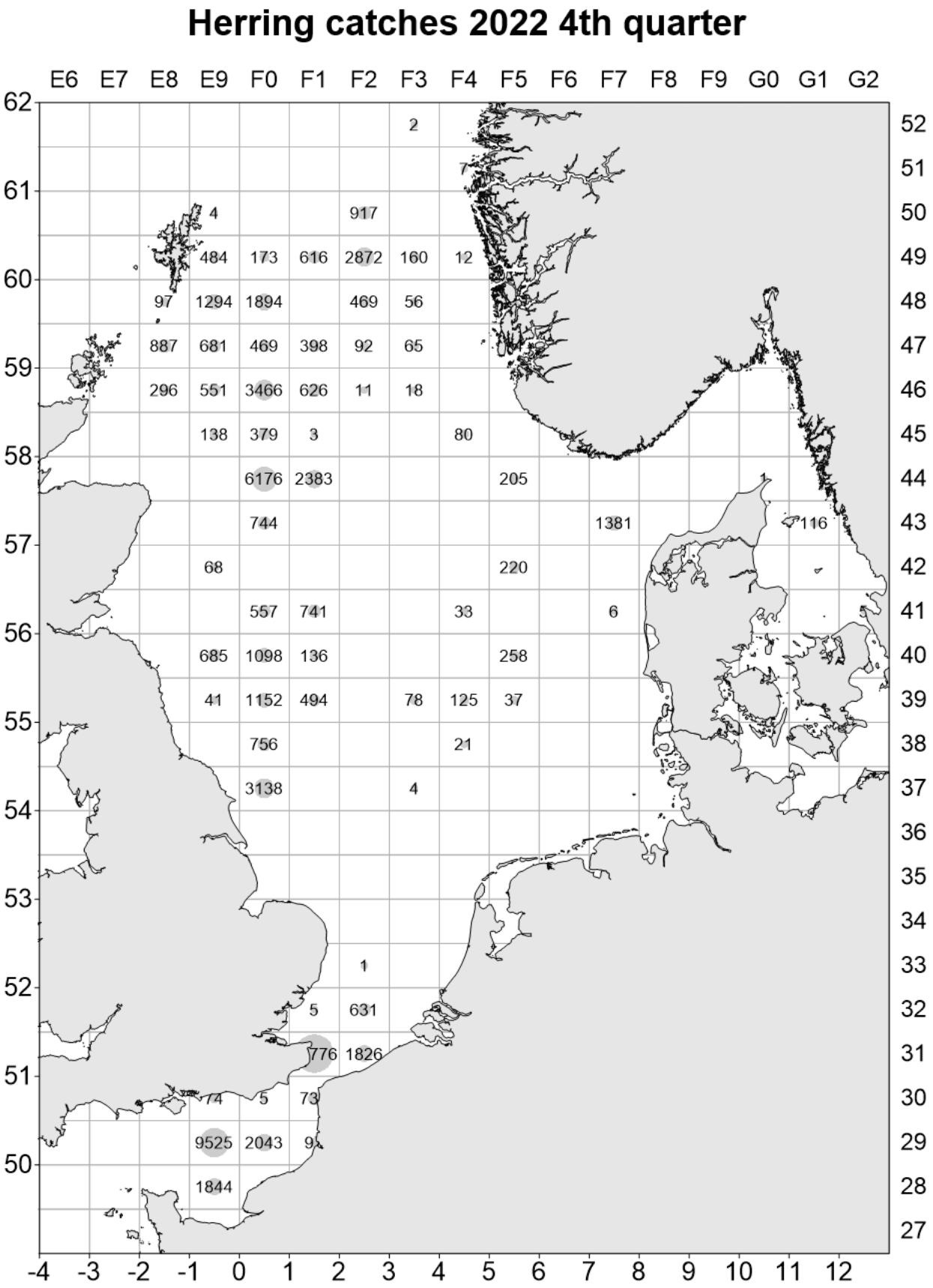


Figure 2.1.1d. Herring catches in the North Sea in the 4th quarter of 2022 (in tonnes) by statistical rectangle.

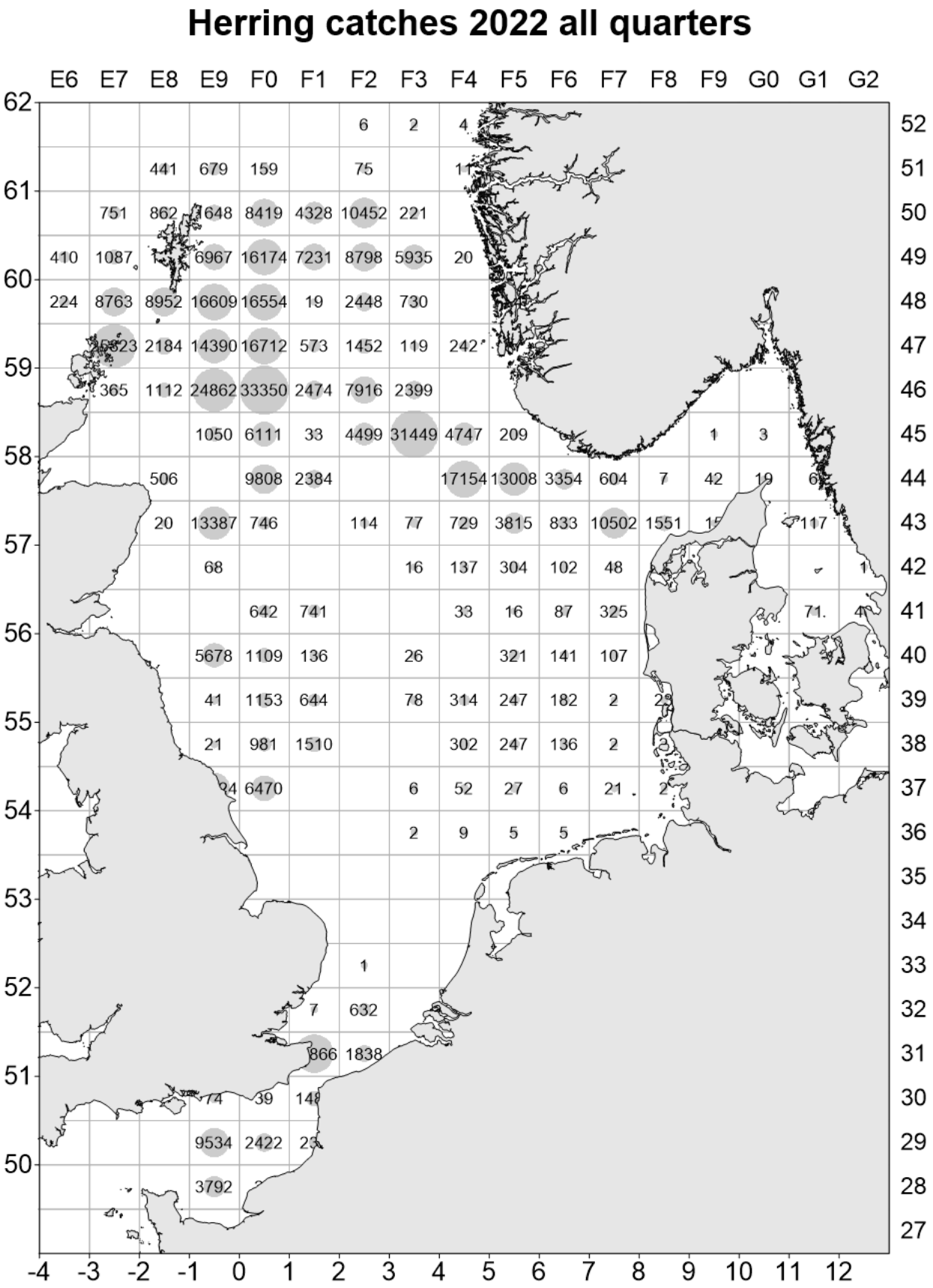


Figure 2.1.1e. Herring catches in the North Sea in all quarters of 2022 (in tonnes) by statistical rectangle.

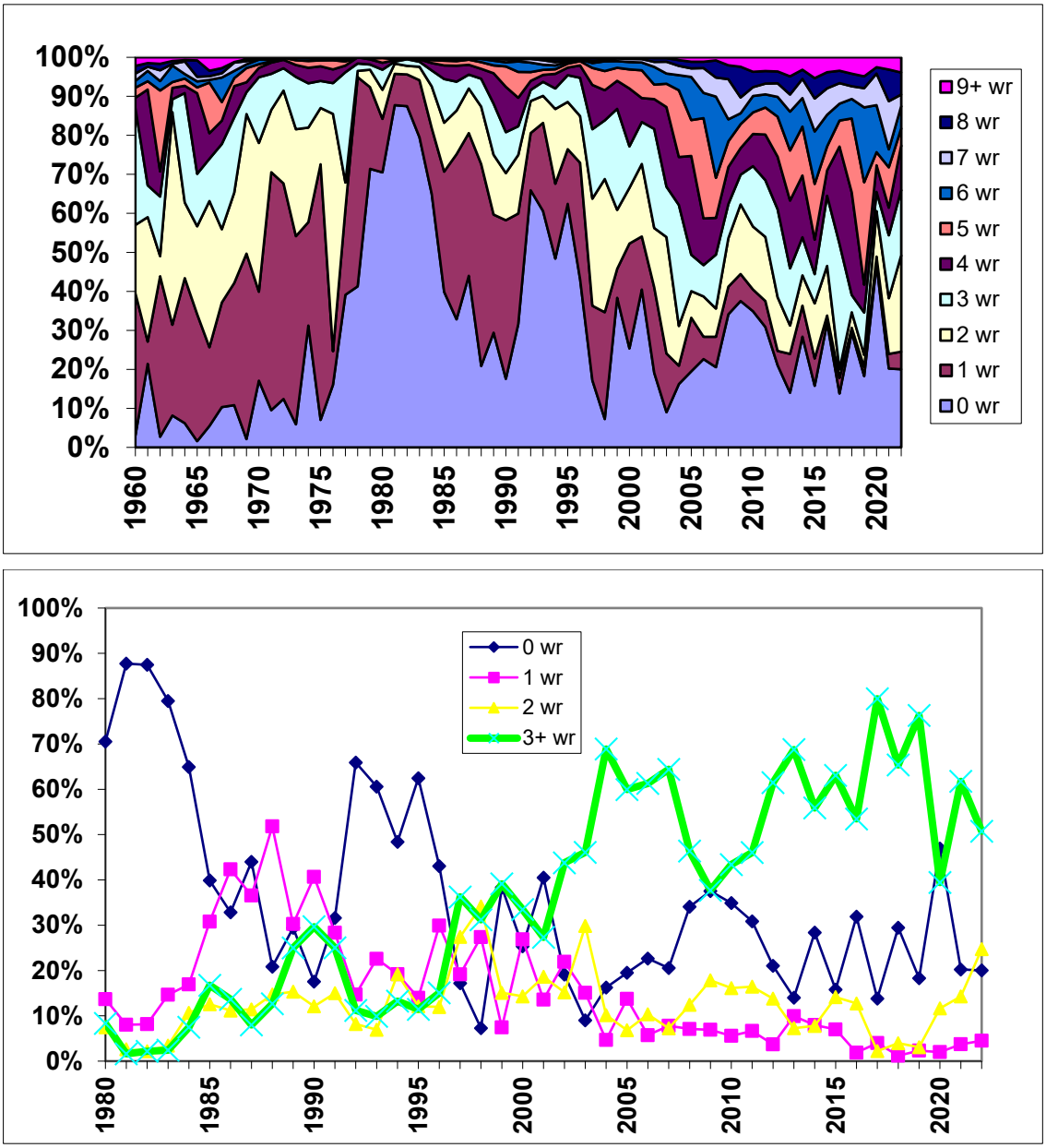


Figure 2.2.1. Proportions of age groups (numbers) in the total catch of herring caught in the North Sea (upper, 1960–2022, and lower panel, 1980–2022).

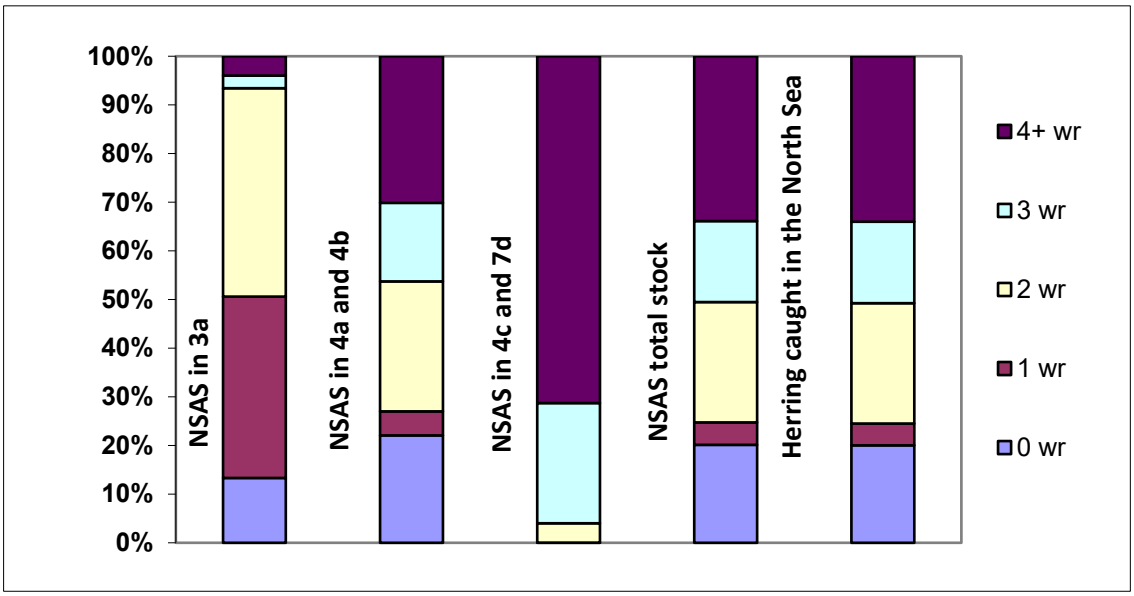


Figure 2.2.2. Proportion of age groups (numbers) in the total catch of NSAS and herring caught in the North Sea in 2022.

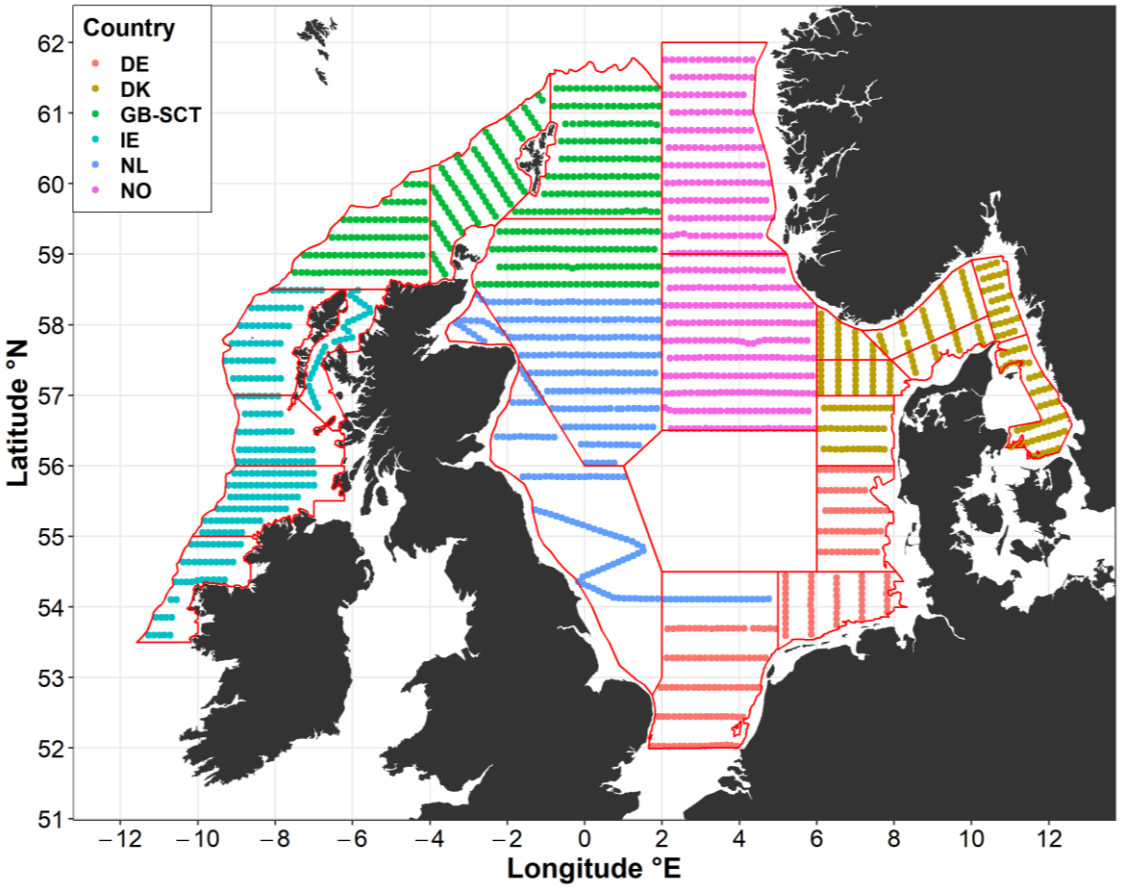


Figure 2.3.1.1. Cruise tracks and survey area coverage in the HERAS acoustic surveys in 2022 by nation.

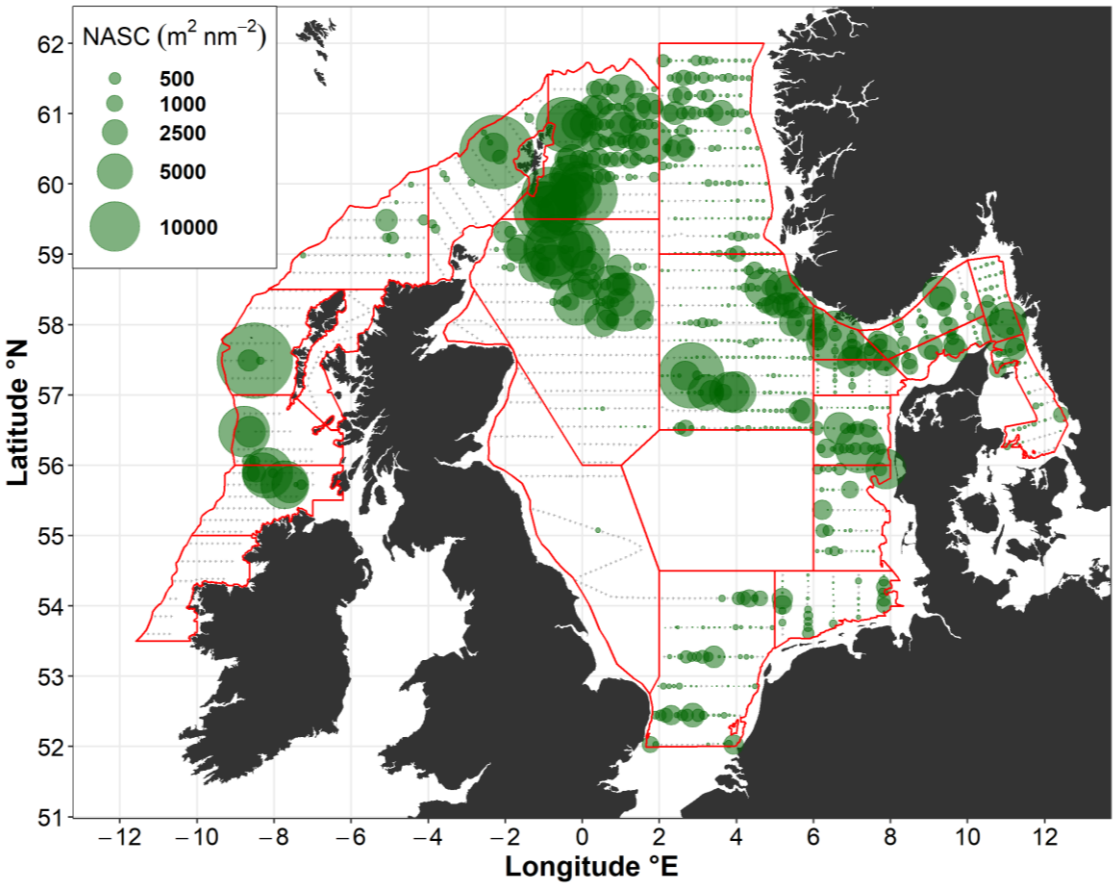


Figure 2.3.1.2. Distribution of NASC attributed to herring in HERAS in 2022. Acoustic intervals represented by light grey dot with green circles representing size and location of herring aggregations. NASC values are resampled at 5 nmi intervals along the cruise track. The red lines show the strata system.

