13 Plaice in Subarea 4 (North Sea) and Subdivision 20 (Skagerrak)

In 2017, the Stock Annex was updated. Therefore, only a comprehensive description of the stock assessment results and deviations from the stock annex are presented within this Section of the report. In 2017, the stock had a benchmark assessment. Decisions from the benchmark in 2017 are also included in the report.

13.1 General

13.1.1 Stock structure

Plaice in the Skagerrak (Subdivision 20) is considered to have two components: an Eastern and a Western. The latter occurs in a mix with plaice migrating in from the North Sea (Ulrich *et al*., 2013) and the predominance of catches occurs on summer feeding aggregations in the Western Skagerrak. In a benchmark (WKPLE, 2015; ICES, 2015) it was decided that plaice in the Skagerrak would be assessed together with the North Sea stock.

In addition, as in previous years, 50% of the mature animals from 7.d in quarter 1 are included in the North Sea plaice assessment, since North Sea plaice migrates into the area in that season (ICES, 2010).

13.1.2 Ecosystem considerations

Available information on ecosystem aspects can be found in the Stock Annex. In addition, the ICES Working Group on the Ecosystem Effects of Fishing Activities (WGECO, ICES, 2014b) met in April 2014 and addressed a specific question in relation to North Sea plaice, in response to a request from WGNSSK in 2013:

"According to WGNSSK estimates, the North Sea is currently ongoing a plaice outburst without precedent. However, plaice is not included in multispecies models, so the consequences of this outburst on the North Sea ecosystem are unclear and would potentially require additional focus".

WGECO addressed the trends shown in the stock assessment of plaice, which show how increasing fishing pressure on the stock has progressively moved SSB away from the desired state (in the 1980s and 1990s), and then how management has rectified this situation in recent years, which has brought the North Sea plaice stock in a situation unlike any other over the whole 58-year period for which data is available. The group investigated a possible relationship of these trends with abundance of benthic biomass, which is a predominant food source for plaice. Q1 IBTS data showed a two-fold increase in demersal benthivore biomass over the last 29-year period of the survey, and that species composition of the demersal benthivore guild has changed as well. The data showed that predation loading by plaice on benthic invertebrates increased by a factor of 13.8 in just eleven years (2000–2011).

The increase in the consumption of benthic invertebrate prey by the whole demersal benthivore guild, and particularly by plaice, raises the question as to whether the abundance of benthic invertebrate prey might be becoming limiting. If the biomass of demersal benthivorous fish is approaching its carrying capacity, then growth rates in the dominant species in the guild might start to decline (which is in this case plaice growth rates). Computed growth coefficients for the

1956 to 2002 cohorts showed a strong declining linear trend over the whole period (albeit with clear systematic variation in the residuals), and this has been related to increasing water temperature in the North Sea. However, fitting a 4th order polynomial function to the data suggested a marked decline in cohort growth towards the end of the time-series. This is perhaps indicative of plaice becoming food limited, possibly suggesting that B_{MSY} targets for the stock might be marginally too high to be supported by available benthic invertebrate food supplies. However, this evidence is by no means conclusive as polynomial functions are known to show a tendency for marked swings at the extremes of the data range.

More in-depth analysis in WGECO 2018 using the recent years' data showed that the co-occurrence of reduced size at age and increasing stock abundance has led to a negative relationship in period 2006–2016. This correlative indication of density-dependent growth reduction, is further strengthened by a coinciding reduction in physical condition across a range of sizes, hinting that food scarcity may indeed be the mechanism behind the patterns (ICES, 2018b).

13.1.3 Fisheries

A basic description of the fisheries is available in the Stock Annex. In recent years, pulse trawling, aiming at reduction of fuel consumption and reduction of bottom disturbance, has been adopted in fisheries. In 2011, approximately 30 derogation licenses for pulse trawls were taken into operation, which increased to 42 in 2012. An additional 42 derogation licenses have been extended in spring 2014. In 2016 and 2018, ICES published advices on ecological and environmental effects of pulse trawling, compared to traditional beam trawls (ICES, 2016; ICES, 2018a). It was concluded that pulse trawling has fewer environmental and ecological effects than beam trawls. Pulse trawls have been increasingly used in the North Sea flatfish fisheries since 2009. Over this period, the fishing mortality has reduced and stock biomass has increased, mostly due to an overall decrease in effort. The shift in fishing method has resulted in a change in distribution of the fishery. Pulse trawling has increased in areas such as off the Thames estuary and the Belgian coast but decreased in others. This change is related to lighter gear, which can be used on softer grounds than the beam trawls (ICES, 2018a).

In 2019 the European Parliament decided to ban pulse fisheries in European waters. This ban on pulse fishing implies that ultimately only 5% of the fleet of each member state can continue its fishing activities with the pulse trawl until the first of July 2021, after which a total ban will apply. In this context, research into the effects of the pulse trawl on commercial stocks and wider ecosystem effects will continue.

13.1.4 ICES Advice

The information in this Section is taken from the ICES advice sheet 2021:

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 142 508 tonnes.

13.1.5 Management

An EU multiannual management plan (MAP) has been agreed by the EU for this stock (EU, 2018). This plan is not adopted by Norway, thus, not used as the basis of the advice for this shared stock. ICES was requested by the EC to provide advice based on the MSY approach and to include the MAP as a catch option.

13.2 Data available

During the benchmark of the eastern channel (7.d) plaice stock (WKFLAT) it was decided that 50% of Q1 mature fish catches taken in the eastern channel are actually plaice from the North Sea stock migrating in and out of the area. Before 2015, 50% of the Q1 eastern channel (7.d) plaice landings were included in the assessment of the North Sea plaice stock. Since 2015, 50% of the mature fish in both landings and discards in Q1 were added to the North Sea stock and the time series was updated, such that in previous years also 50% of the mature catches from Q1 were added. See the stock annex for plaice in Division 7.d for further details.

During the benchmark on plaice (WKPLE ICES, 2015), it was decided that plaice from the Skagerrak would be added to the North Sea stock. Since then, the assessment has been a combined assessment with Skagerrak plaice.

The WKFlatCSNS benchmark in 2020 highlighted several changes in age structure (e.g. ALK) and discards estimates in French national raising procedure. This leads to modifications to 2019 as well as French historical data. Since the French plaice catch is extremely small in the stock, the historical data were not re-processed in Intercatch.

The 2020 covid19 pandemic has led to a reduced fishing effort in quarter 2 from the major Dutch fleet TBB with mesh size 70–99. Despite of this, the overall landing and discards sampling coverage were kept at similar level as previous years. Thus, covid19 impact on catch data precision were marginal.

13.2.1 InterCatch processing

Since 2012, national research institutes submitted landings and discard estimates by métier and quarter in InterCatch. Figures 13.2.1 and 13.2.2 show the landings and discards coverage by country and by métier in Subarea 4 and Subdivision 20. Approximately 72% and 58% of the landings in weight were sampled in Subarea 4 and Subdivision 20 respectively, to obtain information on age-composition (Note that the UK vessels of the TBB_DEF_70–99_mm métier are exclusively Dutch owned flag vessels and de facto are thus sampled in the Dutch market sampling programme). Of the metiers for which discards are monitored in sampling programmes, the largest part of these discards is covered in the TBB_DEF_70–99_mm fleet. In most discards monitoring programmes, age composition information is also collected. To raise the amount of discards for landings that had no discards and to raise the landings and discards for which no age distribution was known, the same grouping strategy was used (see table below). The TBB and OTB fleets that covered most of the catches each had their own group (TBB<100, TBB >=100, OTB/OTM<100, and OTB/OTM>=100). Other major groups include Seines, shrimper, gillnets. All discards raising and age allocations were done per quarter. If discards/age structures were present for data for the whole year only, these were added to all quarters. If there were no discards/age structures in a specific quarter and metier, a similar metier type (from the same quarter) or all other quarters (from the same metier) were used. Allocations to calculate the age compositions were done separately for discards and landings.

Summary of the imported/Raised/SampledOrEstimated data by area.

CatchCategory	RaisedOrImported	SampledOrEstimated	Area	CATON	perc
Landings	Imported_Data	Sampled_Distribution	27.4	23588	72
Landings	Imported_Data	Estimated_Distribution	27.4	9148	28
Discards	Imported_Data	Sampled_Distribution	27.4	24279	68
Discards	Raised_Discards	Estimated_Distribution	27.4	10285	29
Discards	Imported_Data	Estimated_Distribution	27.4	1184	3
BMS landing	Imported_Data	Estimated_Distribution	27.4	25	100
Landings	Imported_Data	Sampled_Distribution	27.3.a.20	4533	58
Landings	Imported_Data	Estimated_Distribution	27.3.a.20	3293	42
Discards	Imported_Data	Sampled_Distribution	27.3.a.20	1335	57
Discards	Raised_Discards	Estimated_Distribution	27.3.a.20	1027	43
Discards	Imported_Data	Estimated_Distribution	27.3.a.20	0	NA
BMS landing	Imported_Data	Estimated_Distribution	27.3.a.20	0	NA

Grouping strategies to raise discards and allocate age structures.

Group for discards raising and age allocation*	quarter + area	description
TBB<100(excluding CRU_16-31)	Each quarter + 4/320	Beam trawl, smaller mesh size
TBB>=100	Each quarter + 4/320	Beam trawl, larger mesh size
TBB/OTB_CRU_16-31	Each quarter + all area	shrimper
OTB/OTM-CRU/DEF/SPF<100(excluding CRU_16-31)	Each quarter + all area	Otter trawl, smaller mesh size
OTB/OTM-CRU/DEF/SPF>=100	Each quarter + all area	Otter trawl, larger mesh size
SSC/SDN<100	Each quarter + all area	Seines, smaller mesh size
SSC/SDN>=100	Each quarter + all area	Seines, larger mesh size
GNS/GTS/GTR<100	Each quarter + all area	Gillnet, smaller mesh size
GNS/GTS/GTR>=100	Each quarter + all area	Gillnet, larger mesh size
Others	All quarter + all area	All other metiers

*** all_0_0 are treated as >=100. TBB/OTB_CRU_16-31 is raised from OTB_CRU<100, because several countries have extremely high discard rates and their fisheries might have different regulations.**

For Subarea 4, 68% of the total discards in 2020 were obtained from sampling. For Subdivision 20, 43% of the total discards were obtained from sampling. BMS landings, where reported, were included with discards as unwanted catch in the assessment since 2016.

13.2.2 Landings

Plaice in Subarea 4 has been under the landing obligation since 2016 for the large mesh trawlers (TR1 and BT1). Since 2019, the fleets (BT2 and TR2), contributing most to the total plaice discards, fell under the landing obligation in Subarea 4. However, several survivability exemptions are in place: 1) the survivability exemption in Subarea 4 for plaice caught with nets, Danish seines and bottom trawls; 2) the survivability in Subarea 4 for undersized plaice caught by beam trawls using 80-119mm mesh size (BT2). According to ICES data, in 2020, BMS landings were 25.1 tonnes and UK was the only country to report to ICES. Meanwhile the official reported BMS landings were 189.5 tonnes from all countries. For the assessment in this report, BMS was treated as discards.

Total ICES estimated landings (including 7.d and Subdivision 20) of North Sea plaice in 2020 was 40 888 tonnes. Of these 32 736 tonnes came from the Subarea 4, 7826 tonnes came from Subdivision 20, and 326 tonnes came from 7.d. The landings in Subarea 4 decreased 18% (of 2019). The landings in Subdivision 20 decreased 3% (of 2019). Total landings (in tonnes) are presented in Table 13.2.1 and landings in numbers at age in Table 13.2.2 and Figure 13.2.4. Since 2010, the majority of landings were age 3–6.

13.2.3 Discards

The discards time series used in the assessment includes Dutch, Danish, German and UK discards observations for 2000–2020, as described in the stock annex. From Belgium, discards data have been available as well but were only used in the assessment since 2012 when it became available in InterCatch. See Section 13.2.1 for more information on the use of InterCatch for raising discards rates across metiers and countries. The Dutch discards data for 2009 and 2010 were derived from a combination of the observer programme that has been running since 2000, and a new self-sampling programme. The estimates from both programmes were combined to come up with an overall estimate of discarding by the Dutch beam trawl fleet. Since 2011, estimates were derived exclusively from the self-sampling data. There is an on-going project within WMR to validate these estimates by examining matched (same vessel and haul) trips where both observer estimates and self-sampling estimates are derived.

To reconstruct the number of plaice discards at age before 2000, catch numbers at age data was reconstructed in 2005 based on a model-based analysis of growth, selectivity of the 80-mm beam trawl gear, and the availability of undersized plaice on the fishing grounds. Discards numbers at age are presented in Table 13.2.3. Figure 13.2.3 presents a time series of landings, catches and discards from these different sources. Age distributions of discards are presented in Figure 13.2.4 and Table 13.2.3. The total discards weight has been gradually decreasing since our first year of observed discards 2000. The discards ratio are illustrated in Figure 13.2.6. Since 2010, the majority of discards were age 1–3.

13.2.4 Catch

The catches of 2020 in Subarea 4 reached 47% of the 146 852 tonnes catch TAC for 2020. The catches of 2020 in Subdivision 20 reached 52% of the 19 647 tonnes catch TAC for 2020. The total catch at age as used in the assessment including all landings and all discards are presented in Table 13.2.4. These include catch of NS plaice in the 1st quarter from 7.d and catch from the Subdivision 20. Landings-at-age, discards-at-age and catch-at-age plots are presented in Figures 13.2.4 and 13.2.5.

13.2.5 Weight-at-age

Stock weights at age are presented in Table 13.2.5. Stock weight at age has varied considerably over time, especially for the older ages. Landing, discards and catch weights at age are presented in Table 13.2.6, 13.2.7 and 13.2.8 respectively. Catch weights at age are derived from the discards and landings weights at age according to the relative contributions of each to the overall catch for each age. Figure 13.2.7 presents the stock, discards, landings and catch weights at age. Notably, there has been a long-term decline in the observed stock weight at age.

13.2.6 Maturity and natural mortality

During the benchmark in 2017, natural mortality and maturity were re-assessed using both survey and commercial data (WKNSEA report). The mortality rates based on Hoenig's Tmax-based estimator (Hoenig, 1983) were thought to be the best for this stock, but did not deviate greatly from the previous estimate based on Beverton (1963) (0.1 $year^{-1}$ for all ages and years). Therefore, natural mortality was not changed from previous values. A new time-varying maturity ogive was estimated using Dutch commercial landings 1957–2015, but the new ogives had marginal effect on the estimated SSB. Therefore, the previously-used, time-invariant maturity ogive (Table 13.2.9) was chosen.

