Contents

33 Sole (*Solea solea*) in Division 7.f and 7.g (Bristol Channel, Celtic Sea)

Type of assessment in 2024

This assessment is an update assessment.

ICES advice applicable to 2024

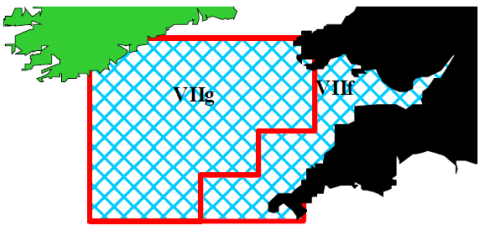
ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 1267 tonnes.

Comments made by the audit of last year's assessment

No major deficiencies for the sole assessment in the Celtic Sea were reported.

33.1 General

Stock description and management units.



The sole fisheries in the Celtic Sea are managed by TAC and technical measures. A TAC is in place for ICES divisions 7.f and 7.g. These divisions correspond to the stock area. The basis for the stock assessment area 7.f and 7.g is described in detail in the Stock Annex.

The agreed TACs in 2023 and 2024 are presented in the text tables below. Technical measures in force for this stock are minimum mesh sizes and minimum conservation reference sizes (MCRS, 25 cm for Belgian vessels from March 11th 2017 onwards, except vessels with engine power <221 kW and/or volume <70 GT). National regulations also restricted areas for certain types of vessels.

Three rectangles in the Celtic Sea (30E4, 31E4 and 32E3, referred to as the "Trevose Box") were closed during the first quarter of 2005, and in February–March each year from 2006 onwards. A derogation has permitted beam trawlers to fish there in March 2005. The effects of this closure have been discussed in previous WGSSDS meetings and ACFM 2007, and evaluated at WKCELT 2014 (ICES, 2014).

33.1.1 Management applicable to 2023 and 2024

The TAC and the national quotas by country for 2023.

Species:	Common sole *Solea solea*	Zone:	7f and 7g (SOL/7FG.)
Belgium	777	Analytical TAC Article 7(2) of this Regulation applies	
France	78		
Ireland	39		
Union	894		
United Kingdom	421		
TAC	1 338		

The TAC and the national quotas by country for 2024.

Species:	Common sole *Solea solea*	Zone:	7f and 7g (SOL/7FG.)
Belgium	730	Analytical TAC	
France	72	Article 7(2) of this Regulation applies	
Ireland	37		
Union	840		
United Kingdom	405		
TAC	1 267		

33.2 Fishery in 2023

An overview of the landings and discard data provided and used by the Working Group (WG) is shown in Table 34.1 and Figure 34.1. The landings have fluctuated over the time-series with higher amounts of around 1500–1600 t in 1986, 2003 and 2020-2022.

In 2023, the WG estimated landings are 1210 t, of which Belgium landed 72.1% (873 t), UK (England and Wales) 20% (242 t), Ireland 3.6% (43.6 t), France 3.4% (41.7 t), and the remainder by Northern Ireland, Spain and Scotland. Discards were estimated to be at 134 t. This catch estimate (1344 t) corresponds to an international overshoot of 0.45% of the agreed TAC in 2023 (1338 t).

In 2023, 87% of the landings and discards were taken by beam trawls, 13% by otter trawls and <1% by other gears.

The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions and are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions creates opportunity for non-compliance and therefore a misreporting analysis was conducted (described in detail in the working document (WD_sol.27.7fg_Belgian landings.docx). The differences between estimated landings and reported landings for the period 2006-2018 are in line with the outcome of the misreporting analysis done within the framework of the WKFlatNSCS in 2020 (ICES, 2020). From 2019 onwards, the difference between estimated and reported landings is within the range of 12.89 - 37.78% and larger than the differences in the period 2008-2018. The Belgian beam trawl landing numbers of sole in ICES divisions 7.f and 7.g in the years 2021 and 2022 were adjusted for under-reporting (Table 34.1) as this follows the same approach (threshold (> 22%)) as the misreporting corrections done in 2020 for the period 2004-2007 as a result of the previous benchmark (ICES, 2020).

33.3 Data

Age-compositions and weights-at-age

InterCatch was used for estimation of both landings and discards numbers and age compositions, as input for the assessment. Belgium, Ireland, France, UK, Spain, Northern Ireland and Scotland have provided data this year under the ICES InterCatch format on a métier basis. Quarterly/yearly data for 2023 were available for landing numbers and weight-at-age, for most of the Belgian, Irish and UK fleets. These comprise 89% of the international landings. Discard weights were available for 74% of the landings. The age coverage for the sampled discards is 100% (rounded value).

If discards were not included for a particular year-quarter-country-métier combination, they are assumed to be unknown (non-zero) and therefore raised (InterCatch). The weighting factor for raising the discards was 'Landings CATON' (landings catch). Discard raising was performed on a gear level regardless of season or country. The following groups were distinguished based on gear:

- TBB
- OTB including OTB, OTT, SSC, SDN
- GTR including GTR and GNS

The remaining gears were combined in a REST group (including MIS, FPO, DRB, LHM, LLS).

The proportion of landings within a gear group for which discard weights are available in 2023 are: GNS/GTR: 3.8%, TBB: 79.3%, OTB/OTT/SSC/SDN: 41.0% and REST: 0%.

Raising within a gear group was performed when the proportion of landings for which discard weights are available was equal or larger than 50% compared to the total landings of that group. For the 2023 data, this was only the case for the TBB gear group. When the threshold was not reached for a gear group, it was pooled with the REST group to raise discards based on all available information.

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and *vice versa*. When age distributions (both landings and discards) had to be borrowed from other strata, allocations were performed on a gear level. The same gear groups (TBB, OTB, GTR and REST) as used for discard raising were applied. In 2023, the proportion of landings covered for age composition is respectively 36.8%, 99.5%, 22.1% and 89.9% for the GNS/GTR, TBB, OTB/OTT/SSC/SDN and REST group. The proportion of landings for which discard age coverage is available is respectively 0%, 79.3%, 5.4% and 0% for the GNS/GTR, TBB, OTB/OTT/SSC/SDN and REST group. When the threshold of 50% was reached for the proportion of landings or discards covered by age, allocation of age occurred with all available information within that gear group. For the 2023 landings, this threshold was reached for the TBB and RESTgroup; for the 2023 discards only for the TBB group. When the threshold was not reached, unsampled data were pooled and ages were allocated using all sampled data. The weighting factor was '*Mean Weight weighted by numbers-at-age*'.

Figure. 33.2 shows the available landings and discards data by country, gear and year.

Raised discard data from InterCatch were available from 2004 onwards. To estimate discard mean weight-at-age and numbers-at-age prior to 2004, a constant ratio of discards to landings by age was applied using data from 2004–2018 (WKFlatNSCS, ICES 2020).

Further details on raising methods are given in the stock annex.

Catch numbers-at-age are given in Table 33.2 and age compositions are plotted in Figures 33.3ab. Weights-at-age in the catch are given in Table 33.3 and Figure 33.4. The standardised catch proportion-at-age is presented in Figure 33.5.

Length-compositions

Annual length compositions for 2023 are given by fleet in Table 33.4 Length distributions of the total Belgian and UK(E&W) landings for the last 23 years are plotted in Figure 33.6. Belgian vessels generally land a greater proportion of small fish compared to the UK(England and Wales).

The length distributions for 2023 of retained and discarded catches of sole by the Belgium beam trawl fleet are presented in Figure 33.7. The Belgian beam trawl fleet mainly discarded fish of 22 and 23 cm. According to the Belgian age–length samples, these fish were mainly age 2.

Discard rate

The discard rate, calculated as the ratio between ICES discard estimates (tonnes) and ICES catch estimates (tonnes), fluctuates around 4% over the years 2004–2017. In 2018 and 2019 the discard rate increased to about 13% (average 2018-2019), whereas in the following 3 years it fell back to about 5% (average 2020-2022). The 2023 discard rate is estimated to be 10.0%.

Biological

The stock weights (Table 33.5 and Figure 33.8) were obtained using the Rivard weight calculator (http://nft.nefsc.noaa.gov./), that conducts a cohort interpolation of the catch weights. The resulting stock weight for age 1 was very variable, and it was decided during the benchmark to set the stock weight of age 1 to the lowest estimated stock weight for age 2 for 1971–2019.

A new maturity ogive was estimated during the WKFlatNSCS (ICES, 2020) using only survey data of the UK(E&W)-Q1SWECOS. Maturity data are available for 2013–2019. The new maturity ogive is calculated with a length-based model with sex-specific ALK. This new ogive indicates that >60% of the 2 and 3-year old individuals are mature, while this was not the case in the maturity ogive used until the WGCSE 2019. The maturity at-age 1 was manually set to 0 as no mature sole at age 1 were encountered at the UK(E&W)-Q1SWECOS survey.

Updated maturity at-age based on data from the UK(E&W)-Q1SWECOS survey.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.0	0.67	0.91	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Natural mortality was assumed to be 0.1 for all ages and years.

Surveys

The WGCSE 2024 Celtic Sea sole stock assessment used one scientific survey index: UK(E&W)-BTS-Q3 (1988–2023), from age 1 to 5. It is the only index providing information on the recruiting age (age 1). Standardised abundance indices for the UK beam trawl survey (UK(E&W)-BTS-Q3)) are shown in Table 33.6 and Figure 33.9. Abundance-at-age 0 is highly variable and not used further on. The UK-survey appears to track the stronger year classes reasonably well. The internal consistency plot indicates also a reasonable fit for most of the ages (Figure 33.10).

After the peak in 2000 (228.46 kg/100 Km fished, Figure 33.11 and Table 33.8), the LPUE from the UK(E&W)-BTS-Q3 dropped gradually to the lowest value in 2006 (68.967 kg/100 Km fished). Thereafter, it fluctuated between 80 kg/100 Km fished and 120 kg/100 Km fished until 2017. In 2018, it increased again to 206.44 kg/100 Km fished and for 2020 and 2021 a lower value of about 112 kg/100 Km fished was noted. In 2022 and 2023, the LPUE slightly increased to 124.67 kg/100 Km fished and 134.14 kg/100 Km fished respectively.

Detailed information on the survey protocols and area coverage can be found in the Stock Annex.

Commercial LPUE

Available estimates of effort and LPUE are presented in Tables 33.7–33.8 and Figure 33.12.

Commercial LPUE and effort data were available for Belgian beam trawlers, UK(E&W) beam and otter trawlers and Irish seiners, otter and beam trawlers. It should be noted that in 2013, the UK administration switched to the EU electronic logbook system. Therefore, effort and LPUE reporting is now based on days fished. It should also be noted that the LPUE reporting of the Belgian beam trawlers does not account for the under-reporting in recent years.

Belgian beam trawl effort was at highest levels in 2003–2005. During these years, effort shifted from the Eastern English Channel (Division 7.d) to the Celtic Sea (divisions 7.fg) because of days-at-sea limitations in the former area. In 2006, these restrictions had been lifted and effort decreased substantially to about half of the values observed in the early 2000s. The sharp effort reduction in 2008 may be a combined result of the unrestricted effort regime in Division 7.d and the high fuel prices. The increase in 2012–2013 is due to the good opportunities of sole catches in the Celtic Sea taken by the mobile Belgian fleet. Afterwards, effort decreased again to lower levels during 2014–2019. Together with the substantial increase of the TAC in 2020, the effort also increased in 2020. It remained at that level in 2022 and 2023, after a slight decrease in 2021.

The effort from the UK(E&W) beam trawl fleet has declined sharply since the early 2000s to a record low in 2011 (area 7f and area 7g east) and 2008 (area 7g west), and fluctuated between this lower value and the time-series mean afterwards. For area 7g a just above average value was noted for 2021. The effort from the UK(E&W) otter trawlers has shown a gradually declining trend over time. The area 7g west otter trawler effort has shown a more fluctuating pattern.

LPUE of the Belgian beam trawlers peaked in 2002. After a sharp decline to its record low in 2004, LPUE has been increasing gradually to around 20–21 kg/hour in 2014–2015. In 2017, a decrease to 15.72 kg/hour was recorded. Afterwards it increased again and was at the highest level of the time-series in 2020 (25.74 kg/hour). The following years lower values were noted: 21.6 kg/hour in 2021, 18.5 kg/hour in 2022 and 18.6 kg/hour in 2023.

At the end of the 1990s and the beginning of the 2000s, the LPUE of the UK beam trawlers was stable at lower levels compared to the period before. Afterwards, the LPUE fluctuated and gradually increased to a value around the time-series mean in 2020–2023. Except for the area 7g west, where the LPUE is lower than the time-series mean in 2023.

The LPUE of the UK otter trawlers is relatively stable at a lower level, but increased in 2022 in area 7f and area 7g east.

Irish effort and LPUE data are also presented. The main target species in the Irish fisheries are megrim, anglerfish, etc. The vessels usually operate on fishing grounds in the Western Celtic Sea with lower sole densities and therefore the LPUE values are low.

Tuning series

All available tuning data are given in Table 33.9, with the data used in the assessment highlighted in bold.

The age-structured UK(E&W)-BTS-Q3 scientific survey tuning series is the only scientific survey used for tuning.

During the WGCSE 2019, two age-structured commercial tuning series (UK(E&W)-CBT and BE-CBT) were used in the assessment. The UK(E&W)-CBT tuning-series used in the WGCSE 2019 assessment was limited to 2012 and earlier, because of effort reporting issues. As the hours fished became an optional field in the logbooks and not consistently filled, this field is inappropriate to use as a metric for effort.

During the WKFlatNSCS (ICES, 2020) an updated UK(E&W)-CBT tuning series was introduced in the assessment. The new UK(E&W)-CBT series from 1987–recent was generated using a random effects model. Activity days was used as an effort measure, since it is mandatory to record.

The Belgian commercial beam trawl tuning fleet consists of two parts (1971–1996 and 2006–recent, BE_CBT and BE_CBT3). During the IBPBrisol (ICES, 2019b), the BE_CBT3 was constructed focusing on the landings and effort data of pure trips from the large fleet segment of the Belgian beam trawl fleet fishing in divisions 7.f and 7.g. Several models were tested and a GLMM including a categorical year effect, a log-linear relationship between the engine power of a beam trawler and the landing rate, a categorical temporal effect 'month' and a categorical spatial effect 'ICES statistical rectangle' were retained. The exponent of the estimated coefficients of the year effect were used as landing rate for the tuning series. More information is provided in the stock annex and the WKFlatNSCS report (ICES, 2020).

During the Benchmark, these commercial tuning series were used as commercial biomass tuning series. These time-series of the commercial tuning series were split in order to better account for changes in catchability due to e.g. technological creep (see figure below). Figure 33.13 shows the evolution through time of the commercial biomass tuning series. The Belgian BE_CBT_2006–2023 and the UK(E&W)-CBT_2006–2023 tuning series show a relatively similar increasing trend during the last years. However, the UK biomass index starts decreasing from 2022 onwards, and the Belgian biomass index shows a decrease in 2023.

Other relevant data

Reports from UK industry suggest that the main issues affecting the fishery in 7.f and 7.g were displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009).

No additional information was received from the Belgian, French and Irish industries.

33.4 Stock assessment

Historical stock development

The method used to assess Celtic Sea sole was XSA until the WGCSE 2019. During the WKFlatNSCS (ICES, 2020), the assessment was transferred to a state–space stock assessment model (SAM). This was done by using the *stock assessment* package, which enables to interface a

performant SAM implementation (https://github.com/fishfollower/SAM/) in *Template Model Builder* (TMB)[1] from the R statistical software.

The main feature of SAM is that it includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as SSB (spawning–stock biomass), TSB (total stock biomass) or landings indices, while the random effects formulation of the process models resulting from the hierarchical nature of the state–space modelling framework, can easily be used to handle missing observations as is the case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

During the benchmark, it was decided to transfer the age-structured commercial tuning series into biomass indices. These time-series of the commercial tuning series were split, in order to better account for changes in catchability due to e.g. technological creep. The age-structured UK(E&W)-BTS-Q3 survey tuning series was also included. The model was further optimized in terms of parameter configuration for the process and observation models (see table below).

The F_{bar} calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The F_{bar} in the WGCSE 2019 assessment was set at age 4–8. However, as age 3 represents a large proportion of the catch (Figure 33.3), during the WKFlatNSCS it was decided to expand the F_{bar} to ages 3–8. The F_{bar} with ages 3–8 represents an average 77% of the catch, with a minimum of 48% and a maximum of 97%.

The SAM model input and configuration are shown in the table below and in Table 33.10.

[1] TMB offers a modelling framework for fast estimation of hierarchical models written in C code through the Laplace approximation. In addition, increased performance of nonlinear optimization procedures is achieved through the use of AUTODIFF (automatic differentiation), and performant C libraries for linear algebra (Eigen and CholMod).

DATA & SETTINGS	
tuning indices	
UK(E&W)-BTS survey (1988-(assessment year-1))	Age (1-5)
BE-CBT_1971-1983	Biomass
BE-CBT_1984-1996	Biomass
BE-CBT3_2006-(assessment year-1)	Biomass
UK(E&W)-CBT_1984-2005	Biomass
UK(E&W)-CBT_2006-(assessment year-1)	Biomass
catch numbers-at-age	Catch numbers for age 1 and 2 set to NA prior 2004
maturity ogive	Age1 = 0; Age2 = 0.67; Age3 = .91; Age4 = .98; Age5 = .99; Age6 = .99; Age6+ = 1
natural mortality	0.1 for all ages and years
prop. M < spawning	0 for all years
prop. F < spawning	0 for all years
Plus group	10
Fbar	3-8
MODEL CONFIGURATION	
stock-recruitment	plain random walk on logN(1)
correlation F-at-age	AR(1)
F parameters-at-age	6 = 0, 1, 2, 3, 3, 3, 4, 4, 5, 5
q parameters (-at-age)	
UK(E&W)-BTS survey (1988-(assessment year-1))	4 = 0, 1, 2, 3, 3, -1, -1, -1, -1, -1
BE-CBT_1971-1983	1
BE-CBT_1984-1996	1
BE-CBT3_2006-(assessment year-1)	1
UK(E&W)-CBT_1984-2005	1
UK(E&W)-CBT_2006-(assessment year-1)	1
σ^2 F parameters-at-age	1 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
σ^2 N parameters-at-age	2 = 0, 1, 1, 1, 1, 1, 1, 1, 1, 1
σ^2 obs pars (-at-age)	
catch numbers-at-age	2 = 0, 0, 1, 1, 1, 1, 1, 1, 1, 1
UK(E&W)-BTS survey (1988-(assessment year-1))	3 = 2, 3, 3, 4, 4, -1, -1, -1, -1
BE-CBT_1971-1983	1
BE-CBT_1984-1996	1
BE-CBT3_2006-(assessment year-1)	1
UK(E&W)-CBT_1984-2005	1
UK(E&W)-CBT_2006-(assessment year-1)	1
ρ observations at-age	
catch numbers-at-age	"AR(1)" (single ρ for all ages)
UK(E&W)-BTS survey (1988-(assessment year-1))	"ID"
BE-CBT_1971-1983	-
BE-CBT_1984-1996	-
BE-CBT3_2006-(assessment year-1)	-
UK(E&W)-CBT_1984-2005	-
UK(E&W)-CBT_2006-(assessment year-1)	-

This year's assessment

The SAM model fitting diagnostics and survey catchabilities are shown in Table 33.11, the fishing mortalities in Table 33.12, the stock numbers in Table 33.13 and the assessment summary in Table 33.14 and Figure 33.14.

In general, the estimated catches from the SAM model corroborate the observed catches. Mainly at the start of the time-series, some observed catches do not fall within the confidence bounds of the estimated catches. The SAM catch estimate for 2020, 2021 and 2022 is also considerably lower than the corresponding ICES catch estimate. The ICES estimated catch for 2021 and 2022 incorporates area misreporting, resulting in higher catches than the reported catches.

Spawning–stock biomass (SSB) has been above MSY $B_{trigger}$ since 2010 and shows an increasing trend over the last years, with the 2019–2021 estimates around the same high level. The 2022 and 2023 estimates are slightly lower than the estimates of the previous three years. Fishing mortality has been above F_{MSY} for most of the time series, except for some years in the beginning of the time

series and in 2018. Recruitment has been variable without an overall trend. Recruitment estimates have been above average since 2015, except in 2020. The 2017 recruitment is estimated to be the highest in the time-series and the 2023 recruitment to be the third highest.

The one-step ahead residuals for the final SAM assessment are shown in Figure 33.15.

Retrospective patterns for the final run are shown in Figure 33.16. Retrospective analysis does not indicate major problems; the retrospective patterns are within the confidence bounds. A Mohn's rho analysis was conducted based on the SAM stock assessment results, i.e. the last data year (2023) was used as the final year for comparison of SSB, F and recruitment and based on a five-year retrospective analysis. The Mohn's rho values for this assessment are low and well within the bounds of -15 % to 20% suggested by ICES, i.e. the current assessment indicates sufficient consistency for advice purposes.

The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (AGES 3-8)	RECRUITMENT
Mohn's rho value	-0.02027	-0.03669	0.10629

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figures 33.17. Trends in fishing mortality, SSB and recruitment are very similar. The 2021 and 2022 recruitment estimates were revised upwards by 8.6% and 1.2% respectively in this year's assessment. In last year's assessment, F and SSB for 2022 were estimated to be 0.244 and 5710 t respectively; this year's estimates for 2022 are 0.309 and 5290 t, an upwardward revision of 26.6% for F and a downward revision of 7.4% for SSB. Similar rescaling is also noted for the 2021 estimates with an upwardward revision of 23.2% for F and a downward revision of 4.5% for SSB.