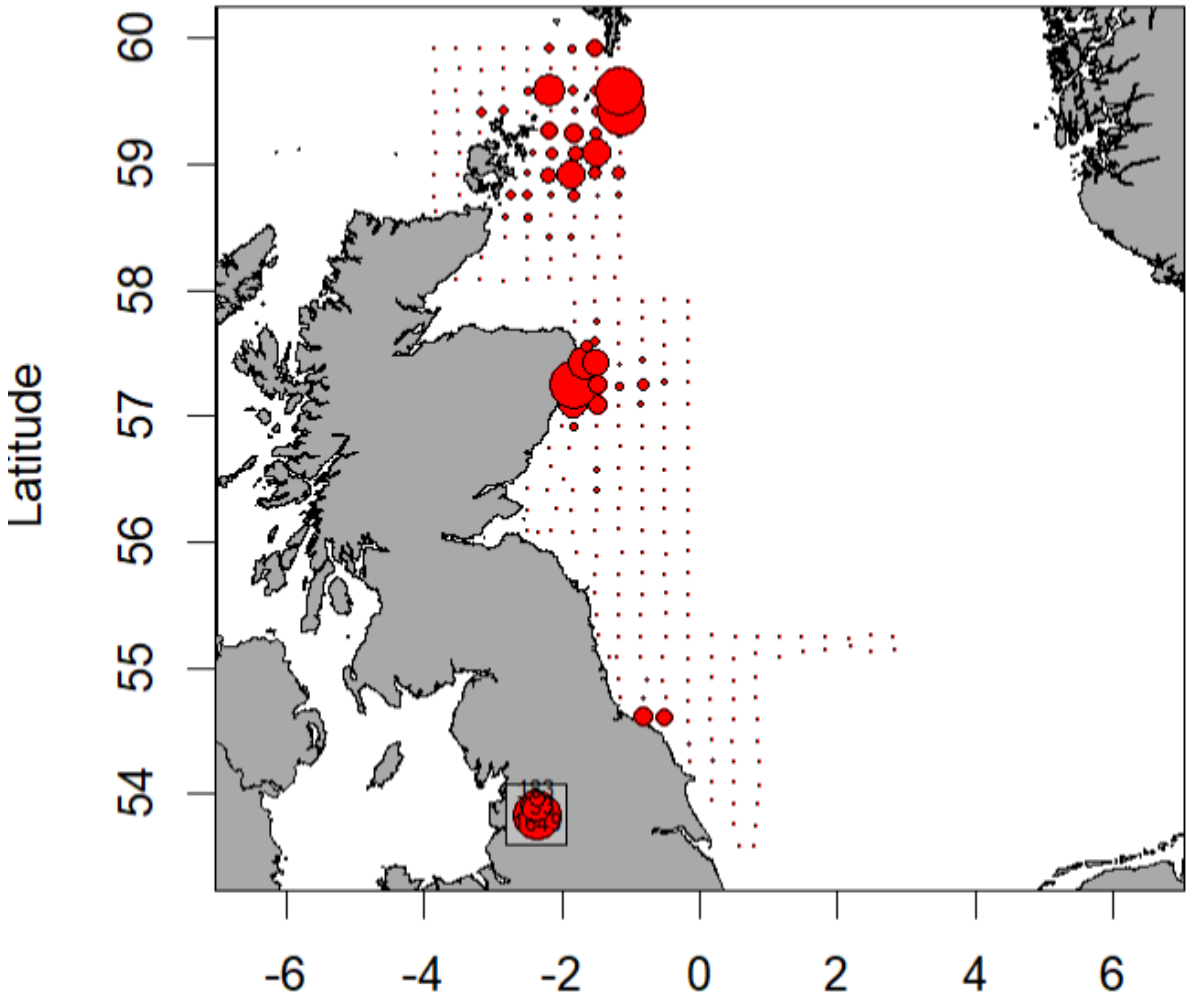


Figure 2.3.2.1. North Sea herring - Abundance of larvae < 10 mm (n/m²) in the Orkney/Shetlands, the Buchan, and the central North Sea area, second half of September 2022 (maximum circle size = 1 650 n/m²).

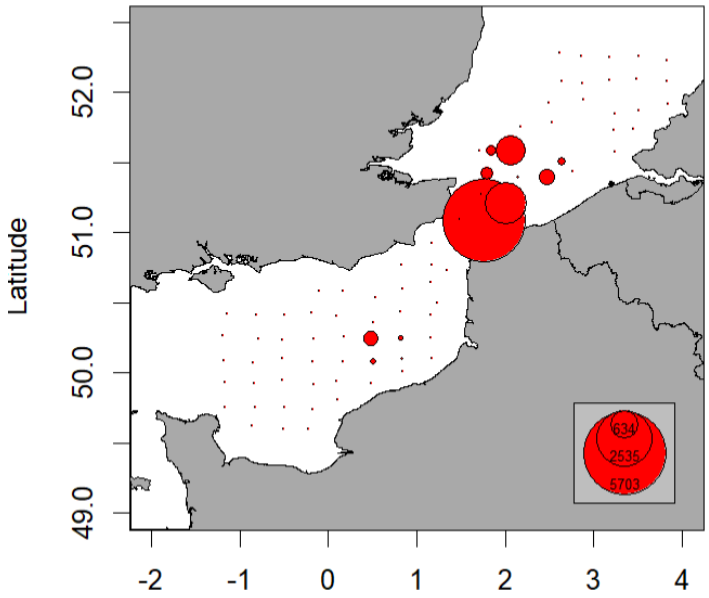


Figure 2.3.2.3. North Sea herring - Abundance of larvae <11 mm (n/m²) in the Southern North Sea and English Channel, second half of December 2022 (maximum circle size = 5 700 n/m²).

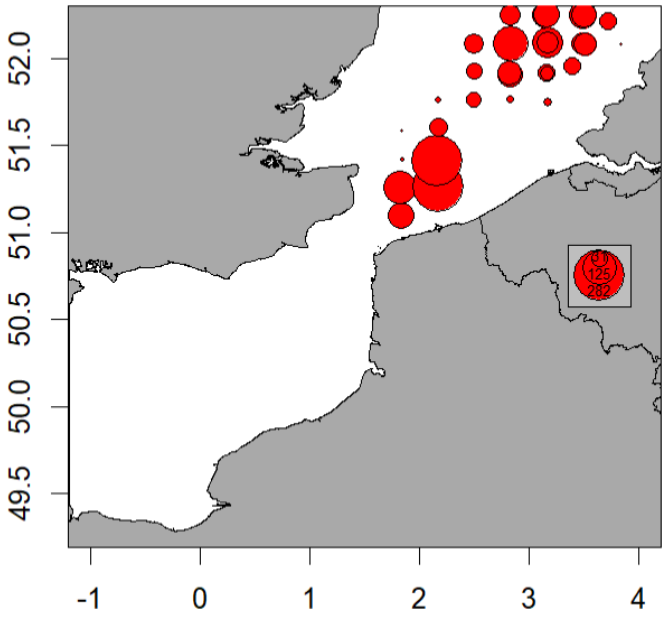


Figure 2.3.2.4. North Sea herring - Abundance of larvae <11 mm (n/m²) in the Southern North Sea and English Channel, first half of January 2023 (maximum circle size = 280 n/m²).

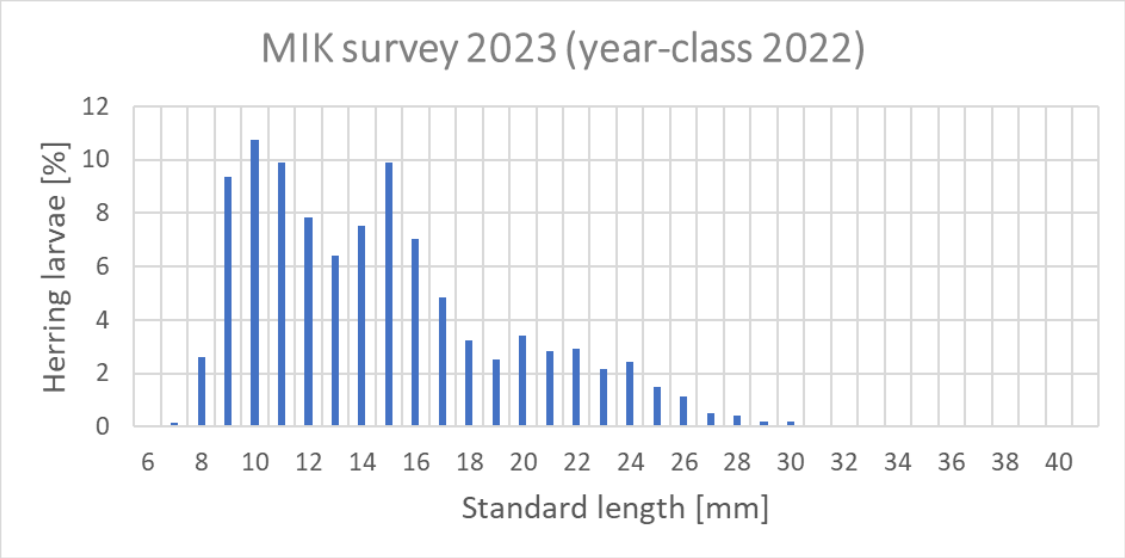


Figure 2.3.3.1.1 North Sea herring. Length distribution of all herring larvae caught in the MIK during the 2023 Q1 IBTS.

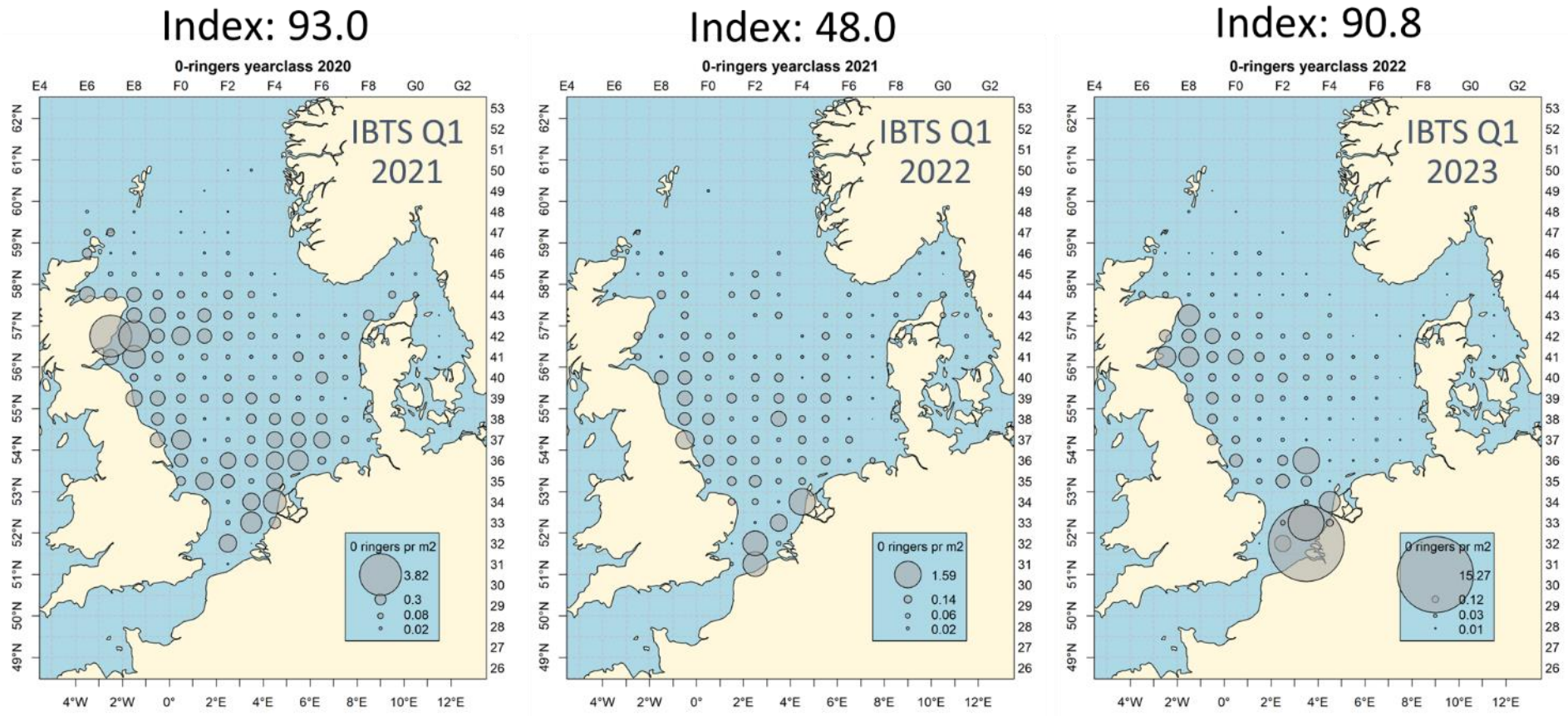


Figure 2.3.3.1.2 North Sea herring. Distribution of 0-ringer herring, year classes 2020–2022. Density estimates of 0-ringers (>18 mm) within each statistical rectangle are based on MIK catches during IBTS in January/February 2021–2023. Areas of filled circles illustrate densities in no m^{-2}.

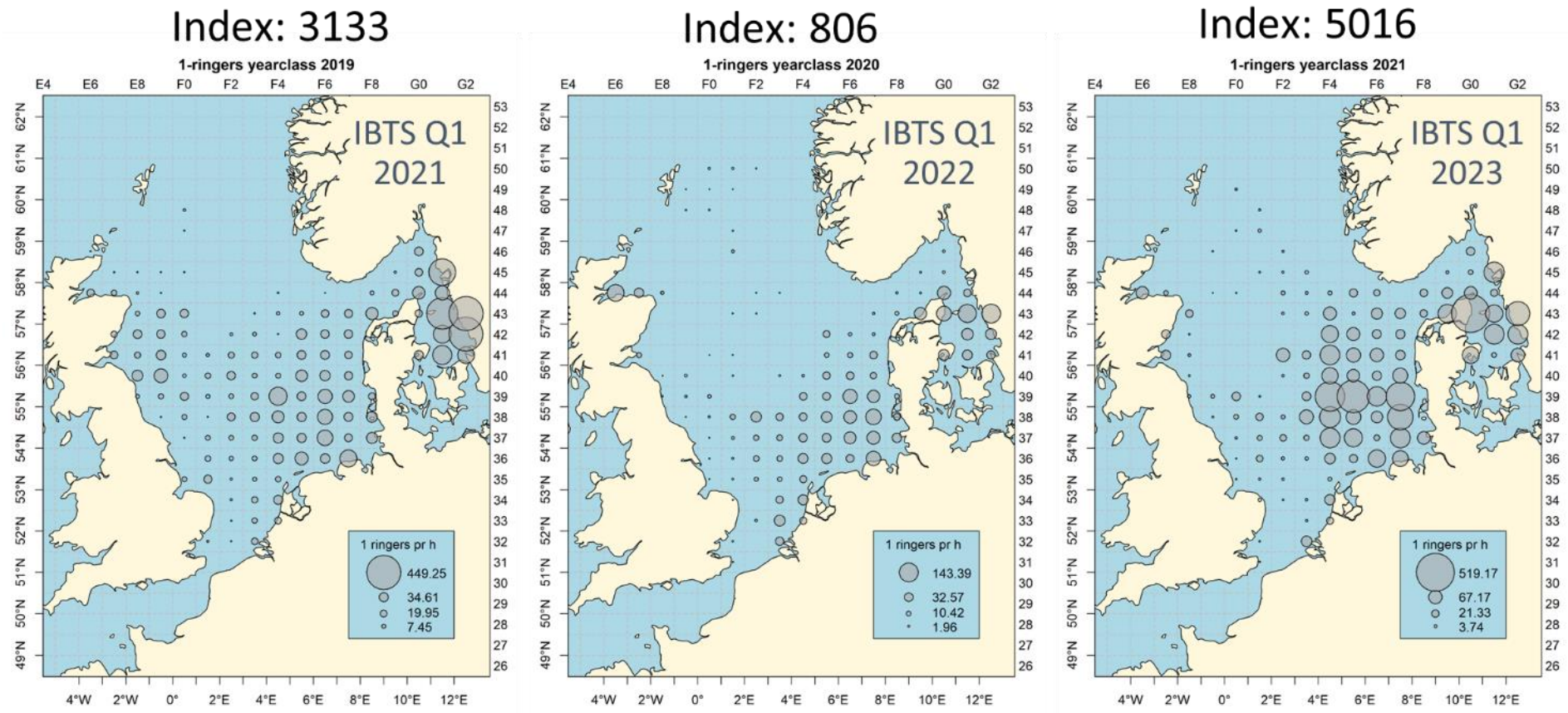


Figure 2.3.3.2.1 North Sea herring. Distribution of 1-ringer herring, year classes 2019–2021. Density estimates of 1-ringers within each statistical rectangle are based on GOV catches during IBTS in January/February 2021–2023. Areas of filled circles illustrate numbers per hour, scaled proportionally to the square root transformed CPUE data.

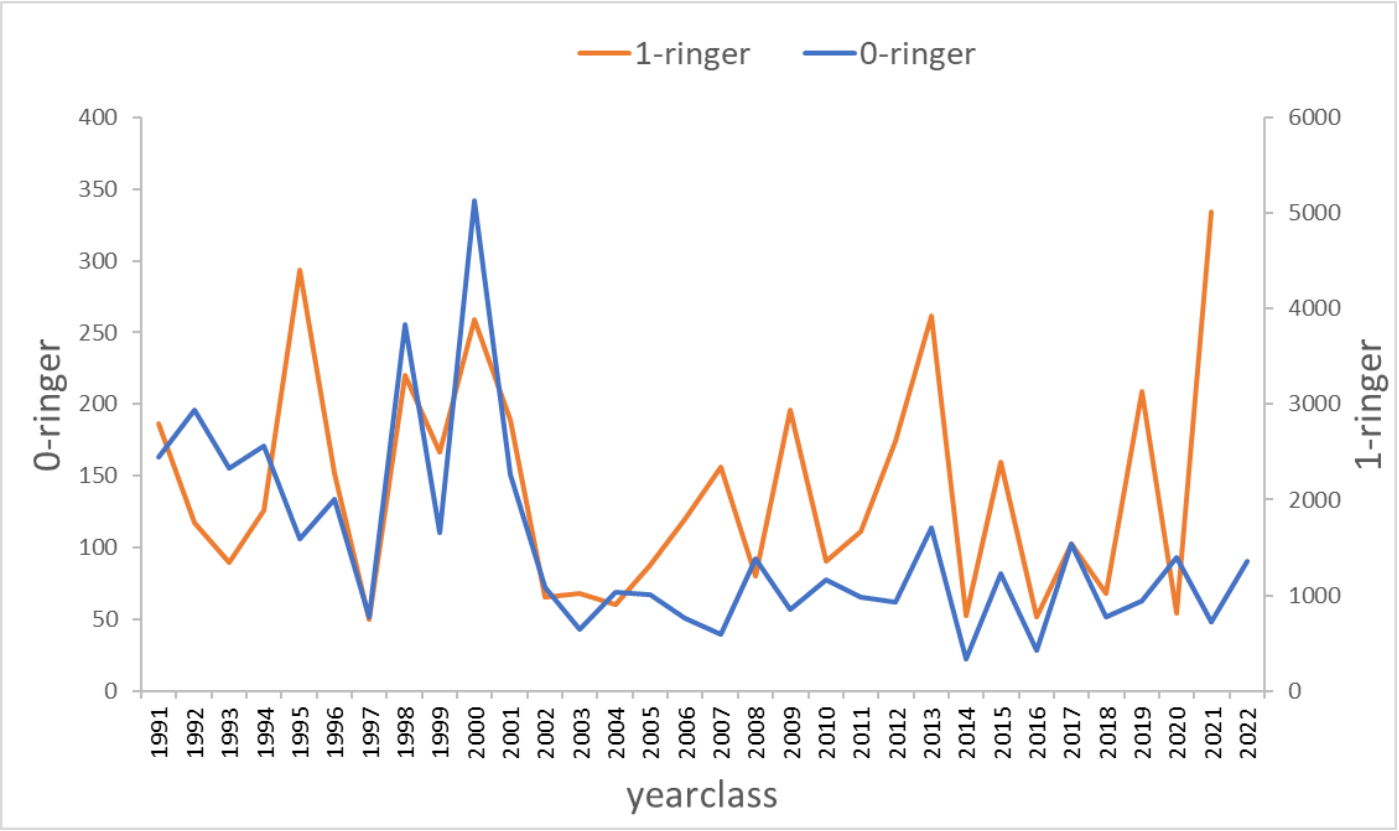


Figure 2.3.3.2.2 North Sea herring. Time series of 0-ringer (blue) and 1-ringer indices (orange). Year-classes 1991 to 2022 for 0-ringers, year-classes 1991–2021 for 1-ringers.

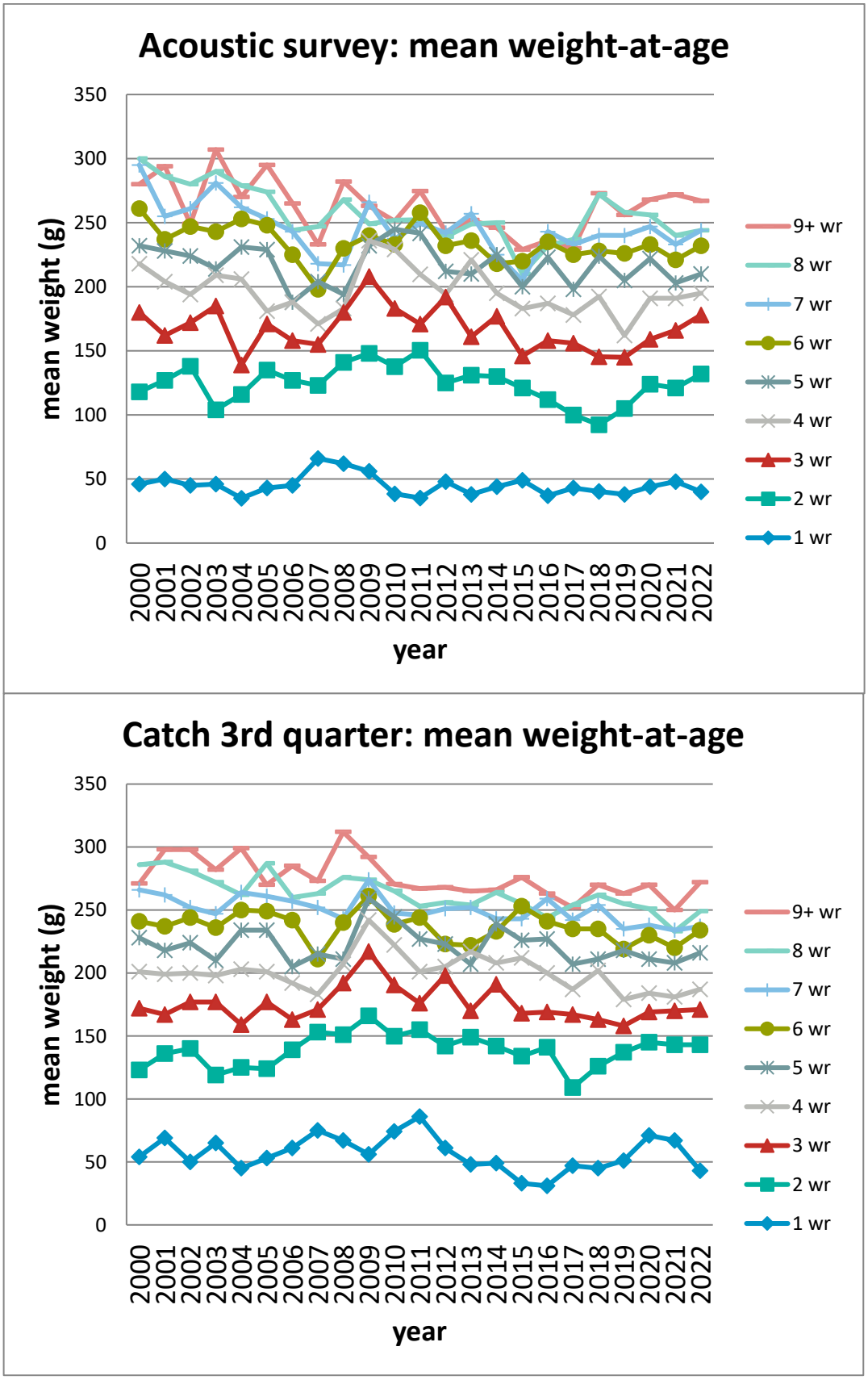


Figure 2.4.1.1. North Sea Herring. Mean weights-at-age for the 3rd quarter in Divisions 4 and 3.a from the acoustic survey (upper panel) and mean weights-in-the-catch (lower panel) for comparison.