13.2.7 Catch, effort and survey data

The following six survey indices are used in the plaice assessment:

- Beam Trawl Survey combined for RV Tridens and ISIS (BTS-combined); (1996–2020); Age 1–9;
- Beam Trawl Survey RV Isis (BTS–Isis) for the older part of the time series; (1985–1995); Age 1–8;
- Sole Net Survey 1 (SNS1); (1970–1999); Age 1–6
- Sole Net Survey 2 (SNS2); (2000–2020); Age 1–6
- IBTS–Q1 plaice index; 2007–2020; Age 1–7;
- IBTS–Q3 plaice index; 1997–2020; Age 1–9.

The most important surveys for demersal fish species in the greater North Sea area are the BTS (3rd Quarter) and the IBTS (1st and 3rd Quarter). The BTS covers areas 4.b, 4.c and the Channel, while the IBTS also covers area 4.a and the Skagerrak and Kattegat (3.a). The spatial distributions of plaice biomass per haul for these 3 surveys in 2020 are illustrated in Figure 13.2.8.

Since 2017, both BTS and IBTS age-structured survey indices were estimated using smoother based delta-GAM method (Berg *et al*., 2014). Since the smoother for historical years will deviate with each increasing data year, the sensitivity to adding new year data needs to be checked before adopting the updated indices for assessment. Figure 13.3.7 illustrates the yearly estimated indices for the 3 surveys. The deviation of historical year indices were small for BTS and IBTS-Q3, while large deviations appear in older ages in IBTS-Q1. The robustness of GAM method on this survey needs to be further investigated.

A time-invariant spatial abundance distribution could be estimated per age from the delta-GAM model for each of these three surveys (Figure 13.2.9). Both Q3 (BTS and IBTS) surveys indicates similar age distributions: Younger plaices are nursed in the Belgium-Netherlands-Germany-Denmark coastal area. As they get older, they move north-west towards the centre of North Sea and Scotland coastal area. On the other hand, the IBTS-Q1 survey does not show strong difference in age distributions. This is likely due to the spawning and nursery season in Q1.

Table 13.2.10 and Figure 13.2.10 show the survey index values. Overall, BTS-Q3 and IBTS-Q3 give consistent indices. Two moderately strong year class 2013 and 2016 were observed. A very strong 2018 year class was observed. Additionally, all surveys show an increasing trend for older fishes (age >= 5) since 2005.

The internal consistency of the survey indices (Figure 13.2.11) appears relatively high for BTS-Q3, but low for the SNS surveys. The log-catch curves of ages 1–6 for the surveys are illustrated in Figure 13.2.14. In general, SNS has a low selectivity for older ages. Compared to BTS, IBTS has a higher selectivity for older ages. Overall, all surveys show relatively consistent catch selectivity pattern over the time series (which is the assumption for the stock assessment), except for IBTS–Q1 where the time series is too short to validate. A gradually increasing catch since 2000 for all 1–6 ages are observed for BTS-combined and IBTS–Q3. Assuming the survey gear selectivity does not change over the time, such trend is likely due to the decreasing mortality. The catch and survey data are plotted together in Figure 13.2.15.

Before WGNSSK 2021, additional survey indices were used for recruitment estimates in the RCT3 analysis for short term forecast

- Demersal Fish Survey (DFS); (1990–2019); age–0;
- Sole Net Survey (SNS); (2000–2019); age-0

Information on these survey indices are described in Section 13.5. During WKNSROP 2020, it was decided that RCT3 analysis is only applicable during autumn update when new survey indices of the assessment year are available. Thus, RCT3 analysis on recruitment indices from these two surveys are no longer conducted in the WGNSSK May forecast.

13.3 Data analysis

The assessment of North Sea plaice by AAP was carried out using the FLR (FLCore v. 2.3 and FLXSA v.2.0), splines and mgcv packages in R version 3.6.1.

Since 2013, ICES does not operate with external review groups anymore. Audits were done by internal reviewers (members of the WGNSSK group) and potential issues were directly discussed between the auditors and the stock assessor. Therefore, there is no written review to be presented here.

13.4 Assessment

13.4.1 Model parameters and diagnostics

The table below gives an overview of data and parameters used in the AAP assessment model:

Stock	PLE.27.420
Assessment year	2021
Catch at age	Landings + (reconstructed) discards based on NL, DK + UK + DE fleets and BE (since 2012)
Fleets (years; ages)	BTS-Isis-early 1985–1995; 1–8 BTS-combined 1996–2020; 1–9 SNS1 1970–1999; 1–6 SNS2 2000-2020 (excl. 2003); 1–6 IBTS-Q1 2007–2020; 1–7 IBTS-Q3 1997–2020; 1–9
Plus group	10
Last data year	2020
Survey selectivity independent of ages for ages >=	6
Age at which the catchability for the F-at-age reaches a plateau >=	9
F tensor spline age knots	6
F tensor spline year knots	26

Model diagnostics including standardized catch and survey residuals and retrospective plots are illustrated in figures 13.3.2–13.3.4. There are age and year patterns in both catch and survey residuals, implying a possible lack of fitting from the splines. Further investigations will be conducted in the coming benchmark in 2021/2022. The retrospective plot for SSB does not exhibit negative or positive pattern. There seems to be upward scaling pattern for F and downward scaling pattern for recruitment.

13.4.2 Assessment results

Figure 13.2.3 illustrates the trends in observed catch, landing and discards. Reported landings gradually increased up to the late 1980s and then rapidly declined until 1995, in line with the decrease in TAC. The landings show a general decline from 1989onwards, increasing slowly but steadily since 2007, and decreasing again since 2016. Discards were particularly high in 1997 and 1998 (reconstructed), and in 2001 and 2003 (observed), resulting from strong year classes.

Figure 13.3.1 and Table 13.3.4 present the model estimated F(2–6), SSB, and recruitment. The estimated SSB in 2020 is 905 056 tonnes and it is well above MSY $B_{trigger}$. SSB has markedly increased since 2008, following a substantial reduction in fishing mortality (F) since 1999. The estimated F in 2020 is 0.149 $year^{-1}$, and it has been around F_{MSY} since 2009. The estimated recruitment in 2020 is 1 390 640 thousand.

The estimated model parameters are presented in Table 13.3.1. The estimated fishing mortality and stock numbers are shown in Tables 13.3.2–13.3.3 and Figure 13.3.5, respectively.

The stock dynamics are partly affected by the occurrence of strong year-classes. In recent years, recruitment has been fluctuating around geometric mean of the entire time series. A high 2019 recruitment has been detected in survey, but not shown in catches. The increased stock size in recent years is could partly the direct consequence of reduced fishing mortality. Additionally, the age composition in SSB (Figure 13.3.6) implies that older aged plaices (age >= 5) have been increasing since 2010. Information from surveys (BTS, IBTS-Q3, SNS and DFS) implies that older

fishes are likely migrating to the north western part of the North Sea (ICES 2019a), where the targeted fishing effort is low (Figure 13.2.12).

The predominant age in the landings is currently age–4 (in 2017 as well as in the past decade, see Figure 13.2.4). Notably, during the time series, this was only also observed in the 1960s. In contrast, the predominant age in the landings in the 1970s, 1980s and 1990s, was age–3. The age distribution in the landings in recent years furthermore shows more similarity with the 1960s in that age–5 and age–6 fish are relatively abundant in the landings in comparison to the rest of the time series and age-2 fish are notably underrepresented in the landings. These shifts in age distribution may be explained by the still relatively low exploitation level in the 1960s, which subsequently substantially increased over the next three decades and since the early 2000s has shown a dramatic decline. Changes in spatial distribution of fishing effort and shifts in spatial distribution of the fish may also have affected these changes. The 'lack' of age-2 fish in the landings in the 1960s as well as in recent years may be for a number of reasons. When considering the age distribution in the catches age–2 fish were also lacking in the catches in the 1960s, while this is not the case in recent years. One possible explanation may be the occurrence of high grading (discarding of smaller fish in order to allow for landing higher numbers of large fish for which a higher price may be received or to avoid exhaustion of quota). The latter seems unlikely since the TAC has not been fully utilised in recent years. Another explanation may be that plaice have become mature at younger ages than in the past since this shift in maturation also leads to mature fish being of a smaller size at age, because growth rate diminishes after maturation. Grift *et al.* (2003) observed that this may occur due to fisheries-induced genetic change: those fish that are genetically programmed to mature late at large sizes are likely to have been removed from the population before they have had a chance to reproduce and pass on their genes. This could cause age–2 fish to be discarded more abundantly in recent years because a larger fraction of them being under the minimum size in comparison to the past.

13.5 Recruitment estimates for short-term forecast

In the short-term forecasts, assumptions are made on a number of things (see also Section 13.6. One of the more difficult things to predict is the strength of incoming year classes (abundance of ages 0–2) in the assessment year. A number of options are considered as follows:

Age–0: More specifically, the abundance estimate of age–1 fish in the year after the assessment year, i.e. in the TAC–year, needs to be assumed and no data is available from surveys or otherwise. Therefore, the geometric mean of the time series is used.

Age–1: The RCT3 analysis is run which combines DFS and SNS survey data and the assessment results to predict the abundance of age–1. Depending on the indicated predictive strength of the RCT3 model (typically the magnitude of the standard error) the RCT3 estimate is used in the short-term forecasts. Otherwise, the geometric mean is used.

Age–2: The RCT3 analysis is run which combines DFS, BTS and SNS survey data and the assessment results to predict the abundance of age–2. Depending on the indicated predictive strength of the RCT3 model (typically the magnitude of the standard error) the RCT3 estimate is used in the short-term forecasts. Otherwise the AAP survivors estimate is used.

During WKNSROP 2020, it was decided that RCT3 analysis is only applicable during autumn update when new survey indices of the assessment year are available. Thus, RCT3 analysis on recruitment were no longer considered in WGNSSK forecast. The geometric mean of 2008–2017 (last 10 years excluding recent 3 years) was chosen for age 1 in 2021. For age 2 in 2021, the estimates from BTS–1 and SNS–0 have a relatively low standard error (compared to the other surveys). However, AAP is relatively strong in predicting age–2 survivors. Hence, AAP estimate

was selected. The recruitment estimates from the different sources are summarized in the text table below. Underlined values were used in the forecast.

Year class	Age in 2021	AAP survivors	RCT3	GM	Accepted estimate
2019	2	1166596	1082119	1005624	AAP survivors
2020	1		1070938	1263949	GM 2008–2017*
2021	0			1263949	GM 2008–2017*

*** GM of recent 10 years data, excluding the last 3 data years due to large uncertainty.**

13.6 Short-term forecasts

Short-term prognoses were carried out in FLR using FLCore (2.3), projecting the stock forward three years from the 2020 (the last data year) into 2021 (the intermediate year in which the assessment is done); into 2022 (the TAC year) and finally into 2023 (the 'result' of the TAC year). For these years, a number of assumptions were made. Weight-at-age in the stock, weight-at-age in the catch and weight at age in the discards were taken to be the average over the last 3 years.

The intermediate year F was assumed to be "F–status quo" (F_{sq}), that is, the exploitation was taken to be the mean value of the last three years. Since there was an increasing trend of F_{bar} since 2017, F_{sq} was further re-scaled to have equal F_{bar} as Fbar_2020. The relative proportions of landings versus discards in the catch were taken to be the mean of the last three years. The option of assuming F to correspond to the TAC being fully caught in the intermediate year was abandoned as an option to pursue, due to the fact that the TAC has not been fully utilised in previous years (Note that the TAC prior to 2019 was not based on ICES catch advice). No results for this option are presented here further for that reason.

Population numbers in the intermediate year for ages 2 and older are taken from the AAP survivor estimates. Numbers at age 1 in both 2021and 2022 were taken from the geometric mean (2008–2017). Input to the short-term forecast is presented in Table 13.5.1 and a summary of the intermediate year assumptions are given in the table below.

Assumption	$F_{(2–6)}$ 2021	SSB 2022	Recruitment 2021	Landings 2021	Discards 2021
F2021 = Fsq-rescaled	0.149	1093696 t	1263949 thousand	51458 t	46140 t

A series of F options were assumed for the TAC year. Resulting management options for 2022 are given in Table 13.5.2.

13.7 Biological reference points

13.7.1 Precautionary approach reference points

The current precautionary approach reference points were established by the WGNSSK in 2004, when the discard estimates were included in the assessment for the first time. The stock-recruitment relationship for North Sea plaice did not show a clear breakpoint where recruitment is impaired at lower spawning stocks. Therefore, ICES considered that B_{lim} can be set at B_{loss} = 160 000 tonnes and that B_{pa} can then be set at 230 000 tonnes using A multiplier of 1.44. F_{lim}

was set at F_{loss} (0.74). F_{pa} was proposed to be set at 0.6 which is the 5th percentile of F_{loss} and gave a 50% probability that SSB is around B_{pa} in the medium term. Equilibrium analysis suggests that F of 0.6 is consistent with an SSB of around 230 000 tonnes.

13.7.2 F_{MSY} reference points

In 2010, ICES implemented the MSY framework for providing advice on the exploitation of stocks. The aim is to manage all stocks at an exploitation rate (F) that is consistent with maximum (high) long term yield while providing a low risk to the stock.

In 2014, the joint ICES MYFISH Workshop (WKMSYREF3, ICES, 2014) held place to consider the basis for F_{MSY} ranges. The workshop was convened in response to a request from the European Commission for advice on potential intervals above and below F_{MSY}. This resulted in an F_{MSY} range for North Sea plaice of 0.13–0.27. The point value of F_{MSY} was set at 0.19.

This value differs from the previous value of F_{MSY} = 0.25 (range 0.2–0.3, Miller and Poos, 2010).