State of the stock

Trends in catch, SSB, F_{bar}(3–8) and recruitment are presented in Table 33.14 and Figure 33.14.

In the beginning of the time-series, fishing mortality fluctuated around F_{MSY} (0.251). During the eighties and nineties fishing mortality increased (0.51 in 1997) for this stock to levels well above F_{MSY}. In the following decades, fishing mortality decreased and was just below F_{MSY} in 2018. Since 2019, fishing mortality has been above F_{MSY}.

Recruitment has fluctuated around 5 million recruits with occasional strong year classes. The 1998 year class is estimated to be among the strongest in the time-series (13 579 thousand fish). Recruitment has been above average (5972 thousand fish) since 2015 (except in 2020), the recruitment of 2017 is estimated to be the highest of the time-series (14 531 thousand fish) and the recruitment of 2023 is estimated to be the third highest (10 713 thousand fish).

SSB has declined almost continuously from the highest value of 6650 t in 1971 to the lowest observed in the time-series in 1997 (2193 t). The exceptional year class of 1998 has increased SSB to above the long-term average (3972 t) in the years 2001-2004. With the exemption of the period 2007-2009, SSB has been above MSY $B_{trigger}$ (3057 t) since 2001. SSB increased in the years 2019-2021 to the highest level (around 5800 t) since 1973 as a result of the good recruitment. The SSB in 2022 (5290 t) and in 2023 (4950 t) is again slightly lower.

33.5 Short-term projections

This year's forecast assumptions

Figure 33.18 shows three different targets for the intermediate year: F_last (F = F_{2023} or status quo), F_average (F = $F_{average\ 2021-2023}$), and catch. For the 'catch' target, the 2024 advised catch value or TAC of 1267 t (Figure 33.19) was assumed and this assumption implies a fishing mortality in 2024 of 0.282 and results in an SSB of 5356 t in 2025. This option was not agreed by the WG because the under-reporting of the Belgian beam trawl fleet in recent years is likely to continue in 2024.

The F in 2023 (0.294) is slightly lower than the mean F over the last three years ($F_{average\ 2021–2023}$ = 0.302) and using this F to project the stock into 2024, would result in slightly lower catches (1309 t) compaired to the F average option (1339 t) in 2024. Both options would imply slightly over-shoting the 2024 TAC (1267 t). Taking into account that there is no trend in F over the last three years, the WG agreed to use F average as target for the intermediate year (2024). This results in an SSB of 5275 t in 2025.

As input for the forecast fishing mortality, catch and stock weights-at-age were calculated as the mean of 2021–2023. Population numbers at the start of 2024 for ages 2 and older, were taken from the SAM output. The long-term median resampled recruitment (1971–2021) as estimated by a stochastic projection (SAM, 5177 thousand fish) was assumed for recruitment in 2024 and subsequent years, as this corresponds with the recent period of higher recruitments.

Last year's forecast assumptions

A comparison of the estimates of this year's assessment and forecast with last year's is given in Figure 33.20.

Higher recruitment was observed from 2015 onwards. However, the 2022 year class (2023 recruitment) is now estimated at 10 713 thousand fish at age 1 (Table 33.14), which is 108% higher than the median resampled recruitment from the years 1971–2020 (5156 thousand fish), used in last year's forecast.

The age 1 estimates are almost solely coming from the UK(E&W)-BTS-Q3. The above average (5.6) abundance indices for age 1 in 1999 (24.6), 2017 (10.5) and 2023 (13.9) align with the high recruitment in those years.

In last year's assessment the 2023 SSB was estimated to be 6002 t, this year the 2023 SSB is revised downwards by 17.5% (4950 t). An F of 0.264 was assumed for the intermediate year in last year's forecast, this value (F in 2023) is now estimated to be 0.294, an upward revision of 11.4%.

MSY forecast

Table 33.15 and Figure 33.21 show the output of the forecast targeting F = F_{MSY} for 2025–2026. Implementing the MSY approach with F = F_{MSY} = 0.251 leads to a total yield of 1149 t in 2025, and an SSB of 5226 t in 2026. This means a decrease in advice compared to last year's advice, caused by the downward revision in recent SSB and an upward revision in recent F.

Figure 33.22 shows the contribution of the assumed median resampled recruitment (1971–2021) to the forecast yield and SSB. The assumed recruitment accounts for about 3.2% of the catch in 2025 and about 18.7% of the 2026 SSB.

Additional options

A management options table is provided in Table 33.15.

33.6 Biological reference points

Current biological reference points calculated during the WGCSE 2020 are given in the text table below:

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	3057	Tonnes; B_{pa}
	F_{MSY}	0.251	EQsim analysis based on the recruitment period 1971–2018
Precautionary approach	B_{lim}	2184	Tonnes; B_{loss} estimated in 2020, corresponding to SSB in 1997
	B_{pa}	3057	Tonnes; $B_{lim} \times 1.4$
	F_{lim}	0.543	EQsim analysis, based on the recruitment period 1971–2018
	F_{pa}	0.402	$Fp.05$; F that leads to SSB ≥ B_{lim} with 95% probability.
Management plan	MAP MSY $B_{trigger}$	3057	Tonnes; MSY $B_{trigger}$
	MAP B_{pa}	3057	Tonnes; B_{pa}
	MAP B_{lim}	2184	Tonnes; B_{lim}
	MAP F_{MSY}	0. 251	F_{MSY}
	MAP range F_{lower}	0.136–0.251	Consistent with ranges provided by ICES (2020), resulting in no more than 5% reduction in long-term yield compared with MSY
	MAP range F_{upper}	0.251–0.462	Consistent with ranges provided by ICES (2020), resulting in no more than 5% reduction in long-term yield compared with MSY

*** EU multiannual plan (MAP) for the Western Waters (EU, 2019).**

33.7 Management plans

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to demersal stocks including sole in ICES divisions 7.f and 7.g.

33.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for 7.f and 7.g sole are sampled (approximately 90% of the total landings). Sampling is considered to be at a reasonable level.

Discards

The annual discard estimate used to be low (2.7%, average 2011-2016), but increased to 14.2% in 2018. In 2021, it decreased to 4.4 and it is now again at a higher level (10% in 2023). Discards are included in the assessment since the WGCSE 2020.

Misreporting

Area misreporting is known to have been considerable over the period 2002–2005. This was due to a combination of the good 1998 year class still being an important part of the catch composition and more restrictive TACs. The area misreporting has been corrected for the years 2002–2006 (WGSSDS 2007). At the WKCELT 2014, analysis revealed that there was additional misreporting taking place in 2002–2003 and 2004, which was not accounted for in the first correction done at WGSSDS in 2007. Since 2007, the area misreporting that could be estimated was negligible. During the WKFlatNSCS (ICES, 2020) a further correction for 2004–2007 Belgian beam trawl landings data was done. The 2021 and 2022 landing numbers were adjusted in the current assessment for under-reporting as this follows the same approach (threshold (> 22%)) as the misreporting corrections done in 2020 WKFlatNSCS (ICES, 2020).

Surveys

The UK(E&W)-BTS-Q3 survey, which is solely responsible for the recruiting estimates, has been able to track year-class strength at-ages greater than 0 rather well in the past. However, the estimates of strong year classes have sometimes been revised downward in previous assessments and may cause bias in the forecast. However, the Mohn's rho value for the recruitment of this assessment is rather low.

33.9 Recommendations for next Benchmark

Sole in 7.f and 7.g have been benchmarked in February 2020. The remaining issues are listed below.

Problem / Aim	Work needed / Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?
Natural mortality Alternate rates of natural mortality. Natural mortality is assumed constant over ages and years at 0.1. When new information is available, this should be investigated.	*estimates of natural mortality	*estimates of natural mortality
Effect of changing exploitation patterns Effect of changing exploitation patterns related to the Trevose Box closure. ICES rectangles 30E4, 31E4 and 32E3 form the Trevose Box which is closed for fishing from February 1st until March 31st. This management measure is in place since 2006 and aims to protect spawning fish, cod and other demersal stocks such as sole in particular (ICES special request, 2007). This measure has a significant effect on the behaviour of the fleets. During the first week after re-opening of the Trevose box, catch rates of the Belgian beam trawl fleet are estimated to be twice as high with respect to the situation before the closure of the Trevose Box (prior to 2006) (Sys *et al*., 2017). Those temporal and spatial effects were accounted for in the new modelled Belgian commercial tuning index (ICES, 2019b). However, this change in exploitation pattern may also have an effect on the mortality of mature females or exhibit hyperstability, in which catch per unit effort (CPUE) remains elevated as stock abundance declines.	* Check for hyperstability * Check mortality of mature females	
Scientific survey information The UK-BTS-Q3 survey is the only survey used in the current assessment and is solely providing information on the recruiting age (age 1). The new UK-Q1SWECOS tuning series was considered during the WKFlatNSCS 2020, but not retained. Criteria such as length of the time-series, amount of spatial coverage and consistent statistical sampling design were considered for including/excluding the new UK-Q1SWECOS tuning series. However, we recommend that those survey data will be uploaded into DATRAS and that the survey design will be reviewed by the WGBEAM (The Working Group on Beam Trawl Surveys), to assure quality control of the data. The time-series was too short for any strong conclusions now but the inclusion of those survey indices should be reconsidered during the next benchmark.	*Investigate if additional survey information (e.g. UK-Q1SWBeam, started in 2006) is available and can be incorporated in the assessment. *Additional survey data can confirm the info provided by the UK-BTS-Q3 survey.	*UK-Q1SWBeam tuning series *other available survey data
Fisheries & ecosystem issues and data - Trends in mean weights Trends and reasons for the decreasing catch and stock weights for the older ages	What drives this change? *Is it driven by an ecosystem change? *Is there a similar trend in the weights from other stocks?	*information on the evolution in the Celtic Sea ecosystem

33.10 Management considerations

The stock–recruitment relationship is not well-defined, there is no real evidence of reduced recruitment at low levels of SSB for this (Figure 33.23). Following the recent strong year classes, SSB increased in the years 2019-2021 to the highest level (around 5800 t) since 1973, as a result of the good recruitment in 2017. The SSB in 2022 (5290 t) and in 2023 (4950 t) is again slightly lower.

The Celtic Sea is an area without days-at-sea limitations for demersal fisheries. In this context and given that many demersal vessels are very mobile, changes in effort measures in areas other than the Celtic Sea, can influence the effort regime in the Celtic Sea (cfr. increased effort in Celtic Sea for Belgian beamers during 2004–2005 when days-at-sea limitations were in place for the Eastern English Channel).

33.11 Ecosystem considerations

Sole and plaice are predominantly caught by beam trawl fisheries. Beam trawling is known to have an impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Benthic drop-out panels have been shown to release around 75% of benthic invertebrates from the catches. Information from the UK industry (Trebilcock and Rozarieux, 2009) suggests that uptake in 2008 was minimal.

A complete ecosystem overview can be found in the stock annex Section A.3.

33.12 References

EU. 2019. REGULATION (EU) 2019/472 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. 17pp. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0472.

ICES. 2009. Report of the Benchmark and Data Compilation Workshop for Flatfish (WKFLAT 2009), 6–13 February 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:31. 192 pp.

ICES. 2014. Report of the Benchmark WKCELT, 3–7 February 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:42. 194 pp.

ICES. 2014b. Report of the Workshop to consider reference points for all stocks (WKMSYREF2), 8–10 January 2014, ICES Headquarters, Copenhagen, Denmark. ICES CM 2014/ACOM:47. 91 pp.

ICES. 2014c. Report of the Joint ICES–MYFISH Workshop to consider the basis for F_{MSY} ranges for all stocks (WKMSYREF3), 17–21 November 2014, Charlottenlund, Denmark. ICES CM 2014/ACOM:64. 147 pp.

ICES. 2016. Report of the Workshop to consider F_{MSY} ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 183 pp.

ICES. 2019a. Inter-benchmark protocol on Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea) (IBPBrisol). ICES Scientific Reports. 1:ISS NO. 106 pp. http://doi.org/10.17895/ices.pub.4708.

ICES. 2019b. Belgium request for a revision of catch advice in 2019 for sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea). In Report of the ICES Advisory Committee, 2019. ICES Advice 2019, sr.2019.21, https://doi.org/10.17895/ices.advice.5623.

ICES. 2020. Benchmark Workshop for Flatfish stocks in the North Sea and Celtic Sea (WKFlatNSCS). ICES Scientific Reports. 2:23. 966 pp. http://doi.org/10.17895/ices.pub.5976.

Trebilcock P. and N. de Rozarieux. 2009. National Federation Fishermen's Organisation Annual Fisheries Reports. Cornish Fish Producers Organisation / Seafood Cornwall Training Ltd, March 2009.

33.13 Tables and Figures

Table 33.1. Sol.27.7fg - Official Nominal landings and landings and discard data used by the Working Group (t).

Year	Belgium		Denmark	France	Ireland	UK(E.&W, NI)	UK(Scotland)	Spain	Other	Total-Official	Area misreported landings	Used by WG	TAC	Discards**
1986	1039	*	2	146	188	611	-	-	3	1989	-	1600		80
1987	701	*	-	117	9	437	-	-	-	1264	-	1222	1600	56
1988	705	*	-	110	72	317	-	-	-	1204	-	1146	1100	61
1989	684	*	-	87	18	203	-	-	-	992	-	992	1000	70
1990	716	*	-	130	40	353	0	-	-	1239	-	1189	1200	57
1991	982	*	-	80	32	402	0	-	-	1496	-	1107	1200	126
1992	543	*	-	141	45	325	6	-	-	1060	-	981	1200	77
1993	575	*	-	108	51	285	11	-	-	1030	-	928	1100	56
1994	619	*	-	90	37	264	8	-	-	1018	-	1009	1100	52
1995	763	*	-	88	20	294	-	-	-	1165	-	1157	1100	50
1996	695	*	-	102	19	265	0	-	-	1081	-	995	1000	47
1997	660	*	-	99	28	251	0	-	-	1038	-	927	900	46
1998	675	*	-	98	42	198	-	-	-	1013	-	875	850	43
1999	604		-	61	51	231	0	-	-	947	-	1012	960	89
2000	694		-	74	29	243	-	-	-	1040	-	1091	1160	158
2001	720		-	77	35	288	-	-	-	1120	-	1168	1020	101
2002	703		-	65	32	318	+	-	-	1118	-	1345	1070	58
2003	715		-	124	26	342	+	-	-	1207	-	1547	1240	54
2004	735		-	79	33	283	-	-	-	1130	237	1391	1050	140
2005	645		-	101	34	217	-	-	-	997	279	1263	1000	23

Year	Belgium	Denmark	France	Ireland	UK(E.&W, NI)	UK(Scotland)	Spain	Other	Total-Official	Area misreported landings	Used by WG	TAC	Discards**
2006	576	-	75	38	232	-	-	-	921	146	1058	950	41
2007	582	-	85	32	245	-	-	-	943	120	1052	890	36
2008	466	-	68	28	218	-	-	-	781	-	790	964	8
2009	513	-	73	26	195	-	-	-	806	-	772	993	30
2010	620	-	44	27	180	-	-	-	871	-	867	993	56
2011	775	-	54	30	168	-	-	-	1027	-	1027	1241	28
2012	843	-	48	33	175	-	-	-	1099	-	1101	1060	32
2013	789	-	49	42	205	-	-	-	1085	-	1093	1100	26
2014	703	-	58	28	252	-	-	-	1042	-	1041	1001	27
2015	674	-	24	27	105	-	-	-	830	-	831	851	17
2016	563	-	72	21	174	-	-	-	830	-	832	779	31
2017	551	-	49	28	149	-	-	-	777	-	778	845	65
2018	607	-	44	27	171	-	-	-	850	-	850	920	141
2019	800	-	42	33	193	-	<1	-	1068	-	1068	1009	145
2020	1121	-	44	51	291	-	<1	-	1507	-	1524	1652	106
2021	858	-	61	48	395	-	2	-	1364	303	1646	1413	76
2022 ^	840	-	67	31	354	-	7	-	1299	252	1551	1337	86
2023 ^	876	-	42	43	242	-	14	-	1218	-	1210	1338	134

^Landings are preliminary.

*** including 7.g–k.**

**** Discards estimated by ICES.**

Table 33.2. Sol.27.7fg - Catch numbers-at-age (in thousands).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	610	855	575	245	188	493	496	502	519	1038	951	540	1023
3	303	1014	2116	492	323	937	492	833	630	1092	759	934	1212
4	1377	322	768	886	345	575	358	348	767	899	813	317	748
5	638	684	311	420	652	624	277	157	212	596	407	477	290
6	439	334	357	212	308	567	248	161	156	183	382	284	354
7	541	214	120	241	111	263	407	100	198	62	151	208	227
8	770	234	111	98	103	132	121	200	125	97	121	93	194
9	379	317	117	110	68	199	28	72	154	101	95	112	52
10+	1231	739	649	547	375	469	368	175	170	355	383	328	322

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1062	310	781	503	831	757	438	2304	684	559	466	204	280	387
3	951	1656	1457	1076	522	1308	1117	776	1911	970	888	1299	1163	1000
4	622	786	1204	818	902	617	1207	676	661	1133	759	1127	928	615
5	553	577	537	589	450	634	407	507	418	339	882	429	433	408
6	187	300	363	277	393	240	459	153	257	189	287	490	232	256
7	279	101	194	206	128	189	139	157	61	162	150	134	193	128
8	107	141	88	101	79	83	116	56	60	64	66	113	58	127
9	47	74	104	61	68	24	50	46	28	84	42	66	43	45
10+	276	241	330	180	270	102	130	163	89	99	146	109	106	106

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0	0	0	0	0	0	5	12	8	19	10	30	26
2	311	961	2720	1111	46	209	393	418	485	697	180	549	506
3	1048	1931	1664	2155	1647	871	1846	1096	1151	979	515	511	1510
4	743	856	701	883	2261	1294	941	1028	844	721	499	588	657
5	303	288	246	445	674	2111	1086	592	706	435	387	435	380
6	173	145	61	245	253	453	742	499	250	382	212	259	257
7	109	81	56	65	96	250	132	336	229	149	209	164	140
8	51	31	43	39	55	90	100	72	169	142	85	121	103
9	52	23	19	26	36	29	54	55	60	155	109	51	80
10+	87	44	51	81	51	84	100	89	106	93	150	203	119

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	18	29	13	14	0	66	47	4	53	0	0	13	41
2	170	361	545	173	193	727	432	989	373	242	162	749	1253
3	1103	318	998	684	837	458	1157	840	2240	777	857	686	1525
4	1389	1039	523	735	924	635	493	1105	729	2775	1363	979	608
5	394	1339	826	308	433	663	421	275	874	1161	2448	911	840
6	308	370	652	388	145	303	353	293	306	789	1200	1934	475
7	187	222	222	381	201	111	147	186	162	304	441	733	933
8	118	130	104	122	114	132	55	95	115	160	148	212	162
9	56	84	61	99	69	94	59	56	105	106	72	73	116
10+	168	219	160	243	113	70	101	122	118	189	197	237	123

Table 33.3. Sol.27.7fg - Catch weights-at-age (kg).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.039	0.106	0.081	0.063	0.046	0.114	0.098	0.068	0.023	0.048	0.078	0.061	0.085
2	0.11	0.136	0.134	0.13	0.127	0.149	0.15	0.141	0.127	0.134	0.141	0.142	0.153
3	0.168	0.185	0.2	0.202	0.208	0.214	0.229	0.228	0.226	0.228	0.22	0.236	0.247
4	0.224	0.227	0.259	0.27	0.286	0.268	0.297	0.308	0.32	0.315	0.292	0.323	0.329
5	0.273	0.265	0.311	0.329	0.355	0.316	0.355	0.377	0.4	0.391	0.355	0.396	0.397
6	0.316	0.303	0.361	0.385	0.416	0.363	0.408	0.44	0.47	0.459	0.413	0.461	0.458
7	0.353	0.34	0.408	0.436	0.473	0.409	0.46	0.498	0.531	0.523	0.469	0.521	0.513
8	0.384	0.377	0.452	0.483	0.523	0.453	0.506	0.55	0.58	0.578	0.519	0.571	0.56
9	0.408	0.413	0.493	0.524	0.565	0.496	0.548	0.596	0.621	0.625	0.564	0.616	0.602
10+	0.441	0.539	0.602	0.624	0.671	0.665	0.668	0.72	0.664	0.72	0.665	0.704	0.679

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.019	0.089	0.046	0.048	0.074	0.013	0.049	0.054	0.073	0.057	0.081	0.068	0.027	0.074
2	0.126	0.151	0.134	0.136	0.143	0.112	0.128	0.138	0.136	0.128	0.139	0.136	0.122	0.142
3	0.229	0.239	0.23	0.23	0.229	0.196	0.21	0.232	0.212	0.204	0.212	0.216	0.21	0.228
4	0.329	0.316	0.32	0.319	0.308	0.28	0.291	0.319	0.281	0.275	0.276	0.288	0.296	0.306
5	0.414	0.382	0.399	0.395	0.377	0.355	0.362	0.392	0.342	0.338	0.331	0.351	0.371	0.375
6	0.492	0.443	0.47	0.465	0.441	0.423	0.429	0.458	0.397	0.396	0.38	0.408	0.438	0.439
7	0.561	0.499	0.536	0.528	0.502	0.487	0.494	0.516	0.451	0.45	0.425	0.462	0.5	0.5
8	0.621	0.551	0.593	0.583	0.556	0.542	0.552	0.564	0.499	0.5	0.465	0.51	0.551	0.554
9	0.673	0.596	0.643	0.632	0.606	0.592	0.609	0.608	0.543	0.544	0.5	0.552	0.598	0.605
10+	0.771	0.703	0.748	0.74	0.738	0.691	0.747	0.674	0.64	0.645	0.563	0.643	0.677	0.707

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.079	0.015	0.078	0.066	0.054	0.123	0.099	0.109	0.142	0.161	0.149	0.105	0.11
2	0.147	0.121	0.148	0.137	0.126	0.151	0.152	0.155	0.144	0.157	0.163	0.157	0.144
3	0.237	0.217	0.24	0.22	0.2	0.214	0.194	0.203	0.186	0.221	0.21	0.188	0.179
4	0.319	0.314	0.321	0.296	0.271	0.266	0.274	0.267	0.272	0.284	0.281	0.242	0.234
5	0.392	0.399	0.389	0.362	0.336	0.313	0.347	0.346	0.33	0.335	0.361	0.294	0.312
6	0.461	0.476	0.45	0.424	0.398	0.361	0.371	0.439	0.401	0.372	0.359	0.348	0.358
7	0.527	0.548	0.506	0.482	0.457	0.408	0.459	0.473	0.412	0.414	0.449	0.378	0.387
8	0.589	0.613	0.553	0.533	0.512	0.454	0.522	0.595	0.411	0.488	0.62	0.476	0.414
9	0.647	0.67	0.594	0.579	0.564	0.501	0.524	0.624	0.465	0.511	0.625	0.485	0.524
10+	0.781	0.765	0.665	0.677	0.704	0.639	0.631	0.707	0.574	0.589	0.59	0.546	0.616

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.123	0.102	0.092	0.138	0.135	0.109	0.093	0.082	0.099	0.155	0.12	0.101	0.094
2	0.155	0.142	0.158	0.15	0.132	0.165	0.151	0.175	0.12	0.114	0.127	0.116	0.124
3	0.185	0.206	0.195	0.199	0.193	0.203	0.2	0.187	0.17	0.176	0.168	0.173	0.167
4	0.233	0.243	0.249	0.268	0.248	0.251	0.255	0.251	0.24	0.205	0.209	0.222	0.22
5	0.277	0.271	0.29	0.347	0.311	0.285	0.315	0.294	0.307	0.257	0.249	0.255	0.245
6	0.361	0.312	0.329	0.394	0.367	0.342	0.33	0.327	0.327	0.331	0.256	0.278	0.299
7	0.431	0.35	0.361	0.427	0.438	0.416	0.382	0.385	0.419	0.363	0.346	0.292	0.299
8	0.465	0.38	0.463	0.496	0.502	0.429	0.444	0.436	0.451	0.415	0.41	0.413	0.382
9	0.483	0.417	0.492	0.523	0.463	0.47	0.513	0.425	0.445	0.504	0.497	0.453	0.412
10+	0.688	0.543	0.587	0.702	0.589	0.621	0.549	0.575	0.614	0.556	0.537	0.462	0.489

Table 33.4. - Sol.27.7fg - Annual landings length distributions by fleet.