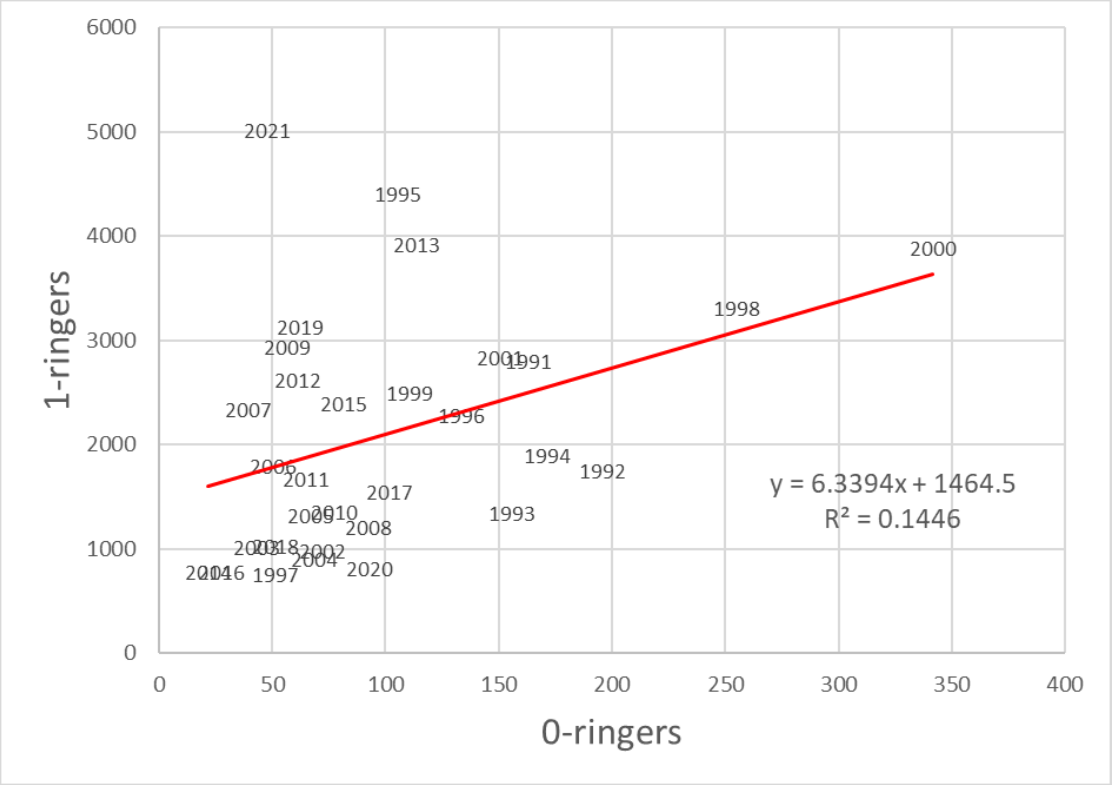


Figure 2.5.1.1 North Sea herring. Relationship between indices of 0-ringers, calculated with the new algorithm, and 1-ringers for year-classes 1991 to 2021.

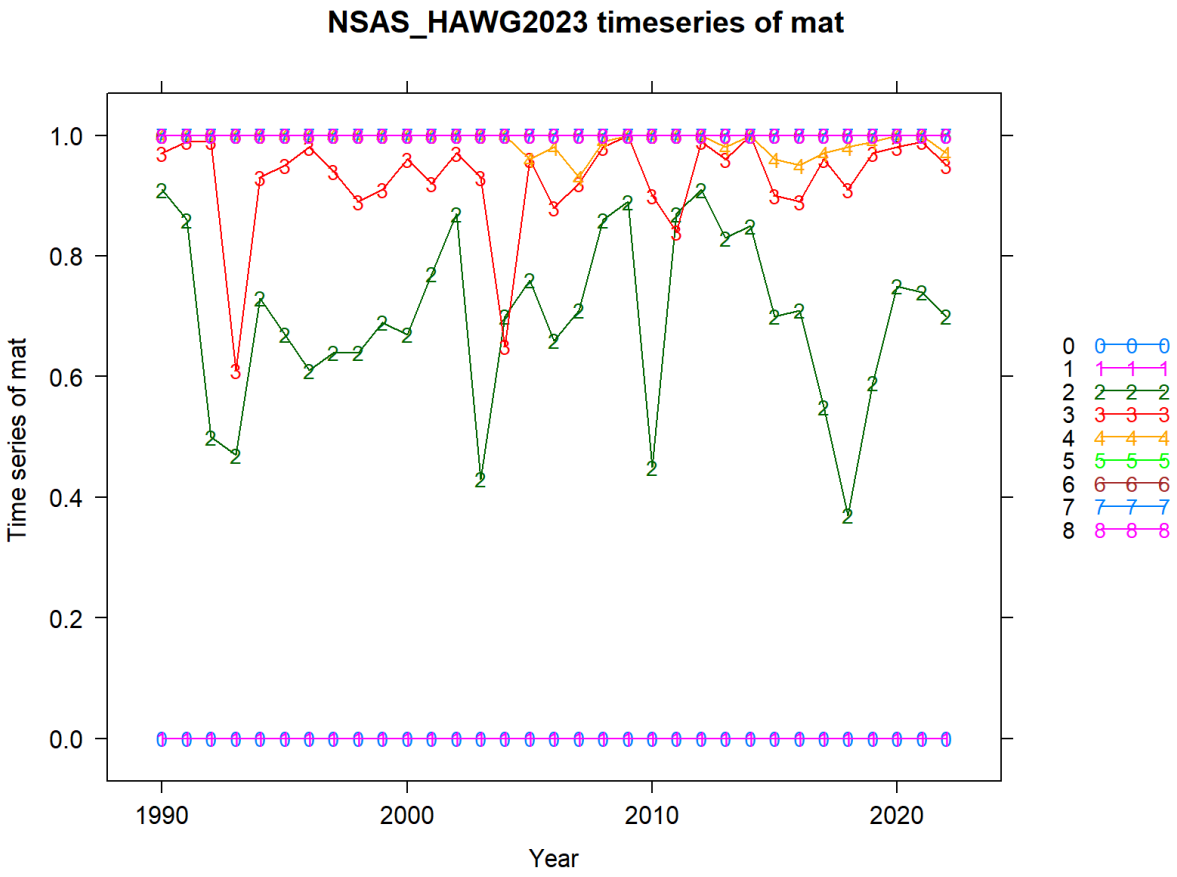


Figure 2.6.1.1. North Sea Herring. Time-series of proportion mature at ages 0 to 8+ as used in the North Sea herring assessment.

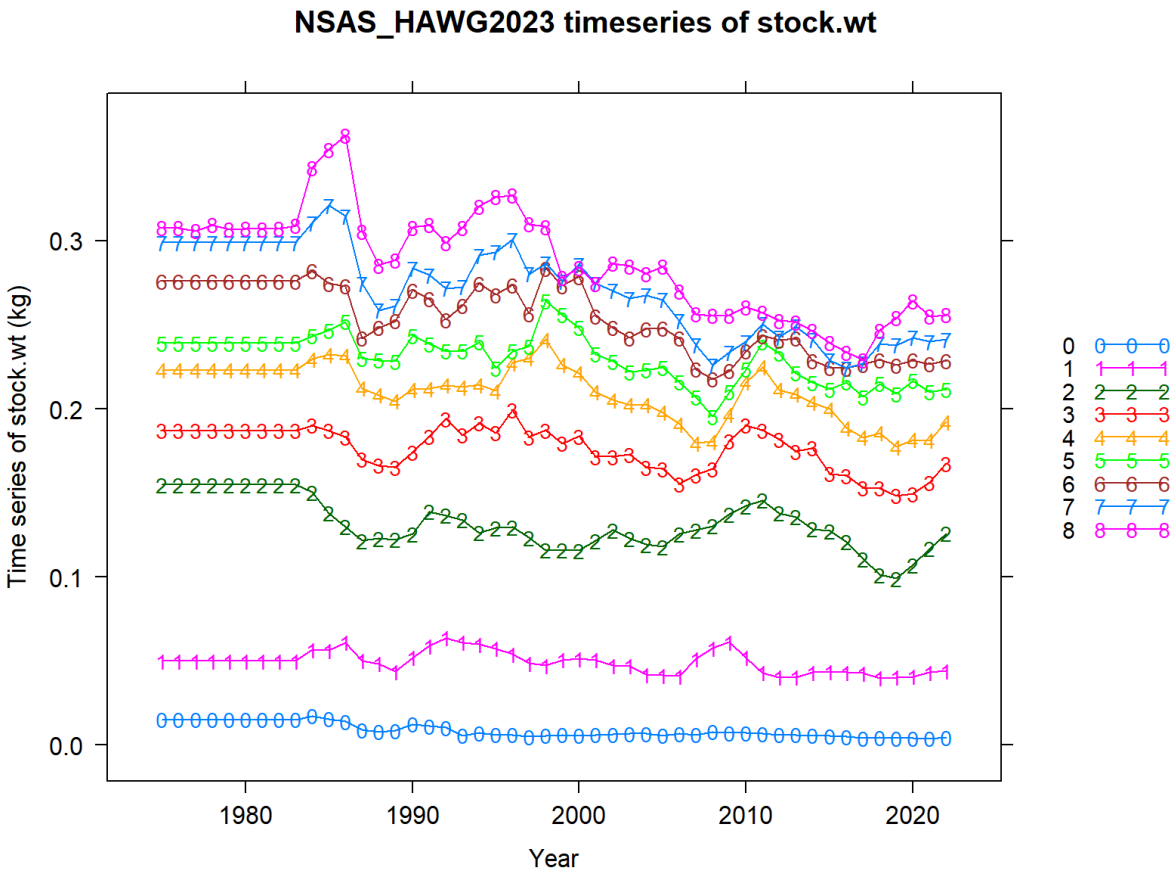


Figure 2.6.1.2. North Sea Herring. Time-series of stock weight at ages 0 to 8+ as used in the North Sea herring assessment.

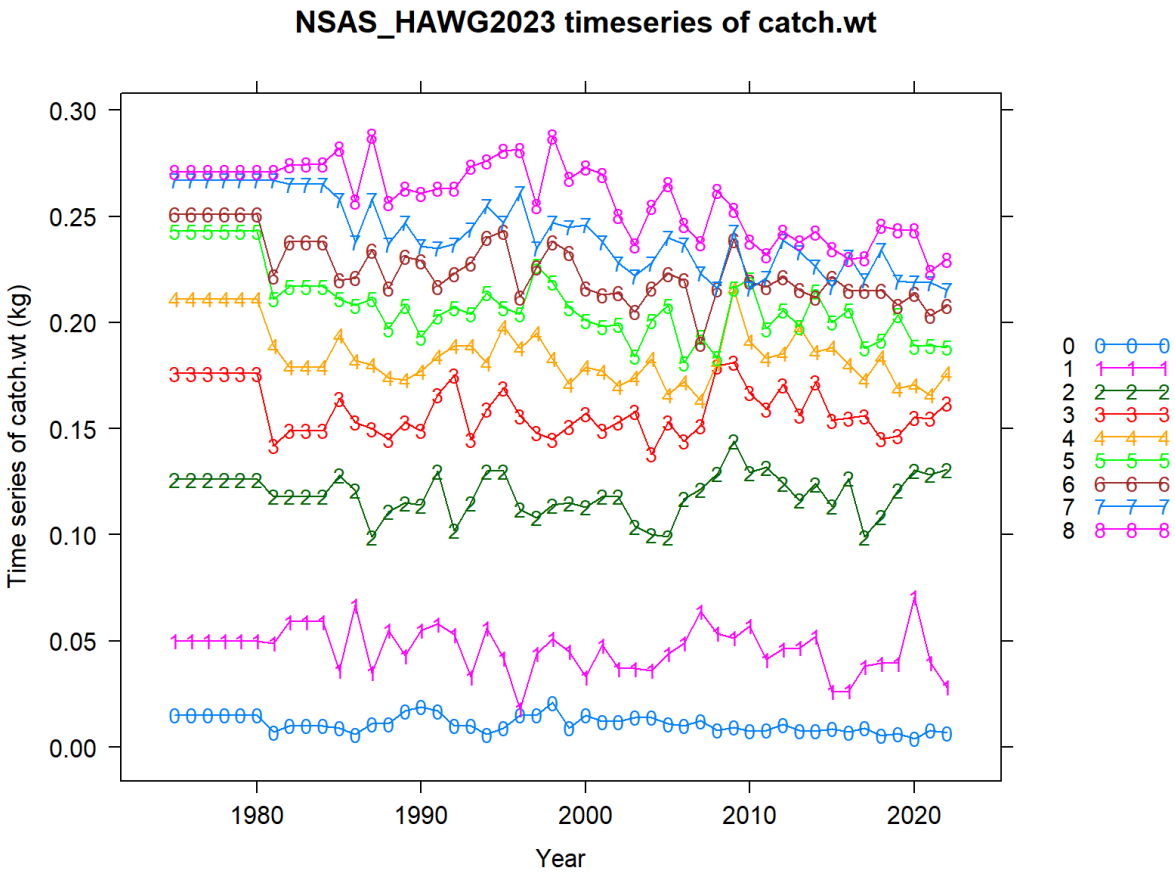


Figure 2.6.1.3. North Sea Herring. Time-series of catch weight at ages 0 to 8+ as used in the North Sea herring assessment.

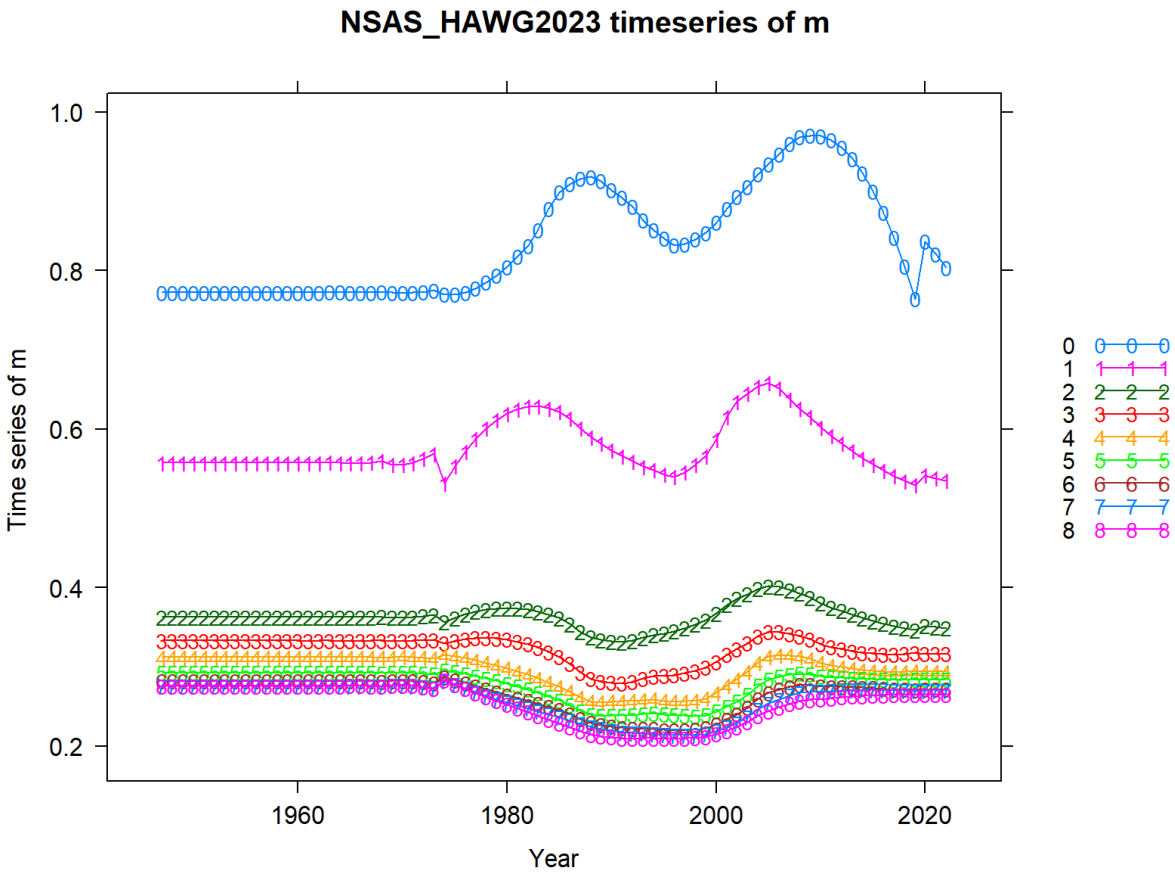


Figure 2.6.1.4. North Sea Herring. Time-series of absolute natural mortality values at age 0–8+ as used in the North Sea herring assessment. Natural mortality values are based on the 2019 North Sea key-run (ICES WGSAM, 2021)

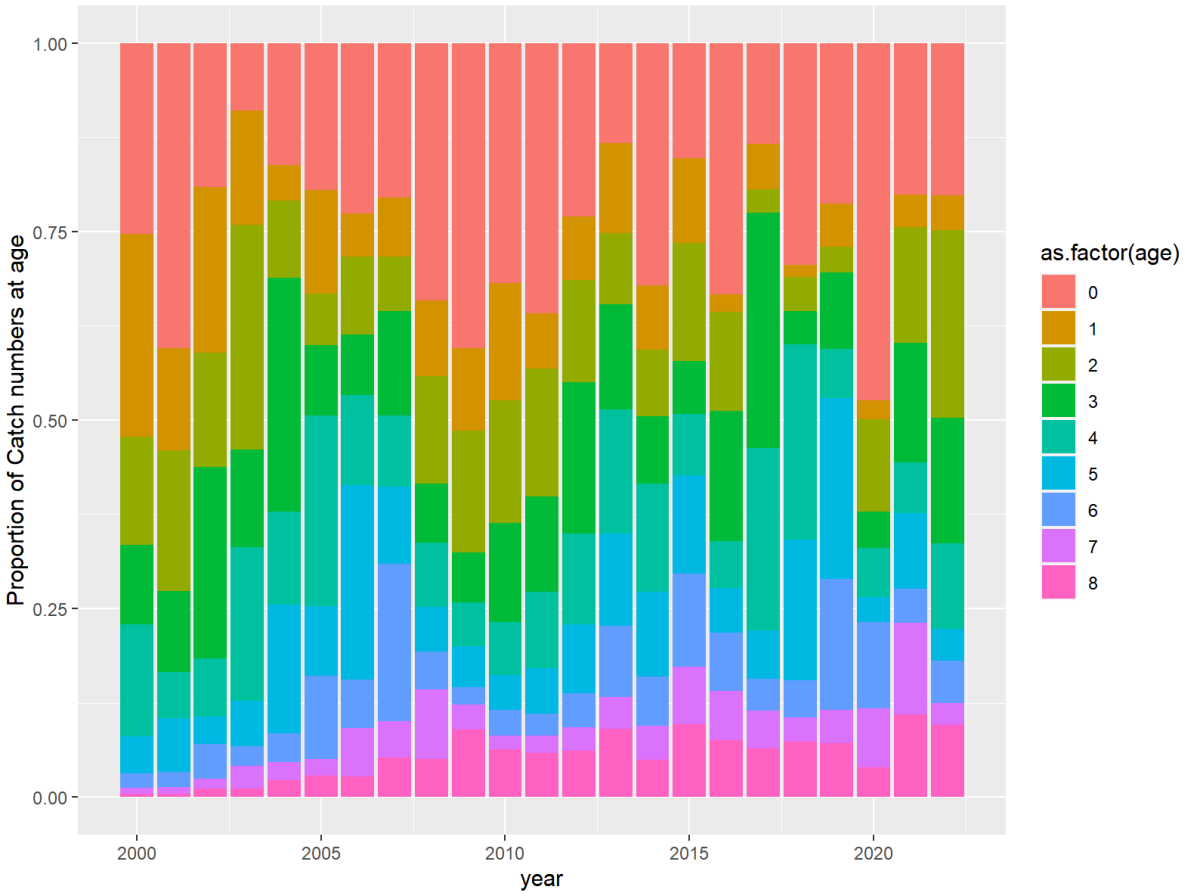


Figure 2.6.1.5. North Sea Herring. Proportion of catch at age since 2000.

Figure 2.6.1.6. North Sea Herring. Proportion of HERAS index at age since 2000.

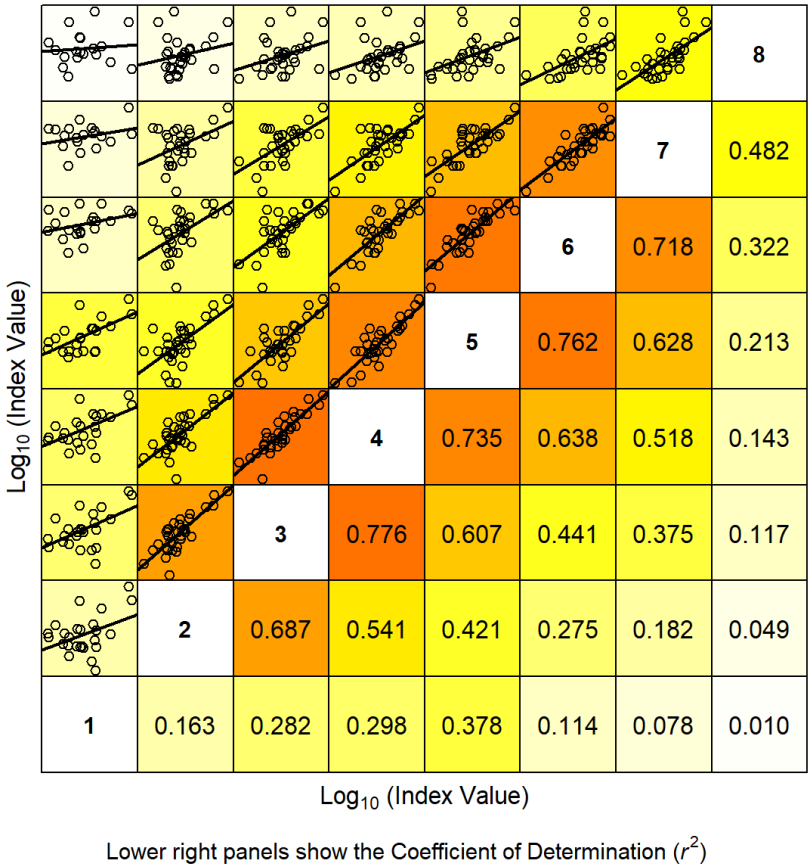


Figure 2.6.1.7. North Sea herring. Internal consistency plot of the acoustic survey (HERAS). Above the diagonal the linear regression is shown including the observations (in points) while under the diagonal the r^2 value that is associated with the linear regression is given.