13.7.3 Update of F_{lim} and F_{pa} values in 2016

In 2016 (ICES, 2016), an updated calculation of F_{lim} is proposed as the F that, in equilibrium from a long-term stochastic projection, gives 50% probability of thou > B_{lim}. The value of F_{pa} is estimated as the F value such that when F is estimated to be at F_{pa}, the probability that true F < F_{lim} is at least 95%. Thus $F_{pa} = F_{lim} /\exp(1.645*\sigma)$, where σ is estimated standard deviation of ln(F) in the final assessment year. In case of plaice where a σ is not available, a default value is used $F_{pa} = F_{lim} /1.4$. The last 10 years of the 2014 stock assessment object (data year 2004–2013) was retrieved and the distribution of recruitment at SSB was simulated using EqSIM, setting B_{lim} = 160 000. The estimated 10 years plaice SSB are all far higher than $B_{lim.}$ The estimated F_{lim} is 0.63 and the corresponding F_{pa} = 0.45 using the default ratio of 1.4. The updated values of both F_{lim} and F_{pa} deviate from their original values, most likely due to the inclusion of Skagerrak (Subdivision 20) data in the recent years where the original reference point was not derived from.

13.7.4 Update of reference point in 2017 benchmark

A full update of the precautionary and MSY based reference points was conducted during 2017 benchmark.

The reference points used prior to 2017 benchmark are listed as below:

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	230000 t	Default to value of B_{pa}	
	F_{MSY}	0.19	Combined stock	ICES (2014)
Precautionary approach	B_{lim}	160000 t	B_{loss} = 160000 t, the lowest observed biomass in 1997 as assessed in 2004	ICES (2004)
	B_{pa}	230000 t	1.44 × B_{lim}	ICES (2004)
	F_{lim}	0.63	The F that in equilibrium will maintain the stock above B_{lim} with a 50% probability	ICES (2016a)
	F_{pa}	0.45	$F_{pa} = F_{lim} \times \exp(-1.645\sigma_F)$; σ_F = 0.20	ICES (2016a)

A series of discussions have been carried out on the value of the new MSY $B_{trigger}$: F has been below (at) F_{MSY} in more than 5 years, which triggers a revision of MSY $B_{trigger}$. According to ICES guidelines the new MSY $B_{trigger}$ should in this case be the 5th percentile of the current SSB. The benchmark came up with an alternative solution: "Estimating SSB from a period with a substantially lower fishing mortality and higher SSB i.e. year 1962" (i.e. 481.5 kt). This deviation from the guidelines was questioned within the WG. The ADG that followed the WG noted that SSB has not stabilized, and could increase even more or decline as a consequence of e.g. density dependent growth or maturity. The ADG decided to follow the guidelines because they felt there was insufficient reason to deviate from the guidelines. The MSY $B_{trigger}$ value shown in the table below reflects this decision. MSY $B_{trigger}$ is therefore the maximum of the following: B_{pa}, or the 5th percentile of current SSB (SSB from the benchmark final run divided by 1.4 = 564 599 t).

The updated reference points are listed as below:

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	564599 t	Fifth percentile of current SSB (SSB2015/1.4) as estimated at the benchmark.	WKNSEA 2017; WKMSYREF4
	F_{MSY}	0.210	Estimated by application of EqSIM evaluation	WKNSEA 2017; WKMSYREF4
	$F_{MSY\ lower}$	0.146	Estimated by application of EqSIM evaluation	WKNSEA 2017; WKMSYREF4
	$F = F_{MSY\ upper}$	0.30	Estimated by application of EqSIM evaluation	WKNSEA 2017; WKMSYREF4
Precautionary approach	B_{lim}	207288 t	Break-point of hockey stick stock-recruit relationship	WKNSEA 2017; WKMSYREF4
	B_{pa}	290203 t	$B_{pa} = B_{lim} \times \exp(1.645 \times 0.2) \approx 1.4 \times B_{lim}$	WKNSEA 2017; WKMSYREF4
	F_{lim}	0.516	Estimated by application of EqSIM evaluation	WKNSEA 2017; WKMSYREF4
	F_{pa} till WGNSSK2020	0.369	$F_{pa} = F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$	WKNSEA 2017; WKMSYREF4
	F_{pa} since WGNSSK 2021	0.769	Fp.05 with AR	

And the proposed MSY reference points:

Reference point	Value
F_{MSY} without $B_{trigger}$	0.21
$F_{MSY\ lower}$ without $B_{trigger}$	0.146
$F_{MSY\ upper}$ without $B_{trigger}$	0.3
FP.05 (5% risk to B_{lim} without $B_{trigger}$)	0.43
F_{MSY} with $B_{trigger}$	0.21
$F_{MSY\ lower}$ with $B_{trigger}$	0.15
$F_{MSY\ upper}$ with $B_{trigger}$	0.3
FP.05 (5% risk to B_{lim} with $B_{trigger}$)	0.769
MSY	104113 t
Median SSB at F_{MSY}	1104120 t
Median SSB lower precautionary (median at $F_{MSY\ upper}$ precautionary)	690328 t
Median SSB upper (median at $F_{MSY\ lower}$)	1616173 t

13.7.5 Update of F_{pa} reference point in WGNSSK 2021

Consistent with ACOM's 2020 decision, the basis for F_{pa} should be $F_{p.05}$ calculated with advice rule. During WGNSSK 2021, the F_{pa} value was then updated as 0.769, which turned out to be higher than F_{lim} (0.516).

13.8 Quality of the assessment

The assessment does not provide robust estimates for ages 1–3 because of conflicting information between different data sources. Information from BTS, SNS and DFS surveys suggest that in recent years the nursery area of plaice (or age 0–1) are shifting from coastal area (covered by DFS and SNS) towards off-shore (covered by BTS and IBTS) (ICES, 2019a). Older ages also show a northward expansion in distribution that may affect estimates for these ages.

The deterioration of recruitment signal of age 0 in SNS and DFS has led to less consistent recruitment estimate for the intermediate year in Spring (using RCT3), as compared to the Autumn estimation where BTS-age1 data are added. With the abandoning of RCT3 recruitment assumption in short term forecast, a new method needs to be considered to include SNS and DYFS age 0 indices in assessment model to predict recruitment in the intermediate year.

Information from surveys (BTS, IBTS-Q3, SNS and DFS) implies inhomogeneous age distributions, i.e. older fishes are more likely distributed at north western part of the North Sea (ICES, 2019a), where the targeted fishing effort is low. This partly resulted in a reduced fishing mortality at older ages and an upward trend of SSB in recent years.

A sensitivity analysis on assessment was conducted by leaving out each survey and comparing the assessment performances (Figure 13.3.8). The leave-one-out results show significantly reduced SSB estimates after leaving out IBTS-Q3. These surprising results were contradictory to the current perception that BTS is the survey with the highest weights in assessment and thus should play the major role in estimating the stock. The leave-out-one results also seem not to be consistent with the runs conducted during 2016 benchmark. Further investigations are needed to understand the contribution of surveys in the assessment. Since 2016, large mesh trawlers (TR1

and BT1) are under landing obligation in Subarea 4. In 2019 the fleets (BT2 and TR2) that contribute most to the total discards will fall under landing obligation in Subarea 4, with *de minimis* exemptions in certain fisheries.

Despite the introduction of the landing obligation 52% and 23% of the total catch in 2020was discarded in Subarea 4 and Subdivision 20, respectively. The reported BMS landings for fleets that are under the landing obligation in Subarea 4 are currently much lower than the estimates of unwanted catch from catch monitoring programmes. ICES understands that this is not in accordance with the current EU regulation.

13.9 Status of the stock

SSB in 2020 is estimated around 905 096 tonnes which is well above MSY $B_{trigger}$, B_{pa}, and B_{lim}. Fishing mortality in 2020 is estimated to be at a value of 0.149 (below F_{pa} of 0.769, below the long-term management target F of 0.30 and below F_{MSY} of 0.210).

13.10 Management considerations

Plaice is mainly taken by beam trawlers in a mixed fishery with sole in the southern and central part of the North Sea. There are a number of EC regulations that affect the fisheries on plaice and sole in the North Sea, e.g. as a basis for setting the TAC, limiting effort, minimum landing size and minimum mesh size.

13.10.1 Multiannual plan North Sea

A multiannual plan for plaice and sole in the North Sea was adopted by the EU Council in 2007 (EC regulation 676/2007). This plan is written for the North Sea stock and does not take the merging with the Skagerrak into account. The plan describes two stages: to be deemed a recovery plan during its first stage and a management plan during its second stage. ICES has evaluated this management plan in 2010 and considers it to be precautionary (ICES, 2010a). Objectives are defined for these two stages; to rebuild the stocks to within safe biological limits and to exploit the stocks at MSY respectively. In 2015 WKMSYREF3 estimated F_{MSY} to be between 0.13 and 0.27. ICES identified the point estimate for the North Sea stock to be 0.19 (ADGMSYREF3).

Stage 1 is deemed to be completed when both stocks have been within safe biological limits for two consecutive years. The plaice stock has been within safe biological limits (F = 0.6) as defined by the plan since 2005. The sole stock has been within safe biological limits in terms of fishing mortality and SSB has been above the biomass limit (B_{pa} = 35 kt) in the latest years. According to the management plan (Article 3.2), this signals the end of stage one. Consequently, utilisation of the plan as a basis for advice is on the basis of transitional arrangements until an evaluation of the plan has been conducted (as stipulated in article 5 of the EC regulation). In 2012, ICES evaluated a proposal by the Netherlands for an amended management plan, which could serve as the 'stage 2' plan (Coers *et al.*, 2012). ICES concluded that the plan, subject to those amendments, is consistent with the precautionary approach and the principle of maximum sustainable yield (MSY). However, implementation of stage two of the plan (as stipulated in article 5 of the EC regulation) is not yet defined.

Since the management plan is now in stage 2, the EU regulation stipulates that the stocks should be managed on the basis of MSY. For plaice, the ICES F_{MSY} estimate is 0.21, which is below the target F (0.3) defined in the plan. Considering that the plan specifies that fishing mortality in stage 2 should not be below the target of 0.3 (which coincides with the upper bound of a range of F_{MSY} values suggested by ICES), the current advice for plaice is still on the basis of moving

towards the target of 0.3, rather than on the basis of F_{MSY} point estimate of 0.21 (albeit that the TAC change is restricted to a maximum 15% change). This apparent conflict in the basis for TAC setting in the management plan should be addressed.

This management plan is written for the North Sea stock. No specific management plan exists for the Skagerrak. The North Sea management plan should be updated including the Skagerrak. The forecast and advice are given for both areas with a combined TAC.

13.10.2 Effort regulations (North Sea)

Regulated effort restrictions in the EU were introduced in 2003 (annexes to the annual TAC regulations) for the protection of the North Sea cod stock. In addition, a long-term plan for the recovery of cod stocks was adopted in 2008 (EC regulation 1342/2008). In 2009, the effort management programme switched from a days-at-sea to a kW–day system (EC regulation 43/2009), in which different amounts of kW–days are allocated within each area by member state to different groups of vessels depending on gear and mesh size. Effort ceilings are updated annually. A minor part of the fleets exploiting sole, i.e. otter trawls (OTB) with a mesh size equal to or larger than 100 mm included in Figure 13.2.1, have since 2009 been affected by the regulation. The beam trawl fleet (BT2) was affected by this regulation only once in 2009 but not afterwards.

The overall fleet capacity and deployed effort of the North Sea beam trawl fleet has been substantially reduced since 1995, likely due to a number of reasons, including the above-mentioned effort limitations for the recovery of the cod stock. 25 vessels were decommissioned in 2014. In addition, the current sole and plaice long-term management plan specifically reduces effort as a management measure. However, the evaluation of amendments to the plan in 2012 showed that the plan is consistent with the precautionary approach and the principle of maximum sustainable yield (MSY) also without reductions of effort (Coers *et al*., 2012).

Fishing effort of the beam trawl fleet has shifted towards the southern North Sea to target sole over the past decade. Juvenile plaice tend to be relatively abundant there, leading to relatively high discarding rates of small plaice. This shift was amongst others driven by a number of economic factors, such as the prices for sole and plaice respectively and fuel costs, which meant that the sole fishery was the most profitable fishery. With the recent substantial increases in biomass of the plaice stock, and thus to be expected increased catch rates, targeting plaice further North may become more economically favourable again. With the relatively low fishing mortality levels in recent years, it is also to be expected that a larger proportion of the population will be made up of older fish, of which the fishery could potentially benefit, since larger plaice receive higher prices on the market than small plaice. However, this benefit may be reduced if weight at age are decreasing, which seems to be the case in the plaice stock. At present, the beam trawl fleet is limited in its ability to move northwards (where larger plaice are more abundant) by effort restrictions for the BT1 fleet, which are imposed on the basis of the North Sea cod management plan. This trade-off between objectives in the cod and flatfish plans deserves some attention. Ongoing work in the Netherlands on the levels of cod catch rates (which are considered to be low) in the beam trawl fisheries should help quantification of this trade-off. The introduction of the landing obligation will likely provide an additional strong driver for at least part of the beam trawl fleet to focus on a more northerly plaice fishery, to avoid the complications of the high unwanted bycatches of undersized plaice in the South. For effort regulations in the Skagerrak see Section 07.

13.10.3 Technical measures

Technical measures applicable to the mixed flatfish beam-trawl fishery in the southern North Sea where sole has become relatively more abundant, affect both sole and plaice. The minimum

mesh size of 80 mm selects sole at the minimum landing size. However, this mesh size generates high discards of plaice with a larger minimum landing size than sole. For the overall fleet the discards ratio has been slightly decreasing since 2003 and increasing up again since 2016. In 2020, discards ratio was approximately 48% by weight. Mesh enlargement would reduce the catch of undersized plaice, but would also result in loss of marketable sole. Furthermore, the size selectivity of the fleet may lead to a shift in the age and size at maturation. For example, in recent years plaice and sole have become mature at younger ages and at smaller sizes than in the past (Grift *et al*., 2003). The introduction of the Omega (mesh size) meter in 2010 has led to a slight increase in the effective mesh size in the fishery.

Technical management measures have caused a shift towards two categories of vessels: 2000 HP (the maximum engine power allowed) and 300 HP. The 300 HP vessels are allowed to fish within the 12–nautical mile coastal zone and in the Plaice Box. The Plaice Box is a partially closed area along the continental coast that was implemented in phases, starting in 1989. The area has been closed to most categories of vessels >300 HP all year round since 1995. The most recent EU-funded evaluation by Beare *et al*. (2010) reported the Plaice Box as having very little impact on the plaice stock.