	UK (England & Wales)	Belgium	Ireland
Length (cm)		Beam trawl	
19			
20			
21			
22	60		
23	1319	1590	
24	2300	137536	163
25	6508	566307	174
26	16040	570490	590
27	23781	509477	1288
28	34866	406739	1479
29	45967	314322	2232
30	48467	265051	3604
31	50532	181746	2795
32	57489	152853	4434
33	48884	124731	4560
34	45086	97918	5100
35	46144	82143	3180
36	29979	59715	2975
37	31330	45061	1808
38	21861	32409	1097
39	19575	24507	717
40	12259	20590	290
41	8154	7896	647
42	4484	7541	309
43	3757	3247	79
44	2655	1839	28
45	1306	1474	22
46	616	305	22
47	456	196	0
48	160	116	6
49	7	328	
50	154		
51	52		
52	0		
53	69		
54			
55			
Total	564317	3616127	37599

Table 33.5. Sol.27.7fg - Stock weights-at-age (kg).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.085	0.073	0.119	0.103	0.089	0.083	0.131	0.118	0.093	0.056	0.082	0.105	0.097
3	0.145	0.143	0.165	0.165	0.165	0.165	0.185	0.185	0.179	0.17	0.172	0.182	0.187
4	0.205	0.196	0.219	0.232	0.241	0.237	0.252	0.266	0.27	0.267	0.258	0.267	0.279
5	0.26	0.244	0.266	0.292	0.31	0.301	0.308	0.335	0.351	0.354	0.334	0.34	0.358
6	0.304	0.288	0.31	0.346	0.37	0.359	0.359	0.395	0.421	0.429	0.402	0.404	0.426
7	0.341	0.328	0.352	0.397	0.426	0.413	0.409	0.451	0.483	0.496	0.464	0.464	0.486
8	0.37	0.365	0.392	0.444	0.477	0.463	0.455	0.503	0.538	0.554	0.521	0.517	0.54
9	0.39	0.398	0.431	0.487	0.523	0.509	0.498	0.549	0.585	0.602	0.571	0.565	0.586
10+	0.416	0.511	0.56	0.599	0.649	0.669	0.643	0.695	0.654	0.7	0.674	0.682	0.676

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.104	0.054	0.109	0.079	0.083	0.091	0.041	0.082	0.086	0.097	0.089	0.105	0.091	0.062
3	0.187	0.174	0.186	0.176	0.176	0.167	0.154	0.173	0.171	0.167	0.165	0.173	0.169	0.167
4	0.285	0.269	0.276	0.271	0.266	0.253	0.239	0.259	0.256	0.242	0.237	0.247	0.253	0.254
5	0.369	0.354	0.355	0.355	0.347	0.331	0.319	0.338	0.33	0.308	0.302	0.311	0.327	0.333
6	0.442	0.428	0.424	0.43	0.417	0.4	0.39	0.407	0.395	0.368	0.358	0.368	0.392	0.404
7	0.507	0.496	0.487	0.498	0.483	0.463	0.457	0.47	0.454	0.423	0.41	0.419	0.452	0.468
8	0.564	0.556	0.544	0.559	0.542	0.521	0.519	0.528	0.507	0.475	0.458	0.466	0.504	0.526
9	0.614	0.608	0.596	0.612	0.594	0.574	0.575	0.58	0.554	0.521	0.5	0.507	0.552	0.577
10+	0.733	0.716	0.715	0.737	0.729	0.686	0.721	0.673	0.648	0.631	0.578	0.602	0.647	0.681

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.104	0.098	0.047	0.103	0.091	0.09	0.137	0.124	0.125	0.149	0.162	0.153	0.123
3	0.184	0.179	0.17	0.181	0.165	0.164	0.172	0.175	0.17	0.178	0.181	0.175	0.168
4	0.27	0.273	0.264	0.267	0.244	0.231	0.242	0.228	0.235	0.23	0.249	0.226	0.21
5	0.346	0.357	0.35	0.341	0.315	0.292	0.304	0.308	0.297	0.302	0.32	0.287	0.275
6	0.416	0.432	0.423	0.406	0.38	0.348	0.341	0.391	0.373	0.35	0.347	0.355	0.325
7	0.481	0.502	0.491	0.466	0.44	0.403	0.407	0.419	0.425	0.408	0.409	0.368	0.367
8	0.542	0.569	0.55	0.519	0.497	0.456	0.462	0.523	0.441	0.448	0.507	0.462	0.396
9	0.599	0.628	0.603	0.566	0.548	0.507	0.488	0.571	0.526	0.458	0.552	0.548	0.499
10+	0.732	0.739	0.695	0.664	0.688	0.645	0.623	0.668	0.605	0.573	0.569	0.572	0.567

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.13	0.132	0.127	0.118	0.135	0.149	0.128	0.128	0.099	0.106	0.14	0.118	0.112
3	0.163	0.179	0.167	0.177	0.171	0.164	0.182	0.168	0.172	0.145	0.139	0.148	0.139
4	0.204	0.212	0.227	0.229	0.222	0.221	0.227	0.224	0.212	0.187	0.192	0.193	0.195
5	0.254	0.251	0.266	0.294	0.288	0.266	0.281	0.274	0.277	0.249	0.226	0.231	0.233
6	0.336	0.294	0.299	0.338	0.357	0.326	0.306	0.321	0.31	0.319	0.256	0.263	0.276
7	0.393	0.356	0.336	0.375	0.415	0.391	0.361	0.356	0.37	0.344	0.338	0.273	0.289
8	0.424	0.405	0.403	0.423	0.463	0.434	0.43	0.408	0.417	0.417	0.385	0.378	0.334
9	0.447	0.44	0.432	0.492	0.479	0.486	0.469	0.434	0.44	0.477	0.454	0.431	0.413
10+	0.651	0.574	0.554	0.668	0.596	0.599	0.544	0.558	0.571	0.555	0.544	0.484	0.469

Table 33.6. Sol.27.7fg - Indices of abundance (No/100km) for UK(E&W)-BTS-Q3.

year/age	0	1	2	3	4	5	6	7	8	9
1988	30	81	326	49	19	5	0	0	0	0
1989	144	222	331	176	20	15	7	4	2	2
1990	30	385	313	50	16	4	7	3	0	0
1991	32	241	517	67	17	15	4	0	2	2
1992	4	394	260	139	30	18	10	1	2	1
1993	3	169	320	43	19	1	2	2	1	1
1994	1	333	387	99	14	7	7	0	0	2
1995	27	124	222	52	11	6	12	1	1	1
1996	3	150	212	54	23	6	3	3	1	3
1997	32	433	180	18	11	12	4	3	5	0
1998	91	770	411	50	10	8	4	2	1	4
1999	24	2464	250	32	13	6	3	4	1	0
2000	13	916	1356	31	22	5	0	2	1	1
2001	22	379	600	259	19	8	5	2	0	2
2002	8	663	239	127	102	12	6	2	3	0
2003	12	392	530	46	25	47	8	3	3	0
2004	56	749	378	86	13	19	37	3	3	0
2005	37	343	225	32	13	6	4	14	1	2
2006	11	273	201	40	13	7	0	2	10	0
2007	91	358	108	43	13	7	6	3	3	11
2008	5	1039	105	13	15	6	8	3	3	4
2009	1	509	318	24	7	8	3	3	3	2
2010	18	85	471	121	17	2	4	8	3	2
2011	18	502	52	138	69	7	2	6	3	0
2012	13	542	231	8	53	24	1	1	1	3
2013	9	279	518	43	13	24	15	1	5	1
2014	34	244	257	76	13	5	23	8	1	1
2015	28	746	48	44	31	7	3	13	6	0
2016	26	573	359	12	27	13	7	3	5	8
2017	6	1046	174	67	13	16	17	4	3	11
2018	27	434	906	279	45	17	9	15	11	4
2019	2	708	325	164	23	29	3	6	7	4
2020	3	331	238	74	67	24	17	2	6	7
2021	57	896	154	45	37	33	12	12	0	3
2022	121	1100	168	48	28	25	23	5	8	0
2023	19	1389	115	51	22	21	15	12	1	4
Mean	29.37	562.83	327.92	75.01	25.05	13.22	8.06	4.33	2.95	2.36

Table 33.7. Sol.27.7fg- Effort.

	England & Wales						Belgium		Ireland		
Year	Otter trawl[1]	Beam trawl[1]	Otter trawl[2]	Beam trawl[2]	Otter trawl[3]	Beam trawl[3]	Beam trawl[4]	Beam trawl[6]	Otter trawl[5]	Scottish seine[6]	Beam trawl[6]
1971							11.06	-	-	-	-
1972							8.44	-	-	-	-
1973							17.39	-	-	-	-
1974							18.83	-	-	-	-
1975							16.38	-	-	-	-
1976							28.07	-	-	-	-
1977							24.11	-	-	-	-
1978							18.09	-	-	-	-
1979							18.90	-	-	-	-
1980							29.02	-	-	-	-
1981							35.39	-	-	-	-
1982							28.77	-	-	-	-
1983	620	195	82	149	0	8	34.95	-	-	-	-
1984	1723	901	316	298	0	129	33.48	-	-	-	-
1985	1493	1101	206	285	23	92	40.49	-	-	-	-
1986	1125	973	334	180	35	29	52.46	-	-	-	-
1987	1211	1681	364	187	26	26	37.26	-	-	-	-
1988	838	1102	351	77	20	36	42.92	-	-	-	-
1989	966	861	327	125	15	7	53.58	-	-	-	-
1990	1229	1256	435	165	24	194	40.27	-	-	-	-
1991	1066	1667	306	483	45	104	18.05	-	-	-	-
1992	898	1420	303	633	435	90	25.47	-	-	-	-
1993	836	1669	251	694	30	135	31.27	-	-	-	-
1994	623	2219	225	610	19	116	38.35	-	-	-	-
1995	580	2303	196	694	30	128	47.81	-	63.33	6.43	20.69
1996	593	2391	341	560	105	220	47.63	53.27	59.97	9.73	26.70
1997	577	2661	370	770	122	146	51.98	57.36	65.00	16.07	28.06
1998	517	2846	385	591	94	159	52.11	57.79	72.25	14.88	35.21
1999	395	3058	176	1461	235	312	55.03	55.11	51.48	8.01	40.83
2000	284	3133	187	1007	160	200	56.05	51.34	60.56	9.86	36.83
2001	309	3172	187	1155	179	91	52.06	54.90	69.37	16.33	39.50
2002	416	2652	123	463	170	60	43.24	49.60	77.20	20.88	31.49
2003	696	2669	51	772	124	158	42.81	62.73	86.78	20.07	49.22
2004	641	2503	198	923	125	178	-	78.73	97.12	18.42	54.89
2005	876	1968	21	618	154	116	-	64.50	124.67	14.64	49.56
2006	924	1330	23	630	233	70	-	49.61	118.04	14.78	60.47
2007	798	1407	31	518	219	12	-	45.91	135.36	15.81	55.81
2008	711	1202	109	290	229	5	-	28.72	125.41	11.65	37.20
2009	656	1105	244	266	296	48	-	30.65	137.11	8.18	37.94
2010	565	1162	84	327	469	78	-	32.46	140.79	9.68	40.22
2011	525	868	8	180	353	111	-	38.77	120.33	11.01	35.33
2012	543	1408	138	275	487	102	-	46.25	127.68	14.14	40.33
2013	280	1611	72	265	37	77	-	45.23	118.20	13.15	38.48
2014	156	959	10	131	0	24	-	31.30	127.34	12.46	37.84
2015	79	726	3	245	0	56	-	31.79	132.69	9.28	37.79
2016	0	915	0	396	0	34	-	32.34	148.17	10.44	39.55
2017	93	986	95	514	193	74	-	33.35	136.05	9.75	35.21
2018	127	1071	71	440	210	15	-	31.48	105.81	9.69	37.42
2019	169	981	34	255	277	8	-	32.03	103.89	14.26	34.08
2020	100	1012	10	346	40	99	-	41.70	89.91	13.59	29.14
2021	155	1260	22	547	28	102	-	37.33	83.91	14.80	31.57
2022	90	1275	4	207	36	77	-	42.72	64.45	14.30	22.50
2023	120	970	22	338	115	92	-	44.87	66.38	16.54	28.85

1. Division 7.f only -days fished (Corrected).

2. 7.g EAST - days fished (corrected).

3. 7.g WEST - days fished (corrected).

4. Fishing hours (x 10^3) corrected for fishing power using P = 0.000204 BHP^1.23.

5. Division 7.g only - Fishing hours (x10^3).

6. Fishing hours (x10^3).

Table 33.8. Sol.27.7fg – LPUE.

	UK							Belgium		Ireland		
Year	BT Survey[1] Div VIIfg	Otter trawl[2] Div VIIf	Beam trawl[2] Div VIIf	Otter trawl[2] Div VIIgEast	Beam trawl[2] Div VIIgEast	Otter trawl[2] Div VIIgWest	Beam trawl[2] Div VIIgWest	Beam trawl[3,5] Div VIIfg	Beam trawl[4,5] Div VIIfg	Otter trawl[4] Div VIIg	Scottish sein[4] Div VIIg	Beam trawl[4] Div VIIg
1971	-	-	-	-	-	-	-	47.92	-	-	-	-
1972	-	-	-	-	-	-	-	37.06	-	-	-	-
1973	-	-	-	-	-	-	-	39.47	-	-	-	-
1974	-	-	-	-	-	-	-	37.81	-	-	-	-
1975	-	-	-	-	-	-	-	31.41	-	-	-	-
1976	-	-	-	-	-	-	-	30.50	-	-	-	-
1977	-	-	-	-	-	-	-	27.90	-	-	-	-
1978	-	-	-	-	-	-	-	23.35	-	-	-	-
1979	-	-	-	-	-	-	-	33.19	-	-	-	-
1980	-	-	-	-	-	-	-	29.73	-	-	-	-
1981	-	-	-	-	-	-	-	24.03	-	-	-	-
1982	-	-	-	-	-	-	-	25.93	-	-	-	-
1983	-	30.54	201.80	35.75	250.70	0.00	39.68	22.18	-	-	-	-
1984	-	19.53	204.65	28.04	130.61	0.00	63.21	20.78	-	-	-	-
1985	-	26.58	240.45	37.31	235.62	33.78	188.28	17.94	-	-	-	-
1986	-	25.55	247.74	21.27	190.11	10.22	184.94	17.83	-	-	-	-
1987	-	19.85	179.34	36.02	225.56	0.47	113.56	17.32	-	-	-	-
1988	79.52	11.13	110.35	8.88	304.43	1.82	230.65	15.29	-	-	-	-
1989	150.02	17.36	130.42	18.75	247.17	10.28	707.10	11.33	-	-	-	-
1990	93.61	13.41	148.47	18.08	269.40	8.12	106.57	15.64	-	-	-	-
1991	122.06	12.26	119.52	16.20	117.12	15.23	169.61	24.24	-	-	-	-
1992	121.41	17.90	105.84	20.99	119.32	20.62	127.52	18.57	-	-	-	-
1993	76.37	8.85	118.08	4.27	119.85	9.83	358.96	15.21	-	-	-	-
1994	109.74	13.00	70.00	3.50	74.32	5.72	116.30	13.94	-	-	-	-
1995	69.91	13.76	73.20	12.75	63.20	15.20	41.46	13.62	-	0.40	0.62	0.81
1996	71.71	9.69	65.05	6.95	43.84	0.68	12.41	11.27	11.45	0.73	0.05	0.88
1997	81.67	12.55	53.81	6.42	43.77	0.44	16.05	9.96	9.68	0.42	0.23	1.16
1998	137.11	8.24	44.86	4.85	27.16	0.04	47.84	10.12	9.64	0.48	0.11	1.11
1999	168.46	13.25	52.36	8.18	26.19	0.01	14.01	11.26	12.14	0.17	0.09	0.50
2000	228.46	7.01	53.85	23.26	36.94	0.09	14.9	11.90	13.77	0.19	0.05	0.26
2001	158.08	17.1	62.39	27.5	33.01	0.11	22.69	13.25	13.60	0.31	0.55	0.18
2002	121.89	11.61	79.47	47.01	54.15	0.11	43.04	18.71	17.80	0.43	0.29	0.14
2003	123.91	8.03	80.85	0.00	45.42	0.70	52.96	19.48	11.40	0.12	0.03	0.19
2004	152.03	8.84	76.09	2.70	37.88	0.05	91.33	-	9.17	0.19	0.02	0.20
2005	76.28	10.67	70.02	3.07	41.36	0.20	80.99	-	9.78	0.14	0.00	0.29
2006	68.96	16.40	81.57	6.23	45.13	0.10	20.93	-	10.63	0.11	0.05	0.26
2007	80.95	10.75	92.17	15.04	43.57	0.05	39.00	-	11.53	0.13	0.02	0.20
2008	115.96	11.94	94.85	10.67	41.48	0.00	19.96	-	14.35	0.12	0.02	0.29
2009	90.64	13.13	69.37	6.88	50.65	0.00	9.81	-	14.01	0.10	0.00	0.28
2010	109.55	13.59	79.90	8.63	53.69	0.00	44.89	-	16.68	0.13	0.01	0.20
2011	99.47	20.78	109.20	4.47	98.38	0.00	50.73	-	17.90	0.19	0.01	0.20
2012	101.45	24.10	80.16	5.17	53.43	0.00	42.43	-	17.01	0.15	0.01	0.48
2013	119.38	27.81	82.82	4.62	44.52	0.07	39.60	-	16.54	0.14	0.01	0.65
2014	86.75	6.19	107.25	11.56	42.11	0	18.57	-	21.30	0.12	-	0.34
2015	85.45	51.13	103.07	5.62	57.39	0	42.64	-	20.14	0.11	-	0.31
2016	113.55	0.00	113.16	0	33.65	0	34.17	-	16.25	0.10	0.01	0.20
2017	111.38	31.29	100.03	18.09	35.05	0.22	58.81	-	15.72	0.18	0.05	0.22
2018	206.44	36.37	119.89	4.86	47.74	0.15	52.26	-	18.09	0.18	-	0.27
2019	150.04	46.55	129.79	11.12	61.33	0.12	23.35	-	23.08	0.25	0.00	0.26
2020	111.72	51.82	168.07	5.58	117.30	0	92.58	-	25.74	0.31	0.02	0.93
2021	112.38	88.53	156.87	6.41	78.38	9.80	136.10	-	21.55	0.34	0.02	0.54

	UK							Belgium		Ireland		
Year	BT Survey[1] Div VIIfg	Otter trawl[2] Div VIIf	Beam trawl[2] Div VIIf	Otter trawl[2] Div VIIgEast	Beam trawl[2] Div VIIgEast	Otter trawl[2] Div VIIgWest	Beam trawl[2] Div VIIgWest	Beam trawl[3,5] Div VIIfg	Beam trawl[4,5] Div VIIfg	Otter trawl[4] Div VIIg	Scottish sein[4] Div VIIg	Beam trawl[4] Div VIIg
2022	124.67	108.90	113.46	28.44	131.02	0.00	103.38	-	18.52	0.33	0.02	0.53
2023*	134.14	46.61	123.44	7.59	122.69	9.26	65.06	-	18.59	0.45	0.01	0.57

[1] **Kg/100 km.**

[2] **Kg/day.**

[3] **Kg/hr corrected for fishing power using P = 0.000204 BHP^1.23.**

[4] **Kg/hour.**

[5] **without misreporting correction.**

***Provisional.**

Table 33.9. Sol.27.7fg - Tuning series.