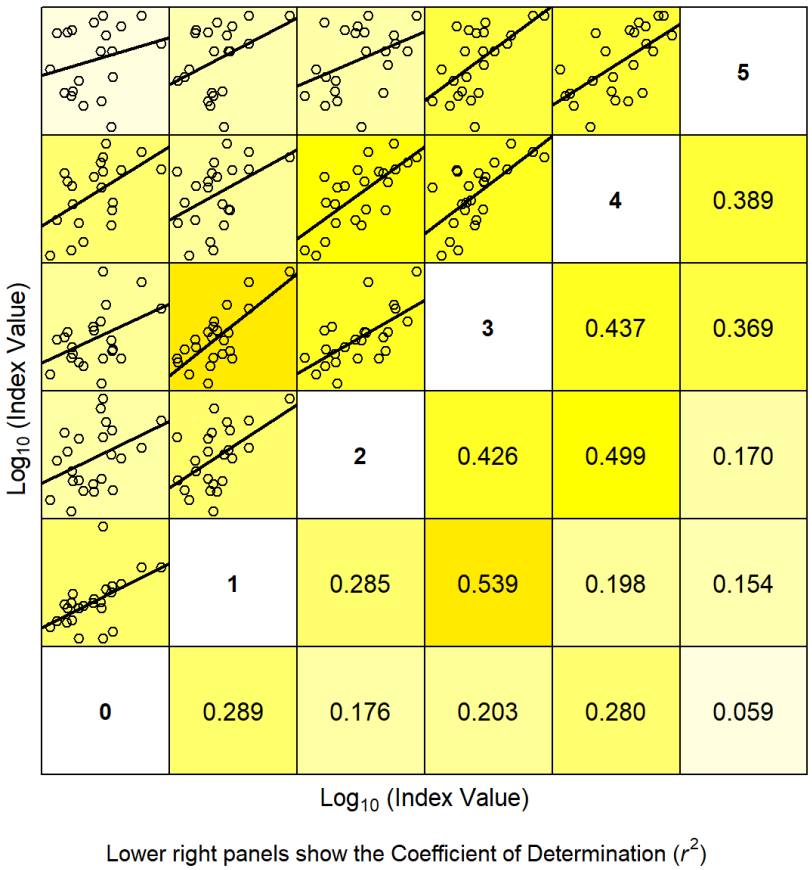


Figure 2.6.1.8. North Sea herring. Internal consistency plot of the IBTS in quarter 3. Above the diagonal the linear regression is shown including the observations (in points) while under the diagonal the r^2 value that is associated with the linear regression is given.

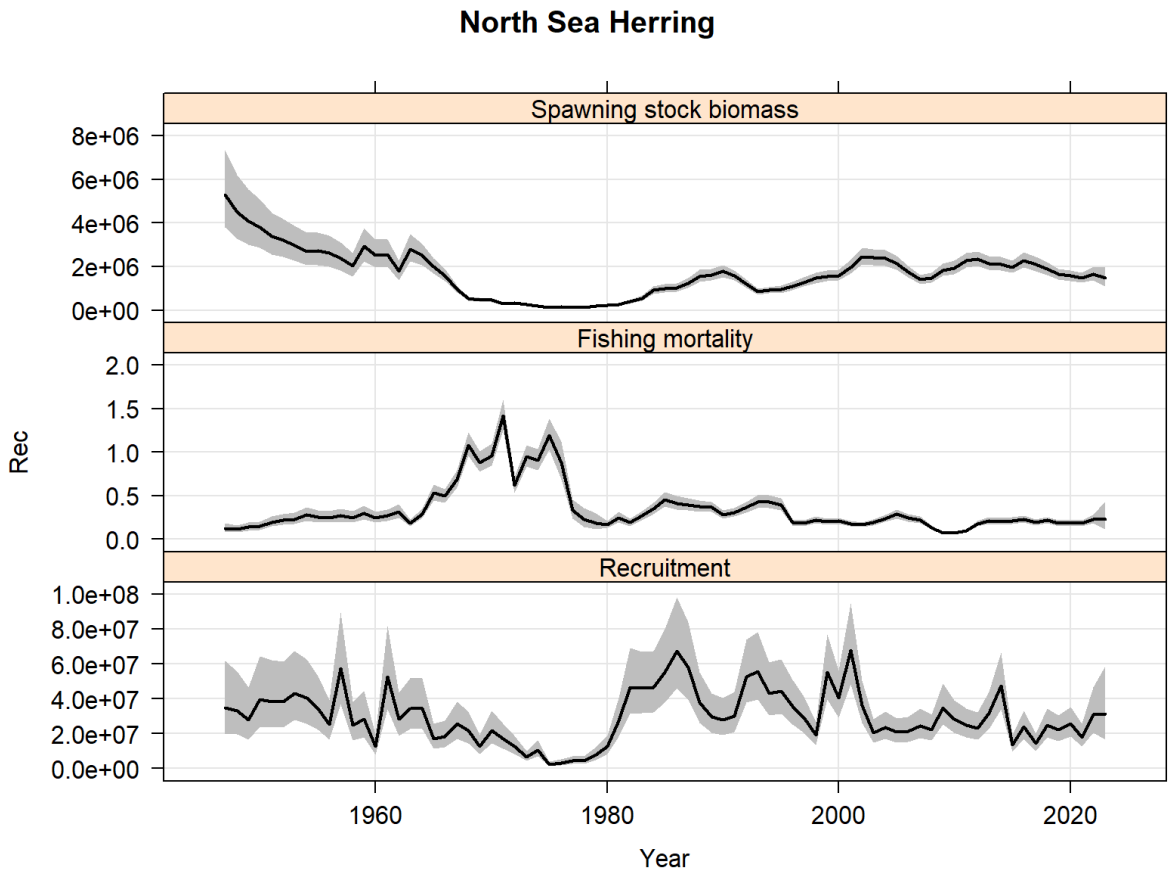


Figure 2.6.2.1. North Sea herring. Stock summary plot of North Sea herring with associated uncertainty for SSB (top panel), F ages 2–6 (middle panel) and recruitment (bottom panel).

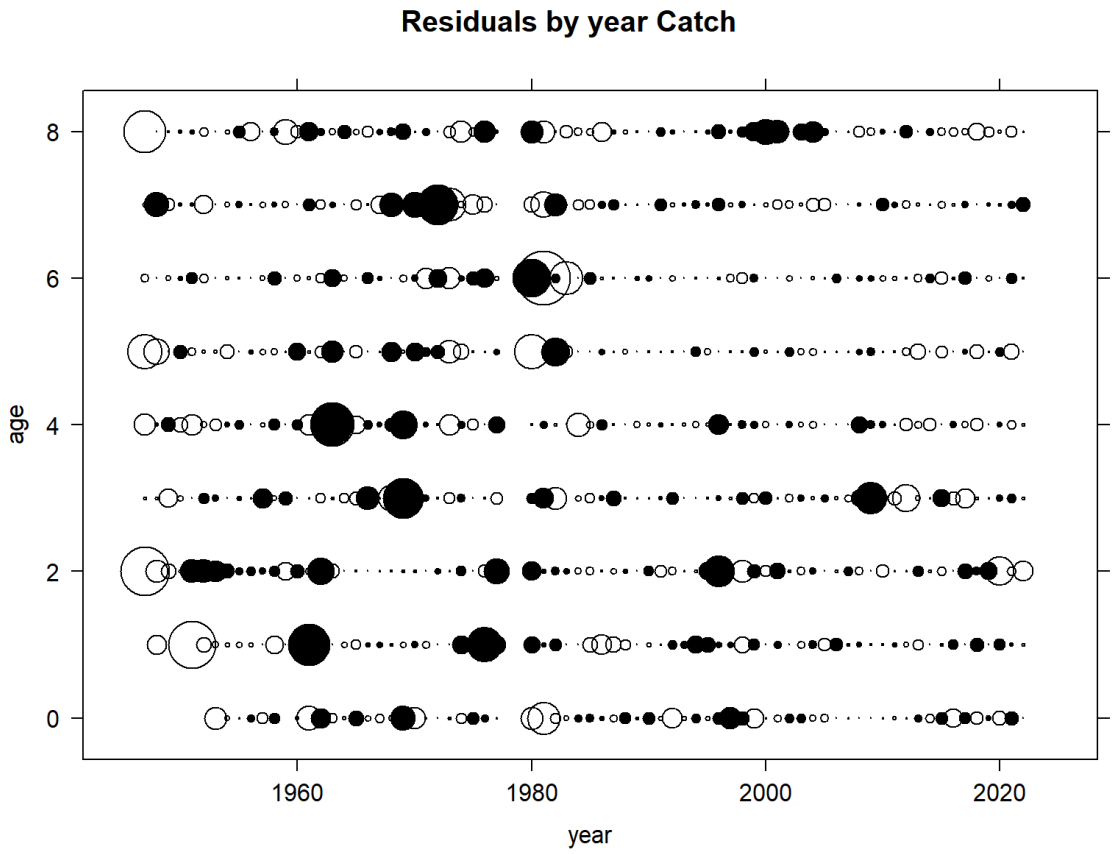


Figure 2.6.2.2. North Sea herring. Bubble plot of standardized catch residual at age.

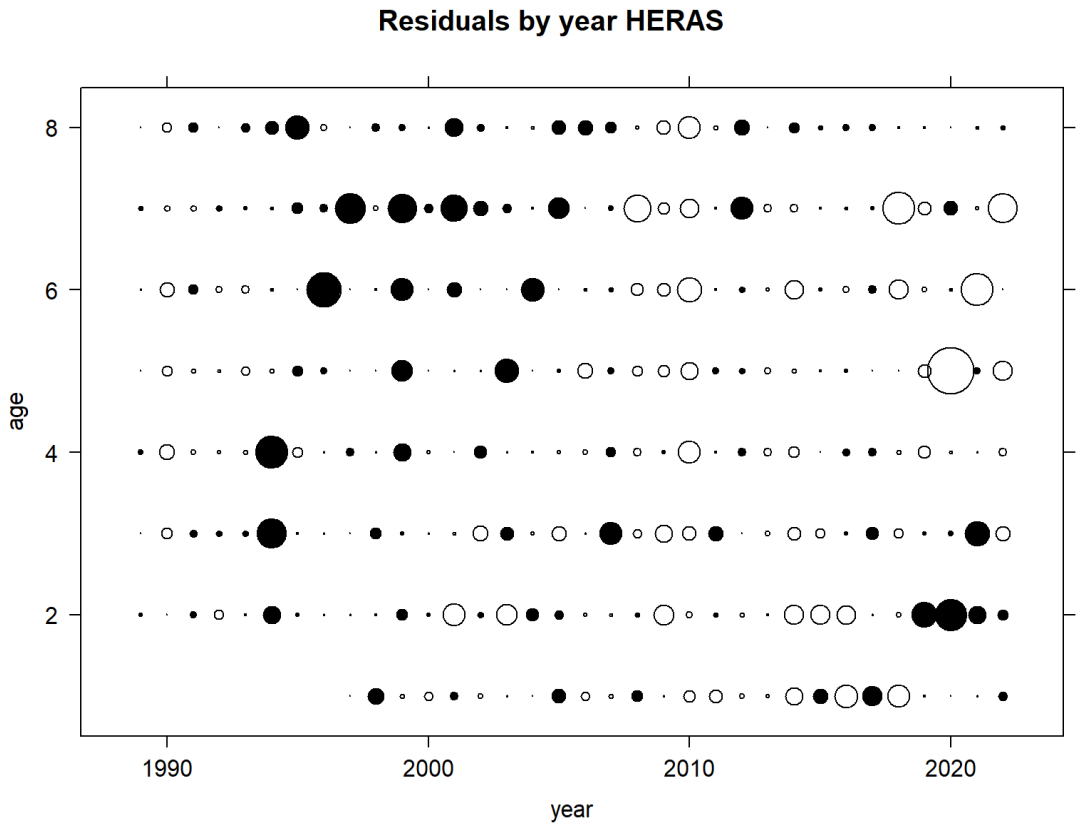


Figure 2.6.2.3. North Sea herring. Bubble plot of standardized acoustic survey residuals at age.

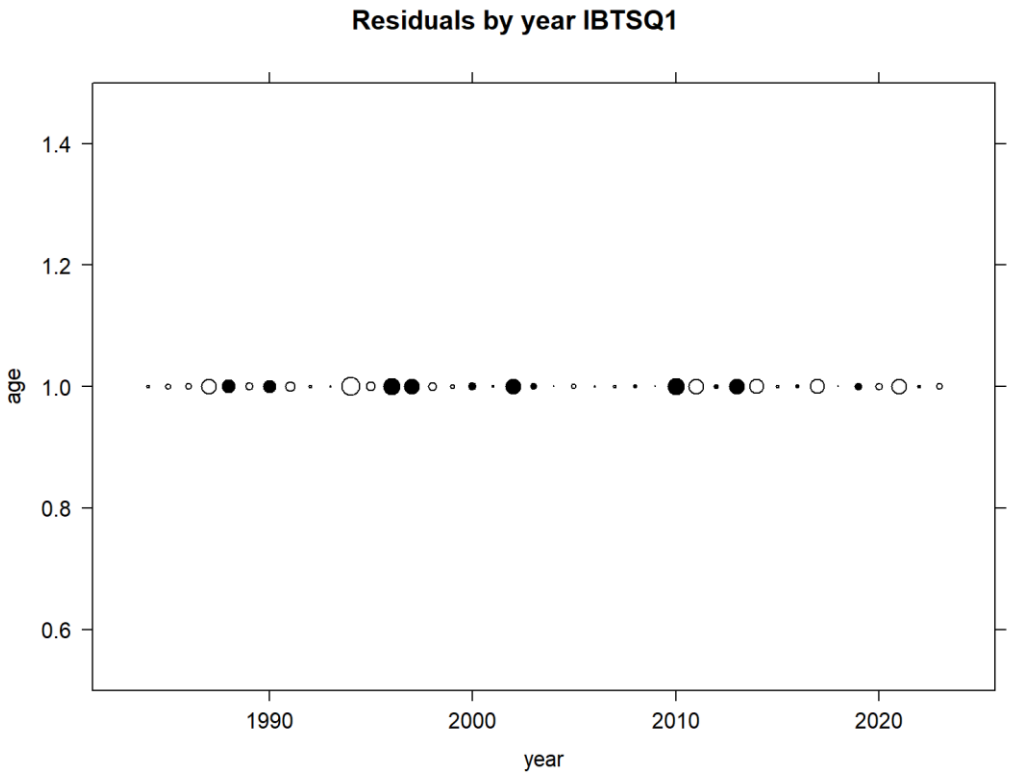


Figure 2.6.2.4. North Sea herring. Bubble plot of standardized IBTSQ1 residuals at age.

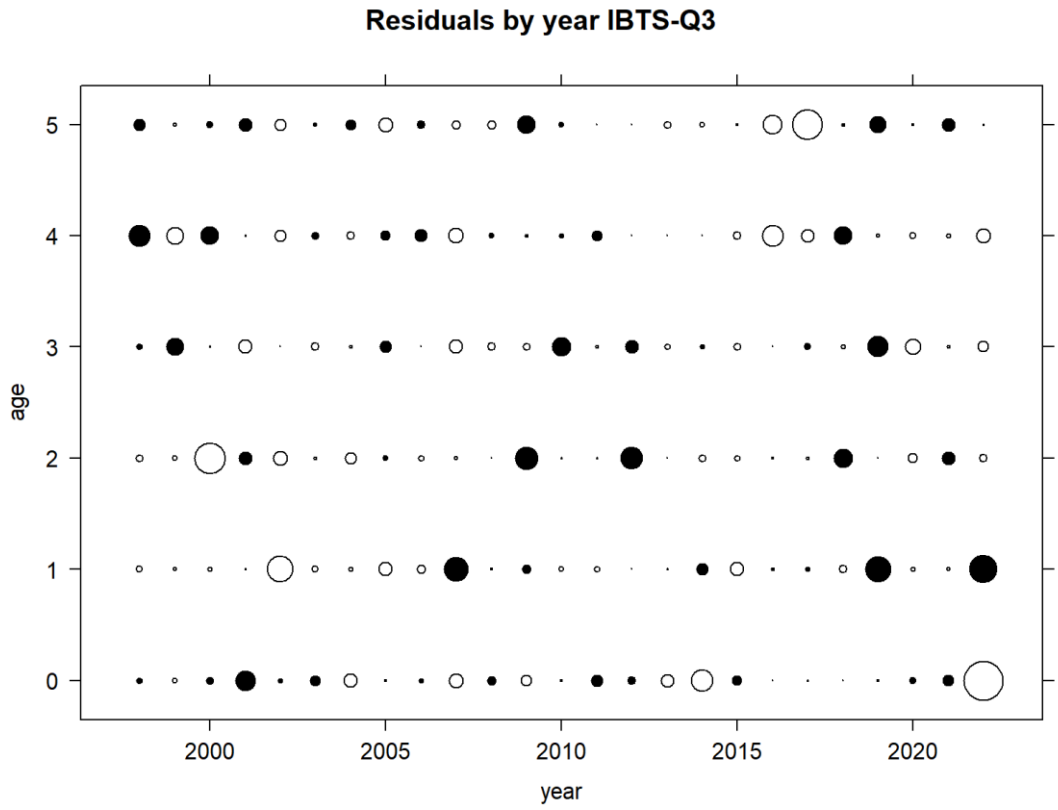


Figure 2.6.2.5. North Sea herring. Bubble plot of standardized IBTSQ3 residuals at age.

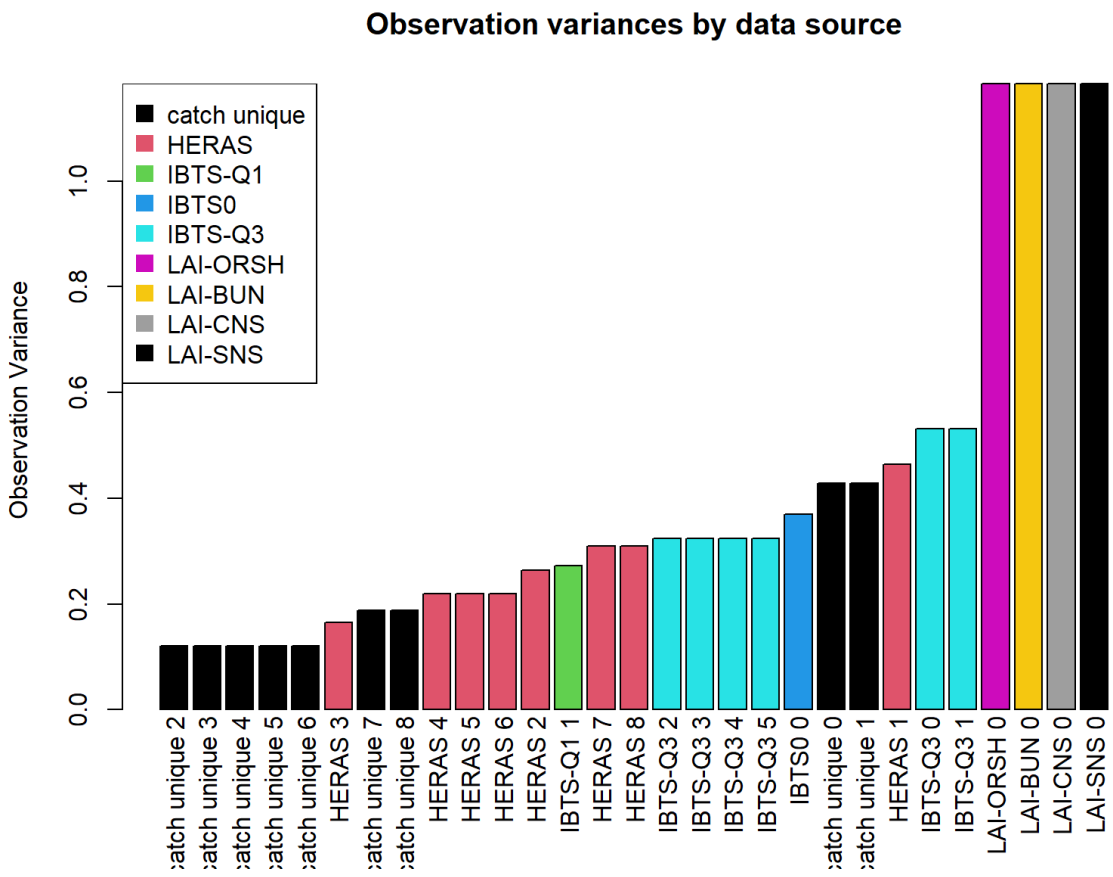


Figure 2.6.2.6. North Sea herring. Observation variance by data source as estimated by the assessment model. Observation variance is ordered from least (left) to most (right). Colours indicate the different data sources. Observation variance is not individually estimated for each data source thereby reducing the parameters needed to be estimated in the assessment model. In these cases of parameter bindings, observation variances have equal values.