13.11 Issues for future benchmarks

13.11.1 Data

- The delta-gam IBTS-Q1 age ≥5 indices showed upward revision since 2017. This is likely causing the upscaling SSB in empirical retrospective analysis (as shown in advice sheet). The quality of IBTS-Q1 data (e.g., age reading) and the cause of the upward revision needs to be investigated.
- Plaice have heterogenous age distributions in the North Sea: younger ages are distributed more closely to coastal area while older ages are distributed towards north-west of the North Sea. In recent years, strong younger age signals appeared in IBTS-Q3 survey around Scotland coast. The accuracy and uncertainty of these signals need to be investigated, e.g., age readings, gear selectivity (Scottish gear has a different selectivity).
- Information from surveys (BTS, IBTS-Q3, SNS and DFS) implies that older fishes are likely migrating or expanding to the north western part of the North Sea (ICES, 2019a). Further investigations are needed to confirm the spatial changes. If so, the current several surveys with not fully overlapped spatial coverages are no longer suitable for stock assessment. A combined survey index, or survey with time-varying spatial random effects might need to be considered.
- The perception of the stock size from industry is not as large as estimated by ICES. Is it possible that the major fishing efforts are not in the same area where plaice stock were located. Further investigation on (spatial) LPUE needs to be conducted.
- Explain stock ID trend and differences between North Sea and north west of North Sea, including genetics, maturity, mortality, sex-ratio, growth rate, etc.

13.11.2 Assessment

- Residual age and year patterns in catches and surveys needs to be solved.
- Sensitivity leave-one-out analysis on individual survey functions on the assessment
- Reduce “error” in discards estimation by including non-zero survival in assessment

13.11.3 Short-term forecast

- The methodology and principles of RCT3 analysis was developed many years ago and might be no longer valid for the current stock situation. Therefore, the RCT3 analysis needs to be validated.

13.12 Added reference

EU. 2018. Regulation (EU) 2018/973 of the European Parliament and of the council of 4 July 2018 establishing a multiannual plan for demersal stocks in the North Sea and the fisheries exploiting those stocks, specifying details of the implementation of the landing obligation in the North Sea and repealing Council Regulations (EC) No 676/2007 and (EC) No 1342/2008. Official Journal of the European Union, L 179: 1–13. http://data.europa.eu/eli/reg/2018/973/oj

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Table 13.2.1. Plaice in Subarea 4 and Subdivision 20 (7.d Q1 not included): Official landings in thousands.

	North Sea													Skagerrak	
YEAR	Belgium	Denmark	France	Germany	Nether-lands	Norway	Sweden	UK	Others	Total	Un- allocated	ICES estimate	TAC NS	Total	TAC_SK
1982	6755	24532	1046	3626	41208	17	6	20740		97930	56616	154546	140000		
1983	9716	18749	1185	2397	51328	15	22	17400		100812	43218	144030	164000		
1984	11393	22154	604	2485	61478	16	13	16853		114996	41153	156149	182000		
1985	9965	28236	1010	2197	90950	23	18	15912		148311	11527	159838	200000		
1986	7232	26332	751	1809	74447	21	16	17294		127902	37445	165347	180000		
1987	8554	21597	1580	1794	76612	12	7	20638		130794	22876	153670	150000	15694	
1988	11527	20259	1773	2566	77724	21	2	24497	43	138412	16063	154475	175000	12858	
1989	10939	23481	2037	5341	84173	321	12	26104		152408	17410	169818	185000	7710	
1990	13940	26474	1339	8747	78204	1756	169	25632		156261	-21	156240	180000	12078	
1991	14328	24356	508	7926	67945	560	103	27839		143565	4438	148003	175000	8685	
1992	12006	20891	537	6818	51064	836	53	31277		123482	1708	125190	175000	11823	11200
1993	10814	16452	603	6895	48552	827	7	31128		115278	1835	117113	175000	11407	11200
1994	7951	17056	407	5697	50289	524	6	27749		109679	713	110392	165000	11334	11200
1995	7093	13358	442	6329	44263	527	3	24395		96410	1946	98356	115000	10766	11200
1996	5765	11776	379	4780	35419	917	5	20992		80033	1640	81673	81000	10517	11200
1997	5223	13940	254	4159	34143	1620	10	22134		81483	1565	83048	91000	10292	11200
1998	5592	10087	489	2773	30541	965	2	19915	1	70365	1169	71534	87000	8431	11200
1999	6160	13468	624	3144	37513	643	4	17061		78617	2045	80662	102000	8719	11200
2000	7260	13408	547	4310	35030	883	3	20710		82151	-1001	81150	97000	8826	11200
2001	6369	13797	429	4739	33290	1926	3	19147		79700	2147	81847	78000	11653	9400

	North Sea												Skagerrak	
YEAR	Belgium	Denmark	France	Germany	Nether-lands	Norway	Sweden	UK	Others	Total	Un- allocated	ICES estimate	TAC NS	Total	TAC_SK
2002	4859	12552	548	3927	29081	1996	2	16740		69705	512	70217	77000	8789	6400
2003	4570	13742	343	3800	27353	1967	2	13892		65669	820	66489	73250	9110	1400
2004	4314	12123	231	3649	23662	1744	1	15284		61008	428	61436	61000	9090	9500
2005	3396	11385	112	3379	22271	1660	0	12705		54908	792	55700	59000	6764	7600
2006	3487	11907	132	3599	22764	1614	0	12429		55933	2010	57943	57441	9565	7600
2007	3866	8128	144	2643	21465	1224	4	11557	-	49031	713	49744	50261	8747	8500
2008	3396	8229	125	3138	20312	1051	20	11411		47682	1193	48875	49000	8657	9300
2009	3474	NA*	NA*	2931	29142	1116	1	13143	-	NA*	-	54973	55500	6748	9300
2010	3699	435	383	3601	26689	1089	5	14765	-	50666	10008	60674	63825	9057	9300
2011	4466	11634	344	3812	29272	1223	3	15169	-	65923	1463	67386	73400	8251	7900
2012	4862	12245	281	3742	32201	1022	5	16888	-	71246	2584	73830	84410	7611	7900
2013	6462	13650	249	4903	33537	843	3	19334	-	78982	-77	78905	97070	6911	9142
2014	7105	12003	276	4203	29306	577	5	17370	-	69179	1668	70847	111631	9004	10056
2015	5522	14401	223	5171	32074	169	7	17240	-	74807	156	74963	128376	10171	10056
2016	6659	16398	169	4371	32227	94	9	18731	-	78659	2400	81059	131714	10883	11766
2017	5317	12518	151	2526	28775	67	5	14993	0	64352	1090	65442	129917	8467	17639
2018	4894	9666	112	2580	22586	69	3	9603	0	49513	1270	50783	112643	5958	15343
2019	3912	6583	61	2059	19289	57	3	7410	0	39374	596	39970	125435	4614	16782
2020	2560	5636	25	1396	16870	37	5	5582	0	32110	626	32736	146852	5179	19647

*** Official estimates not available.**

Table 13.2.2. Plaice in Subarea 4 and Subdivision 20: Landings (SOP corrected) in numbers by age (including 1st quarter of 7.d) in thousands.

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0	4792	66428	49659	35282	9867	12248	10026	5522	12059
1958	0	7581	23612	65979	36274	20836	8696	8507	6497	13981
1959	0	16914	31085	26040	41988	23432	14173	6547	6739	16530
1960	0	5998	62285	51359	21462	27510	14280	9073	5121	15253
1961	0	2299	33913	68965	33209	12958	14909	9900	6089	14889
1962	0	2075	34677	64548	48387	19939	8757	8733	5081	12373
1963	0	4424	21886	78412	55414	32413	13096	6965	7183	16912
1964	0	14818	40789	65219	57837	37368	15937	6644	4010	17012
1965	0	9913	42438	53486	43919	30320	18464	8602	4237	17686
1966	0	4220	66196	52428	37336	27870	16801	10981	6585	15201
1967	0	6101	30905	115157	42204	22490	16496	8163	6861	11397
1968	0	9750	41883	39251	127220	17638	10642	10396	4039	13754
1969	3	15892	47819	38185	37657	107955	11016	6440	8669	17029
1970	74	16850	49861	54712	39642	34174	76862	6149	4078	14459
1971	20	30568	49876	34580	26919	23659	17471	30711	6626	17468
1972	2296	37561	63958	54402	23695	17479	14787	11211	19111	16094
1973	1332	33342	62095	76769	44397	14517	9335	10347	6392	25194
1974	2305	23972	57595	43677	42588	20391	8300	6554	5773	22790
1975	1042	29877	65465	33211	27004	22509	12613	6292	4362	20923
1976	2892	34497	79621	98846	14129	10156	9352	6553	3022	12871
1977	3225	57061	43359	66120	83841	9157	5922	5030	4068	9206
1978	1102	58412	60114	52398	48310	34240	5728	3232	2333	7201
1979	1316	57933	118662	48879	47805	39864	24187	4154	2802	9272
1980	996	66095	136274	79035	25548	18321	14018	8621	1898	5497
1981	259	103354	125928	59565	36670	12750	9805	8295	5005	6091
1982	3373	48354	212188	71167	29191	16975	7704	5551	4539	8775
1983	1214	119696	115332	100473	29591	12960	8238	4224	3013	8308
1984	108	63507	280481	62835	41492	15417	6842	5593	2729	6551
1985	120	72806	146839	201629	37939	17106	7441	3780	2813	5830
1986	1669	66935	165986	106461	101684	27971	9839	4704	2834	7083
1987	1	85153	118416	120782	81304	44590	13539	4669	2346	5610
1988	1	15200	253815	85347	59950	31492	19347	6198	3434	6402
1989	1254	46810	108272	238243	58767	21667	11605	8025	2321	5806
1990	1546	33766	104796	119829	169465	29946	9053	4689	3803	4206
1991	1425	43064	87196	122233	76075	78728	15410	5390	3215	5634
1992	3386	43769	86358	81470	88534	37542	30444	7229	3295	6976
1993	3416	53555	99805	80856	63275	35042	14745	11500	3704	5883

year	age									
	1	2	3	4	5	6	7	8	9	10
1994	1375	44554	105863	86992	47577	27680	17279	6661	5449	5458
1995	7779	36761	82649	84778	47911	24572	14746	5285	2495	3896
1996	1103	43346	68155	52961	37285	19160	12400	5881	2799	4989
1997	897	43122	88687	49362	31750	18673	9518	5037	3054	4400
1998	197	30594	74441	62339	22793	9151	5703	2870	1983	3360
1999	549	8690	158088	47391	31778	14077	4038	2625	1597	3234
2000	2603	15656	40819	171994	25935	12586	2979	1135	953	2121
2001	4523	37095	58678	57195	101524	11492	4739	1212	650	2364
2002	1229	15868	60204	55511	44243	43066	6527	2256	794	1638
2003	700	44801	50607	54864	34689	20311	18128	1774	689	880
2004	544	12049	119093	39053	23766	13309	5152	4774	460	569
2005	2948	18885	29734	90989	20175	10900	5905	2760	2303	647
2006	363	20214	79934	34221	51057	8057	5589	2301	1318	1408
2007	1436	21357	41941	55949	20379	21837	3095	2011	604	1303
2008	400	13190	52382	45336	34035	7566	8066	978	735	936
2009	1563	12420	61907	42545	24886	18544	3400	4260	587	821
2010	2114	19874	49030	69702	25181	12622	9766	1866	2520	1267
2011	407	12977	45353	62017	51581	14815	6643	6984	1261	2743
2012	163	6164	60603	62070	44968	32037	7556	3402	3482	1924
2013	550	10530	63366	77056	42315	29486	15349	3955	2468	3795
2014	7	5384	40649	77966	52266	21932	12955	8387	2472	3440
2015	0	3844	42673	67065	60967	32309	12793	8902	4055	4834
2016	0	4179	39190	85205	60972	39883	19146	7710	5310	5125
2017	27	5289	24694	58141	57766	30891	16860	7600	3068	3213
2018	17	7829	24768	34001	43504	31018	15991	8987	5394	4159
2019	0	6528	43711	32251	18781	18124	11446	6948	3924	4055
2020	80	5638	19007	44780	19082	10224	11645	7614	4813	6395

Table 13.2.3. Plaice in Subarea 4 and Subdivision 20: Discards in numbers by age (including 1st quarter of 7.d) in thousands.

year	age							
	1	2	3	4	5	6	7	8
1957	32356	45596	9220	909	961	25	0	0
1958	66199	73552	23655	2572	2137	65	0	0
1959	116086	127771	46402	11407	4737	106	0	0
1960	73939	167893	44948	997	1067	519	0	0
1961	75578	144609	89014	538	1612	130	0	0
1962	51265	181321	87599	21716	799	186	0	0
1963	90913	136183	129778	9964	2112	188	0	0
1964	66035	153274	64156	33825	3011	323	0	0
1965	43708	426021	59262	3404	923	267	0	0
1966	38496	163125	349358	14399	1402	125	0	0
1967	20199	133545	87532	152496	623	260	0	0
1968	73971	72192	46339	26530	22436	58	0	0
1969	85192	67378	16747	19334	773	2024	0	0
1970	123569	152480	27747	1287	5061	161	0	0
1971	69337	96968	42354	2675	426	81	0	0
1972	70002	55470	33899	5714	567	73	0	0
1973	132352	49815	4008	673	1289	67	0	0
1974	211139	308411	3652	285	611	109	0	0
1975	244969	280130	190536	4807	253	123	0	0
1976	183879	140921	71054	18013	174	41	0	0
1977	256628	103696	79317	33552	9317	129	0	0
1978	226872	154113	27257	10775	1244	570	0	0
1979	293166	215084	57578	18382	589	310	0	0
1980	226371	122561	932	687	193	86	0	0
1981	134142	193241	1850	373	431	55	0	0
1982	411307	204572	4624	1109	216	98	0	0
1983	261400	436331	30716	2235	804	72	0	0
1984	310675	313490	52651	24529	1492	69	0	0
1985	405385	229208	35566	2221	200	78	0	0
1986	1117345	490965	48510	26470	1451	146	0	0
1987	361519	1374202	180969	1427	1348	248	0	0
1988	348597	608109	459385	61167	882	177	0	0
1989	213291	485845	193176	85758	7224	115	0	0
1990	145314	279298	168674	28102	5011	177	0	0
1991	183126	301575	141567	40739	5528	939	0	0
1992	138755	219619	94581	34348	4307	880	0	0
1993	96371	154083	48088	11966	1635	216	0	0
1994	62122	95703	35703	1038	822	144	0	0

year	age							
	1	2	3	4	5	6	7	8
1995	118863	82676	15753	860	663	120	0	0
1996	111250	331065	27606	3930	451	116	0	0
1997	128653	510918	193828	588	271	108	0	0
1998	104538	646250	191631	53354	297	33	0	0
1999	127321	208401	231769	54869	278	58	0	0
2000	103468	171213	51092	64971	1230	241	263	167
2001	30346	352452	186900	74744	54276	152	45	1
2002	310442	178402	78296	13940	2834	718	109	1
2003	67798	523336	56580	20184	4358	419	5756	1
2004	233682	183508	127876	10650	1975	450	41	1
2005	93936	332157	46454	23763	4494	6007	287	6
2006	220982	226944	117342	9785	2369	251	736	195
2007	77687	210407	73043	13942	1594	7028	190	1644
2008	135504	255948	37983	5356	1785	336	8852	885
2009	148666	193174	68975	9471	2007	1108	138	3220
2010	167387	180364	59943	22776	2699	1736	2074	283
2011	117902	153773	62696	37050	12949	2924	143	2273
2012	91961	313013	123821	32986	9439	1547	226	7
2013	128227	156837	125878	24797	4679	1033	219	15
2014	293515	192537	116178	55315	19141	2610	478	67
2015	83433	288990	130826	38858	12591	2367	521	209
2016	79202	144049	133284	48501	21078	7479	2068	1857
2017	129559	144559	77236	59006	16045	3812	1268	268
2018	64618	266462	101461	39258	21422	4803	1480	243
2019	134628	115294	119574	29706	11845	8536	3134	1412
2020	93983	191175	64298	55815	9809	3645	4399	1189

Table 13.2.4. Plaice in Subarea 4 and Subdivision 20: Catch in numbers by age (including 1st quarter of 7.d) in thousands.