BE-CBT_1971_1983	Belgium Beam trawl (Biomass tuning index)		
1971	1983		
1	1	0	0
1	-1		
1	**45.319**		
1	**33.193**		
1	**35.906**		
1	**35.915**		
1	**29.286**		
1	**27.369**		
1	**25.677**		
1	**23.971**		
1	**32.663**		
1	**28.343**		
1	**23.326**		
1	**26.083**		
1	**20.742**		

BE-CBT_1984_1996	Belgium Beam trawl (Biomass tuning index)		
1984	1996		
1	1	0	0
1	-1		
1	**19.788**		
1	**20.556**		
1	**19.824**		
1	**18.996**		
1	**15.129**		
1	**12.805**		
1	**16.620**		
1	**23.442**		
1	**20.455**		
1	**16.472**		
1	**15.722**		
1	**15.199**		
1	**12.243**		

BE-CBT3-2006-2023	Belgium Beam trawl (Biomass tuning index)		
2006	2023		
1	1	0	0
1	-1		
1	**2.381528**		
1	**2.168798**		
1	**2.07615**		
1	**1.884788**		
1	**2.312626**		
1	**2.669895**		
1	**2.67652**		
1	**2.301635**		
1	**2.906322**		
1	**2.720626**		
1	**2.603039**		
1	**2.836455**		
1	**3.41186**		
1	**4.148661**		
1	**4.207157**		
1	**4.800401**		
1	**3.772017**		
1	**3.49148**		

UK(E&W)-CBT_1984_2005	UK(E+W) Beam trawl (Biomass tuning index)		
1984	2005		
1	1	0	0
1	-1		
1	**145.56**		
1	**128.25**		
1	**140.79**		
1	**103.92**		
1	**90.35**		
1	**72.65**		
1	**92.04**		
1	**69.29**		
1	**54.8**		
1	**44.32**		
1	**46.04**		
1	**47.83**		
1	**41.71**		
1	**56.61**		
1	**78.31**		
1	**84.84**		
1	**58.93**		
1	**53.26**		
1	**63.71**		
1	**75.05**		
1	**82.39**		
1	**86.68**		

UK(E&W)-CBT_2006_2023	UK(E+W) Beam trawl (Biomass tuning index)		
2006	2023		
1	1	0	0
1	-1		
1	**132.54**		
1	**220.31**		
1	**243.9**		
1	**211.31**		
1	**235.43**		
1	**284.15**		
1	**252.03**		
1	**215**		
1	**300.75**		

1	**238.46**
1	**204.46**
1	**210**
1	**259.23**
1	**240.04**
1	**300.59**
1	**354.42**
1	**360.09**
1	**329.07**

UK(E&W)-BTS-Q3 - Ages used in the assessment are in bold										
1988	2023									
1	1	0.75	0.85							
0	9									
74.12	22	**60**	**242**	**36**	**14**	**4**	0	0	0	0
91.909	132	**204**	**304**	**162**	**18**	**14**	6	4	2	2
69.858	21	**269**	**219**	**35**	**11**	**3**	5	2	0	0
123.41	40	**297**	**638**	**83**	**21**	**18**	5	0	3	2
125.078	5	**493**	**325**	**174**	**37**	**23**	12	1	2	1
127.672	6	**207**	**436**	**52**	**28**	**3**	2	2	1	1
120.816	1	**424**	**430**	**133**	**23**	**11**	9	0	0	3
114.886	31	**142**	**255**	**60**	**13**	**7**	14	1	1	1
118.592	3	**178**	**251**	**64**	**27**	**7**	3	4	1	3
114.886	37	**498**	**207**	**21**	**13**	**14**	5	3	6	0
114.886	104	**885**	**472**	**58**	**11**	**9**	5	2	1	5
118.592	29	**2922**	**297**	**38**	**16**	**7**	4	5	1	0
118.592	16	**1086**	**1608**	**37**	**26**	**6**	0	2	1	1
118.592	26	**449**	**711**	**307**	**23**	**9**	6	2	0	2
118.592	9	**786**	**283**	**151**	**121**	**14**	7	2	3	0
118.592	14	**465**	**628**	**55**	**30**	**56**	9	3	3	0
114.886	64	**860**	**434**	**99**	**15**	**22**	42	4	3	0
118.592	44	**407**	**267**	**38**	**16**	**7**	5	17	1	2
118.592	13	**324**	**238**	**47**	**16**	**8**	0	2	12	0
118.592	108	**424**	**128**	**51**	**16**	**8**	7	3	4	13
118.592	6	**1232**	**124**	**15**	**18**	**7**	9	4	3	5
118.592	1	**604**	**377**	**29**	**8**	**10**	4	3	3	2
118.592	21	**101**	**558**	**144**	**20**	**2**	5	9	4	2
118.592	21	**595**	**62**	**164**	**82**	**8**	2	7	3	0
118.592	16	**643**	**274**	**9**	**63**	**28**	1	1	1	3
118.592	11	**331**	**614**	**51**	**16**	**29**	18	1	6	1
118.592	40	**289**	**305**	**90**	**16**	**6**	27	9	1	1
118.592	33	**885**	**57**	**52**	**37**	**8**	4	16	7	0
118.592	31	**680**	**426**	**14**	**32**	**15**	8	4	6	9
118.592	7	**1240**	**206**	**80**	**15**	**19**	20	5	4	13
118.592	32	**515**	**1074**	**331**	**53**	**20**	11	18	13	5
118.592	2	**840**	**386**	**195**	**27**	**34**	4	7	8	5
118.592	3	**393**	**282**	**88**	**80**	**28**	20	2	7	8
118.592	68	**1062**	**183**	**53**	**44**	**39**	14	14	0	3
118.592	143	**1305**	**199**	**57**	**33**	**30**	27	6	10	0
118.592	23	**1647**	**136**	**61**	**26**	**25**	18	14	1	5

Table 33.10. Sol.27.7fg – Configuration.

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$maxAge
[1] 10

$maxAgePlusGroup
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[1,]    0    1    2    3    3    3    4    4    5     5
[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[3,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[4,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[5,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[6,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[7,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1

$corFlag
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$keyLogFpar
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
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[2,]    0    1    2    3    3   -1   -1   -1   -1    -1
[3,]    4   -1   -1   -1   -1   -1   -1   -1   -1    -1
[4,]    5   -1   -1   -1   -1   -1   -1   -1   -1    -1
[5,]    6   -1   -1   -1   -1   -1   -1   -1   -1    -1
[6,]    7   -1   -1   -1   -1   -1   -1   -1   -1    -1
[7,]    8   -1   -1   -1   -1   -1   -1   -1   -1    -1

$keyQpow
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[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[3,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[4,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[5,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[6,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[7,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1

$keyVarF
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[1,]    0    0    0    0    0    0    0    0    0     0
[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
```

```
[3,]  -1  -1  -1  -1  -1  -1  -1  -1  -1  -1
[4,]  -1  -1  -1  -1  -1  -1  -1  -1  -1  -1
[5,]  -1  -1  -1  -1  -1  -1  -1  -1  -1  -1
[6,]  -1  -1  -1  -1  -1  -1  -1  -1  -1  -1
[7,]  -1  -1  -1  -1  -1  -1  -1  -1  -1  -1

$keyVarLogN
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$keyVarLogP
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$keyVarObs
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[2,]    2    3    3    4    4   -1   -1   -1   -1    -1
[3,]    5   -1   -1   -1   -1   -1   -1   -1   -1    -1
[4,]    6   -1   -1   -1   -1   -1   -1   -1   -1    -1
[5,]    7   -1   -1   -1   -1   -1   -1   -1   -1    -1
[6,]    8   -1   -1   -1   -1   -1   -1   -1   -1    -1
[7,]    9   -1   -1   -1   -1   -1   -1   -1   -1    -1

$obsCorStruct
[1] AR ID ID ID ID ID ID
Levels: ID AR US

$keyCorObs
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[3,]  -1  -1  -1  -1  -1  -1  -1  -1   -1
[4,]  -1  -1  -1  -1  -1  -1  -1  -1   -1
[5,]  -1  -1  -1  -1  -1  -1  -1  -1   -1
[6,]  -1  -1  -1  -1  -1  -1  -1  -1   -1
[7,]  -1  -1  -1  -1  -1  -1  -1  -1   -1

$stockRecruitmentModelCode
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$noScaledYears
[1] 0

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numeric(0)

$keyParScaledYA
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[1] 3 8

$keyBiomassTreat
[1] -1 -1  0  0  0  0  0

$obsLikelihoodFlag
[1] LN LN LN LN LN LN LN
Levels: LN ALN

$fixVarToWeight
[1] 0

$fracMixF
[1] 0

$fracMixN
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$fracMixObs
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$predVarObsLink
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[2,]   -1   -1   -1   -1   -1   NA   NA   NA   NA    NA
[3,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[4,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[5,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[6,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[7,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA

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$keyCatchWeightMean
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$keyCatchWeightObsVar
    [          1] [          2] [          3] [          4] [          5] [          6] [          7] [          8] [          9] [         10]
[1          ]  NA   NA   NA   NA   NA   NA   NA   NA   NA   NA