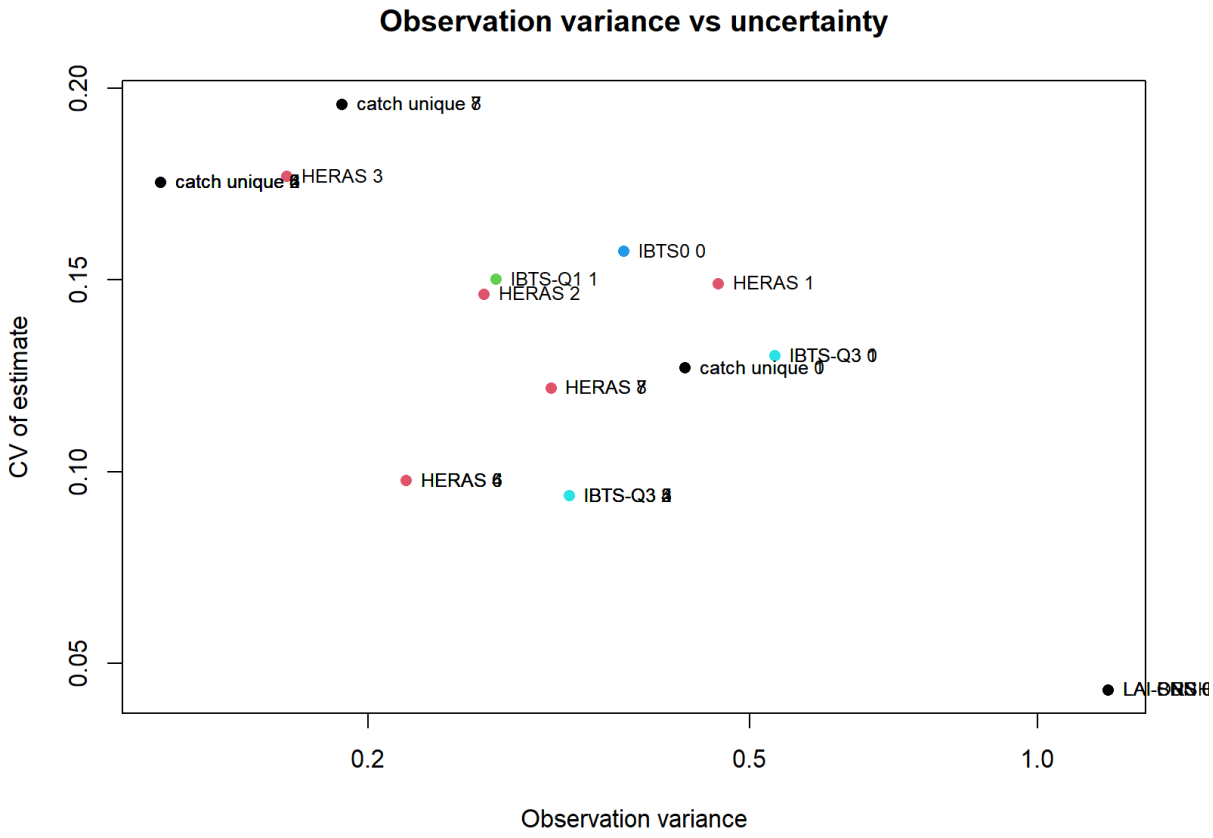


Figure 2.6.2.7. North Sea herring. Observation variance by data source as estimated by the assessment model plotted against the CV estimate of the observation variance parameter.

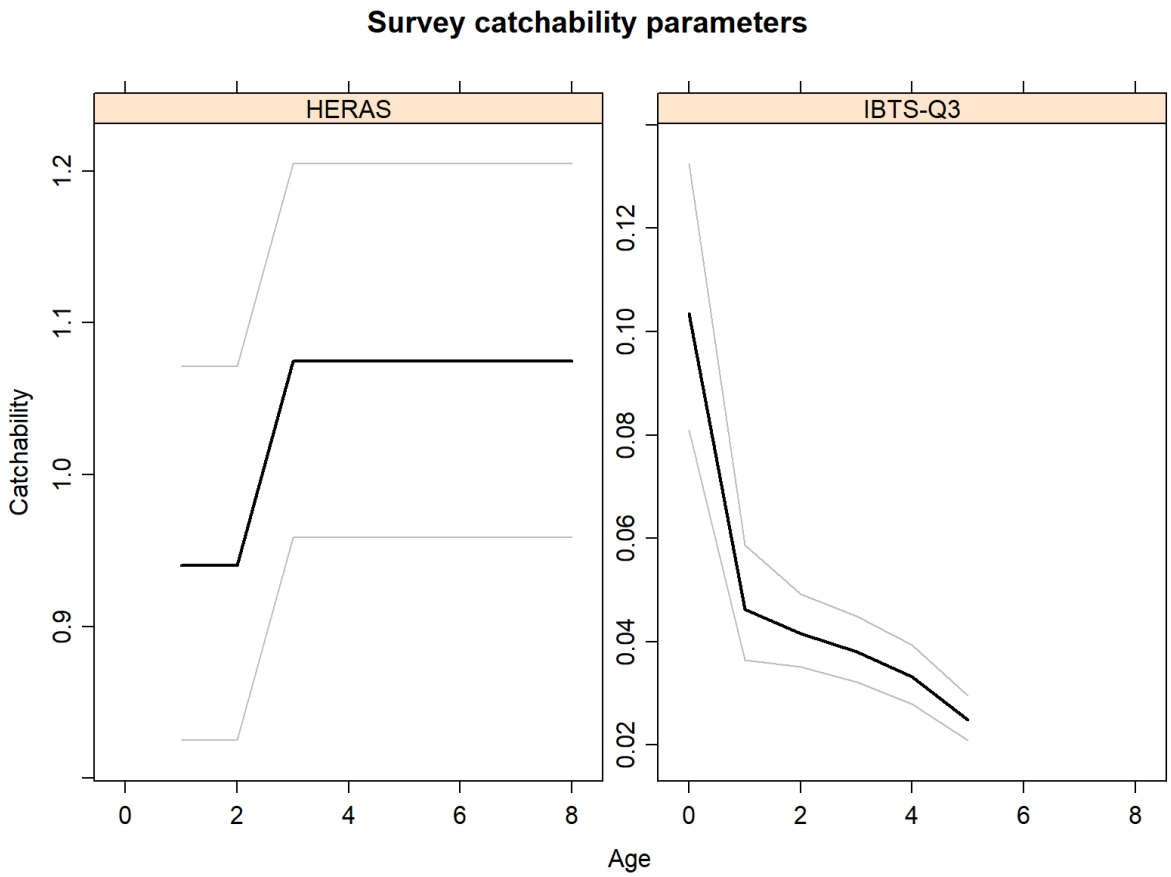


Figure 2.6.2.8. North Sea herring. Catchability at age for the HERAS and IBTSQ3 surveys.

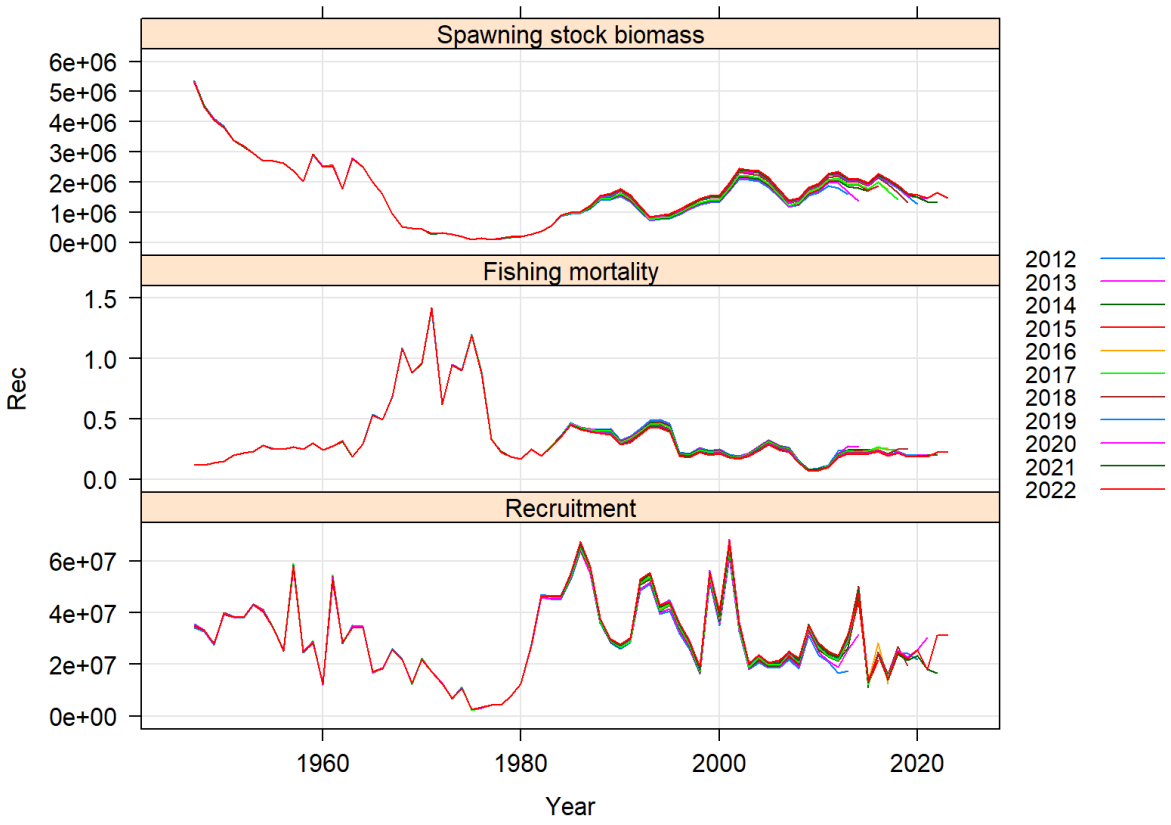


Figure 2.6.2.9. North Sea herring. Assessments retrospective pattern of SSB (top panel) F (middle panel) and recruitment (bottom panel).

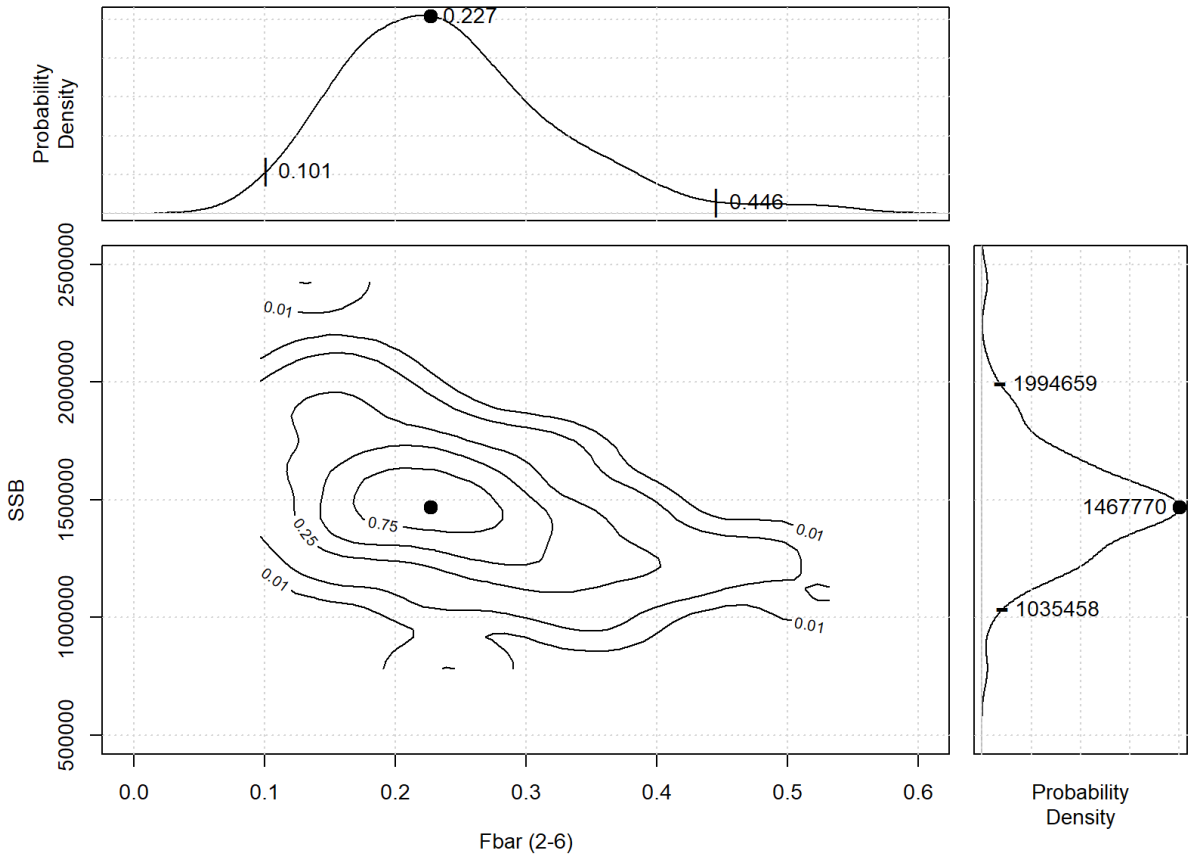


Figure 2.6.2.10. North Sea herring. Model uncertainty; distribution and quantiles of estimated SSB and F2-6 in the terminal year of the assessment. Estimates of precision are based on a parametric bootstrap from the FLSAM estimated variance/covariance estimates from the model.

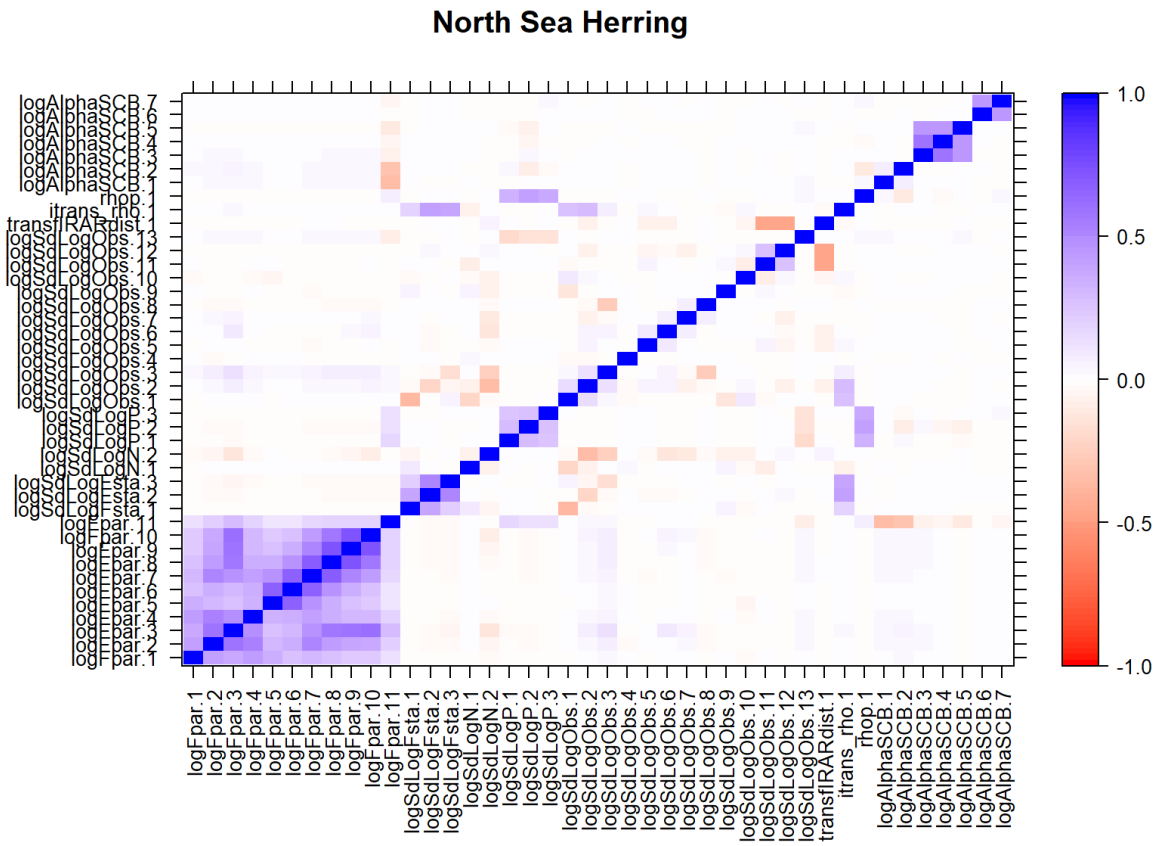


Figure 2.6.2.11. North Sea herring. Correlation plot of the FLSAM assessment model with the final set of parameters estimated in the model. The diagonal represents the correlation with the data source itself.

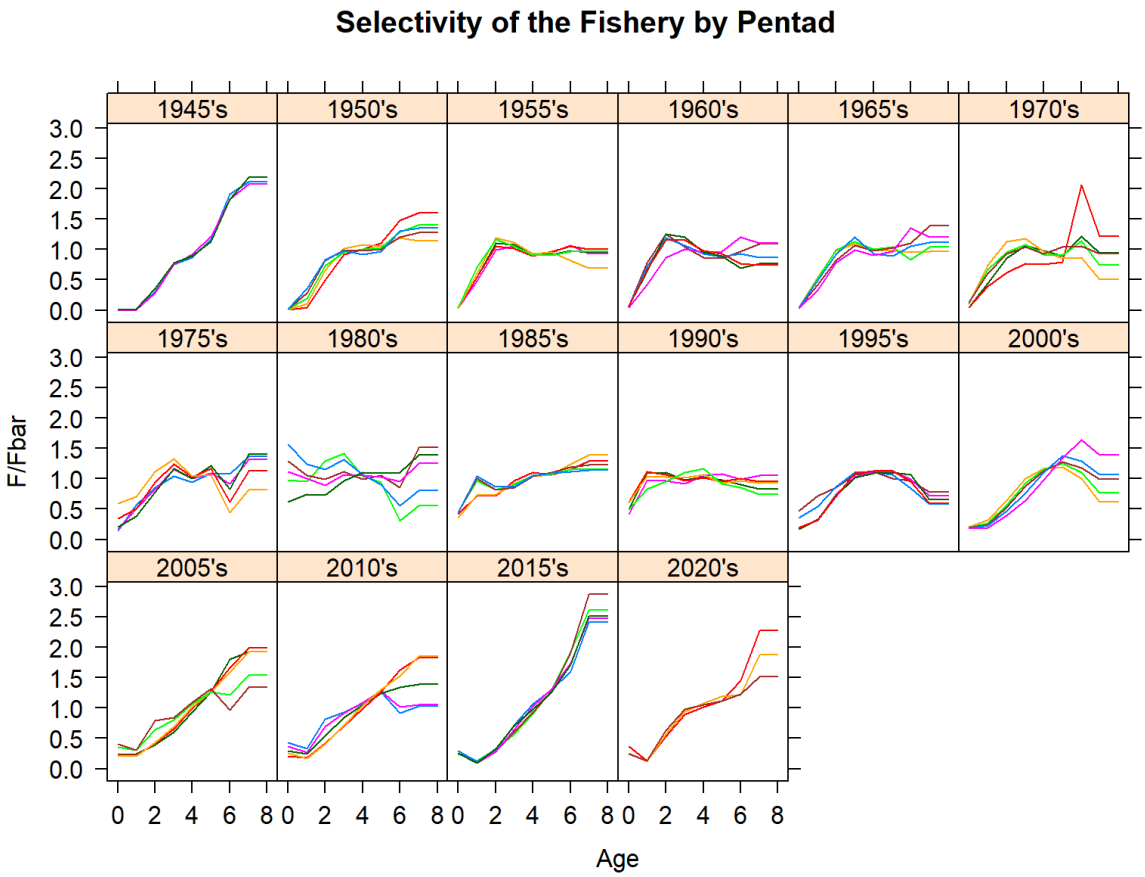


Figure 2.6.2.12. North Sea herring. Fishing selectivity by pentad.

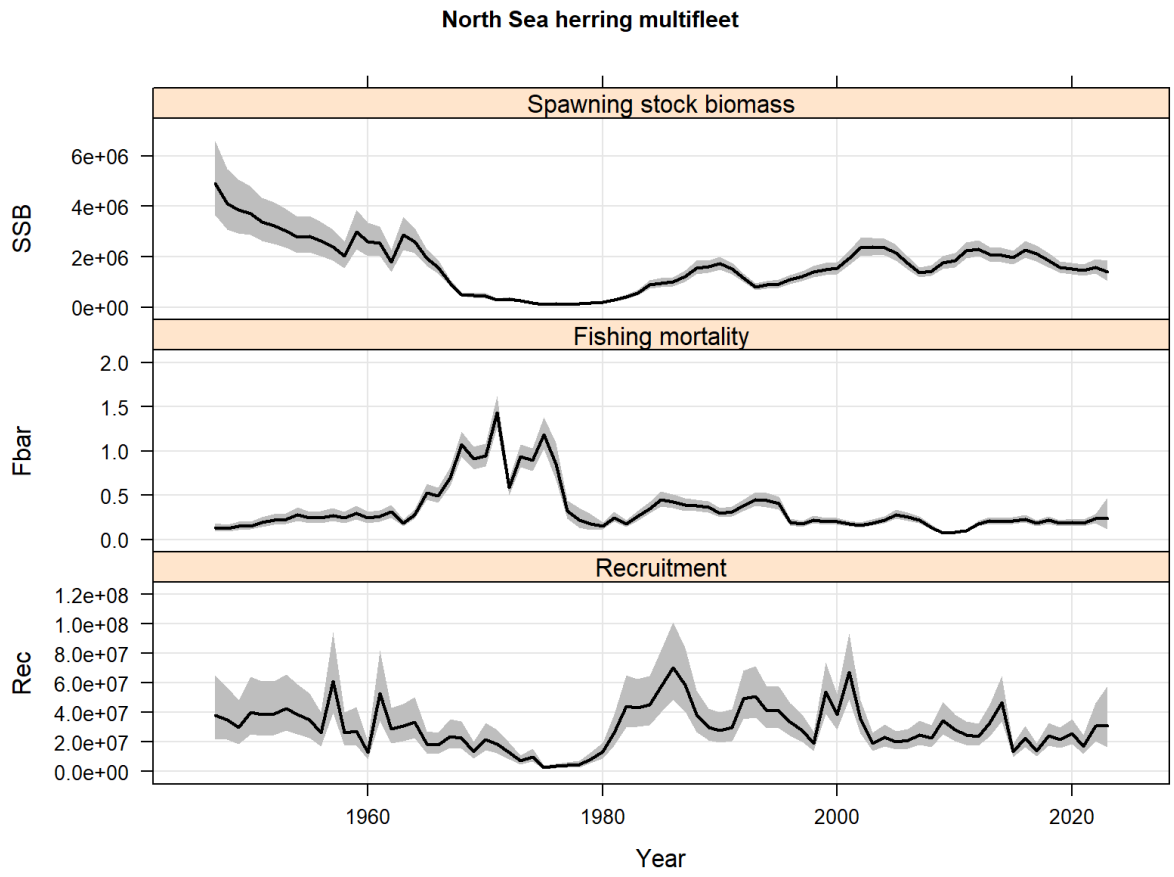


Figure 2.6.3.1 North Sea herring multi-fleet model. Stock summary plot with associated uncertainty for SSB (top panel), F ages 2–6 (middle panel) and recruitment (bottom panel).