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	32356	50388	75648	50568	36243	9892	12248	10026	5522	12059
1958	66199	81133	47267	68551	38411	20901	8696	8507	6497	13981
1959	116086	144685	77487	37447	46725	23538	14173	6547	6739	16530
1960	73939	173891	107233	52356	22529	28029	14280	9073	5121	15253
1961	75578	146908	122927	69503	34821	13088	14909	9900	6089	14889
1962	51265	183396	122276	86264	49186	20125	8757	8733	5081	12373
1963	90913	140607	151664	88376	57526	32601	13096	6965	7183	16912
1964	66035	168092	104945	99044	60848	37691	15937	6644	4010	17012
1965	43708	435934	101700	56890	44842	30587	18464	8602	4237	17686
1966	38496	167345	415554	66827	38738	27995	16801	10981	6585	15201
1967	20199	139646	118437	267653	42827	22750	16496	8163	6861	11397
1968	73971	81942	88222	65781	149656	17696	10642	10396	4039	13754
1969	85195	83270	64566	57519	38430	109979	11016	6440	8669	17029
1970	123643	169330	77608	55999	44703	34335	76862	6149	4078	14459
1971	69357	127536	92230	37255	27345	23740	17471	30711	6626	17468
1972	72298	93031	97857	60116	24262	17552	14787	11211	19111	16094
1973	133684	83157	66103	77442	45686	14584	9335	10347	6392	25194
1974	213444	332383	61247	43962	43199	20500	8300	6554	5773	22790
1975	246011	310007	256001	38018	27257	22632	12613	6292	4362	20923
1976	186771	175418	150675	116859	14303	10197	9352	6553	3022	12871
1977	259853	160757	122676	99672	93158	9286	5922	5030	4068	9206
1978	227974	212525	87371	63173	49554	34810	5728	3232	2333	7201
1979	294482	273017	176240	67261	48394	40174	24187	4154	2802	9272
1980	227367	188656	137206	79722	25741	18407	14018	8621	1898	5497
1981	134401	296595	127778	59938	37101	12805	9805	8295	5005	6091
1982	414680	252926	216812	72276	29407	17073	7704	5551	4539	8775
1983	262614	556027	146048	102708	30395	13032	8238	4224	3013	8308
1984	310783	376997	333132	87364	42984	15486	6842	5593	2729	6551
1985	405505	302014	182405	203850	38139	17184	7441	3780	2813	5830
1986	1119014	557900	214496	132931	103135	28117	9839	4704	2834	7083
1987	361520	1459355	299385	122209	82652	44838	13539	4669	2346	5610
1988	348598	623309	713200	146514	60832	31669	19347	6198	3434	6402
1989	214545	532655	301448	324001	65991	21782	11605	8025	2321	5806
1990	146860	313064	273470	147931	174476	30123	9053	4689	3803	4206
1991	184551	344639	228763	162972	81603	79667	15410	5390	3215	5634
1992	142141	263388	180939	115818	92841	38422	30444	7229	3295	6976
1993	99787	207638	147893	92822	64910	35258	14745	11500	3704	5883
1994	63497	140257	141566	88030	48399	27824	17279	6661	5449	5458

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	126642	119437	98402	85638	48574	24692	14746	5285	2495	3896
1996	112353	374411	95761	56891	37736	19276	12400	5881	2799	4989
1997	129550	554040	282515	49950	32021	18781	9518	5037	3054	4400
1998	104735	676844	266072	115693	23090	9184	5703	2870	1983	3360
1999	127870	217091	389857	102260	32056	14135	4038	2625	1597	3234
2000	106071	186869	91911	236965	27165	12827	3242	1302	953	2121
2001	34869	389547	245578	131939	155800	11644	4784	1213	650	2364
2002	311671	194270	138500	69451	47077	43784	6636	2257	794	1638
2003	68498	568137	107187	75048	39047	20730	23884	1775	689	880
2004	234226	195557	246969	49703	25741	13759	5193	4775	460	569
2005	96884	351042	76188	114752	24669	16907	6192	2766	2303	647
2006	221345	247158	197276	44006	53426	8308	6325	2496	1318	1408
2007	79123	231764	114984	69891	21973	28865	3285	3655	604	1303
2008	135904	269138	90365	50692	35820	7902	16918	1863	735	936
2009	150229	205594	130882	52016	26893	19652	3538	7480	587	821
2010	169501	200238	108973	92478	27880	14358	11840	2149	2520	1267
2011	118309	166750	108049	99067	64530	17739	6786	9257	1261	2743
2012	92124	319177	184424	95056	54407	33584	7782	3409	3482	1924
2013	128777	167367	189244	101853	46994	30519	15568	3970	2468	3795
2014	293522	197921	156827	133281	71407	24542	13433	8454	2472	3440
2015	83433	292834	173499	105923	73558	34676	13314	9111	4055	4834
2016	79202	148228	172474	133706	82050	47362	21214	9567	5310	5125
2017	129586	149848	101930	117147	73811	34703	18128	7868	3068	3213
2018	64635	274291	126229	73259	64926	35821	17471	9230	5394	4159
2019	134628	121822	163285	61957	30626	26660	14580	8360	3924	4055
2020	94063	196813	83305	100596	28891	13869	16044	8803	4813	6395

Table 13.2.5. Plaice in Subarea 4 and Subdivision 20: Stock weight at age (kg).

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0.038	0.102	0.157	0.242	0.325	0.485	0.719	0.682	0.844	0.918
1958	0.041	0.093	0.180	0.272	0.303	0.442	0.577	0.778	0.793	0.945
1959	0.045	0.106	0.173	0.264	0.329	0.470	0.650	0.686	0.908	0.897
1960	0.038	0.111	0.181	0.272	0.364	0.469	0.633	0.726	0.845	0.918
1961	0.037	0.098	0.185	0.306	0.337	0.483	0.579	0.691	0.779	0.911
1962	0.036	0.096	0.173	0.301	0.424	0.573	0.684	0.806	0.873	1.335
1963	0.041	0.103	0.176	0.273	0.378	0.540	0.663	0.788	0.882	0.961
1964	0.024	0.113	0.184	0.296	0.373	0.477	0.645	0.673	0.845	0.973
1965	0.031	0.068	0.198	0.294	0.333	0.43	0.516	0.601	0.722	0.578
1966	0.031	0.099	0.127	0.305	0.403	0.455	0.503	0.565	0.581	0.848
1967	0.029	0.104	0.179	0.205	0.442	0.528	0.585	0.650	0.703	0.833
1968	0.055	0.094	0.175	0.287	0.344	0.532	0.592	0.362	0.667	0.746
1969	0.047	0.158	0.188	0.266	0.344	0.390	0.565	0.621	0.679	0.635
1970	0.043	0.113	0.236	0.274	0.369	0.410	0.468	0.636	0.732	0.747
1971	0.051	0.109	0.251	0.344	0.413	0.489	0.512	0.583	0.696	0.707
1972	0.056	0.158	0.218	0.407	0.473	0.534	0.579	0.606	0.655	0.759
1973	0.037	0.134	0.237	0.308	0.468	0.521	0.566	0.583	0.617	0.690
1974	0.049	0.105	0.217	0.416	0.437	0.524	0.570	0.629	0.652	0.690
1975	0.063	0.141	0.187	0.388	0.483	0.544	0.610	0.668	0.704	0.762
1976	0.082	0.169	0.226	0.308	0.484	0.550	0.593	0.658	0.694	0.743
1977	0.064	0.184	0.265	0.311	0.405	0.551	0.627	0.690	0.667	0.759
1978	0.064	0.151	0.319	0.373	0.411	0.467	0.547	0.630	0.704	0.773
1979	0.062	0.179	0.258	0.365	0.414	0.459	0.543	0.667	0.764	0.826
1980	0.049	0.163	0.289	0.428	0.444	0.524	0.582	0.651	0.778	1.025
1981	0.041	0.140	0.239	0.421	0.473	0.536	0.570	0.624	0.707	0.849
1982	0.048	0.128	0.250	0.351	0.490	0.589	0.631	0.679	0.726	0.828
1983	0.045	0.128	0.242	0.381	0.494	0.559	0.624	0.712	0.754	0.791
1984	0.048	0.129	0.216	0.413	0.464	0.571	0.649	0.692	0.787	0.898
1985	0.048	0.146	0.232	0.320	0.452	0.536	0.635	0.656	0.764	0.869
1986	0.043	0.126	0.245	0.311	0.440	0.533	0.692	0.779	0.888	0.971
1987	0.036	0.105	0.200	0.383	0.401	0.503	0.573	0.711	0.747	0.817
1988	0.036	0.097	0.172	0.264	0.426	0.467	0.547	0.644	0.706	0.897
1989	0.039	0.101	0.192	0.247	0.362	0.484	0.553	0.616	0.759	0.837
1990	0.043	0.108	0.176	0.261	0.343	0.422	0.555	0.647	0.701	0.760
1991	0.048	0.131	0.184	0.260	0.342	0.401	0.463	0.633	0.652	0.744
1992	0.043	0.121	0.199	0.270	0.318	0.403	0.500	0.573	0.683	0.730
1993	0.050	0.119	0.208	0.315	0.330	0.391	0.490	0.587	0.633	0.723
1994	0.053	0.141	0.214	0.290	0.360	0.404	0.462	0.533	0.653	0.702

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	0.050	0.142	0.254	0.336	0.399	0.448	0.509	0.584	0.678	0.789
1996	0.044	0.117	0.229	0.368	0.390	0.462	0.488	0.554	0.660	0.791
1997	0.035	0.115	0.233	0.359	0.439	0.492	0.521	0.543	0.627	0.734
1998	0.038	0.081	0.207	0.333	0.474	0.577	0.581	0.648	0.656	0.642
1999	0.044	0.091	0.150	0.319	0.437	0.524	0.586	0.644	0.664	0.620
2000	0.051	0.106	0.165	0.219	0.408	0.467	0.649	0.695	0.656	0.744
2001	0.061	0.122	0.202	0.233	0.331	0.452	0.560	0.641	0.798	0.816
2002	0.048	0.118	0.213	0.301	0.319	0.403	0.446	0.612	0.685	0.781
2003	0.057	0.111	0.227	0.269	0.344	0.391	0.464	0.600	0.714	0.960
2004	0.047	0.116	0.201	0.306	0.384	0.430	0.489	0.495	0.780	0.921
2005	0.053	0.106	0.216	0.237	0.378	0.422	0.434	0.527	0.621	0.815
2006	0.052	0.130	0.190	0.316	0.354	0.424	0.439	0.506	0.583	0.688
2007	0.047	0.093	0.235	0.238	0.337	0.394	0.458	0.412	0.526	0.512
2008	0.048	0.114	0.196	0.274	0.355	0.429	0.484	0.627	0.598	0.449
2009	0.052	0.114	0.194	0.344	0.373	0.412	0.472	0.540	0.565	0.576
2010	0.053	0.116	0.179	0.340	0.361	0.401	0.448	0.572	0.568	0.655
2011	0.039	0.100	0.187	0.209	0.355	0.483	0.438	0.422	0.530	0.580
2012	0.052	0.093	0.142	0.188	0.331	0.393	0.484	0.479	0.480	0.518
2013	0.043	0.107	0.153	0.208	0.320	0.354	0.434	0.493	0.662	0.468
2014	0.048	0.104	0.158	0.202	0.312	0.380	0.439	0.484	0.458	0.615
2015	0.024	0.065	0.120	0.207	0.279	0.323	0.379	0.435	0.465	0.457
2016	0.030	0.066	0.117	0.198	0.260	0.329	0.380	0.434	0.479	0.514
2017	0.032	0.069	0.132	0.181	0.270	0.333	0.359	0.458	0.476	0.557
2018	0.036	0.064	0.116	0.165	0.215	0.276	0.327	0.366	0.412	0.595
2019	0.022	0.063	0.117	0.173	0.240	0.261	0.352	0.391	0.415	0.443
2020	0.026	0.058	0.114	0.163	0.208	0.248	0.323	0.351	0.424	0.458

Table 13.2.6. Plaice in Subarea 4 and Subdivision 20: Landings weight at age (kg).