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$mortalityModel
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$keyMortalityMean
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$keyMortalityObsVar
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$logNMeanAssumption
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$initState
[1] 0
```

Table 33.11. Sol.27.7fg – Diagnostics.

Name	Type	Years	Ages	LogQ _age1	Sd _age1	LogQ _age2	Sd _age2	LogQ _age3	Sd _age3	LogQ _age4	Sd _age4	LogQ _age5	Sd _age5
UK-BTS-Q3	age-based	1988-2023	1-5	-7.157	0.099	-7.449	0.099	-8.625	0.098	-9.222	0.063	-9.222	0.063
BE-CBT_71-83	biomass	1971-1983	-1	-5.114	0.065	NA	NA	NA	NA	NA	NA	NA	NA
BE-CBT_84-96	biomass	1984-1996	-1	-5.242	0.055	NA	NA	NA	NA	NA	NA	NA	NA
BE-CBT_06-23	biomass	2006-2023	-1	-7.233	0.048	NA	NA	NA	NA	NA	NA	NA	NA
UK-CBT_84-05	biomass	1984-2005	-1	-3.805	0.075	NA	NA	NA	NA	NA	NA	NA	NA
UK-CBT_06-23	biomass	2006-2023	-1	-2.77	0.066	NA	NA	NA	NA	NA	NA	NA	NA

log(L)	#par	AIC
-265.694	24	579.3873

Table 33.12. Sol.27.7fg - Fishing mortality.

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004
2	0.091	0.085	0.08	0.077	0.075	0.086	0.078	0.072	0.077	0.086	0.097	0.101	0.106
3	0.28	0.261	0.246	0.234	0.229	0.262	0.24	0.22	0.234	0.265	0.298	0.313	0.329
4	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
5	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
6	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
7	0.291	0.268	0.249	0.237	0.231	0.263	0.239	0.217	0.23	0.26	0.293	0.311	0.329
8	0.291	0.268	0.249	0.237	0.231	0.263	0.239	0.217	0.23	0.26	0.293	0.311	0.329
9	0.27	0.248	0.231	0.22	0.214	0.242	0.218	0.198	0.208	0.234	0.263	0.277	0.29
10+	0.27	0.248	0.231	0.22	0.214	0.242	0.218	0.198	0.208	0.234	0.263	0.277	0.29

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
2	0.107	0.114	0.124	0.121	0.117	0.112	0.116	0.113	0.111	0.119	0.128	0.14	0.141	0.144
3	0.331	0.354	0.383	0.375	0.364	0.345	0.36	0.349	0.344	0.367	0.396	0.433	0.438	0.446
4	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
5	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
6	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
7	0.333	0.358	0.392	0.389	0.38	0.359	0.375	0.362	0.354	0.38	0.412	0.452	0.456	0.465
8	0.333	0.358	0.392	0.389	0.38	0.359	0.375	0.362	0.354	0.38	0.412	0.452	0.456	0.465
9	0.293	0.315	0.345	0.342	0.335	0.316	0.331	0.322	0.317	0.342	0.372	0.407	0.411	0.42
10+	0.293	0.315	0.345	0.342	0.335	0.316	0.331	0.322	0.317	0.342	0.372	0.407	0.411	0.42

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003
2	0.136	0.122	0.107	0.104	0.105	0.113	0.116	0.113	0.107	0.101	0.093	0.087	0.083
3	0.42	0.374	0.326	0.316	0.32	0.345	0.355	0.342	0.324	0.303	0.276	0.258	0.245
4	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
5	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
6	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
7	0.438	0.387	0.339	0.334	0.343	0.376	0.391	0.383	0.371	0.356	0.334	0.321	0.311
8	0.438	0.387	0.339	0.334	0.343	0.376	0.391	0.383	0.371	0.356	0.334	0.321	0.311
9	0.397	0.352	0.311	0.309	0.318	0.351	0.37	0.366	0.357	0.346	0.326	0.315	0.306
10+	0.397	0.352	0.311	0.309	0.318	0.351	0.37	0.366	0.357	0.346	0.326	0.315	0.306

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.003
2	0.084	0.088	0.088	0.088	0.081	0.074	0.068	0.064	0.066	0.072	0.077	0.079	0.076
3	0.246	0.259	0.258	0.256	0.235	0.214	0.195	0.184	0.19	0.206	0.223	0.228	0.219
4	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
5	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
6	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
7	0.32	0.344	0.348	0.351	0.32	0.291	0.265	0.252	0.261	0.287	0.31	0.316	0.3
8	0.32	0.344	0.348	0.351	0.32	0.291	0.265	0.252	0.261	0.287	0.31	0.316	0.3
9	0.315	0.341	0.347	0.352	0.322	0.292	0.266	0.253	0.262	0.285	0.306	0.312	0.296
10+	0.315	0.341	0.347	0.352	0.322	0.292	0.266	0.253	0.262	0.285	0.306	0.312	0.296

Table 33.13. Sol.27.7fg - Stock numbers-at-age (start of year, in thousands).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	8718	4556	3435	3497	3537	5277	4880	5223	3757	4917	5076	5069	6474
2	5302	8298	3987	3023	3158	3091	4953	4350	4872	3226	4523	4590	4479