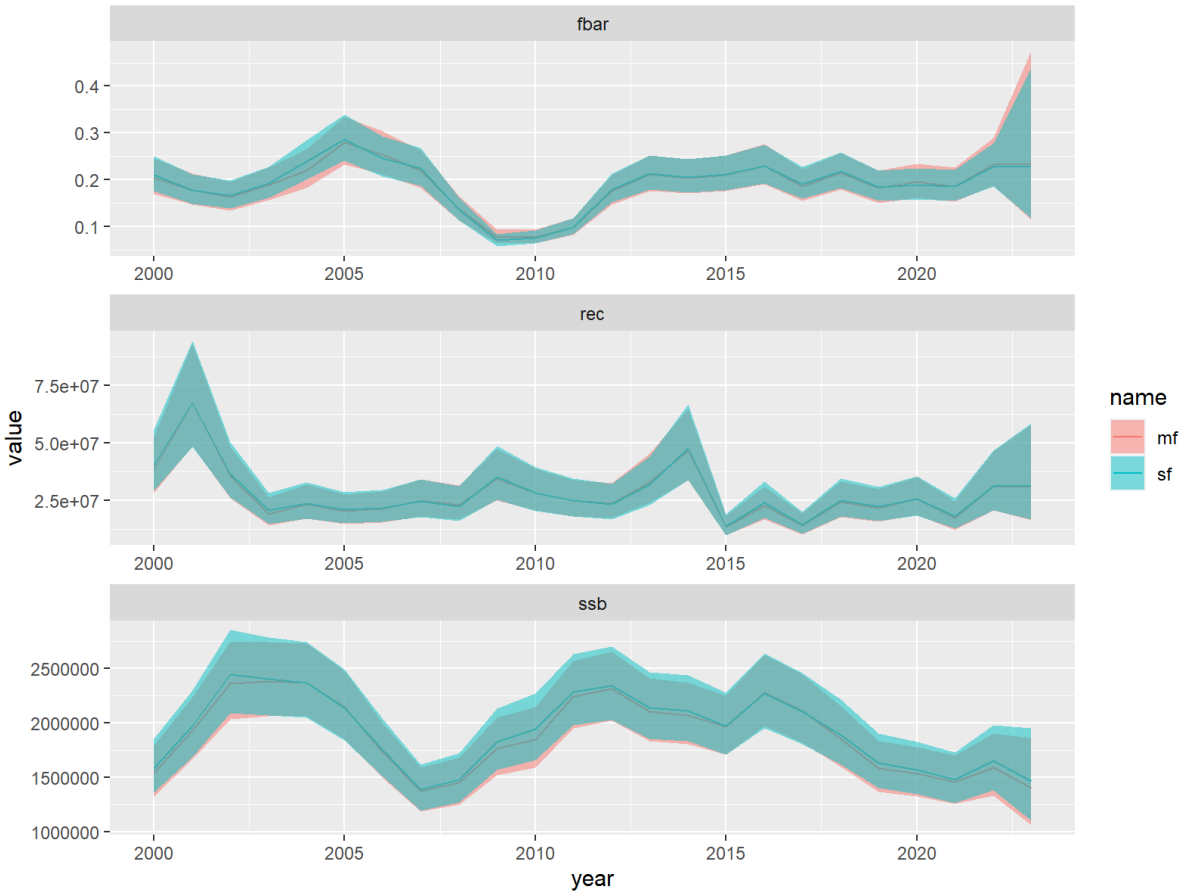


Figure 2.6.3.2 North Sea herring multi-fleet model. Comparison between single fleet and multi-fleet assessment models for SSB (top panel), F ages 2–6 (middle panel) and recruitment (bottom panel).

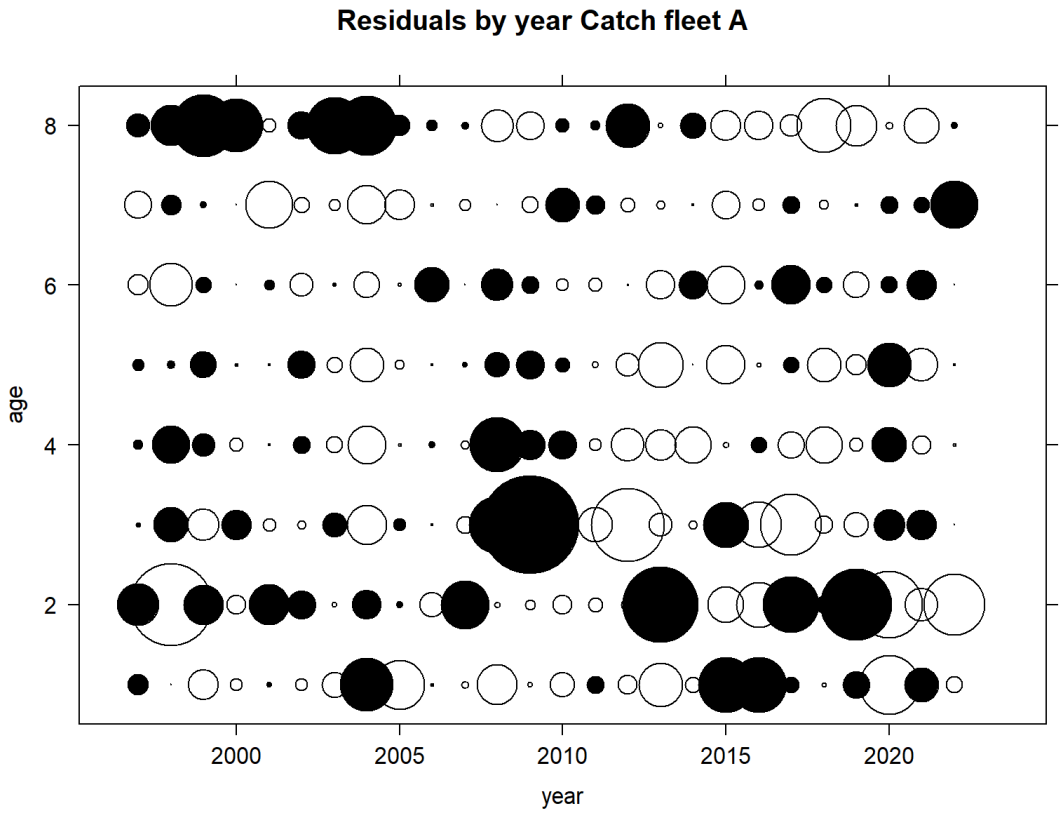


Figure 2.6.3.3. North Sea herring multifleet assessment model. Bubble plot of standardized residuals for catches of fleet A.

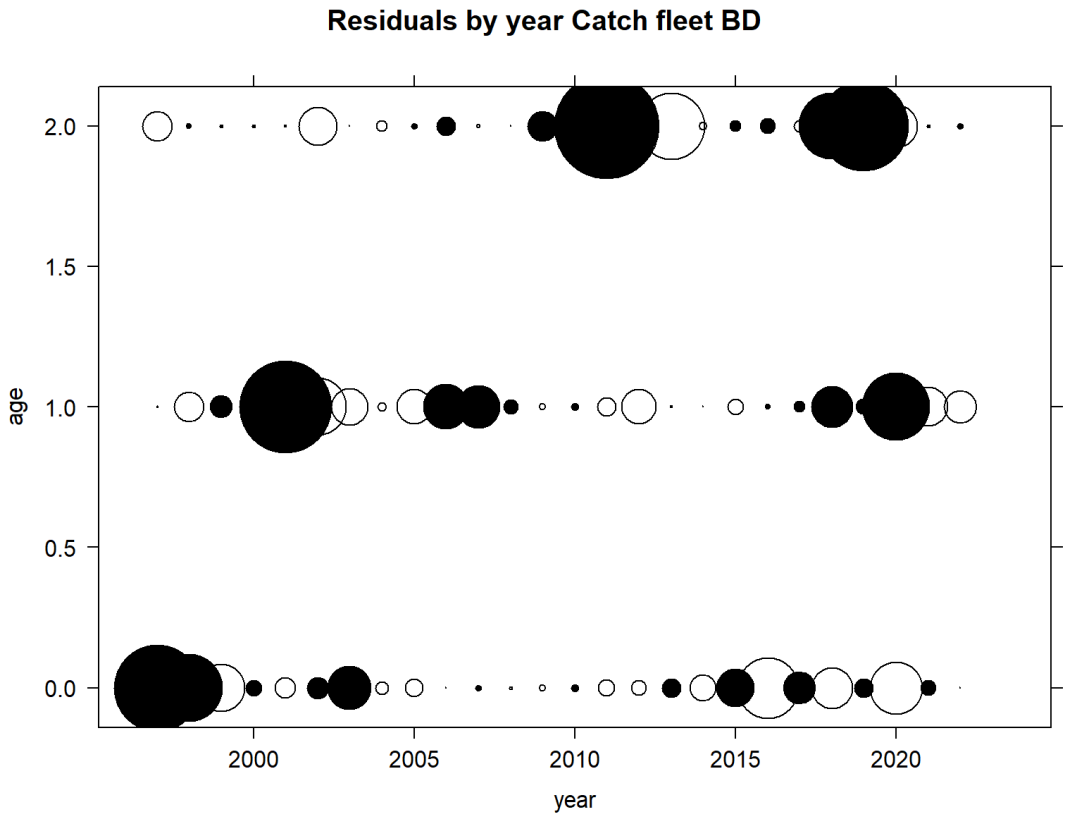


Figure 2.6.3.4. North Sea herring multifleet assessment model. Bubble plot of standardized residuals for catches of fleet B&D.

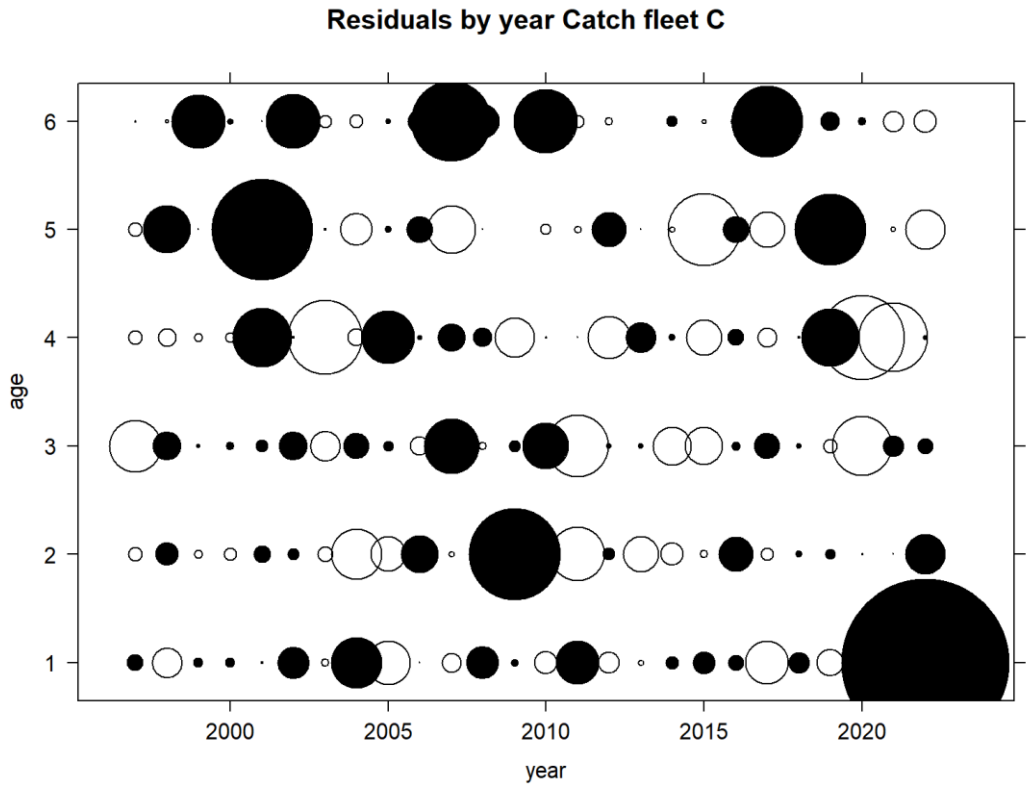


Figure 2.6.3.5. North Sea herring multifleet assessment model. Bubble plot of standardized residuals for catches of fleet C.

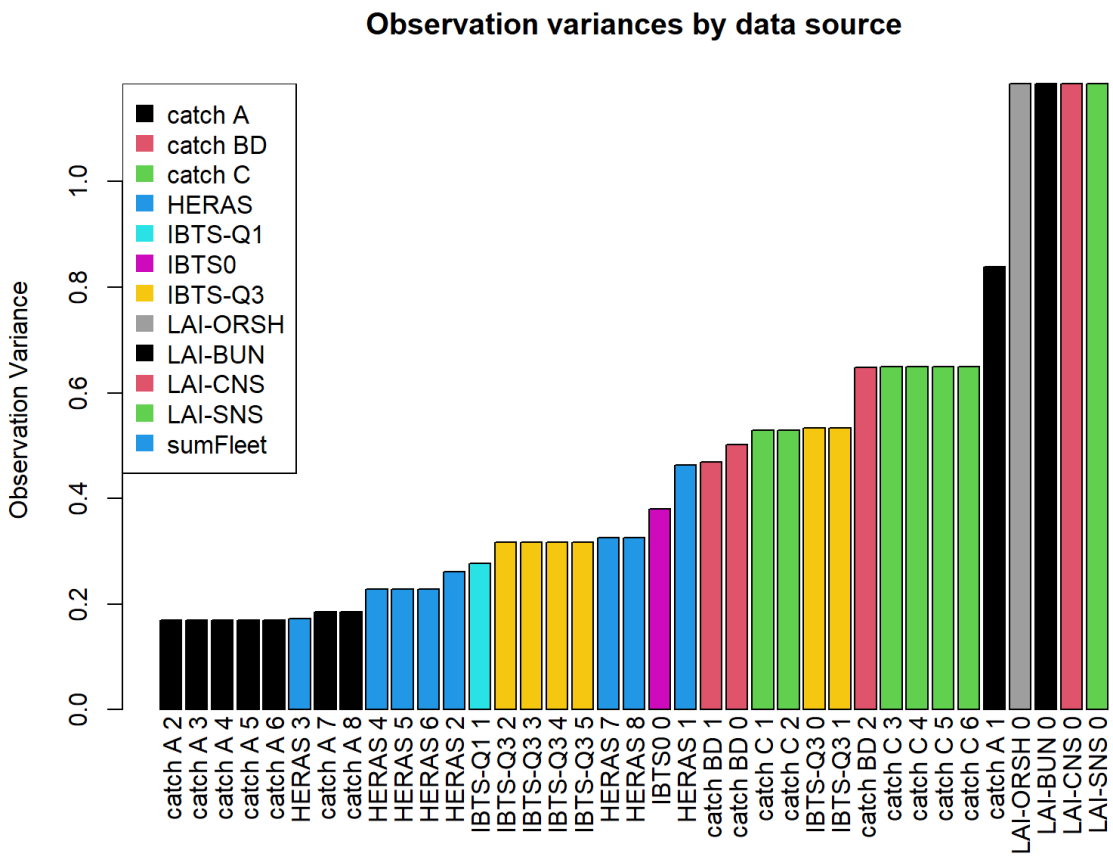


Figure 2.6.3.6. North Sea herring multifleet assessment model. Observation variance by data source as estimated by the assessment model. Observation variance is ordered from least (left) to most (right). Colours indicate the different data sources. Observation variance is not individually estimated for 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.

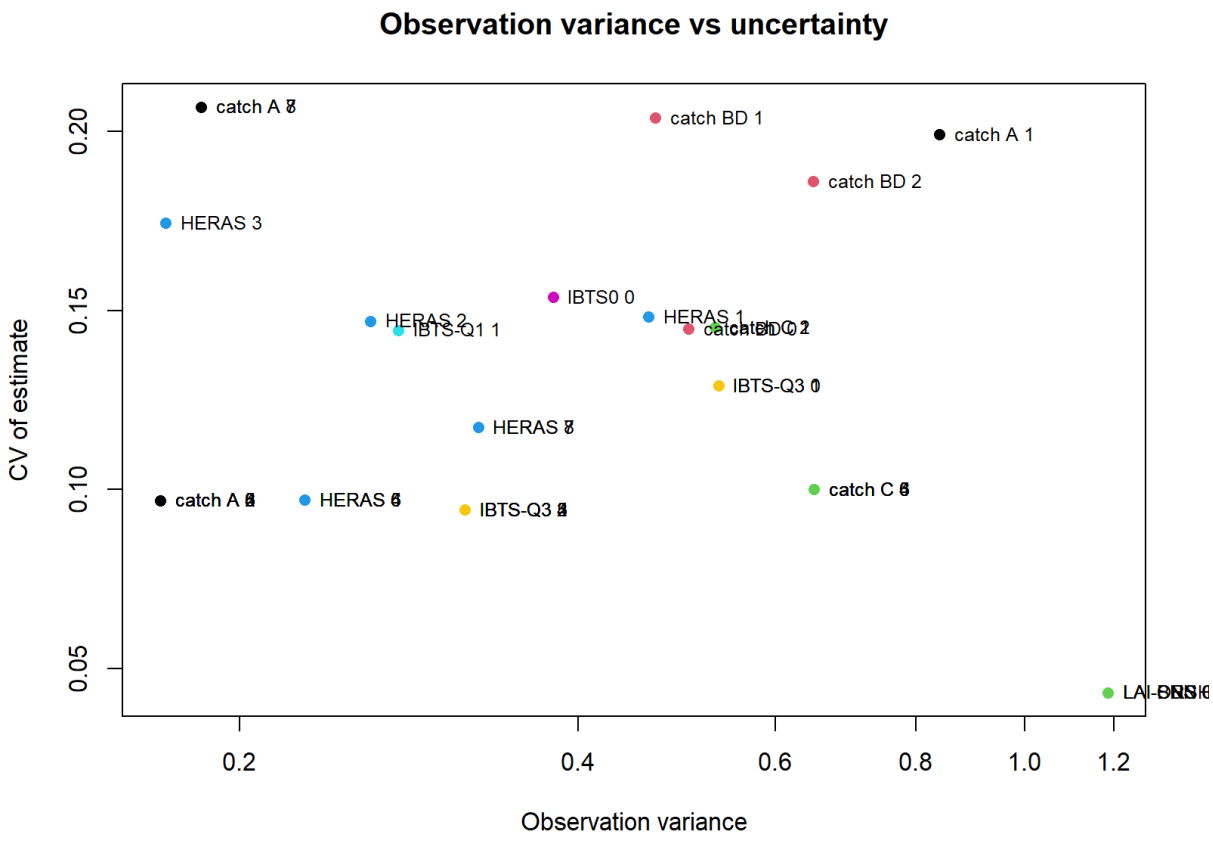


Figure 2.6.3.7. North Sea herring multifleet assessment model. Observation variance by data source as estimated by the assessment model plotted against the CV estimate of the observation variance parameter.

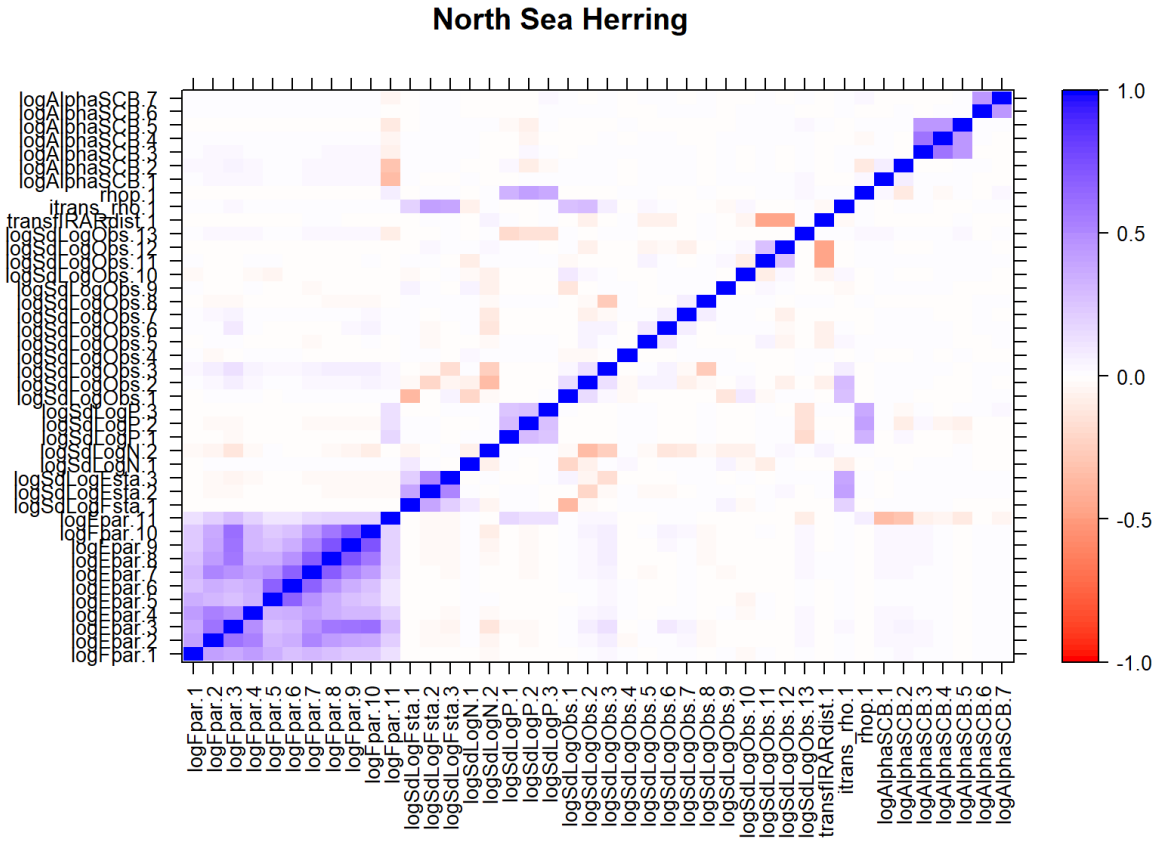


Figure 2.6.3.8. North Sea multifleet assessment model. Correlation plot of the FLSAM assessment model with the final set of parameters estimated in the model. The diagonal represents the correlation with the data source itself.