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0.000	0.165	0.201	0.258	0.353	0.456	0.533	0.589	0.396	0.998
1958	0.000	0.198	0.221	0.259	0.337	0.453	0.513	0.615	0.665	0.992
1959	0.000	0.218	0.246	0.293	0.362	0.473	0.592	0.623	0.750	1.000
1960	0.000	0.200	0.236	0.289	0.386	0.485	0.601	0.683	0.724	1.094
1961	0.000	0.191	0.233	0.302	0.412	0.509	0.604	0.671	0.812	1.071
1962	0.000	0.211	0.248	0.300	0.400	0.541	0.570	0.692	0.777	1.127
1963	0.000	0.253	0.286	0.319	0.399	0.533	0.624	0.667	0.715	1.028
1964	0.000	0.250	0.273	0.312	0.388	0.487	0.628	0.700	0.737	1.005
1965	0.000	0.242	0.282	0.321	0.385	0.471	0.539	0.663	0.726	0.887
1966	0.000	0.232	0.270	0.348	0.436	0.484	0.559	0.624	0.690	0.933
1967	0.000	0.232	0.279	0.322	0.425	0.547	0.597	0.662	0.738	0.978
1968	0.000	0.267	0.298	0.331	0.366	0.517	0.590	0.596	0.686	0.911
1969	0.217	0.294	0.310	0.333	0.359	0.412	0.573	0.655	0.658	0.893
1970	0.315	0.286	0.318	0.356	0.419	0.443	0.499	0.672	0.744	0.892
1971	0.256	0.318	0.356	0.403	0.448	0.514	0.542	0.607	0.699	0.891
1972	0.246	0.296	0.352	0.428	0.493	0.541	0.608	0.646	0.674	0.939
1973	0.272	0.316	0.344	0.405	0.486	0.539	0.605	0.627	0.677	0.842
1974	0.285	0.311	0.354	0.405	0.476	0.554	0.609	0.693	0.707	0.926
1975	0.249	0.300	0.330	0.420	0.495	0.587	0.636	0.703	0.783	1.019
1976	0.265	0.295	0.338	0.375	0.513	0.594	0.641	0.705	0.741	0.980
1977	0.254	0.323	0.353	0.380	0.418	0.556	0.647	0.721	0.715	0.978
1978	0.244	0.315	0.369	0.397	0.438	0.491	0.609	0.687	0.776	0.950
1979	0.235	0.311	0.349	0.388	0.429	0.474	0.550	0.675	0.796	0.960
1980	0.238	0.286	0.344	0.401	0.473	0.545	0.588	0.662	0.772	1.013
1981	0.237	0.274	0.329	0.416	0.505	0.558	0.604	0.642	0.725	1.007
1982	0.279	0.262	0.311	0.424	0.514	0.608	0.664	0.712	0.738	0.984
1983	0.200	0.250	0.300	0.383	0.515	0.604	0.677	0.771	0.815	0.984
1984	0.231	0.263	0.283	0.364	0.480	0.591	0.677	0.726	0.839	1.036
1985	0.245	0.264	0.290	0.335	0.445	0.563	0.667	0.730	0.807	1.021
1986	0.221	0.269	0.303	0.339	0.405	0.473	0.668	0.750	0.856	1.014
1987	0.000	0.249	0.299	0.345	0.378	0.472	0.574	0.728	0.835	0.993
1988	0.000	0.254	0.278	0.341	0.418	0.478	0.590	0.680	0.808	1.017
1989	0.236	0.280	0.308	0.331	0.385	0.515	0.591	0.668	0.785	0.940
1990	0.271	0.284	0.297	0.315	0.364	0.441	0.586	0.690	0.761	1.010
1991	0.227	0.286	0.292	0.302	0.360	0.452	0.526	0.666	0.743	0.924
1992	0.251	0.263	0.290	0.312	0.330	0.415	0.530	0.607	0.719	0.891
1993	0.249	0.273	0.288	0.319	0.343	0.408	0.512	0.630	0.720	0.856
1994	0.229	0.263	0.284	0.333	0.375	0.417	0.491	0.610	0.731	0.906

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	0.272	0.277	0.301	0.335	0.375	0.420	0.474	0.593	0.734	0.906
1996	0.240	0.279	0.304	0.346	0.415	0.465	0.490	0.553	0.712	0.858
1997	0.208	0.271	0.313	0.355	0.410	0.474	0.541	0.574	0.616	0.912
1998	0.151	0.260	0.306	0.384	0.452	0.546	0.613	0.673	0.687	0.899
1999	0.245	0.253	0.280	0.347	0.415	0.416	0.538	0.637	0.748	0.804
2000	0.228	0.267	0.283	0.312	0.378	0.461	0.597	0.689	0.752	0.888
2001	0.238	0.267	0.291	0.307	0.360	0.412	0.582	0.701	0.796	0.799
2002	0.237	0.264	0.289	0.311	0.336	0.430	0.477	0.644	0.760	0.904
2003	0.232	0.252	0.285	0.320	0.353	0.389	0.482	0.635	0.763	0.857
2004	0.214	0.246	0.281	0.328	0.391	0.429	0.508	0.560	0.797	0.872
2005	0.272	0.265	0.280	0.330	0.382	0.426	0.465	0.555	0.617	0.910
2006	0.253	0.267	0.282	0.322	0.383	0.389	0.457	0.477	0.531	0.748
2007	0.263	0.268	0.303	0.343	0.364	0.432	0.507	0.486	0.587	0.632
2008	0.249	0.269	0.309	0.341	0.400	0.446	0.531	0.720	0.640	0.638
2009	0.176	0.260	0.308	0.355	0.415	0.481	0.531	0.608	0.668	0.792
2010	0.206	0.265	0.308	0.348	0.418	0.476	0.516	0.625	0.682	0.649
2011	0.235	0.242	0.281	0.341	0.414	0.504	0.604	0.521	0.556	0.804
2012	0.236	0.258	0.305	0.351	0.380	0.436	0.518	0.558	0.558	0.680
2013	0.031	0.242	0.281	0.313	0.364	0.417	0.494	0.600	0.607	0.680
2014	0.207	0.252	0.285	0.318	0.368	0.418	0.479	0.543	0.628	0.650
2015	NA	0.251	0.284	0.321	0.359	0.409	0.473	0.487	0.582	0.600
2016	NA	0.249	0.271	0.296	0.350	0.385	0.450	0.531	0.556	0.684
2017	0.212	0.247	0.276	0.299	0.357	0.410	0.455	0.543	0.642	0.735
2018	0.167	0.243	0.259	0.287	0.306	0.356	0.400	0.447	0.439	0.589
2019	NA	0.249	0.258	0.295	0.349	0.388	0.431	0.488	0.504	0.601
2020	0.211	0.236	0.264	0.269	0.302	0.333	0.372	0.422	0.451	0.562

Table 13.2.7. Plaice in Subarea 4 and Subdivision 20: Discards weight at age (kg).

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0.044	0.104	0.146	0.181	0.206	0.244	0.244	0.231	0.000	0.000
1958	0.047	0.096	0.158	0.188	0.200	0.244	0.000	0.000	0.000	0.000
1959	0.051	0.107	0.155	0.186	0.197	0.231	0.000	0.000	0.000	0.000
1960	0.045	0.112	0.159	0.188	0.204	0.212	0.244	0.000	0.000	0.000
1961	0.044	0.100	0.160	0.194	0.204	0.220	0.220	0.000	0.000	0.000
1962	0.042	0.098	0.155	0.193	0.213	0.221	0.221	0.231	0.000	0.000
1963	0.048	0.105	0.156	0.188	0.205	0.231	0.221	0.231	0.000	0.000
1964	0.032	0.114	0.160	0.192	0.204	0.221	0.244	0.231	0.000	0.000
1965	0.038	0.072	0.166	0.192	0.212	0.221	0.231	0.000	0.000	0.000
1966	0.038	0.101	0.125	0.194	0.205	0.231	0.231	0.244	0.000	0.000
1967	0.036	0.105	0.158	0.169	0.220	0.220	0.244	0.244	0.000	0.000
1968	0.060	0.096	0.156	0.191	0.192	0.244	0.220	0.000	0.000	0.000
1969	0.052	0.146	0.162	0.186	0.211	0.212	0.000	0.231	0.000	0.000
1970	0.049	0.114	0.179	0.189	0.196	0.000	0.220	0.231	0.000	0.000
1971	0.057	0.110	0.183	0.200	0.212	0.000	0.000	0.231	0.000	0.000
1972	0.061	0.147	0.173	0.211	0.211	0.244	0.000	0.000	0.000	0.000
1973	0.043	0.131	0.179	0.195	0.211	0.244	0.000	0.000	0.000	0.000
1974	0.054	0.106	0.173	0.212	0.220	0.231	0.244	0.000	0.000	0.000
1975	0.068	0.136	0.162	0.206	0.221	0.244	0.244	0.000	0.000	0.000
1976	0.085	0.153	0.176	0.195	0.220	0.000	0.244	0.000	0.000	0.000
1977	0.069	0.160	0.186	0.196	0.198	0.220	0.000	0.000	0.000	0.000
1978	0.069	0.143	0.197	0.205	0.211	0.213	0.231	0.000	0.000	0.000
1979	0.066	0.158	0.185	0.204	0.220	0.231	0.221	0.244	0.000	0.000
1980	0.055	0.149	0.191	0.212	0.231	0.000	0.000	0.000	0.000	0.000
1981	0.048	0.135	0.179	0.212	0.220	0.000	0.000	0.000	0.000	0.000
1982	0.054	0.126	0.182	0.203	0.231	0.244	0.244	0.000	0.000	0.000
1983	0.051	0.126	0.180	0.205	0.211	0.244	0.000	0.000	0.000	0.000
1984	0.053	0.127	0.172	0.211	0.205	0.000	0.244	0.000	0.000	0.000
1985	0.054	0.139	0.177	0.197	0.231	0.244	0.000	0.000	0.000	0.000
1986	0.049	0.124	0.181	0.196	0.220	0.244	0.244	0.000	0.000	0.000
1987	0.043	0.105	0.166	0.205	0.220	0.231	0.000	0.000	0.000	0.000
1988	0.043	0.098	0.153	0.185	0.220	0.244	0.000	0.000	0.000	0.000
1989	0.046	0.102	0.163	0.181	0.196	0.000	0.000	0.000	0.000	0.000
1990	0.051	0.111	0.157	0.186	0.212	0.231	0.000	0.000	0.000	0.000
1991	0.055	0.130	0.161	0.185	0.203	0.221	0.231	0.231	0.000	0.000
1992	0.050	0.122	0.167	0.188	0.204	0.212	0.231	0.244	0.000	0.000
1993	0.056	0.121	0.171	0.197	0.211	0.231	0.244	0.000	0.000	0.000
1994	0.060	0.140	0.175	0.194	0.213	0.244	0.244	0.221	0.000	0.000

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	0.058	0.141	0.186	0.201	0.220	0.232	0.232	0.244	0.000	0.000
1996	0.052	0.122	0.179	0.205	0.221	0.232	0.000	0.000	0.000	0.000
1997	0.044	0.117	0.178	0.203	0.221	0.244	0.000	0.000	0.000	0.000
1998	0.047	0.086	0.170	0.199	0.220	0.000	0.244	0.000	0.000	0.000
1999	0.053	0.097	0.143	0.197	0.220	0.000	0.000	0.000	0.000	0.000
2000	0.059	0.110	0.151	0.174	0.244	0.000	0.203	0.000	0.000	0.000
2001	0.068	0.122	0.167	0.178	0.197	0.244	0.000	0.244	0.000	0.000
2002	0.056	0.119	0.170	0.182	0.172	0.208	0.003	0.000	0.000	0.000
2003	0.064	0.113	0.174	0.185	0.198	0.204	0.221	0.000	0.000	0.000
2004	0.054	0.117	0.164	0.183	0.189	0.192	0.196	0.000	0.000	0.000
2005	0.061	0.109	0.170	0.175	0.215	0.205	0.210	0.176	0.000	0.000
2006	0.060	0.128	0.164	0.193	0.198	0.204	0.212	0.220	0.000	0.000
2007	0.055	0.098	0.177	0.178	0.188	0.199	0.225	0.200	0.000	0.000
2008	0.056	0.116	0.163	0.186	0.187	0.230	0.220	0.191	0.000	0.000
2009	0.060	0.116	0.164	0.199	0.202	0.212	0.210	0.220	0.000	0.000
2010	0.060	0.117	0.159	0.199	0.190	0.198	0.211	0.234	0.001	0.000
2011	0.047	0.104	0.162	0.171	0.192	0.196	0.199	0.211	0.000	0.000
2012	0.052	0.093	0.142	0.188	0.198	0.206	0.215	0.215	0.000	0.000
2013	0.051	0.081	0.127	0.151	0.170	0.194	0.228	0.346	0.000	0.000
2014	0.025	0.089	0.132	0.162	0.180	0.212	0.300	0.370	0.255	0.000
2015	0.026	0.078	0.122	0.149	0.164	0.185	0.173	0.218	0.404	0.291
2016	0.048	0.079	0.124	0.150	0.151	0.179	0.166	0.192	0.251	0.500
2017	0.051	0.080	0.121	0.139	0.161	0.194	0.208	0.206	0.513	0.758
2018	0.058	0.084	0.121	0.137	0.149	0.152	0.159	0.179	0.196	NA
2019	0.044	0.083	0.118	0.135	0.146	0.148	0.158	0.172	0.182	0.194
2020	0.054	0.079	0.119	0.133	0.146	0.148	0.154	0.164	0.159	0.166

Table 13.2.8. Plaice in Subarea 4 and Subdivision 20: Catch weight at age (kg).