3	1831	4349	7303	3227	2461	2656	2486	4321	3653	4164	2546	3811	3745
4	4679	1399	2935	5016	2321	1838	1665	1718	3299	2669	2916	1552	2473
5	2034	2804	1084	2008	3432	1743	1324	1041	1155	2170	1684	1935	976
6	1514	1265	1743	793	1402	2379	1132	999	727	807	1360	1092	1240
7	1807	1000	786	1143	547	975	1748	773	779	505	523	830	699
8	2658	1155	711	545	771	367	671	1273	606	553	416	333	520
9	1469	1728	768	529	405	601	220	478	956	463	385	325	212
10+	4846	4024	3828	3081	2410	1976	1798	1320	1296	1687	1553	1376	1247

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	5724	5613	4001	5701	4650	4903	7375	4981	5057	4753	4338	3816	4425	6378
2	6017	5116	5195	3403	5380	4375	4382	7206	4419	4570	4441	3899	3482	4049
3	3620	5049	4085	4261	2572	4515	3673	3431	6078	3478	3631	3593	3039	2762
4	2373	2307	3164	2399	2830	1662	2980	2376	2113	3726	2128	2252	2144	1705
5	1590	1528	1374	1797	1272	1730	966	1719	1387	1163	2112	1115	1127	1095
6	610	948	900	778	1042	698	1068	547	954	768	670	1148	592	585
7	835	398	554	499	452	590	403	617	320	531	460	360	584	313
8	455	535	274	325	267	295	355	241	378	209	295	277	203	322
9	297	300	336	186	203	148	189	206	151	259	135	183	156	120
10+	1097	984	900	782	671	563	501	489	439	380	425	348	329	295

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	7952	13579	9145	5735	7101	5421	4778	4269	3533	3891	7288	6791	3184
2	5826	6883	12671	8169	4906	6584	4826	4333	3887	3165	3326	6901	6377
3	3230	4560	5326	10349	6557	3808	5374	3763	3514	3191	2541	2639	6487
4	1593	1967	2636	3229	7178	4257	2435	3193	2303	2237	2068	1766	2006
5	872	774	1109	1512	1878	4476	2625	1429	1884	1341	1347	1304	1166
6	543	464	389	684	919	1024	2376	1484	806	1153	808	827	855
7	295	297	272	246	402	585	541	1288	861	480	716	528	540
8	175	154	179	178	168	265	356	319	761	539	296	458	353
9	176	107	94	111	124	106	169	216	203	505	360	187	313
10+	249	245	236	240	234	264	261	284	323	332	547	617	539

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	5400	6402	5177	4020	7810	8418	14531	7055	7164	5121	7942	7991	10713
2	2601	4918	5819	4791	3322	7303	7078	14393	6357	6282	4354	7277	7006
3	5604	2033	4034	4850	4019	2663	6360	5839	13319	5548	5272	3462	6234
4	5129	3998	1535	2852	3533	2749	2020	4903	4404	10791	4548	3908	2367
5	1363	3411	2430	1023	1748	2263	1789	1447	3439	3632	8002	2978	2723
6	851	950	1970	1463	653	1123	1433	1198	1113	2278	2854	5600	1871
7	567	578	630	1184	903	442	745	904	775	804	1455	1854	3850
8	379	373	372	403	666	557	312	528	593	520	529	909	1061
9	228	252	235	247	265	434	353	232	410	412	336	326	612
10+	625	614	575	546	463	422	550	594	570	718	812	785	692

Table 33.14. Sol.27.7fg - Summary ('Catch' refers to model estimate).

year	R (age1) low	R (age1) value	R (age1) high	TSB low	TSB value	TSB high	SSB low	SSB value	SSB high	Catch low	Catch value	Catch high	Fbar (3-8) low	Fbar (3-8) value	Fbar (3-8) high
1971	5853	8718	12985	6184	7210	8406	5647	6650	7832	1372	1696	2098	0.246	0.308	0.386
1972	3184	4556	6520	5357	6230	7245	4927	5771	6760	1187	1405	1663	0.234	0.285	0.346
1973	2399	3435	4918	5452	6321	7329	5057	5894	6870	1196	1412	1666	0.219	0.266	0.322
1974	2442	3497	5009	5006	5811	6745	4701	5485	6400	1053	1246	1476	0.207	0.252	0.307
1975	2461	3537	5084	4610	5351	6211	4325	5049	5895	961	1138	1348	0.201	0.246	0.301
1976	3708	5277	7510	4253	4927	5707	3912	4564	5324	910	1088	1300	0.23	0.281	0.343
1977	3435	4880	6931	4193	4829	5561	3759	4356	5048	828	974	1145	0.211	0.256	0.31
1978	3653	5223	7467	4253	4896	5636	3819	4424	5124	772	926	1111	0.188	0.234	0.289
1979	2604	3757	5421	4330	4973	5711	3972	4586	5295	868	1032	1226	0.204	0.248	0.303
1980	3464	4917	6979	4303	4934	5659	3974	4584	5288	1003	1184	1397	0.235	0.281	0.337
1981	3576	5076	7206	4038	4605	5251	3667	4209	4831	958	1134	1343	0.266	0.317	0.378
1982	3566	5069	7206	4039	4576	5185	3622	4128	4705	1041	1229	1451	0.282	0.335	0.399
1983	4540	6474	9232	4034	4556	5146	3576	4062	4614	1062	1255	1484	0.299	0.354	0.419
1984	4010	5724	8171	4204	4736	5336	3726	4212	4761	1090	1285	1515	0.304	0.359	0.424
1985	3933	5613	8011	3845	4334	4885	3456	3912	4428	1143	1355	1605	0.329	0.387	0.455
1986	2802	4001	5713	3982	4496	5075	3579	4050	4583	1215	1451	1732	0.358	0.424	0.503