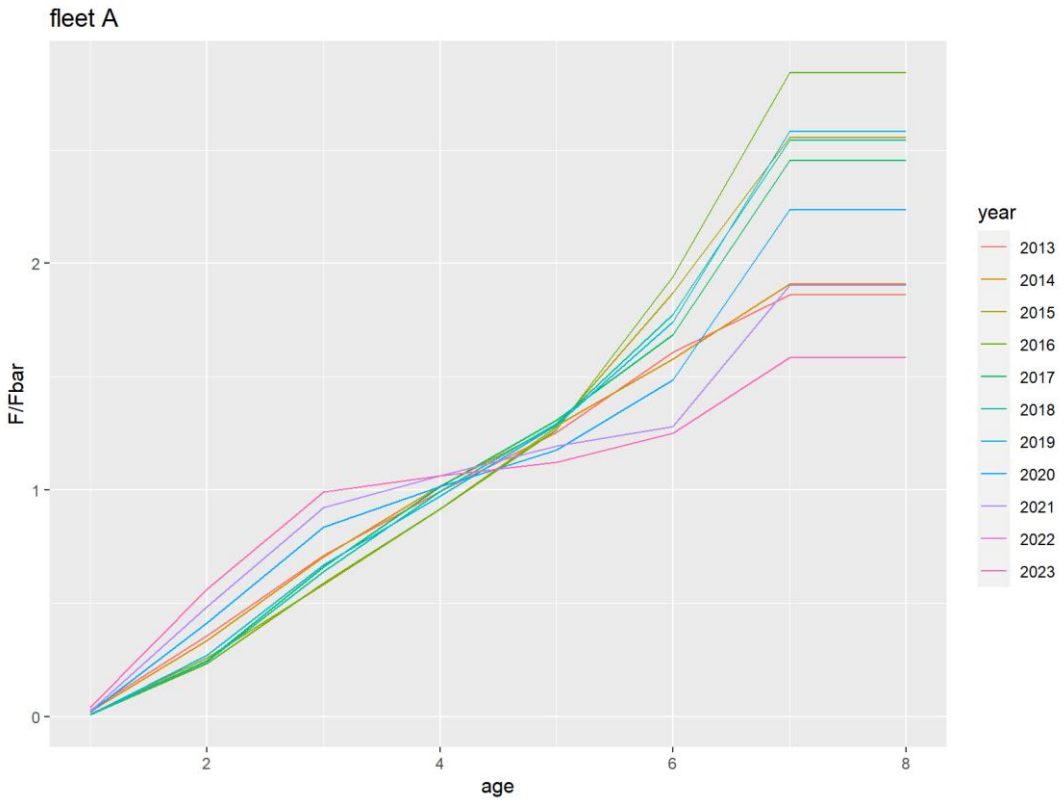


Figure 2.6.3.9. North Sea herring multifleet assessment model. Fishing selectivity fleet A.

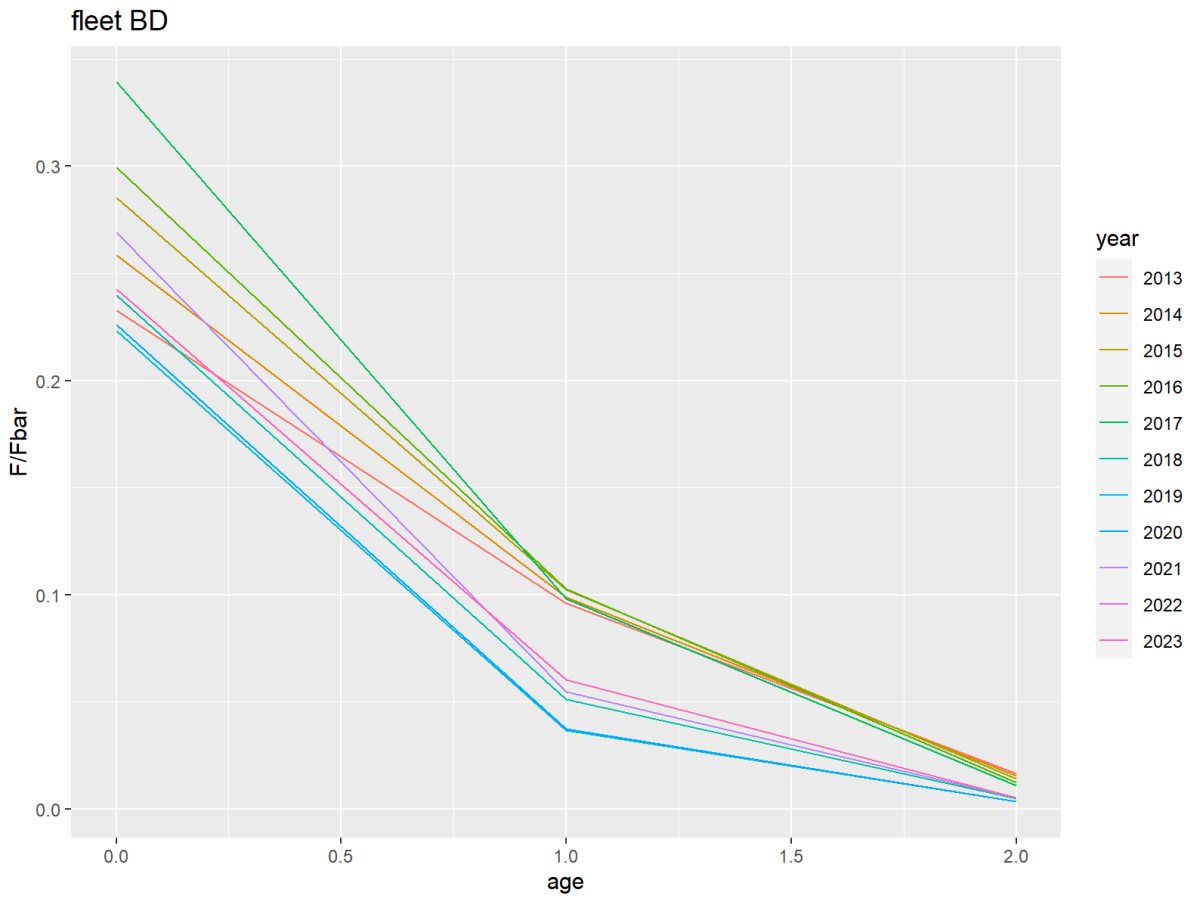


Figure 2.6.3.10. North Sea herring multifleet assessment model. Fishing selectivity fleet B and D combined.

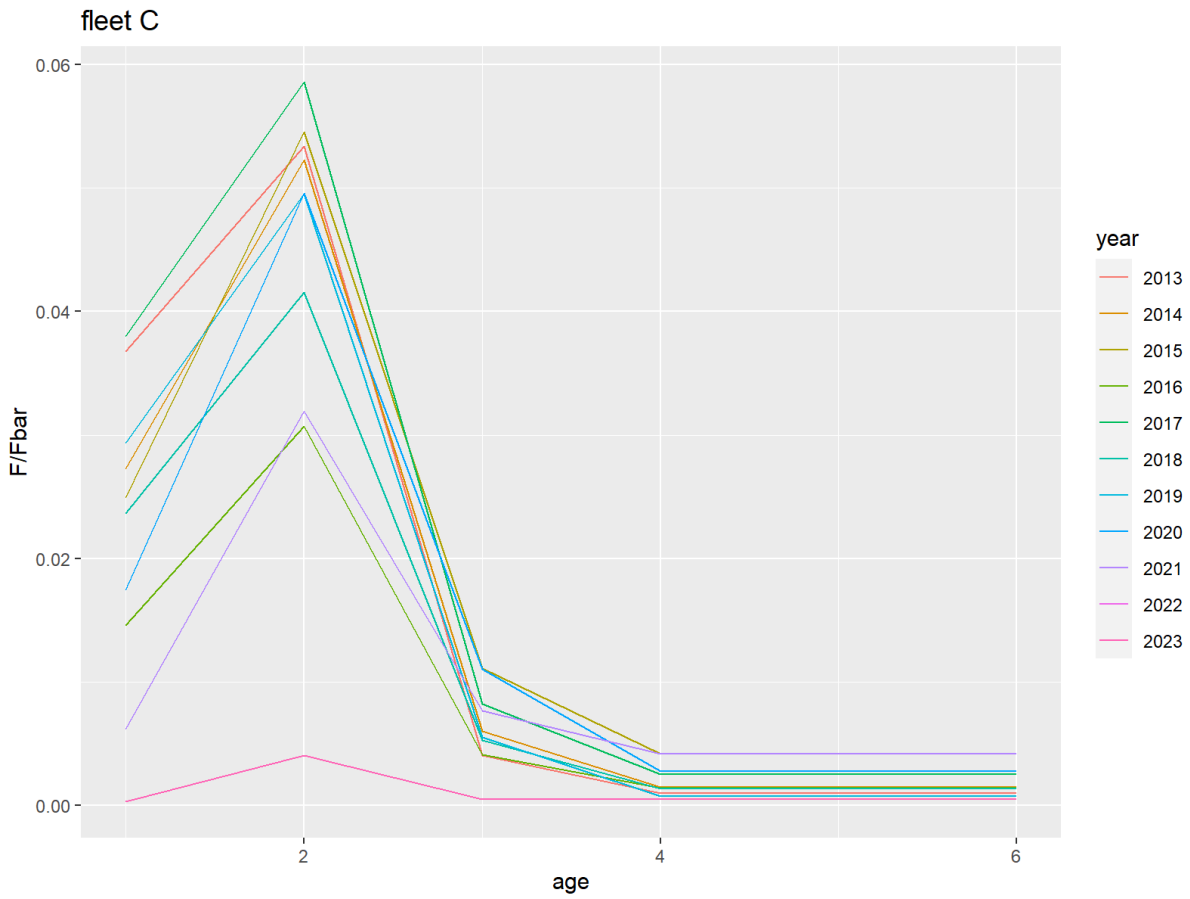


Figure 2.6.3.11. North Sea herring multifleet assessment model. Fishing selectivity fleet C.

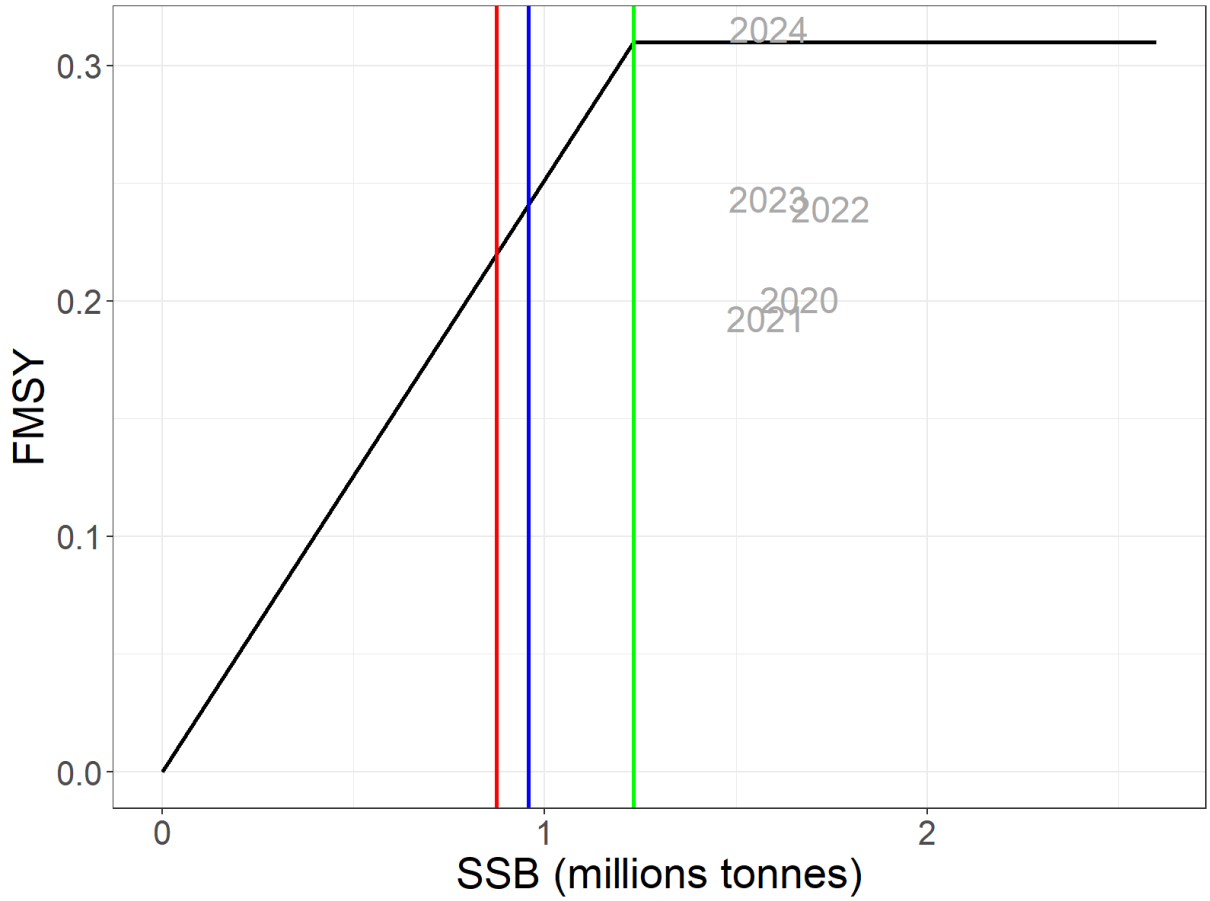


Figure 2.7.1.1. North Sea herring. FMSY advice rule and SSB/Fbar data point since 2020.

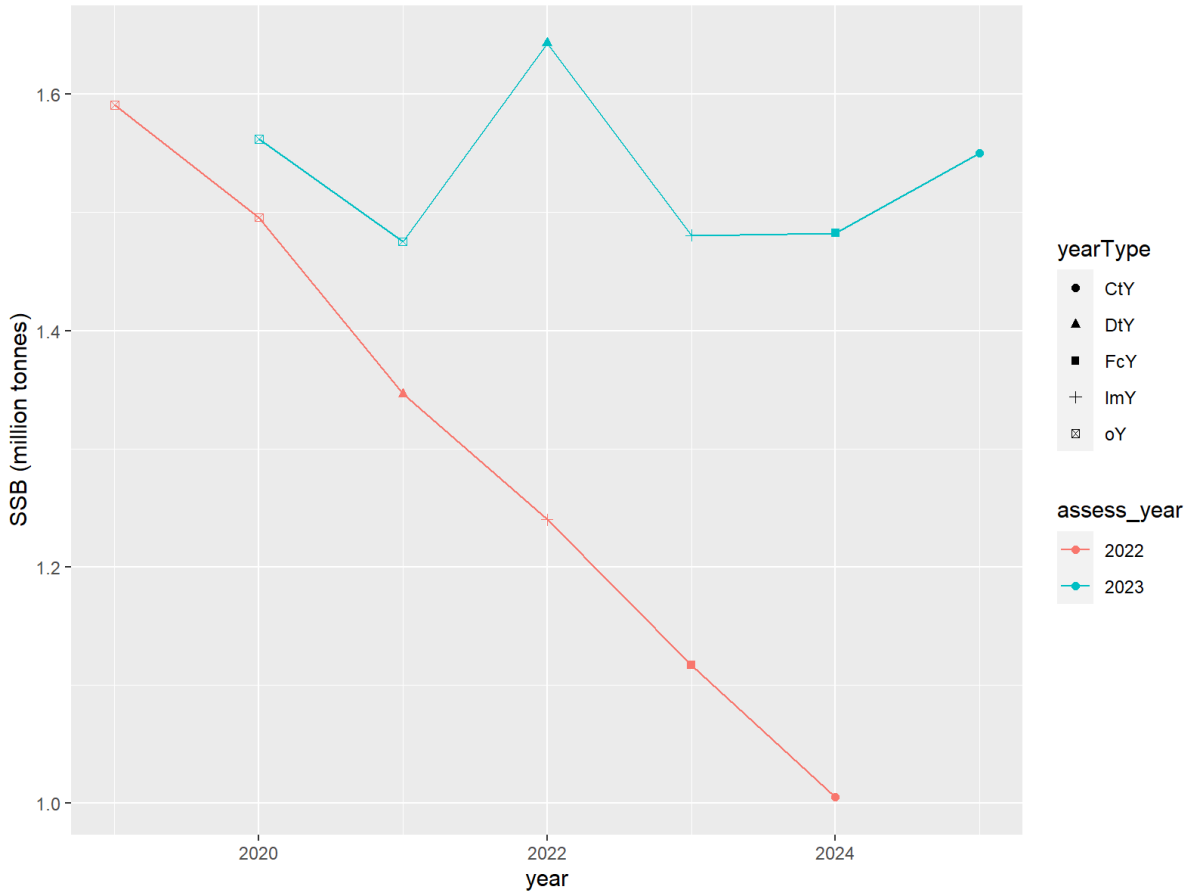


Figure 2.7.2.1. North Sea herring. comparison of SSB trajectory between short term forecasts applied to HAWG2021 and HAWG2022 data. oY: old years (prior to data year). DtY: data year. ImY: intermediate year. FcY: forecast year. CtY: continuation year.

Figure 2.7.2.2. North Sea Herring. Realized and projected catch (in weight) by age (wr) between 2021 assessment (2022 as forecast year), 2022 assessment (2023 as forecast year) and 2023 assessment (2024 as forecast year).

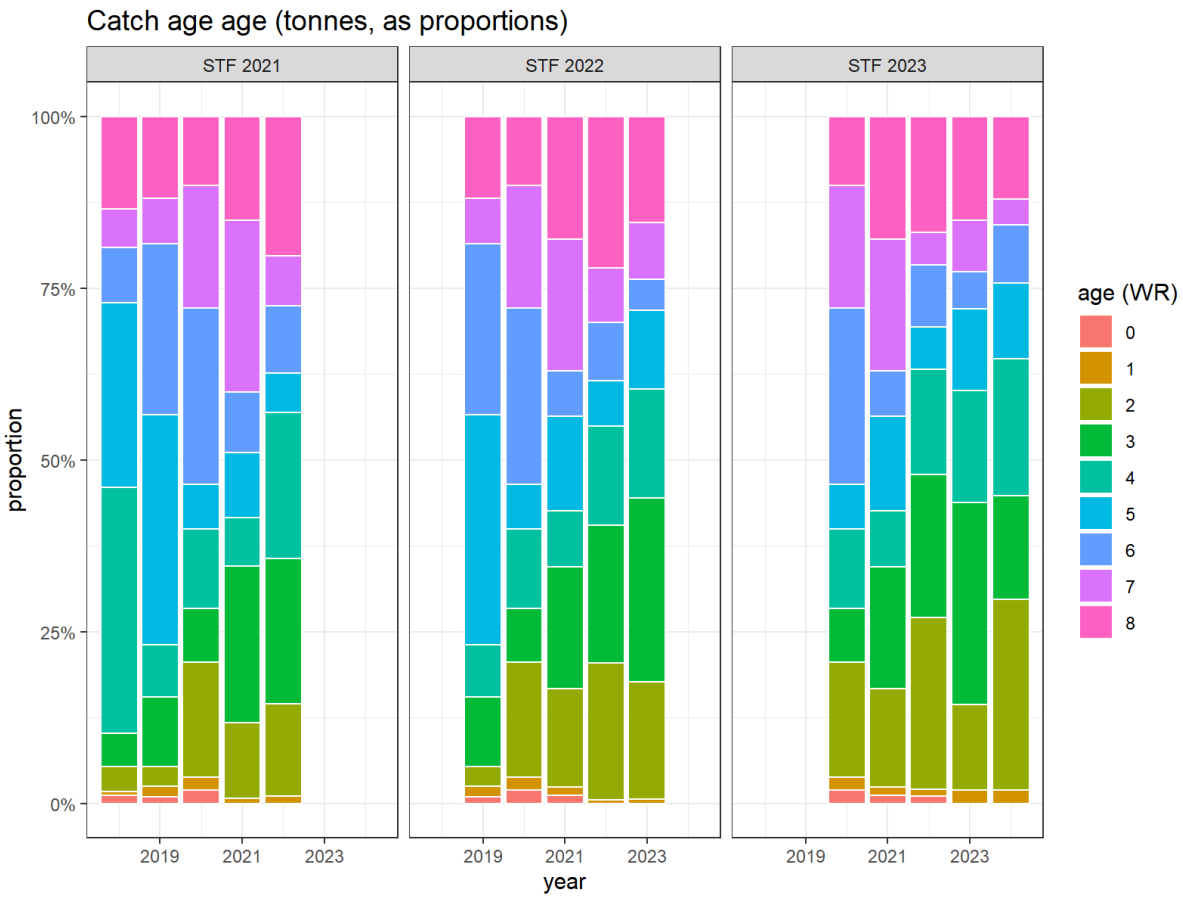


Figure 2.7.2.3. North Sea Herring. Catch proportions for the different ages between the 2021 short-term forecast (2022 as forecast year), 2022 short-term forecast (2023 as forecast year) and 2023 short term forecast (2024 as forecast year).