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0.044	0.110	0.194	0.257	0.349	0.455	0.533	0.589	0.396	0.998
1958	0.047	0.106	0.189	0.256	0.329	0.452	0.513	0.615	0.665	0.992
1959	0.051	0.120	0.192	0.260	0.345	0.472	0.592	0.623	0.750	1.000
1960	0.045	0.115	0.204	0.287	0.377	0.480	0.601	0.683	0.724	1.094
1961	0.044	0.101	0.180	0.301	0.402	0.506	0.604	0.671	0.812	1.071
1962	0.042	0.099	0.181	0.273	0.397	0.538	0.570	0.692	0.777	1.127
1963	0.048	0.110	0.175	0.304	0.392	0.531	0.624	0.667	0.715	1.028
1964	0.032	0.126	0.204	0.271	0.379	0.485	0.628	0.700	0.737	1.005
1965	0.038	0.076	0.214	0.313	0.381	0.469	0.539	0.663	0.726	0.887
1966	0.038	0.104	0.148	0.315	0.428	0.483	0.559	0.624	0.690	0.933
1967	0.036	0.111	0.190	0.235	0.422	0.543	0.597	0.662	0.738	0.978
1968	0.060	0.116	0.223	0.275	0.340	0.516	0.590	0.596	0.686	0.911
1969	0.052	0.174	0.272	0.284	0.356	0.408	0.573	0.655	0.658	0.893
1970	0.049	0.131	0.268	0.352	0.394	0.441	0.499	0.672	0.744	0.892
1971	0.057	0.160	0.277	0.388	0.444	0.512	0.542	0.607	0.699	0.891
1972	0.067	0.207	0.290	0.407	0.486	0.540	0.608	0.646	0.674	0.939
1973	0.045	0.205	0.334	0.403	0.478	0.538	0.605	0.627	0.677	0.842
1974	0.056	0.121	0.343	0.404	0.472	0.552	0.609	0.693	0.707	0.926
1975	0.069	0.152	0.205	0.393	0.492	0.585	0.636	0.703	0.783	1.019
1976	0.088	0.181	0.262	0.347	0.509	0.592	0.641	0.705	0.741	0.980
1977	0.071	0.218	0.245	0.318	0.396	0.551	0.647	0.721	0.715	0.978
1978	0.070	0.190	0.315	0.364	0.432	0.486	0.609	0.687	0.776	0.950
1979	0.067	0.190	0.295	0.338	0.426	0.472	0.550	0.675	0.796	0.960
1980	0.056	0.197	0.343	0.399	0.471	0.542	0.588	0.662	0.772	1.013
1981	0.048	0.183	0.327	0.415	0.502	0.556	0.604	0.642	0.725	1.007
1982	0.056	0.152	0.308	0.421	0.512	0.606	0.664	0.712	0.738	0.984
1983	0.052	0.153	0.275	0.379	0.507	0.602	0.677	0.771	0.815	0.984
1984	0.053	0.150	0.265	0.321	0.470	0.588	0.677	0.726	0.839	1.036
1985	0.054	0.169	0.268	0.333	0.444	0.562	0.667	0.730	0.807	1.021
1986	0.049	0.141	0.275	0.311	0.402	0.472	0.668	0.750	0.856	1.014
1987	0.043	0.113	0.219	0.343	0.375	0.471	0.574	0.728	0.835	0.993
1988	0.043	0.102	0.197	0.276	0.415	0.477	0.590	0.680	0.808	1.017
1989	0.047	0.118	0.215	0.291	0.364	0.512	0.591	0.668	0.785	0.940
1990	0.053	0.130	0.211	0.290	0.360	0.440	0.586	0.690	0.761	1.010
1991	0.056	0.149	0.211	0.273	0.349	0.449	0.526	0.666	0.743	0.924
1992	0.055	0.145	0.226	0.275	0.324	0.410	0.530	0.607	0.719	0.891
1993	0.063	0.160	0.250	0.303	0.340	0.407	0.512	0.630	0.720	0.856
1994	0.064	0.179	0.257	0.331	0.372	0.416	0.491	0.610	0.731	0.906

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	0.071	0.183	0.283	0.334	0.373	0.419	0.474	0.593	0.734	0.906
1996	0.054	0.140	0.268	0.336	0.413	0.464	0.490	0.553	0.712	0.858
1997	0.045	0.129	0.220	0.353	0.408	0.473	0.541	0.574	0.616	0.912
1998	0.047	0.094	0.208	0.299	0.449	0.544	0.613	0.673	0.687	0.899
1999	0.054	0.103	0.199	0.267	0.413	0.414	0.538	0.637	0.748	0.804
2000	0.063	0.123	0.210	0.274	0.372	0.452	0.565	0.601	0.752	0.888
2001	0.090	0.136	0.197	0.234	0.303	0.410	0.577	0.701	0.796	0.799
2002	0.057	0.131	0.222	0.285	0.326	0.426	0.469	0.644	0.760	0.904
2003	0.066	0.124	0.226	0.284	0.336	0.385	0.419	0.635	0.763	0.857
2004	0.054	0.125	0.220	0.297	0.376	0.421	0.506	0.560	0.797	0.872
2005	0.067	0.117	0.213	0.298	0.352	0.347	0.453	0.554	0.617	0.910
2006	0.060	0.139	0.212	0.293	0.375	0.383	0.428	0.457	0.531	0.748
2007	0.059	0.114	0.223	0.310	0.351	0.375	0.491	0.357	0.587	0.632
2008	0.057	0.123	0.248	0.325	0.389	0.437	0.368	0.469	0.640	0.638
2009	0.061	0.125	0.232	0.327	0.399	0.466	0.518	0.441	0.668	0.792
2010	0.062	0.132	0.226	0.311	0.396	0.442	0.463	0.574	0.682	0.649
2011	0.048	0.115	0.212	0.277	0.369	0.453	0.595	0.445	0.556	0.804
2012	0.052	0.096	0.196	0.294	0.348	0.425	0.509	0.557	0.558	0.680
2013	0.051	0.091	0.179	0.274	0.345	0.409	0.490	0.599	0.607	0.680
2014	0.025	0.093	0.172	0.253	0.318	0.396	0.473	0.542	0.628	0.650
2015	0.026	0.080	0.162	0.258	0.326	0.394	0.461	0.481	0.582	0.600
2016	0.048	0.084	0.157	0.243	0.299	0.352	0.422	0.465	0.556	0.684
2017	0.051	0.086	0.159	0.218	0.314	0.386	0.438	0.532	0.642	0.735
2018	0.058	0.089	0.148	0.207	0.254	0.329	0.380	0.440	0.439	0.622
2019	0.044	0.092	0.155	0.218	0.270	0.311	0.372	0.435	0.504	0.601
2020	0.054	0.083	0.152	0.194	0.249	0.284	0.312	0.387	0.451	0.562

Table 13.2.9 Plaice in Subarea 4 and Subdivision 20: Natural mortality at age and maturity at age.

age	1	2	3	4	5	6	7	8	9	10
natural mortality	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
maturity	0	0.5	0.5	1	1	1	1	1	1	1

Table 13.2.10 Plaice in Subarea 4 and Subdivision 20: Survey tuning indices.

BTS–Isis	age								
year	1	2	3	4	5	6	7	8	9
1985	137	173.9	36.1	11	1.27	0.973	0.336	0.155	0.091
1986	667	131.7	50.2	9.21	3.78	0.4	0.418	0.147	0.07
1987	226	764.2	33.8	4.88	1.84	0.607	0.252	0.134	0.078
1988	680	147	182.3	9.99	2.81	0.814	0.458	0.036	0.112
1989	468	319.3	314.7	47.3	5.85	0.833	0.311	0.661	0.132
1990	185	146.1	79.3	26.35	5.47	0.758	0.189	0.383	0.239
1991	291	159.4	34	13.57	4.31	5.659	0.239	0.204	0.092
1992	361	174.5	29.3	5.96	3.75	2.871	1.186	0.346	0.05
1993	189	283.4	62.8	14.27	1.13	1.13	0.584	0.464	0.155
1994	193	77.1	34.5	10.59	2.67	0.6	0.8	0.895	0.373
1995	266	40.6	13.2	7.53	1.11	0.806	0.33	1.051	0.202

BTS–Combined	1	2	3	4	5	6	7	8	9
1996	24131.0	23724.3	5110.0	1824.9	1397.1	588.7	247.8	143.9	64.2
1997	86228.1	15967.3	6526.0	1618.4	510.8	384.3	131.2	160.6	30.7
1998	34124.8	85886.3	9654.2	2700.7	651.9	379.6	225.4	190.3	73.7
1999	31204.4	23943.0	36472.5	3056.2	1171.7	270.0	101.1	87.1	41.3
2000	41121.4	22701.5	9096.8	9991.0	619.3	214.1	105.3	92.4	16.4
2001	29427.6	21105.8	7048.9	3550.8	3529.9	276.4	90.4	72.6	57.0
2002	126025.9	16831.4	7373.3	4060.5	2275.6	1680.2	299.9	145.4	49.2
2003	31685.4	47186.9	7204.4	3610.6	1729.4	1011.4	988.8	77.4	55.5
2004	44035.3	15320.8	18112.6	3135.6	1634.3	959.8	540.9	844.2	51.1
2005	41788.6	29442.0	5031.4	7324.9	1057.8	1135.0	390.6	94.5	897.5
2006	46122.2	19124.9	9434.9	2455.4	3924.4	645.4	773.3	113.2	151.3
2007	69994.1	22634.7	11144.4	7969.3	1778.8	2664.6	318.7	651.8	79.6
2008	70536.2	43460.1	12300.3	6405.6	4486.6	991.5	1571.2	304.5	473.4
2009	63296.6	25530.1	19968.9	5367.5	3308.7	2579.7	668.5	1480.3	287.9
2010	76156.5	28329.8	14317.4	10397.4	3189.5	1788.1	1782.3	621.7	1013.6
2011	119965.7	41702.7	18859.4	9428.7	6268.1	2032.5	917.5	1609.5	236.8
2012	55272.0	62135.3	39045.0	14146.9	6958.4	4525.5	1412.5	1121.7	1552.3
2013	81421.3	52754.4	40417.7	20026.0	7449.7	4447.1	3216.6	1299.1	797.3
2014	133710.3	61041.3	27867.4	20986.7	8758.7	3710.3	2227.1	1768.9	1000.4
2015	48851.1	67154.6	35592.0	17558.2	13359.2	6969.3	2315.1	1694.6	1557.2
2016	77603.9	32060.1	33726.2	18749.8	9775.7	6768.7	3719.9	1723.0	1110.2
2017	130588.6	50607.7	18491.0	20040.7	10608.3	5163.0	3101.9	1986.9	683.9
2018	79604.5	71794.9	22864.8	11704.4	11462.0	5574.8	3378.7	1944.7	1618.4
2019	311556.7	59019.2	32052.5	9909.3	6933.7	4958.2	2922.0	2259.3	1231.9
2020	153502.2	125092.0	28588.4	17536.6	5314.7	3320.3	2430.9	1762.6	1122.3

	SNS1							SNS2					
	age							age					
year	1	2	3	4	5	6	year	1	2	3	4	5	6
1970	9311	9732	3273	770	170	37.5	2000	22855	2493	891	983	17	2.0
1971	13538	28164	1415	101	50	23.6	2001	11511	2898	370	176	691	105.8
1972	13207	10780	4478	89	84	0.0	2002	30809	1103	265	65	69	30.7
1973	65643	5133	1578	461	15	5.7	2003	NA	NA	NA	NA	NA	NA
1974	15366	16509	1129	160	82	7.0	2004	18202	1350	1081	51	27	29.7
1975	11628	8168	9556	65	15	0.0	2005	10118	1819	142	366	8	19.0
1976	8537	2403	868	236	0	2.3	2006	12164	1571	385	52	54	0.0
1977	18537	3424	1737	590	213	0.0	2007	14175	2134	140	52	0	7.4
1978	14012	12678	345	135	45	13.6	2008	14706	2700	464	179	34	6.7
1979	21495	9829	1575	161	17	42.2	2009	14860	2019	492	38	20	0.0
1980	59174	12882	491	180	24	7.8	2010	11947	1812	529	55	10	0.0
1981	24756	18785	834	38	32	4.7	2011	18349	1143	308	75	60	28.0
1982	69993	8642	1261	88	8	8.7	2012	5893	2929	682	82	30	15.0
1983	33974	13909	249	71	6	1.3	2013	15395	3021	1638	428	89	31.1
1984	44965	10413	2467	42	0	0.0	2014	17313	2258	514	458	58	16.4
1985	28101	13848	1598	328	17	1.5	2015	16727	5040	1882	478	200	97.5
1986	93552	7580	1152	145	30	6.6	2016	10385	2434	1086	522	223	131.7
1987	33402	32991	1227	200	30	16.7	2017	15936	1716	1212	534	144	70.6
1988	36609	14421	13153	1350	88	12.1	2018	9465	5250	993	533	489	88
1989	34276	17810	4373	7126	289	113.6	2019	28309	1886	1533	338	196	62
1990	25037	7496	3160	816	422	48.8	2020	11393	3931	283	607	118	5
1991	57221	11247	1518	1077	128	74.4							
1992	46798	13842	2268	613	176	52.0							
1993	22098	9686	1006	98	60	58.8							
1994	19188	4977	856	76	23	2.7							
1995	24767	2796	381	97	38	0.0							
1996	23015	10268	1185	45	47	0.0							
1997	95901	4473	497	32	0	13.3							
1998	33666	30242	5014	50	10	0.0							
1999	32951	10272	13783	1058	17	0.0							

IBTS–Q3	1	2	3	4	5	6	7	8	9
1997	3567.9	3312.1	1979.6	564.8	228.0	170.2	90.4	85.6	25.7
1998	1052.5	5086.1	1716.4	841.9	318.7	139.3	85.5	93.7	42.1
1999	948.2	2326.6	4377.7	734.6	315.7	133.6	50.4	45.3	26.4
2000	944.2	1773.4	1967.3	2163.6	225.9	126.3	54.0	42.4	12.5
2001	1160.7	3304.5	2112.4	1136.5	1165.4	176.7	78.5	64.8	50.8
2002	6104.0	2867.3	2352.9	1286.0	680.9	442.9	102.5	94.2	44.2
2003	1377.6	4975.4	1692.0	1035.3	466.4	276.7	276.7	51.5	53.6
2004	2528.3	2580.9	4063.4	940.1	616.1	310.8	187.5	232.0	42.8
2005	1962.2	4725.5	1601.0	2322.0	409.4	501.8	235.4	81.3	230.7
2006	2219.9	3075.7	3770.0	1109.1	1237.8	399.2	403.6	156.8	83.8
2007	5697.5	4676.2	3717.9	3238.4	831.2	1314.2	330.8	455.4	116.7
2008	6133.0	10655.9	5051.6	3408.4	2196.5	738.4	738.0	312.1	270.1
2009	2794.2	5041.5	7677.9	2798.6	1720.3	1205.4	454.9	735.4	191.7
2010	3224.6	4957.9	5390.7	4900.2	1628.7	1156.7	1081.6	477.2	653.2
2011	6616.6	8966.4	7380.9	4830.3	3442.5	1284.2	858.2	1058.4	267.3
2012	2427.4	10892.2	11291.3	6362.4	3581.7	2478.2	1110.7	894.2	913.2
2013	2685.1	6750.1	9584.5	6410.2	3379.9	2083.1	1561.1	728.1	479.2
2014	5239.4	8877.7	7681.2	6439.5	3245.8	1507.2	1062.6	763.1	476.1
2015	1701.2	7393.9	8343.9	6068.7	4623.3	2583.3	1297.6	953.6	783.6
2016	3165.8	4957.1	7400.3	5624.7	3098.9	2362.9	1548.3	984.1	761.9
2017	4065.4	4879.4	3513.3	4481.0	2918.2	1773.9	1143.0	881.1	511.8
2018	2205.1	6088.9	3973.0	2509.2	2458.8	1615.0	1239.0	760.4	635.8
2019	6016.1	5415.7	4211.8	2094.9	1354.4	1063.9	751.4	635.5	345.9
2020	3231.7	7311.2	3617.9	2806.7	1294.5	900.5	760.3	694.3	396.9

IBTS–Q1	1	2	3	4	5	6	7
2007	2394.7	5344.7	5693.8	6178.2	2138.4	1104.0	604.9
2008	2354.8	11155.4	7599.4	3583.4	2701.6	733.7	731.1
2009	2995.6	7480.2	13046.7	4288.9	2237.2	917.8	496.0
2010	1474.9	5843.6	9477.3	8219.6	3604.8	1447.3	1016.9
2011	1167.1	5946.8	6492.0	6618.3	5264.5	1813.2	967.9
2012	2018.4	13641.9	15601.4	7267.6	5093.1	3408.9	1439.6
2013	1415.6	5162.6	10272.8	6831.1	3366.7	1943.8	1017.1
2014	2730.2	7401.4	9056.7	8934.0	5046.5	1806.5	1127.1
2015	902.2	9943.4	10948.0	8698.9	6244.7	2893.0	1275.7
2016	2178.9	5134.9	9507.6	7572.7	5266.5	2493.8	1437.7
2017	1973.1	6501.1	4190.8	7094.0	4728.9	3002.1	1534.4
2018	700.8	5927.7	6201.6	2274.1	3204.8	1911.1	1390.1
2019	4164.2	4237.0	6711.6	3289.4	1763.4	1459.9	1375.9
2020	2062.9	8636.2	4506.5	3830.8	1826.7	1274.4	1143.5

Table 13.3.1. Plaice in Subarea 4 and Subdivision 20: Estimated parameters from AAP model in final run.