1987	4041	5701	8043	3545	3995	4502	3164	3582	4055	1110	1317	1561	0.356	0.42	0.495
1988	3329	4650	6497	3283	3691	4151	2912	3289	3715	977	1159	1374	0.349	0.411	0.484
1989	3510	4903	6849	3144	3523	3949	2760	3106	3495	844	1002	1191	0.331	0.39	0.46
1990	5252	7375	10356	2968	3323	3721	2567	2889	3251	936	1108	1313	0.345	0.408	0.483
1991	3589	4981	6914	3250	3674	4154	2827	3201	3625	954	1141	1365	0.334	0.395	0.467
1992	3663	5057	6982	3276	3707	4195	2873	3262	3703	897	1087	1316	0.325	0.388	0.462
1993	3431	4753	6584	3078	3460	3890	2697	3042	3432	908	1085	1296	0.353	0.416	0.49
1994	3141	4338	5993	2848	3191	3575	2500	2810	3159	914	1086	1289	0.386	0.451	0.527
1995	2743	3816	5311	2767	3095	3463	2433	2729	3060	960	1143	1360	0.422	0.495	0.58
1996	3182	4425	6156	2523	2819	3150	2204	2470	2769	883	1042	1231	0.427	0.499	0.584
1997	4599	6378	8846	2314	2594	2908	1948	2193	2470	832	990	1178	0.431	0.508	0.6
1998	5684	7952	11126	2658	3009	3407	2134	2416	2734	812	970	1160	0.405	0.479	0.565
1999	9619	13579	19170	3116	3546	4035	2354	2678	3046	785	947	1141	0.358	0.424	0.502
2000	6613	9145	12646	3148	3577	4063	2550	2904	3307	897	1106	1364	0.308	0.371	0.447
2001	4114	5735	7995	4380	5035	5787	3755	4328	4988	1124	1373	1678	0.305	0.363	0.433
2002	5131	7101	9827	4380	5001	5711	3849	4421	5078	1222	1479	1791	0.315	0.372	0.439
2003	3937	5421	7464	4116	4666	5289	3648	4156	4733	1242	1497	1804	0.345	0.405	0.476
2004	3499	4778	6525	4094	4609	5187	3618	4083	4608	1214	1451	1735	0.356	0.42	0.494
2005	3144	4269	5795	3702	4139	4628	3300	3703	4155	1106	1310	1552	0.347	0.408	0.48
2006	2594	3533	4812	3269	3633	4039	2921	3255	3627	876	1027	1204	0.332	0.391	0.46
2007	2857	3891	5300	3035	3382	3768	2686	2997	3345	824	963	1126	0.314	0.372	0.439
2008	5232	7288	10153	3087	3477	3916	2616	2941	3308	735	858	1001	0.289	0.344	0.409
2009	4965	6791	9289	3241	3725	4281	2656	3042	3483	620	729	858	0.275	0.327	0.389
2010	2287	3184	4433	3394	3825	4311	2945	3323	3750	715	841	989	0.265	0.315	0.374
2011	3971	5400	7342	3619	4044	4519	3211	3601	4040	869	1022	1201	0.271	0.32	0.379
2012	4711	6402	8699	3651	4079	4557	3157	3541	3971	855	1011	1195	0.288	0.342	0.407
2013	3801	5177	7050	3574	3990	4455	3088	3454	3864	850	999	1174	0.288	0.344	0.412
2014	2913	4020	5547	3693	4137	4634	3284	3687	4141	945	1113	1309	0.285	0.345	0.417
2015	5726	7810	10653	3626	4063	4552	3114	3510	3955	798	940	1106	0.26	0.315	0.382
2016	6241	8418	11356	3846	4324	4862	3162	3559	4006	706	833	982	0.236	0.287	0.348
2017	10418	14531	20266	4369	4926	5555	3470	3909	4403	718	848	1002	0.214	0.261	0.319
2018	5150	7055	9664	5258	5961	6758	4375	4946	5590	835	996	1189	0.202	0.247	0.303
2019	5235	7164	9802	5760	6486	7303	5089	5746	6489	1048	1235	1455	0.211	0.256	0.311
2020	3636	5121	7211	5717	6418	7204	5200	5859	6602	1226	1453	1722	0.231	0.28	0.34
2021	5479	7942	11512	5646	6370	7187	5048	5734	6513	1265	1517	1820	0.245	0.303	0.374
2022	4925	7991	12963	5284	5983	6776	4654	5290	6012	1177	1406	1679	0.245	0.309	0.39
2023	5450	10713	21056	4887	5747	6758	4263	4950	5748	1029	1239	1493	0.226	0.294	0.384

Table 33.15. Sol.27.7fg – Short-term forecast.

Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
Fages 3–8 (2024)	0.302	F = FAverage (2021–2023)
SSB(2025)	5275	Short-term forecast; in tonnes
Rage 1 (2024, 2025)	5177	Median recruitment, resampled from the years 1971–2021; in thousands
Catch (2024)	1347	Short-term forecast; in tonnes
Projected landings (2024)	1252	Short-term forecast; assuming average landings ratio by age 2021–2023; in tonnes
Projected discards (2024)	95	Short-term forecast; assuming average discard ratio by age 2021–2023; in tonnes

Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings* (2025)	Projected discards** (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change ***	% advice change^	Probability of SSB (2026) < Blim (%)
ICES advice basis										
MSY approach: F = F_{MSY}	1149	1080	69	0.251	0.237	0.014	5226	-0.93	-9.3	0
Other scenarios										
EU MAP^^: F_{MSY}	1149	1080	69	0.251	0.237	0.014	5226	-0.93	-9.3	0
EU MAP^^: $F_{MSY\ lower}$	656	617	39	0.136	0.128	0.008	5734	8.7	-48	0
EU MAP^^ : $F_{MSY\ upper}$	1922	1802	120	0.462	0.436	0.026	4425	-16.1	52	0.01