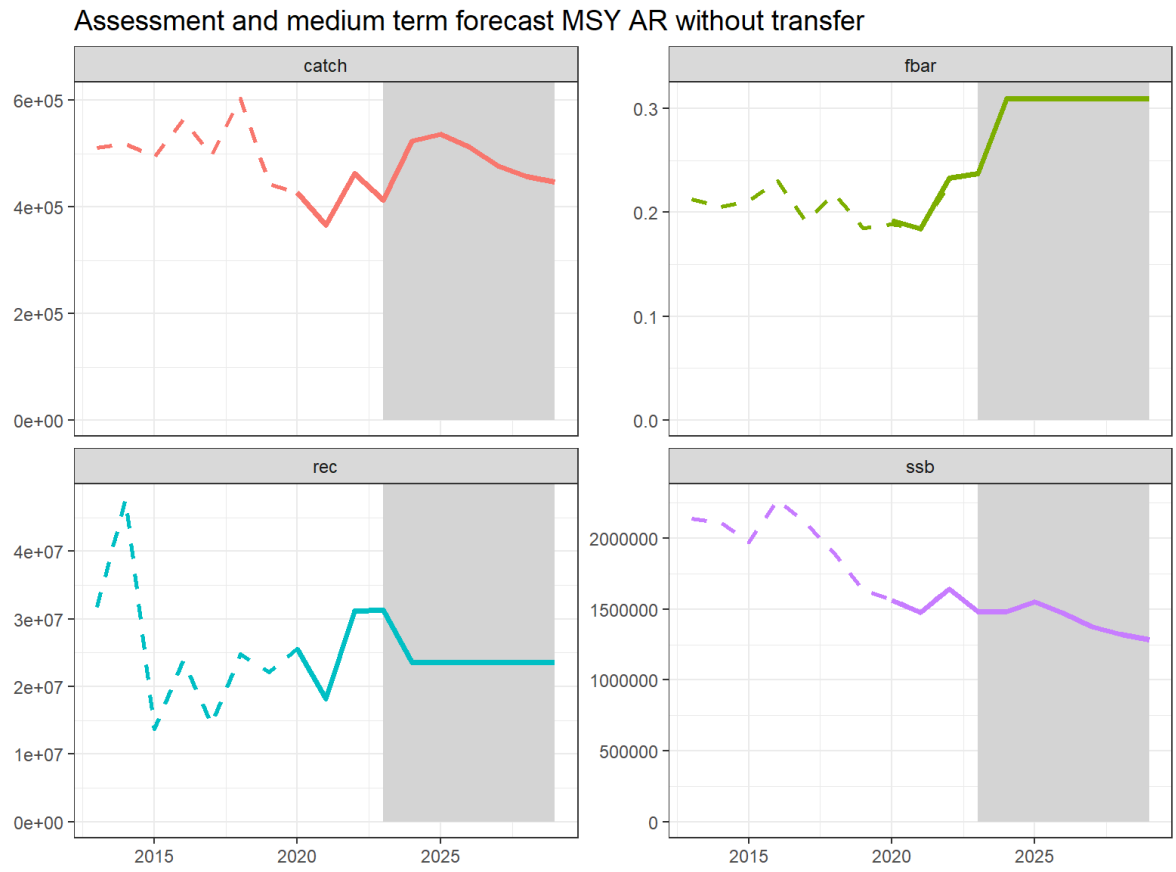
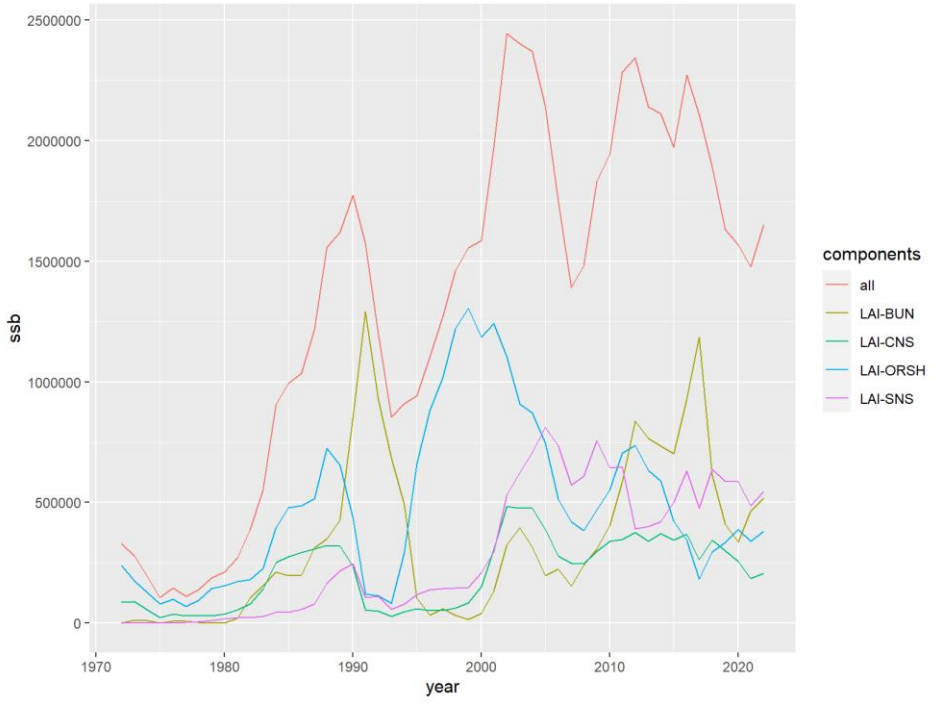


Figure 2.7.2.4. North Sea Herring. Short-term projections using an F status quo from TAC year (i.e., advice year). Intermediate year is in 2023 and the TAC year is 2024.



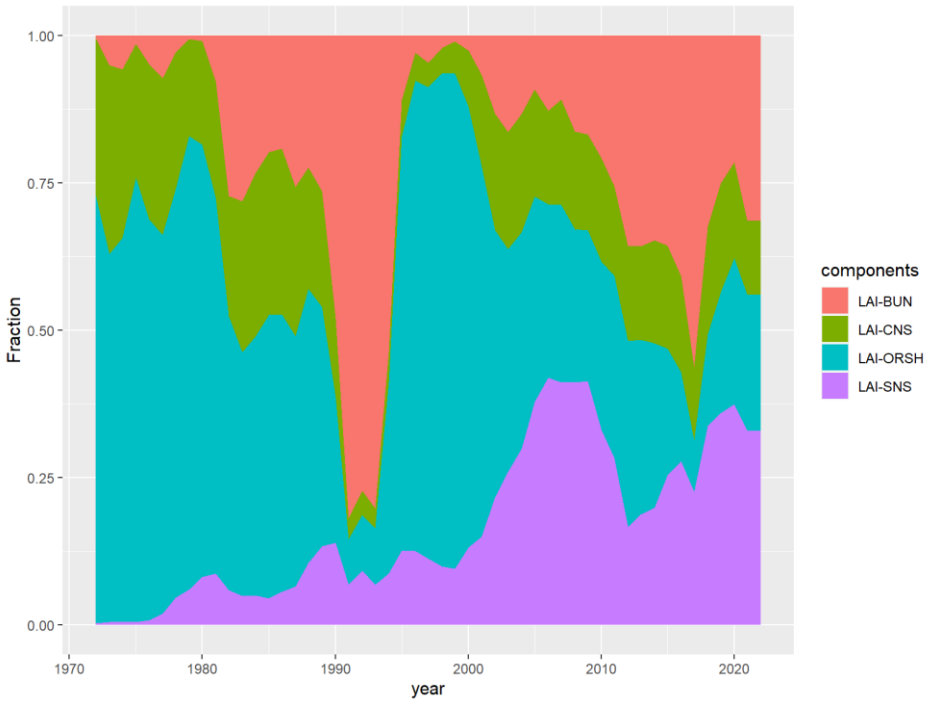


Figure 2.11.1. North Sea herring. Time-series of spawning-stock biomass of each component (top), and contribution of each component to the total stock (bottom; Payne, 2010) as estimated from the LAI index Areas are arranged from top to bottom according to the south-to-north arrangement of the components.

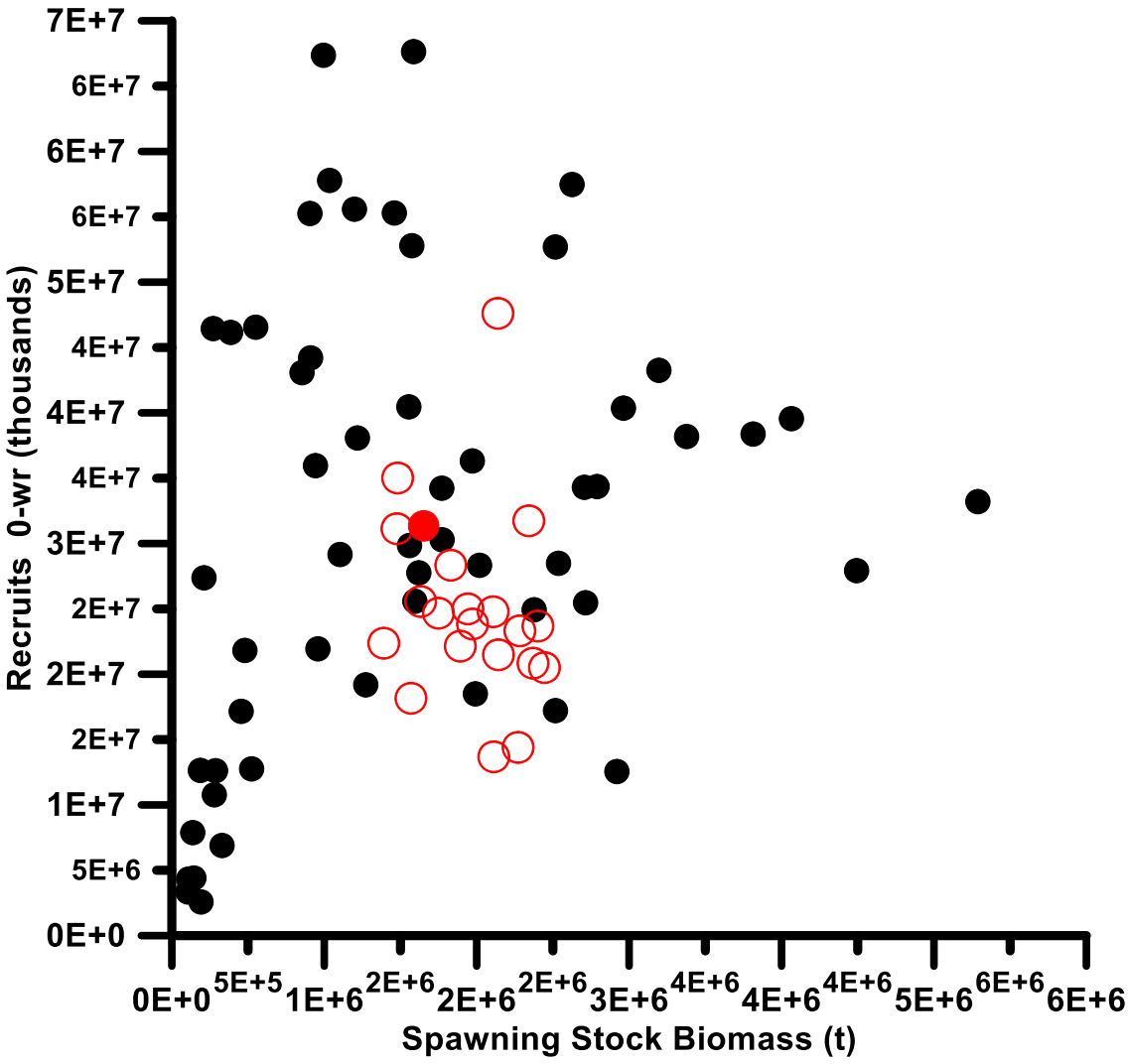


Figure 2.13.1. North Sea Autumn Spawning Herring stock recruitment curve, plotting estimated spawning-stock biomass against the resulting recruitment. Year classes spawned after 2001 are plotted with open red circles, to highlight the years of recent low recruitment. The most recent year class is plotted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

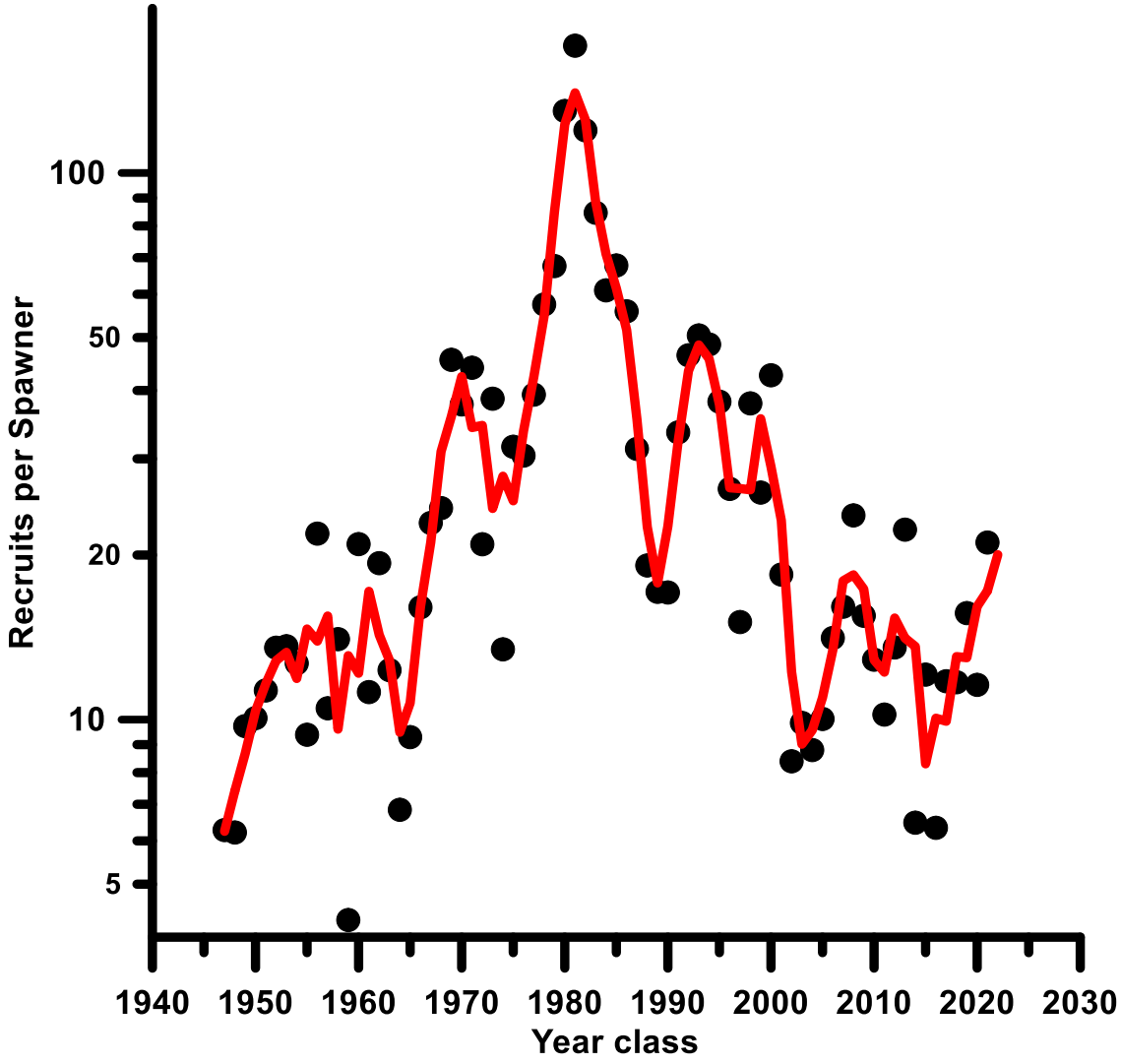


Figure 2.13.2. North Sea Autumn Spawning Herring time-series of recruits per spawner (RPS). RPS is calculated as the estimated number of recruits from the assessment divided by the estimated number of mature fish at the time of spawn- ing and is plotted against the year in which spawning occurred. Black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

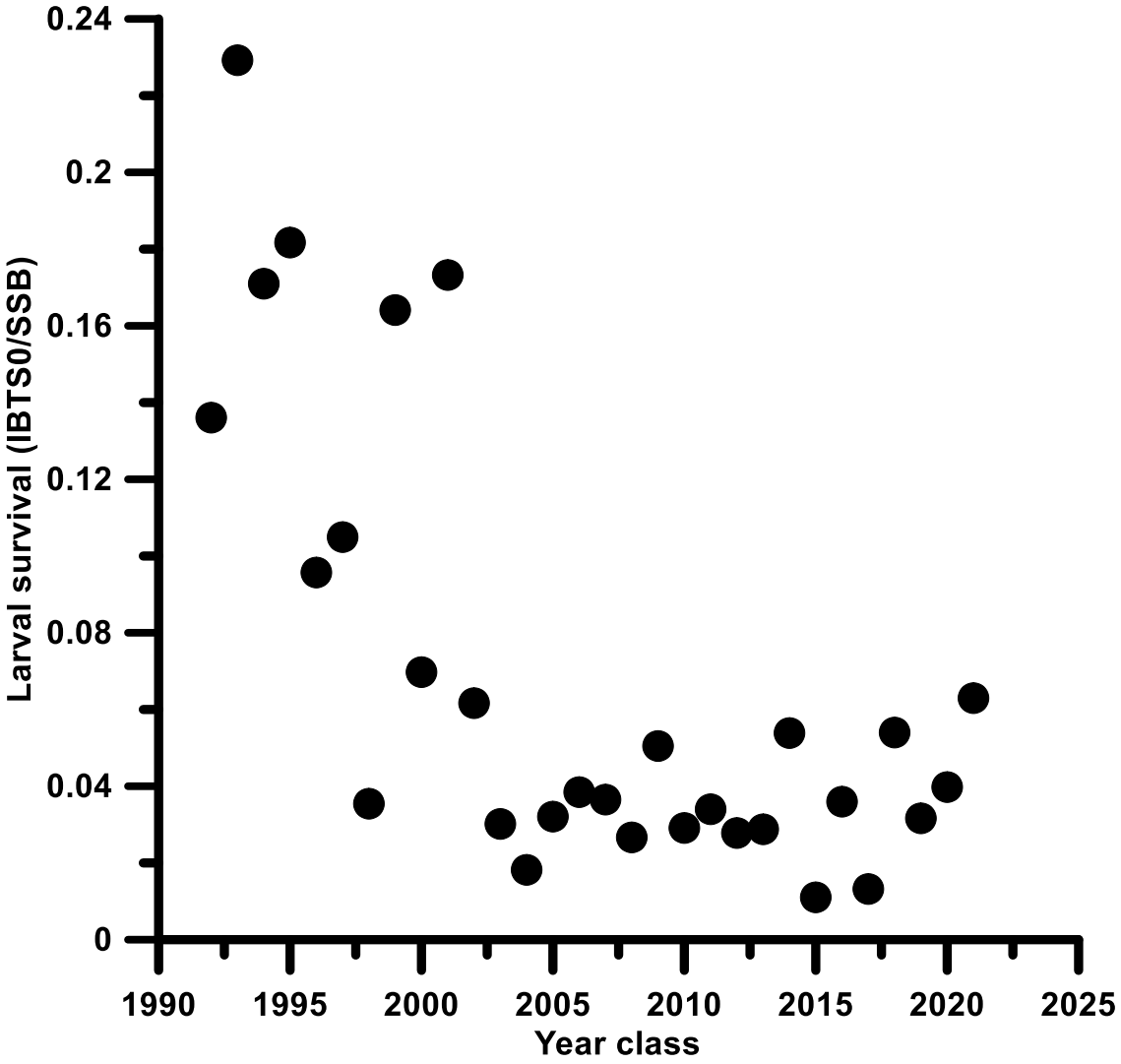


Figure 2.13.3. North Sea Autumn Spawning Herring time-series of larval survival ratio (Dickey-Collas & Nash, 2005; Payne *et al.,* 2009), defined as the ratio of the SSB larval index (representing larvae less than 10–11 mm) and the IBTS0 index (representing the late larvae, > 18 mm). Survival ratio is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

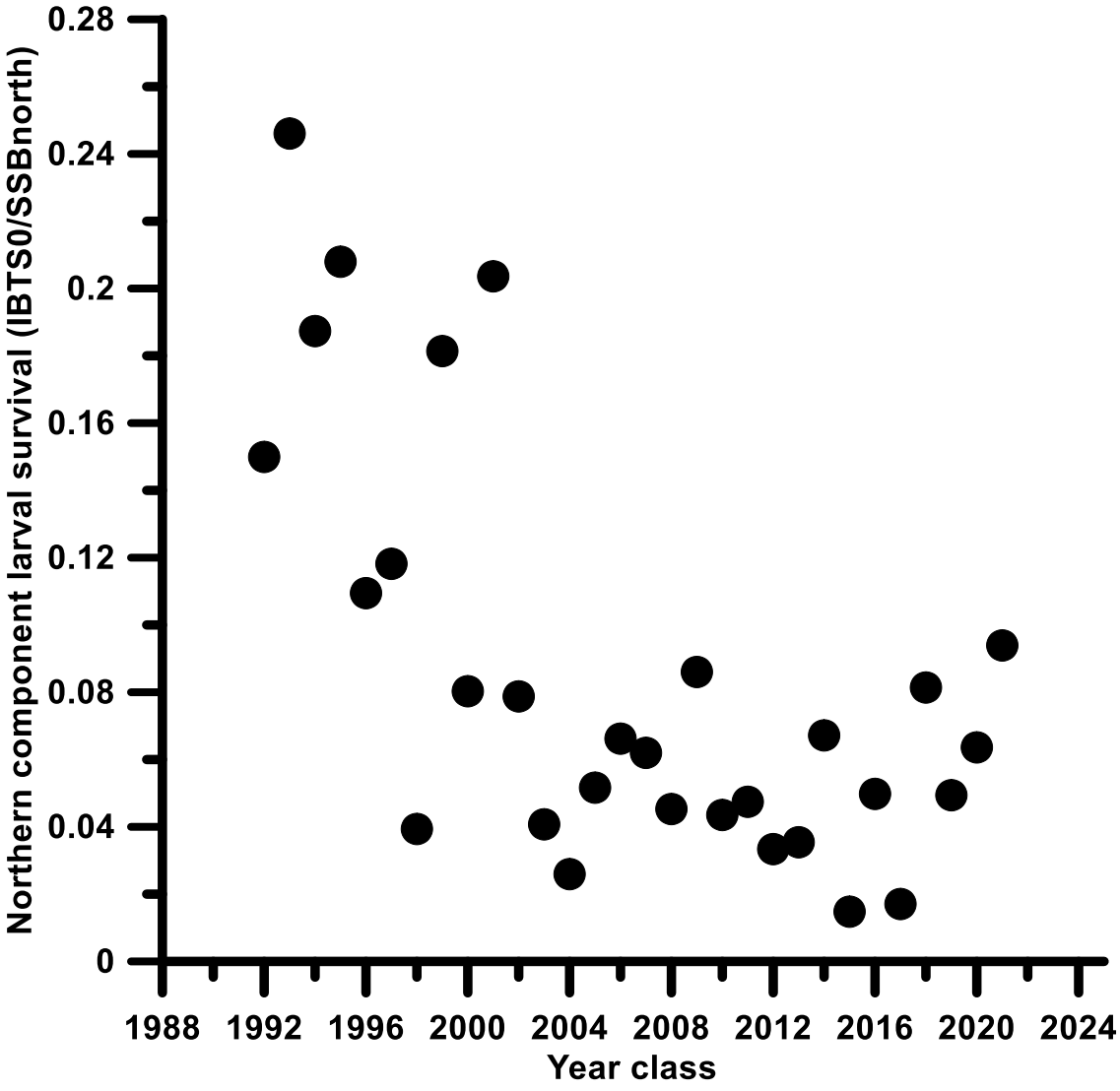


Figure 2.13.4. North Sea Autumn Spawning Herring time-series of larval survival ratio (Dickey-Collas & Nash, 2005; Payne *et al.,* 2009) for the northern-most spawning components (Banks, Buchan, Orkney-Shetland), defined as the ratio of the sum of the larvae indices for these components (representing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