F = 0	0	0	0	0	0	0	6427	22	-100	0
F= F_{pa}	1718	1611	107	0.402	0.379	0.023	4637	-12.1	36	0
F= F_{lim}	2180	2042	138	0.543	0.513	0.03	4159	-21	72	0.06
$SSB_{2026} = B_{lim}$	4117	3823	294	1.48	1.393	0.083	2184	-59	220	50
$SSB_{2026} = B_{pa} = MSY\ B_{trigger}$	3252	3037	215	0.96	0.91	0.054	3057	-42	157	8.3
$SSB_{2026} = SSB_{2025}$	1101	1034	67	0.24	0.226	0.013	5275	0	-13.1	0
$F = F_{2024}$	1350	1267	83	0.30	0.285	0.017	5017	-4.9	6.6	0

*** Marketable landings, assuming recent discard rate.**

**** Including BMS landings (EU stocks), assuming recent discard rate.**

***** SSB 2026 relative to SSB 2025.**

^ Advice value for 2025 relative to the advice value for 2024 (1267 tonnes). The 2024 TAC is similar to the advice value.

^^ EU multiannual plan (MAP) for the Western Waters and adjacent waters (EU, 2019).

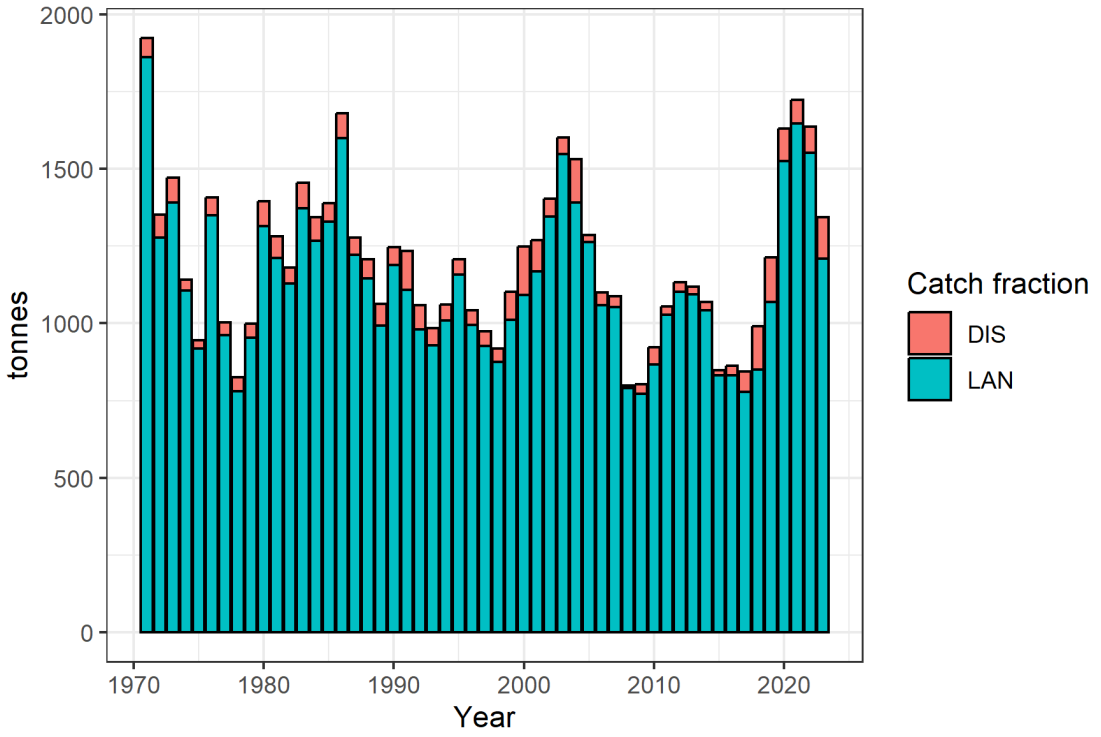


Figure 33.1. Sol.27.7fg - Landings and discards estimates by weight, as used by the WG.

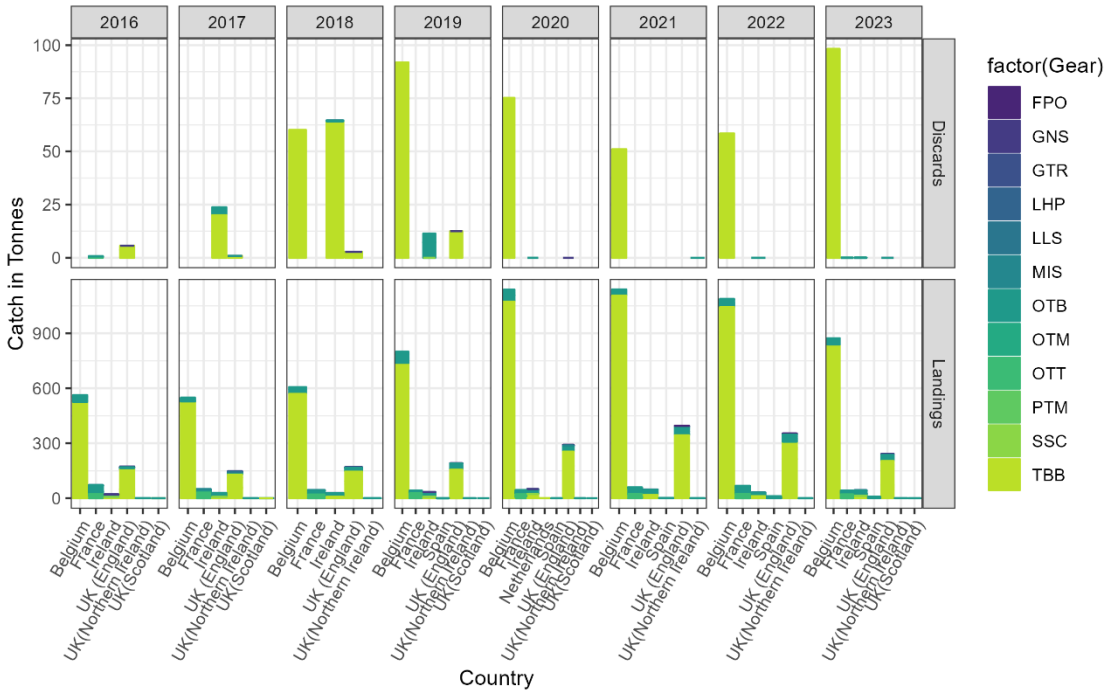


Figure 33.2. Sol.27.7fg - InterCatch landings and discard data by year, country and gear.

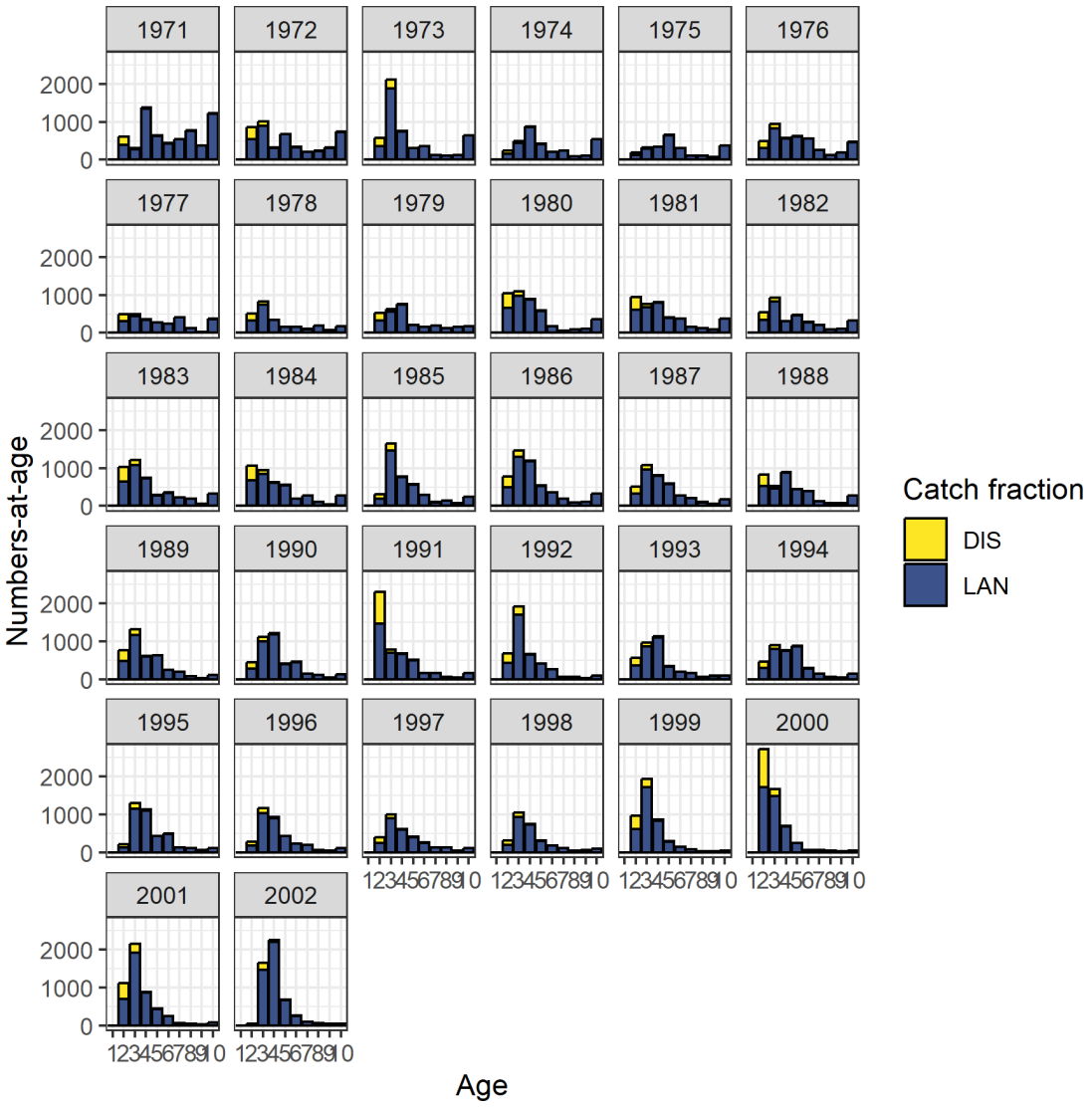


Figure 33.3a. Sol.27.7fg - Age composition of the catch.

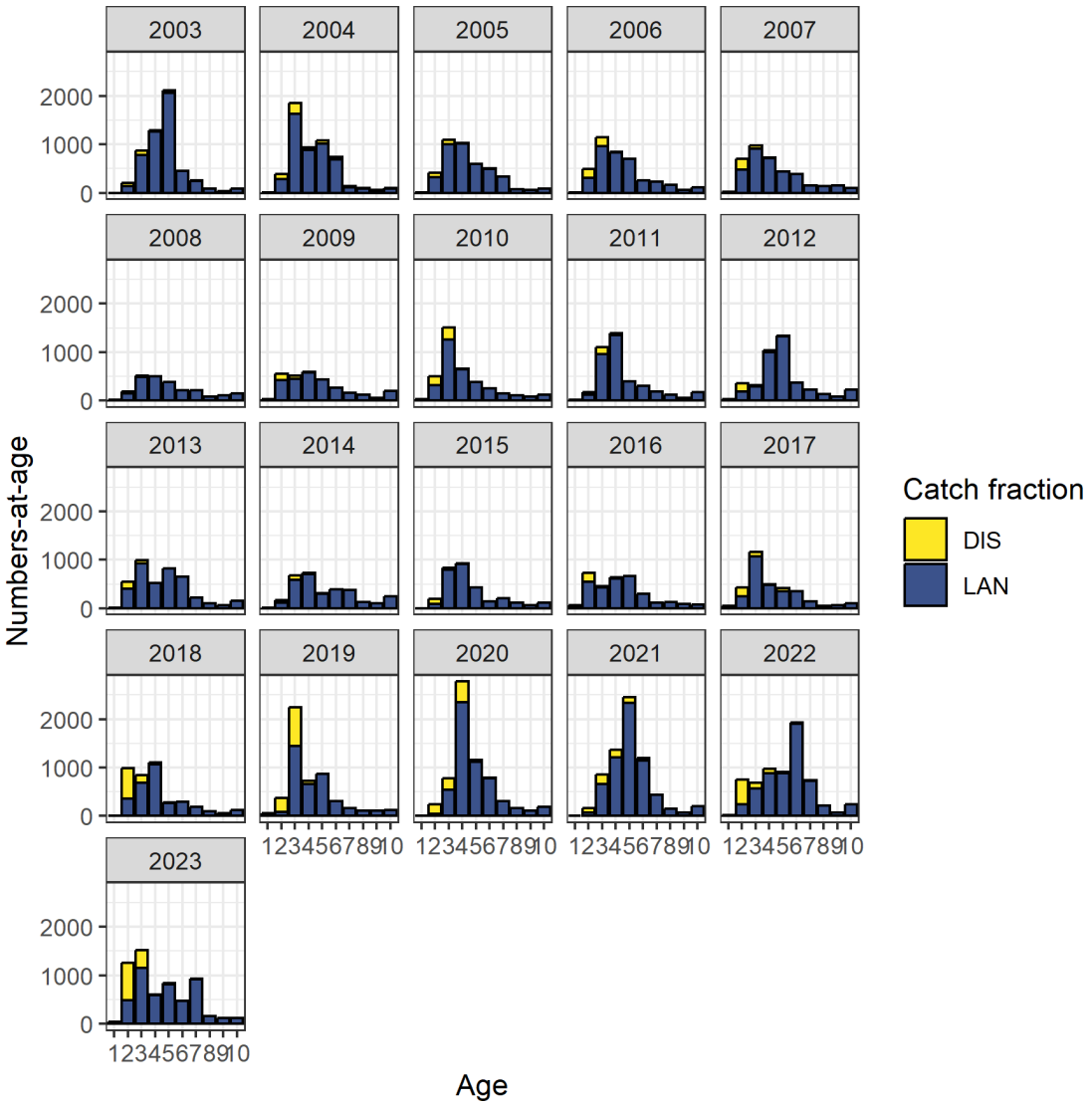


Figure 33.3b. Sol.27.7fg - Age composition of the catch.

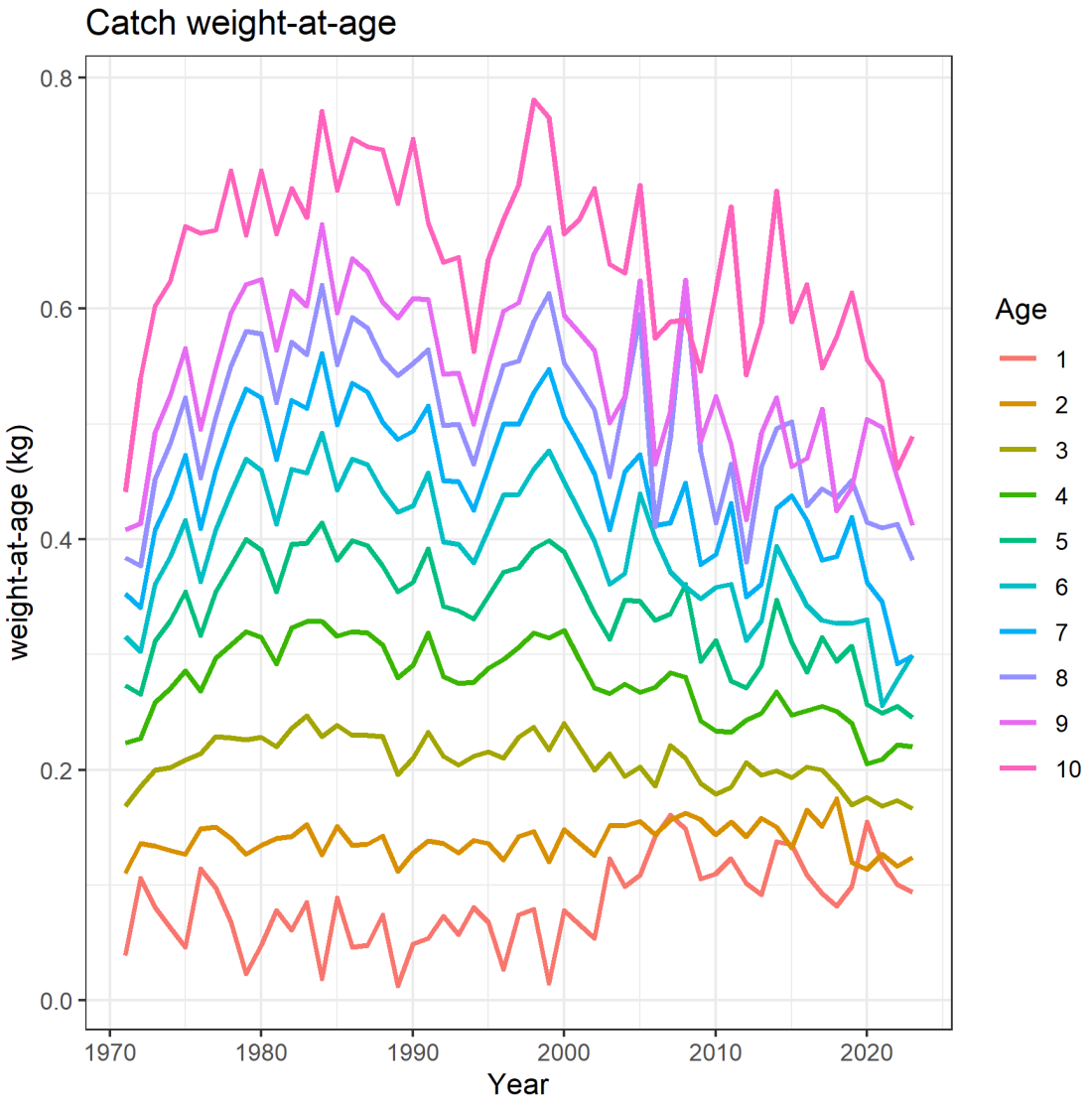


Figure 33.4. Sol.27.7fg - Catch weights-at-age (kg).

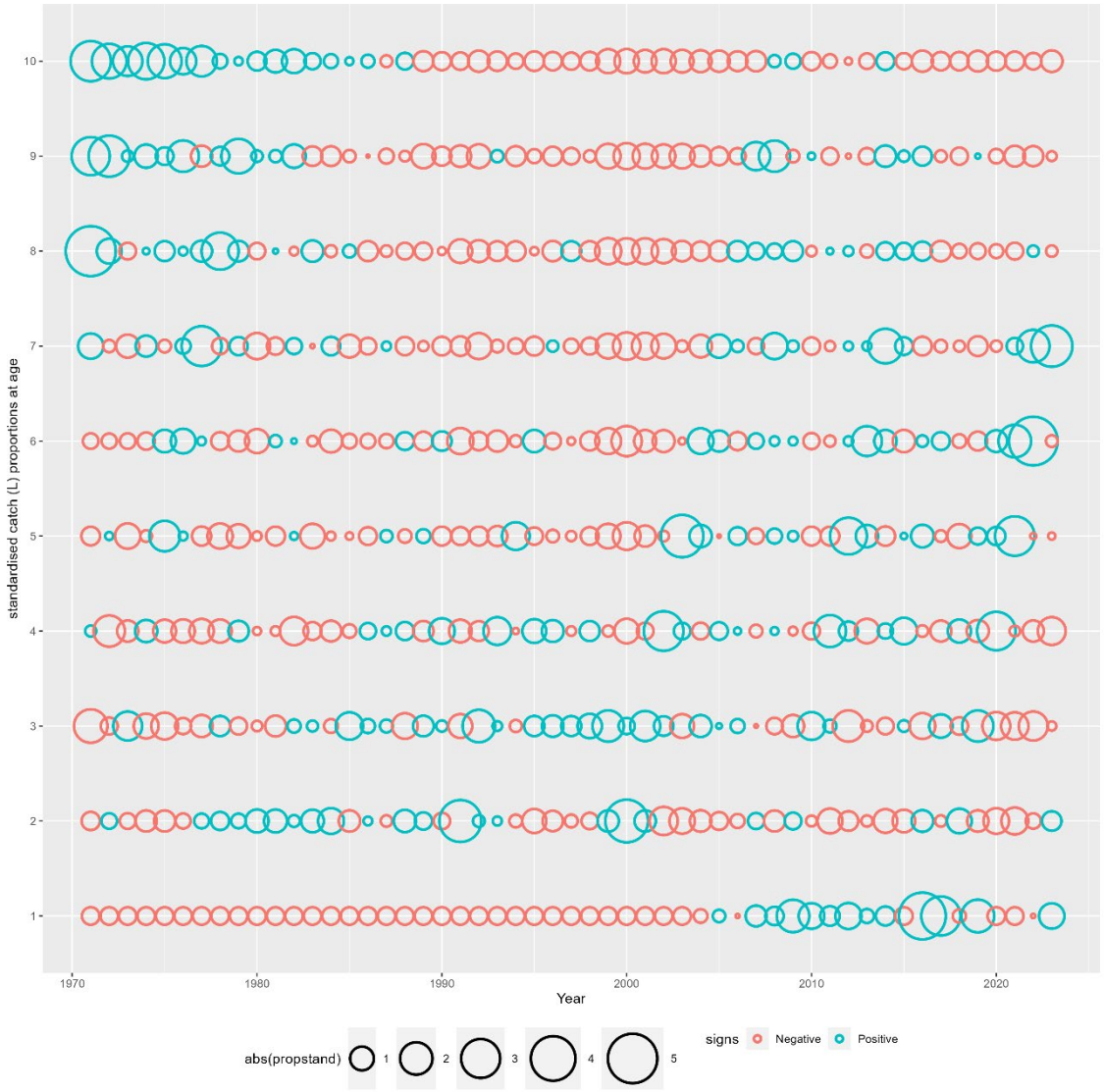


Figure 33.5. Sol.27.7fg - Standardized catch proportion.

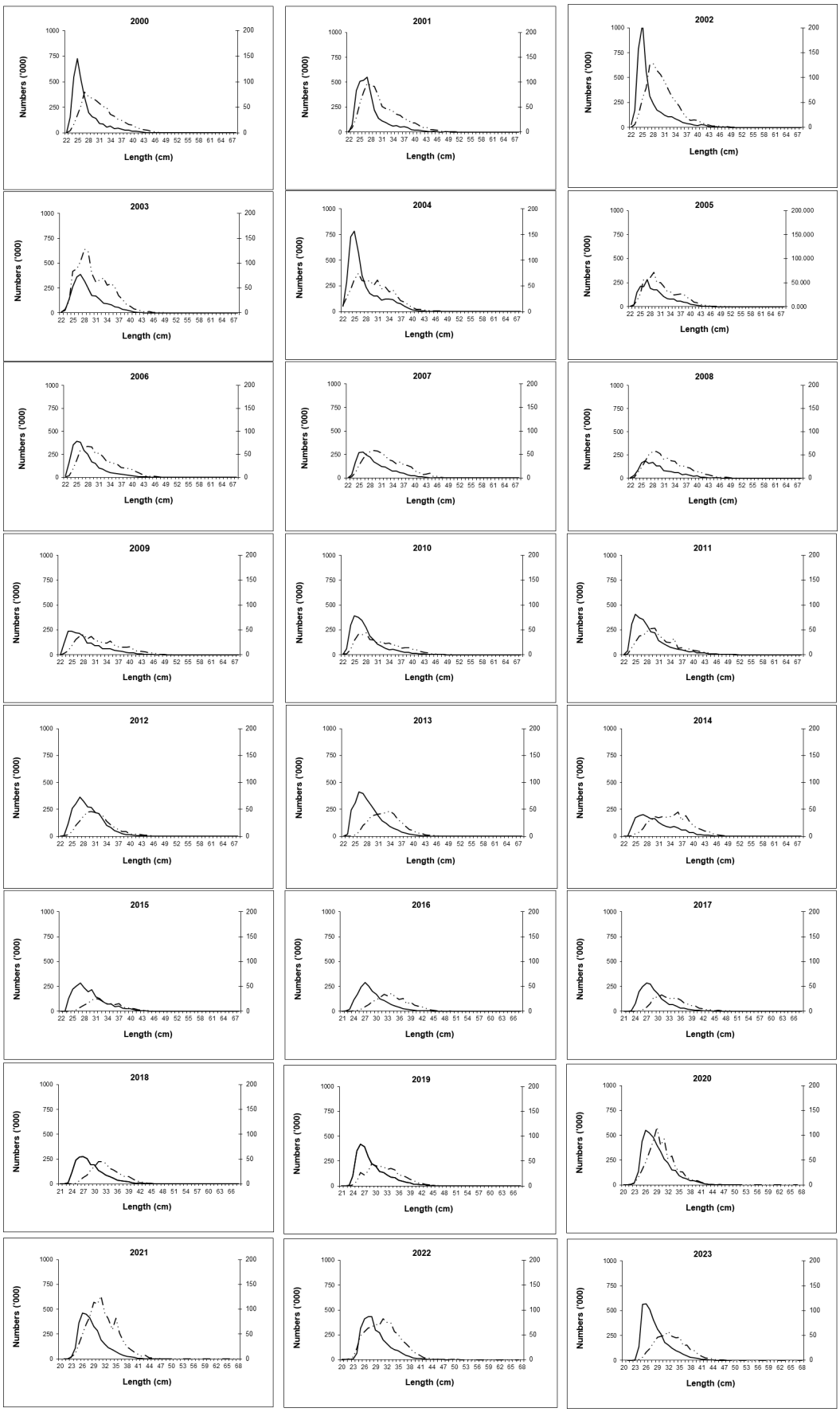


Figure 33.6. Sol.27.7fg - The length distributions of UK (England and Wales) landings (dotted lines) and of Belgian landings (solid lines).

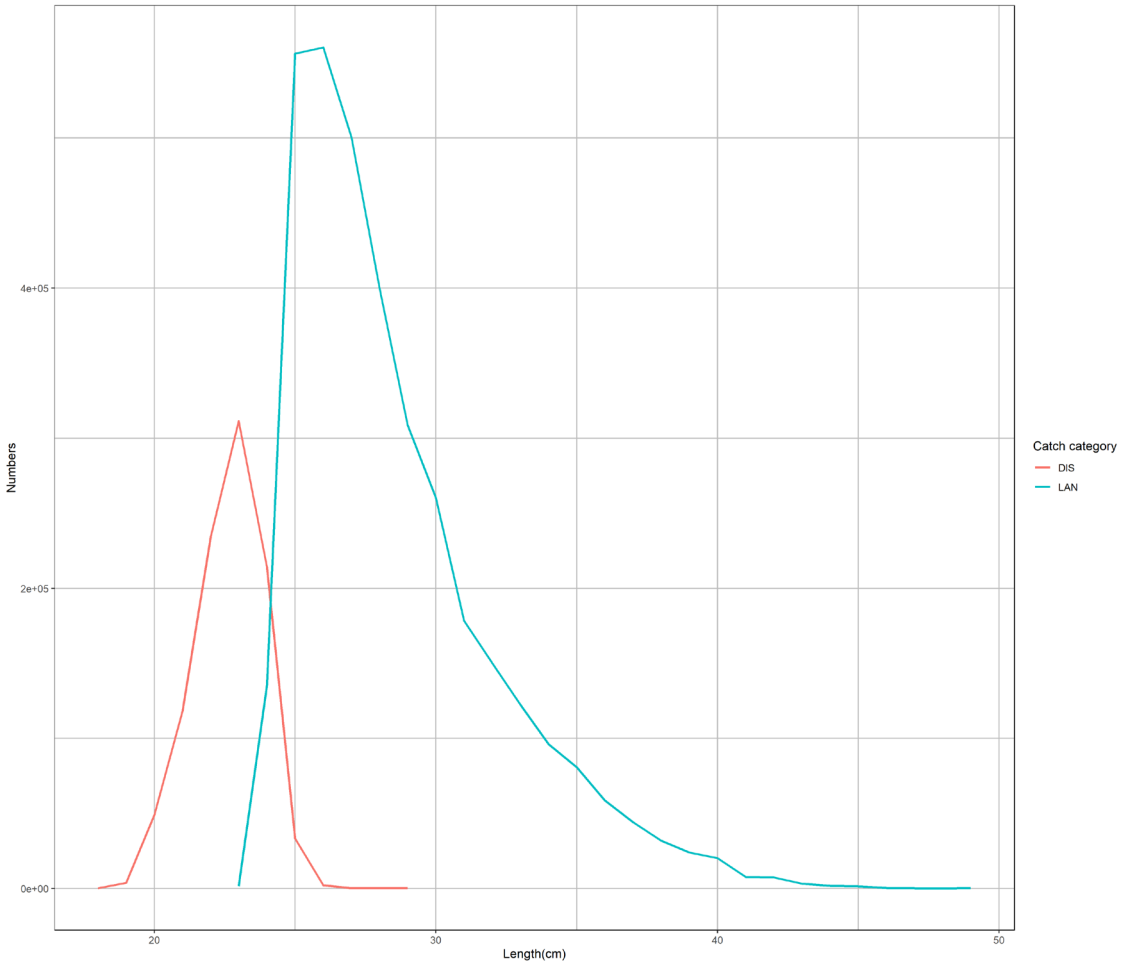


Figure 33.7. Sol.27.7fg - Belgian length distributions of discarded and retained fish from discard sampling studies.

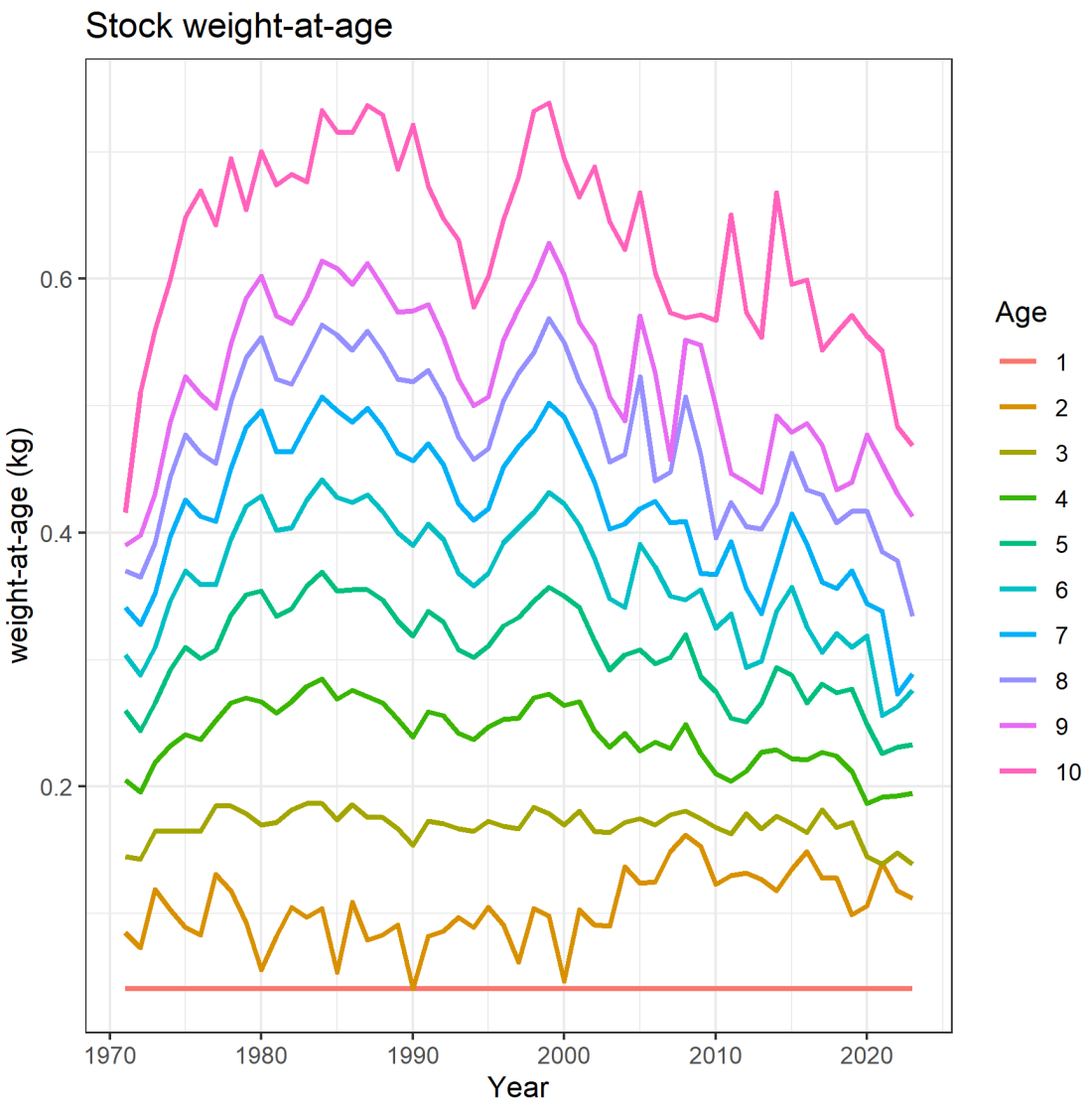


Figure 33.8. Sol.27.7fg - Stock weights-at-age (kg).

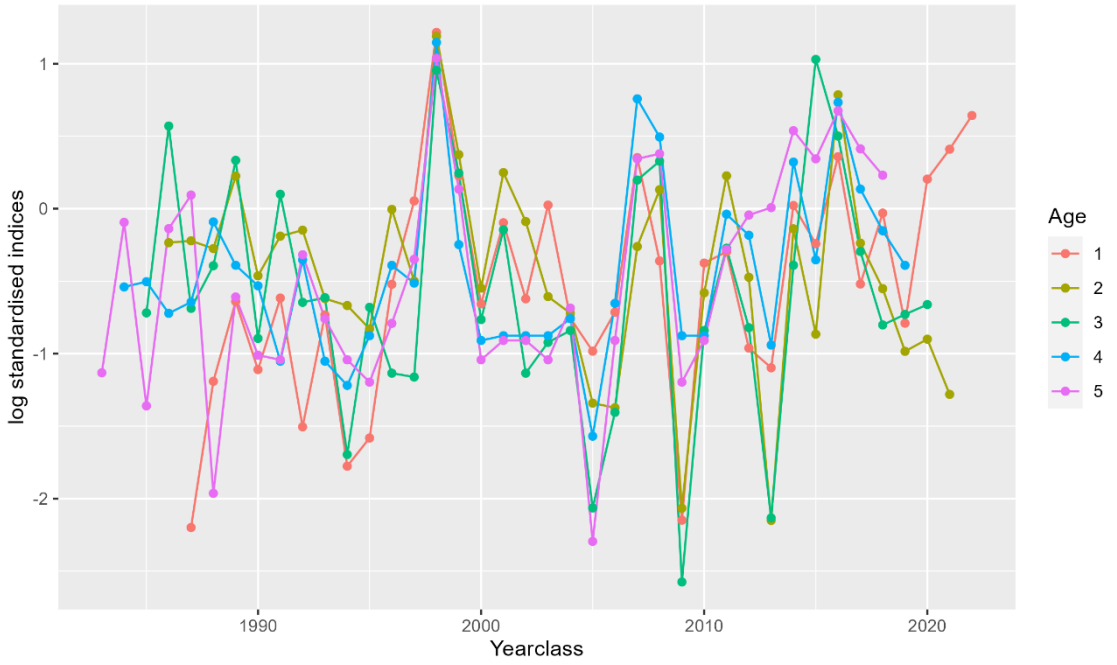


Figure 33.9a. Sol.27.7.fg - Mean-standardised indices.

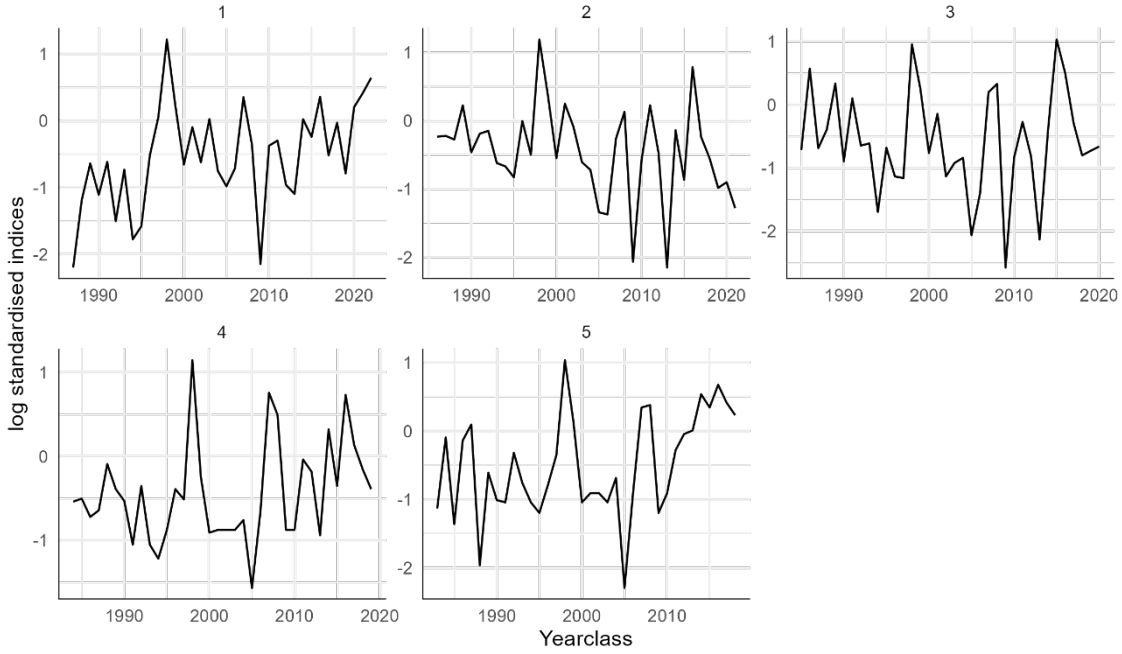


Figure 33.9b. Sol.27.7.fg - Mean-standardised indices.

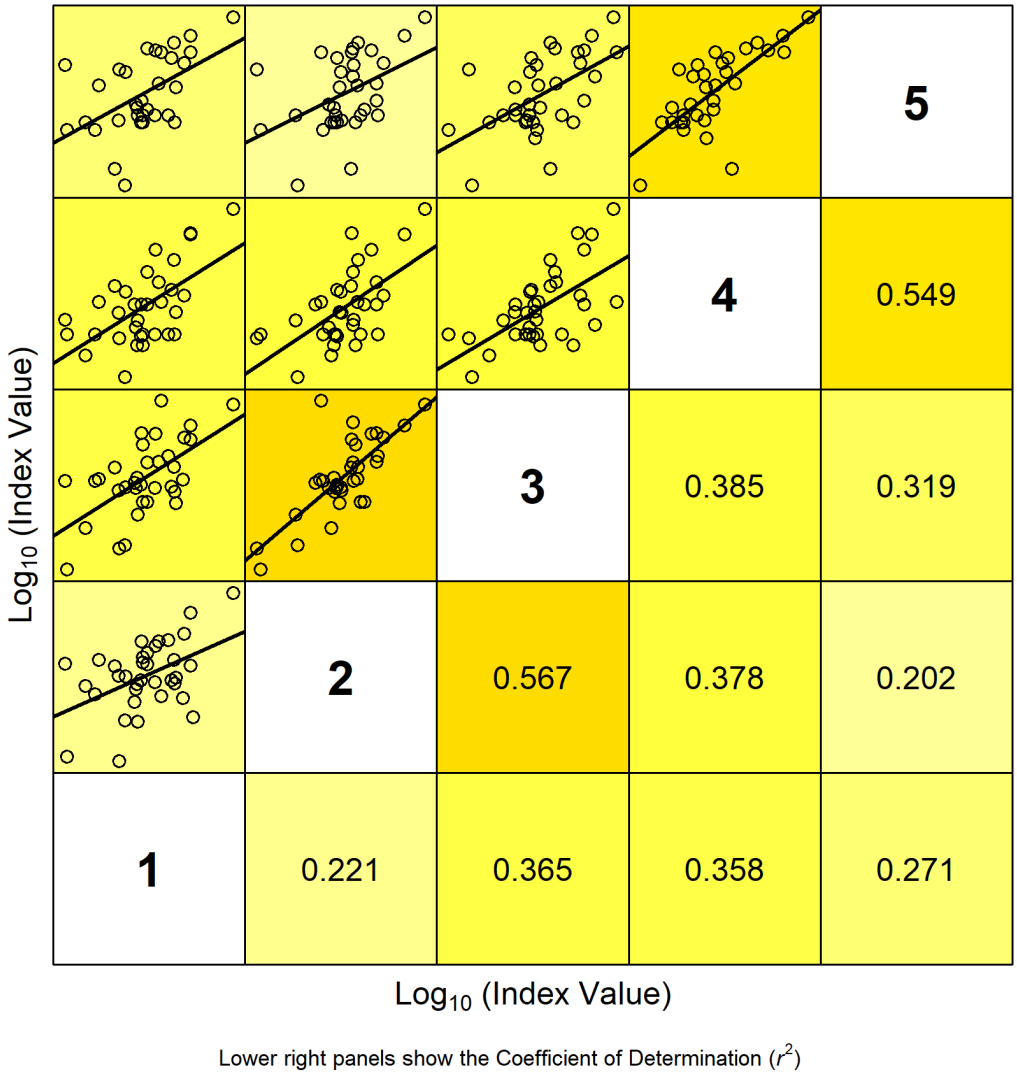


Figure 33.10. Sol.27.7fg - Consistency plot UK(E&W)-BTS-Q3 survey.

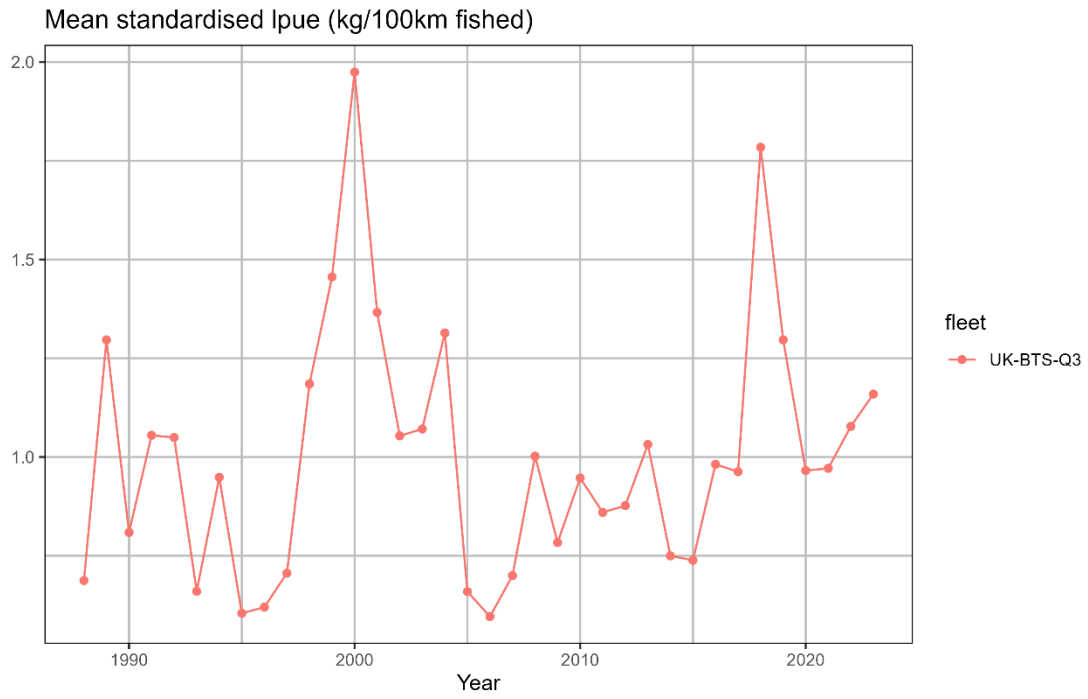


Figure 33.11. Sol.27.7fg – Mean standardized LPUE UK(E&W)-BTS-Q3 survey (kg/100 km fished).

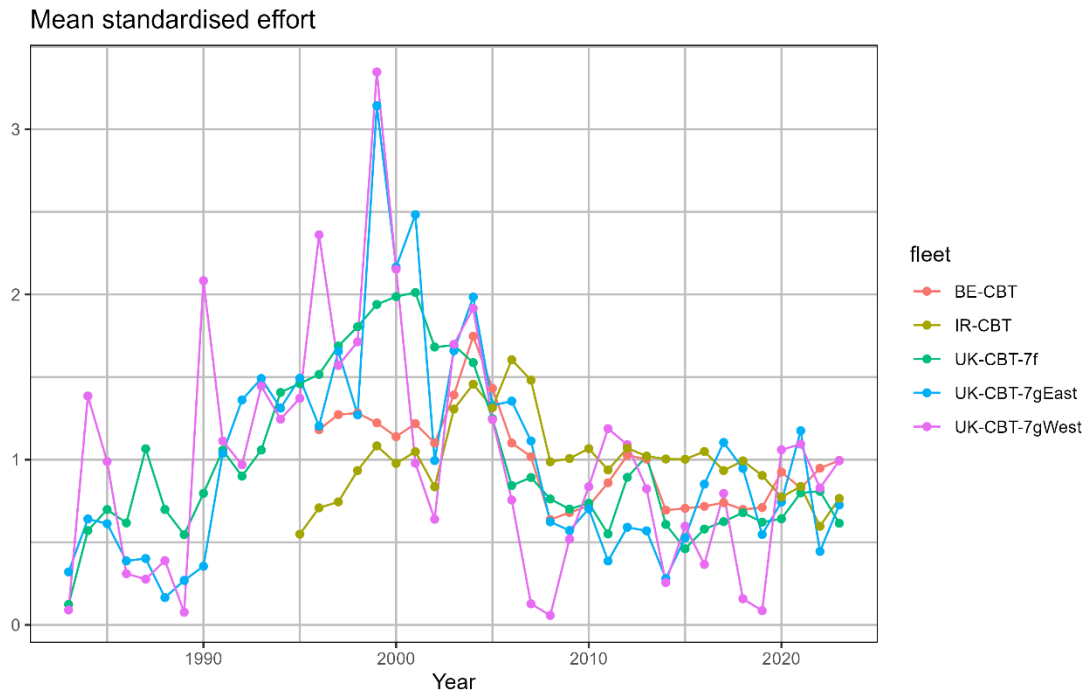


Figure 33.12a. Sol.27.7fg - Mean standardised Effort (fishing hours (BE-CBT and IR-CBT), days fished (UK-CBT)).

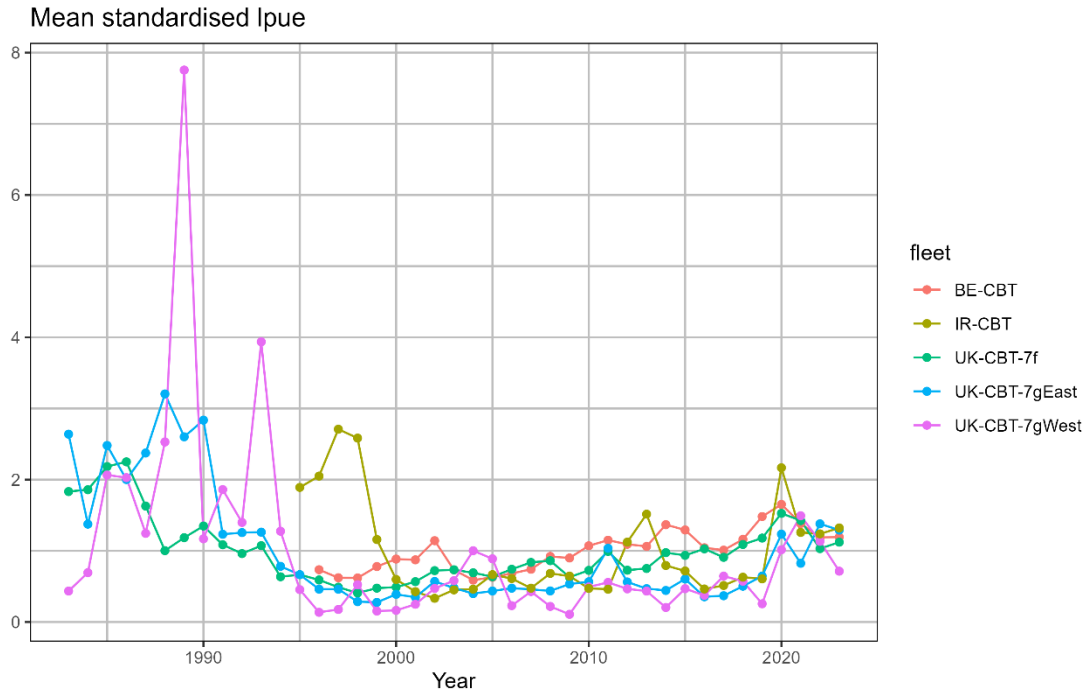


Figure 33.12b. Sol.27.7fg - Mean standardised LPUE (kg/hour (BE-CBT and IR-CBT), kg/day (UK-CBT)).

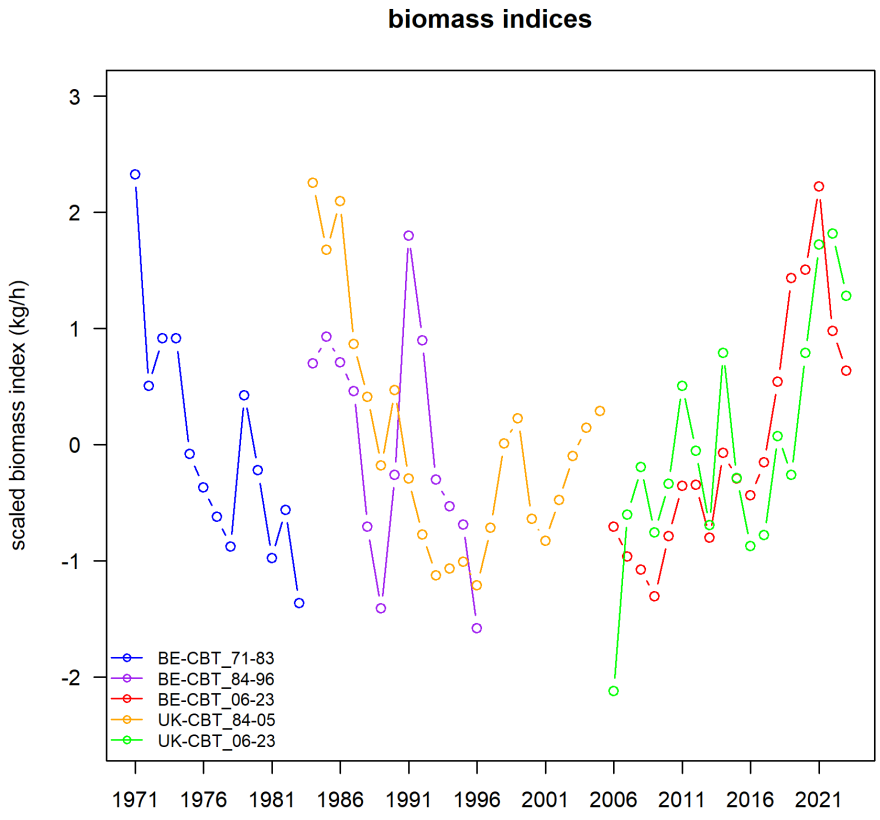


Figure 33.13. Sol.27.7fg - Commercial biomass tuning indices.

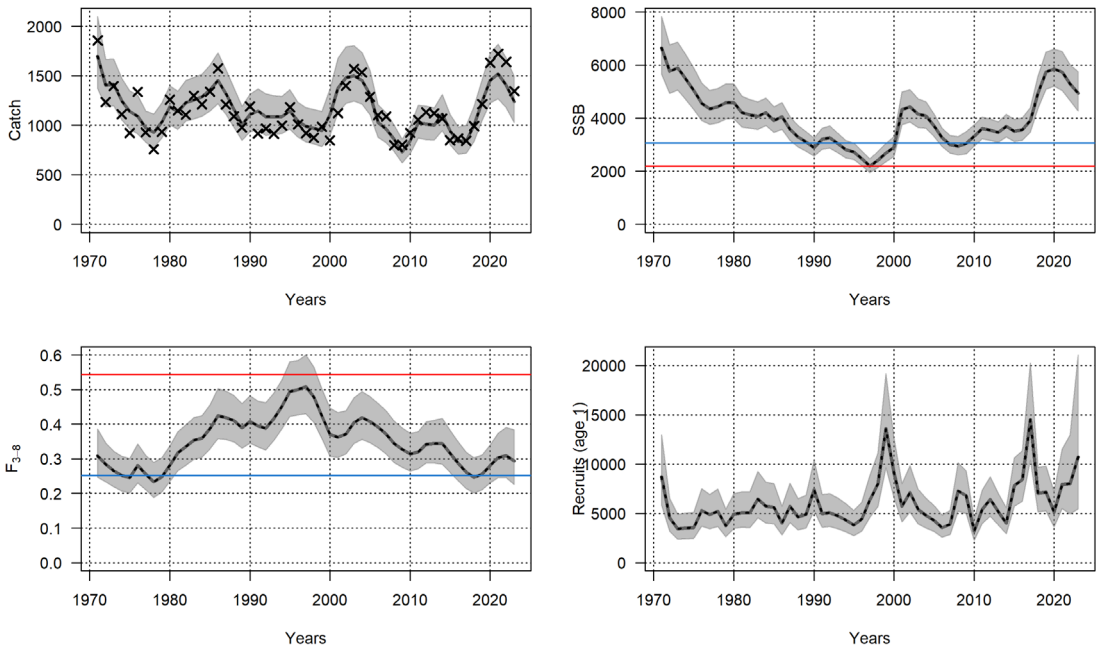


Figure 33.14. Sol.27.7fg - Summary plots. Red lines = precautionary reference points (lim) and blue lines = MSY reference points

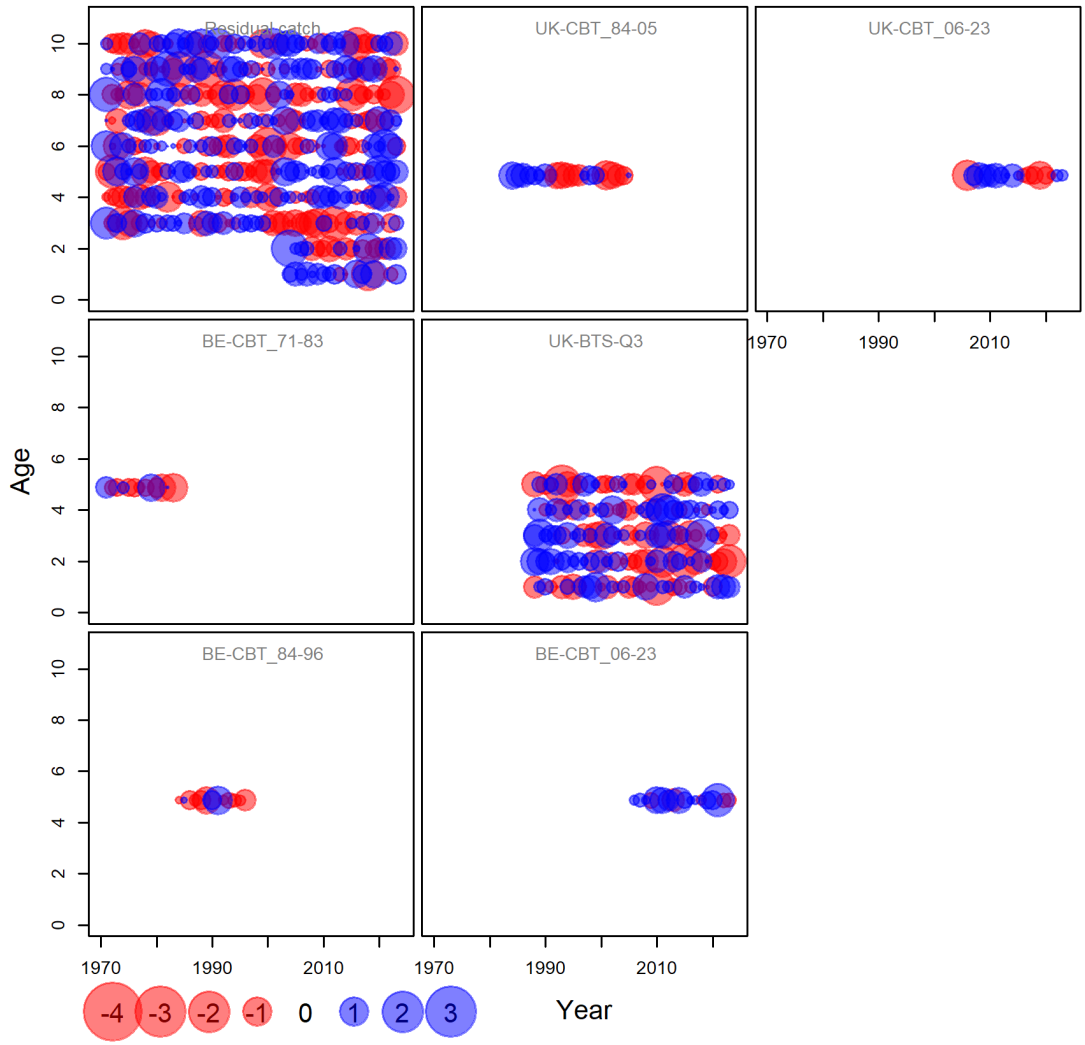


Figure 33.15. Sol.27.7fg - One Step Ahead residuals.

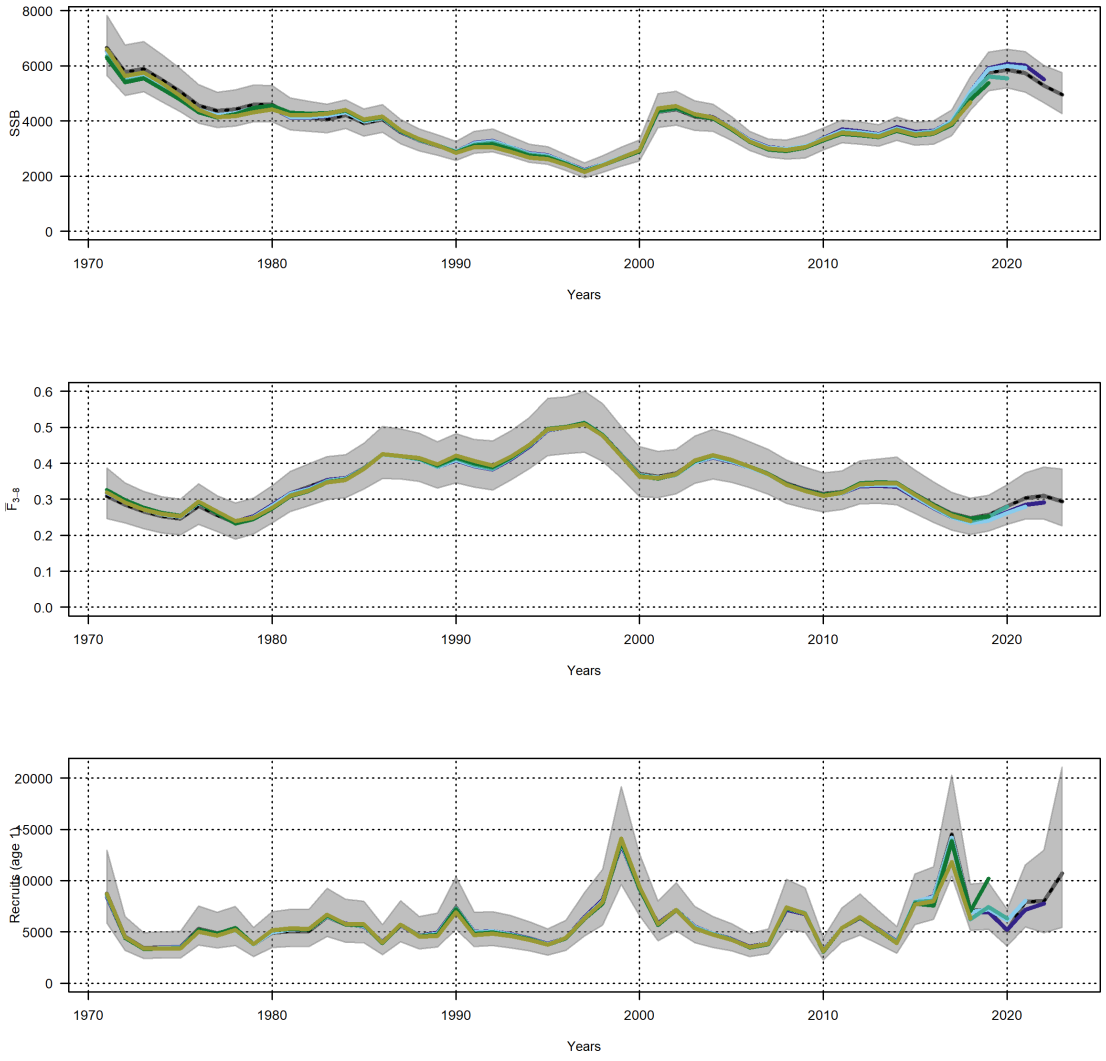


Figure 33.16. Sol.27.7fg - Retrospective analysis.

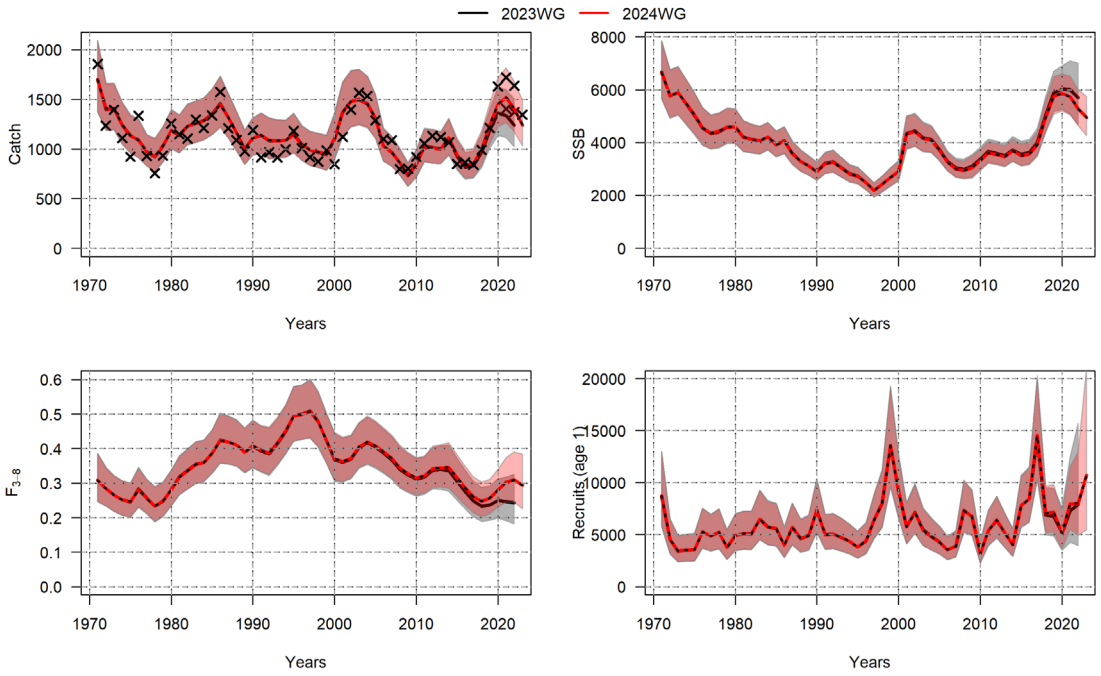


Figure 33.17. Sol.27.7fg - Comparison with last year's assessment.

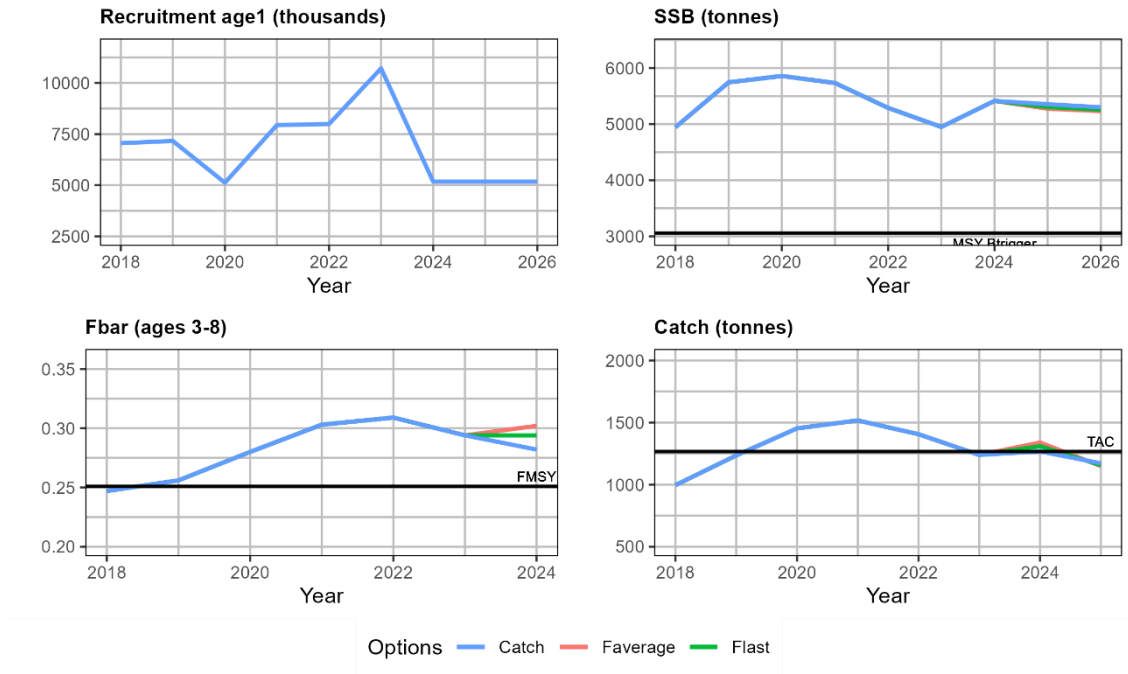


Figure 33.18. Sol.27.7fg - Options for the intermediate year in the short-term forecast.

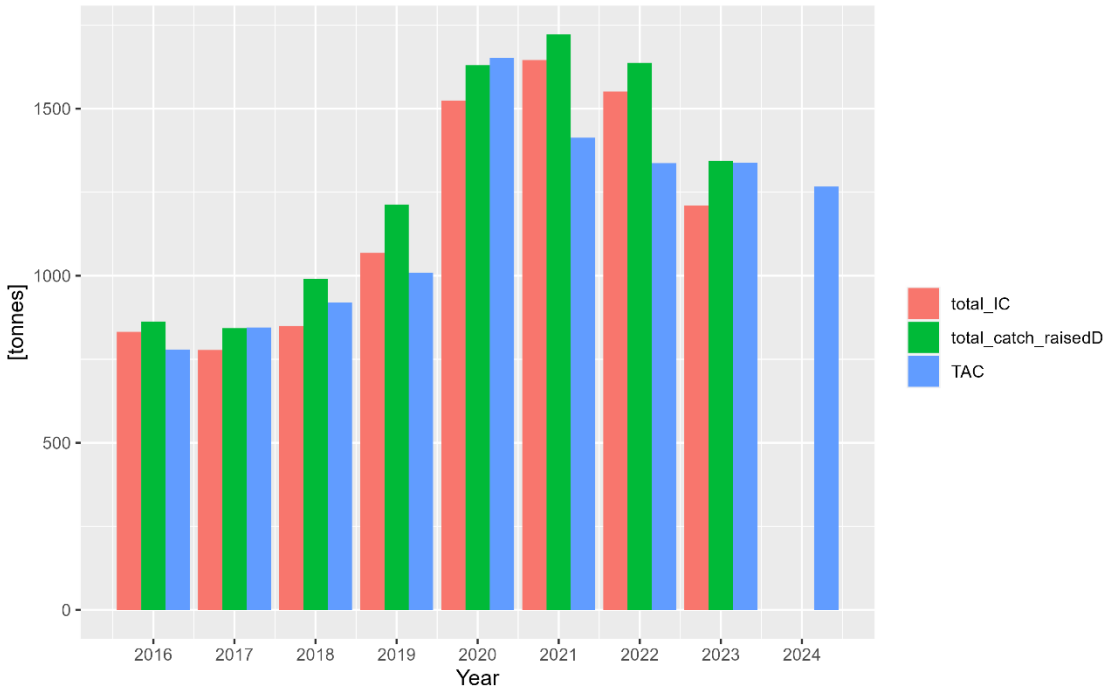


Figure 33.19. Sol.27.7fg - Comparison of international TAC, catch and landings.

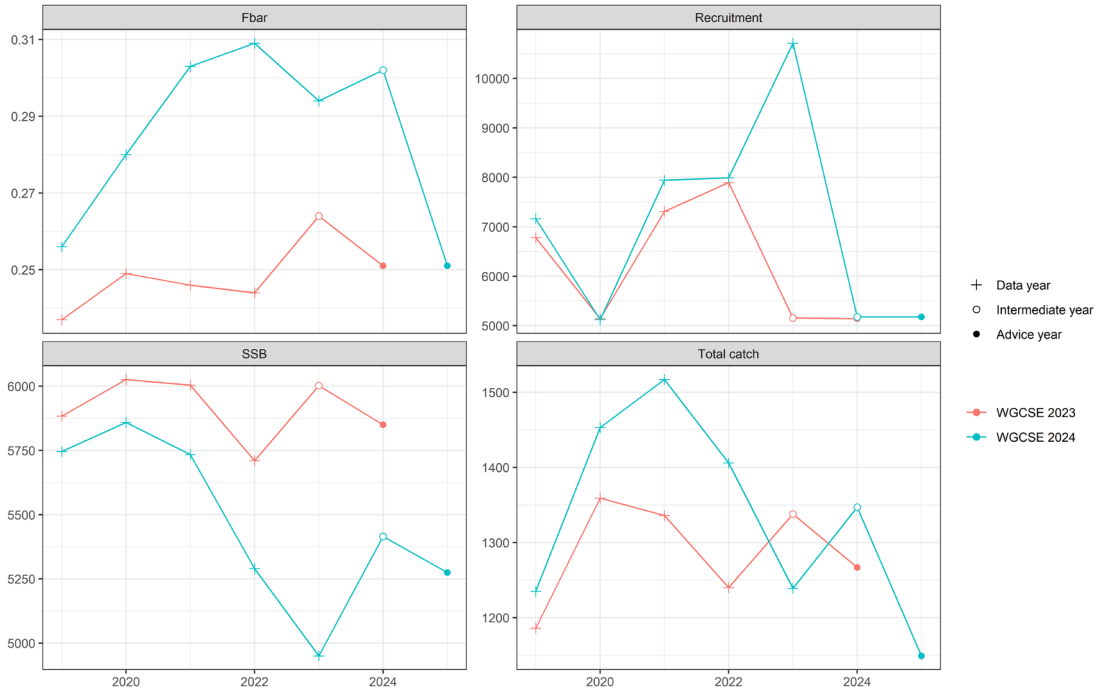


Figure 33.20. - Sol.27.7fg - Comparison with last year's assessment – short-term forecast assumptions.

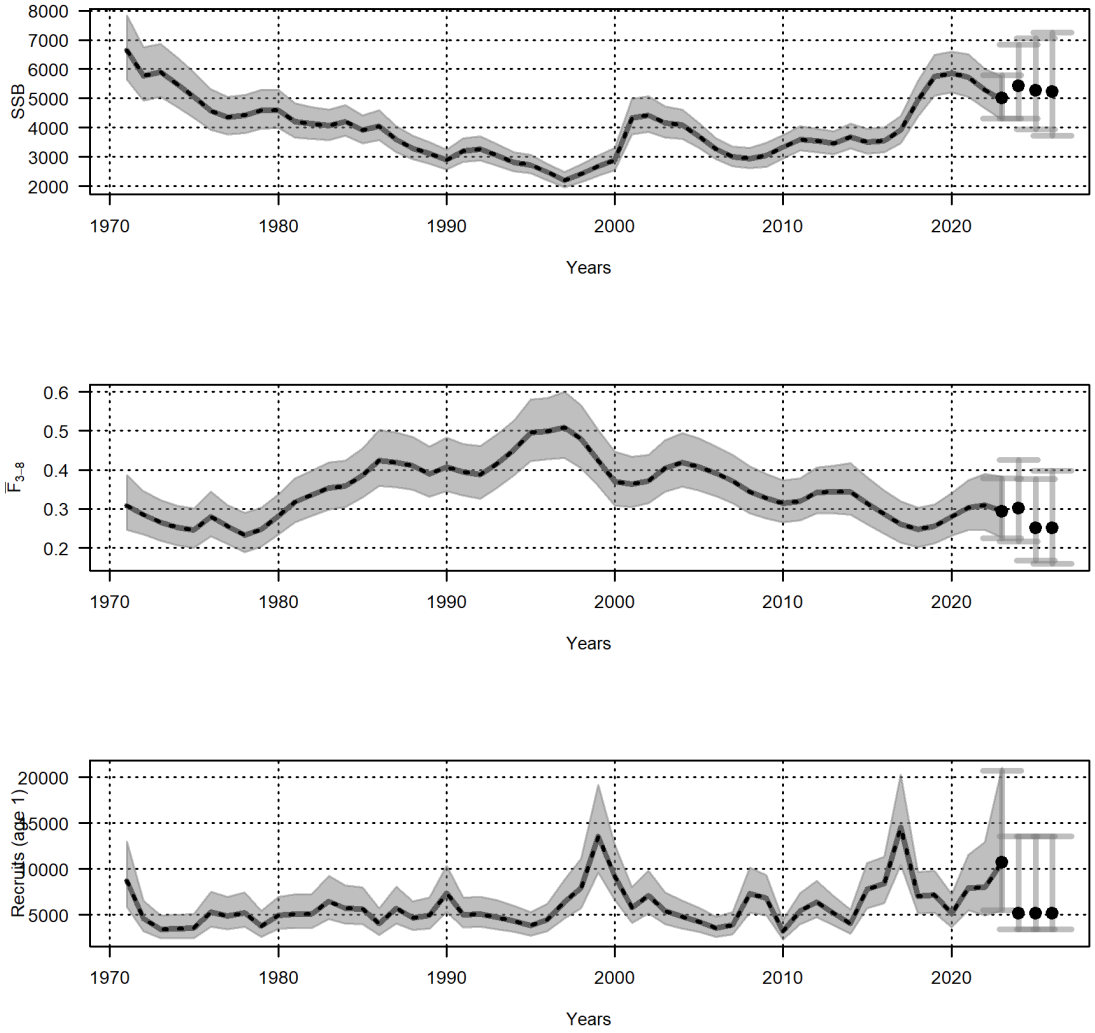
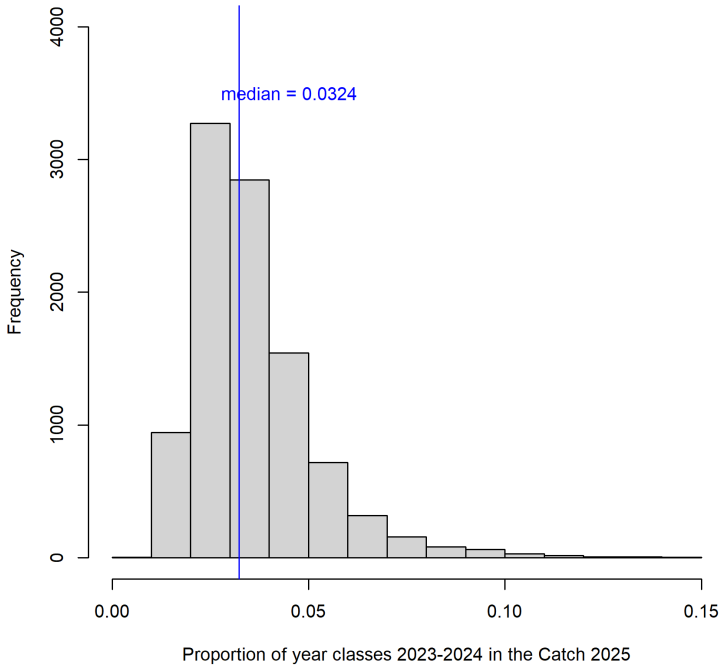


Figure 33.21. Sol.27.7fg - SAM forecast assuming F average in the intermediate year followed by targeting F_{MSY} in subsequent years.



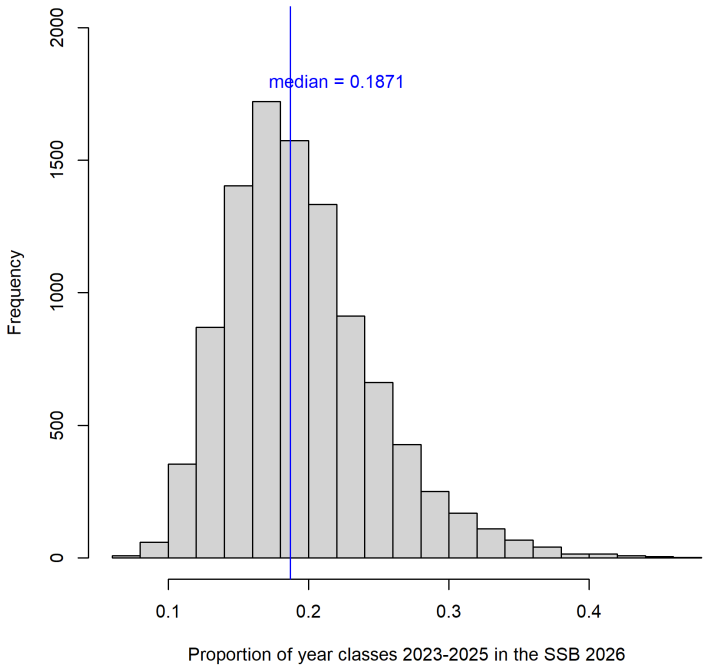


Figure 33.22. Sol.27.7fg - Contributions of the recruitment assumption for the short-term forecast.

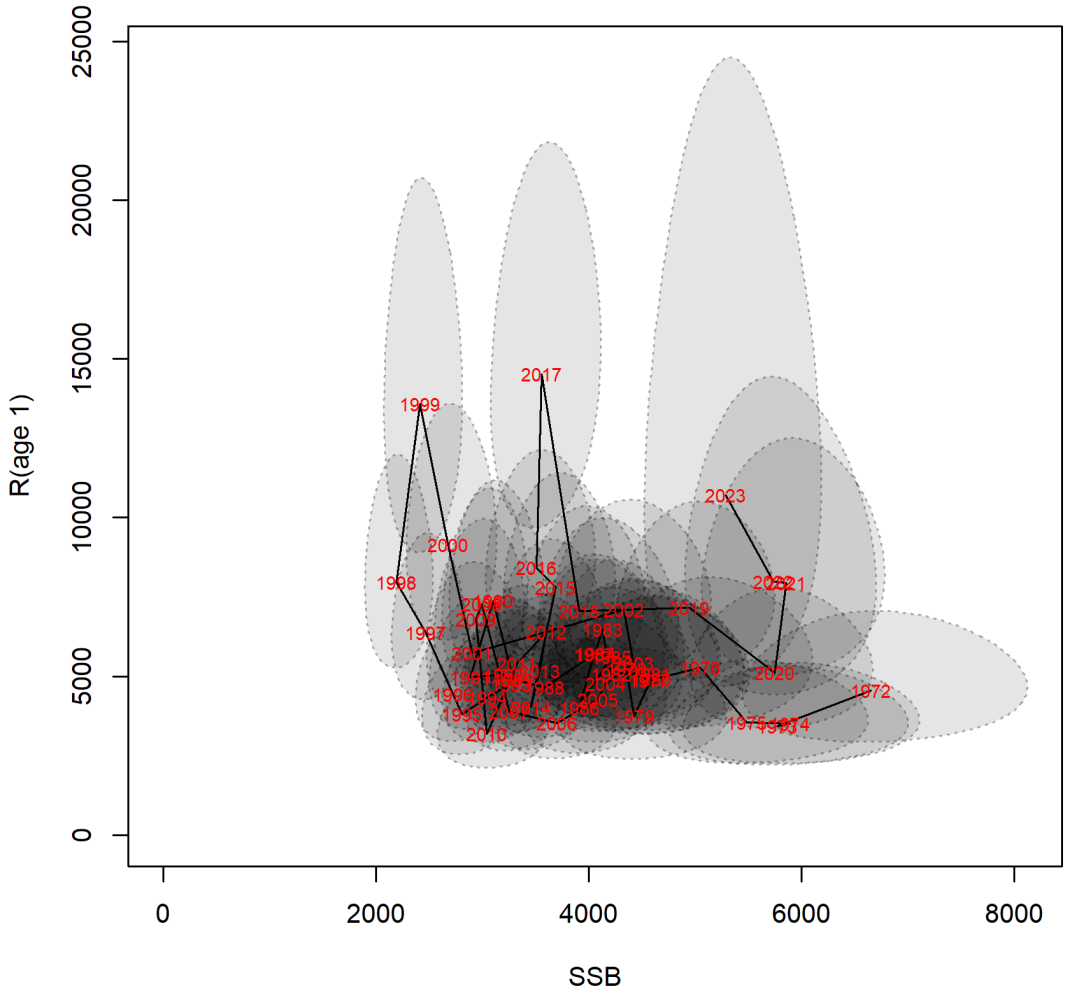


Figure 33.23. Sol.27.7fg – Stock–recruitment plot.