Number of parameters = 281 Objective function value = 217.518 Maximum gradient component = 0.000181604
logsigmaC:
-0.617168 -0.504893 0.0422849

logsigmaU:
-0.398622 -0.282866 0.0375541
-1.51585 -0.161800 0.0300500
-1.30868 0.414907 -0.0213647
-1.00014 0.0336696 0.0391202
-0.541302 -0.407085 0.0398088
-0.502623 -0.532421 0.0685190

log_sel_coff1:
-1.14845 -0.790063 -0.882113 -1.36330 -1.34300 -0.553643 -0.372125 -0.407433 0.138556 0.204755 -0.198657 -0.164703 0.0429292 -0.0208952 -0.375456 -0.171662 -0.509110 -0.880786 -0.642861 -0.691668 -0.324114 -0.434331 -0.593532 -0.834888 -1.21691 -0.808113 -0.284115 0.174487 0.136545 0.452858 0.215830 0.274090 0.310372 0.410668 0.477524 0.483239 0.791621 0.660336 0.556787 0.788738 0.656899 0.743389 0.560400 1.03471 0.614959 0.694405 0.832496 0.415033 0.206078 -0.274193 -0.253639 -0.483025 0.0345331 0.176056 0.207598 0.294340 0.317467 0.157742 0.284479 0.591867 0.538992 0.541659 0.676357 0.779778 0.697360 0.836758 0.773416 0.722060 0.841587 0.850017 1.01833 0.788133 0.491736 0.204251 -0.252286 -0.178688 -0.286798 -0.486129 -0.336882 0.0871279 0.146532 0.374482 0.253555 0.301352 0.287460 0.431558 0.410647 0.504132 0.517375 0.424557 0.552227 0.951506 0.754840 1.09170 0.733692 1.06359 0.840380 0.871323 0.536812 -0.105554 -0.600446 -0.839690 -0.557283 -1.06969 -0.248331 -0.236107 -0.126631 0.0527021 -0.0587154 0.0273478 0.187473 0.210259 0.319445 0.207893 0.417785 0.223737 0.267476 0.620925 0.466408 0.685283 0.894453 0.727803 0.629787 0.252136 0.334137 -0.572027 -0.879499 -1.31407 -1.54656 -1.32402 -0.429474 -0.163230 -0.437111 -0.156522 -0.206041 -0.294187 0.0504182 0.133846 0.283964 -0.0134519 0.0660383 0.166361 0.0357094 0.322994 0.231511 0.512736 0.470302 0.582455 0.277824 0.0585613 -0.949345 -1.14180 -2.36786 -2.21846 -2.38198 -2.51956

log_sel_cofU:
-8.10531 -7.75360 -8.72695 -9.94052 -10.7785 -10.6427
-2.80415 -2.85981 -3.25314 -3.50186 -3.83948 -3.99434
-3.33270 -3.38615 -4.51724 -7.02904 -8.25618 -8.64899
-4.22922 -5.28119 -6.57403 -7.65278 -8.74884 -8.84951
-5.96899 -5.19467 -4.48819 -4.49424 -4.77819 -4.63514
-6.49587 -5.32359 -4.03061 -4.21779 -4.11257 -4.52632

log_initpop:
12.5095 12.7968 12.3129 11.8923 11.0174 11.0438 10.8072 10.3789 11.1393 13.0723 13.4735 13.6826 13.5776 13.6882 13.3297 13.3243 14.7078 13.4123 13.2703 12.9561 12.9379 13.4177 13.4240 12.9855 12.8038 14.1209 13.9008 13.5991 13.4299 13.8283 13.6736 13.7297 13.9013 13.8301 14.4708 14.1159 14.0667 14.4140 15.2893 14.4665 14.3588 14.0315 13.9235 13.8145 13.6139 13.1860 13.3021 13.7672 13.6157 14.6544 13.6249 13.5071 13.6713 13.3255 14.4313 13.3273 14.0550 13.6471 13.6977 14.1967 13.9720 13.8863 14.2181 14.4104 14.0952 14.2808 14.5981 13.7333

Table 13.3.2. Plaice in Subarea 4 and Subdivision 20: Harvest (F) at age.

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	0.103	0.176	0.263	0.306	0.255	0.212	0.225	0.229	0.206	0.206
1958	0.115	0.210	0.306	0.329	0.291	0.246	0.222	0.220	0.233	0.233
1959	0.127	0.242	0.343	0.347	0.324	0.281	0.224	0.214	0.247	0.247
1960	0.137	0.260	0.358	0.353	0.344	0.310	0.239	0.213	0.231	0.231
1961	0.139	0.261	0.356	0.350	0.350	0.331	0.265	0.219	0.199	0.199
1962	0.125	0.260	0.368	0.355	0.355	0.350	0.294	0.234	0.187	0.187
1963	0.098	0.266	0.419	0.381	0.370	0.370	0.313	0.257	0.216	0.216
1964	0.075	0.271	0.477	0.412	0.389	0.387	0.318	0.274	0.265	0.265
1965	0.068	0.261	0.479	0.422	0.401	0.389	0.308	0.268	0.275	0.275
1966	0.078	0.241	0.419	0.403	0.399	0.380	0.292	0.243	0.236	0.236
1967	0.102	0.238	0.369	0.375	0.386	0.373	0.290	0.232	0.204	0.204
1968	0.142	0.271	0.365	0.354	0.369	0.377	0.316	0.254	0.211	0.211
1969	0.188	0.322	0.390	0.347	0.357	0.386	0.353	0.296	0.244	0.244
1970	0.210	0.345	0.408	0.360	0.361	0.387	0.367	0.324	0.280	0.280
1971	0.199	0.325	0.407	0.392	0.383	0.379	0.350	0.321	0.301	0.301
1972	0.188	0.308	0.415	0.439	0.420	0.381	0.336	0.317	0.321	0.321
1973	0.202	0.331	0.454	0.493	0.467	0.409	0.353	0.337	0.353	0.353
1974	0.243	0.379	0.501	0.534	0.506	0.446	0.386	0.367	0.383	0.383
1975	0.299	0.413	0.507	0.532	0.511	0.458	0.399	0.375	0.382	0.382
1976	0.352	0.413	0.467	0.495	0.484	0.439	0.383	0.353	0.347	0.347
1977	0.377	0.409	0.443	0.468	0.464	0.426	0.373	0.334	0.311	0.311
1978	0.353	0.433	0.483	0.485	0.478	0.452	0.397	0.343	0.299	0.299
1979	0.304	0.473	0.573	0.537	0.513	0.495	0.440	0.371	0.306	0.306
1980	0.262	0.494	0.654	0.596	0.538	0.505	0.454	0.390	0.325	0.325
1981	0.239	0.477	0.673	0.633	0.535	0.465	0.424	0.385	0.344	0.344
1982	0.237	0.445	0.638	0.641	0.524	0.424	0.384	0.365	0.349	0.349
1983	0.259	0.419	0.579	0.621	0.526	0.419	0.366	0.343	0.331	0.331
1984	0.295	0.412	0.533	0.595	0.548	0.453	0.379	0.336	0.313	0.313
1985	0.323	0.433	0.537	0.593	0.591	0.527	0.430	0.363	0.326	0.326
1986	0.323	0.478	0.596	0.623	0.650	0.628	0.519	0.431	0.379	0.379
1987	0.297	0.507	0.658	0.657	0.697	0.708	0.593	0.493	0.433	0.433
1988	0.255	0.479	0.656	0.662	0.698	0.703	0.583	0.484	0.429	0.429
1989	0.222	0.428	0.611	0.639	0.670	0.652	0.527	0.437	0.395	0.395
1990	0.214	0.413	0.587	0.612	0.654	0.642	0.507	0.423	0.400	0.400
1991	0.233	0.450	0.607	0.593	0.664	0.702	0.557	0.471	0.469	0.469
1992	0.251	0.480	0.625	0.589	0.679	0.763	0.628	0.539	0.538	0.538
1993	0.233	0.434	0.591	0.601	0.672	0.735	0.651	0.561	0.507	0.507
1994	0.191	0.366	0.553	0.628	0.651	0.657	0.630	0.540	0.422	0.422

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	0.153	0.357	0.595	0.663	0.638	0.620	0.617	0.526	0.385	0.385
1996	0.131	0.433	0.764	0.700	0.648	0.658	0.627	0.534	0.419	0.419
1997	0.125	0.515	0.920	0.727	0.674	0.703	0.605	0.511	0.455	0.455
1998	0.135	0.465	0.817	0.734	0.708	0.673	0.505	0.415	0.404	0.404
1999	0.156	0.350	0.596	0.717	0.728	0.595	0.396	0.308	0.297	0.297
2000	0.171	0.304	0.495	0.676	0.701	0.546	0.355	0.254	0.210	0.210
2001	0.172	0.357	0.554	0.616	0.621	0.549	0.393	0.253	0.158	0.158
2002	0.172	0.455	0.665	0.550	0.525	0.539	0.432	0.257	0.127	0.127
2003	0.189	0.482	0.650	0.485	0.442	0.456	0.370	0.219	0.105	0.105
2004	0.218	0.420	0.522	0.422	0.371	0.339	0.255	0.158	0.087	0.087
2005	0.224	0.357	0.420	0.358	0.303	0.249	0.177	0.112	0.066	0.066
2006	0.190	0.328	0.383	0.298	0.238	0.197	0.143	0.087	0.046	0.046
2007	0.155	0.305	0.358	0.251	0.189	0.161	0.126	0.073	0.033	0.033
2008	0.148	0.261	0.302	0.222	0.160	0.131	0.109	0.063	0.026	0.026
2009	0.157	0.211	0.238	0.208	0.147	0.109	0.091	0.056	0.024	0.024
2010	0.149	0.178	0.205	0.204	0.147	0.099	0.076	0.048	0.024	0.024
2011	0.114	0.169	0.211	0.206	0.157	0.104	0.066	0.041	0.024	0.024
2012	0.090	0.174	0.234	0.210	0.168	0.114	0.062	0.036	0.024	0.024
2013	0.099	0.184	0.242	0.213	0.171	0.117	0.064	0.037	0.024	0.024
2014	0.140	0.197	0.234	0.217	0.167	0.112	0.069	0.041	0.024	0.024
2015	0.179	0.216	0.241	0.229	0.169	0.112	0.075	0.044	0.023	0.023
2016	0.160	0.240	0.287	0.254	0.186	0.123	0.075	0.041	0.020	0.020
2017	0.117	0.251	0.341	0.278	0.204	0.135	0.073	0.036	0.018	0.018
2018	0.090	0.228	0.337	0.275	0.199	0.132	0.072	0.035	0.017	0.017
2019	0.080	0.177	0.268	0.244	0.169	0.111	0.073	0.039	0.017	0.017
2020	0.076	0.128	0.190	0.205	0.134	0.086	0.075	0.045	0.017	0.017

Table 13.3.3. Plaice in Subarea 4 and Subdivision 20: Stock numbers (thousands).

year	age									
	1	2	3	4	5	6	7	8	9	10
1957	477589	265152	362528	223911	150134	60466	63124	49513	31182	68065
1958	709851	389833	201292	252104	149240	105262	44279	45625	35633	73115
1959	875663	572482	285865	134082	164181	100908	74489	32104	33138	77935
1960	812141	697798	406470	183487	85749	107392	68958	53864	23461	78479
1961	862591	640794	486816	257067	116681	55004	71272	49149	39392	73244
1962	612897	679124	446444	308493	163920	74423	35730	49478	35718	83560
1963	605848	489191	473827	279520	195680	104040	47455	24096	35432	89508
1964	2471860	497104	339192	282047	172851	122320	65009	31385	16866	91043
1965	664338	2074150	342972	190411	169063	105954	75196	42784	21582	74936
1966	577369	561345	1446180	192310	113011	102436	64951	50012	29620	66359
1967	428580	483405	399139	860571	116323	68632	63380	43887	35487	68611
1968	418924	350202	344754	249836	535416	71530	42784	42910	31501	76808
1969	675320	328845	241745	216498	158678	334877	44385	28232	30124	79395
1970	677563	506340	215715	148109	138407	100422	205900	28224	18997	77621
1971	422011	496836	324605	129815	93542	87307	61729	129109	18471	66078
1972	358303	312797	324905	195417	79384	57710	54102	39370	84705	56597
1973	1430910	268639	207971	194137	113956	47176	35679	34971	25940	92762
1974	1103680	1057490	174624	119562	107245	64636	28364	22675	22598	75484
1975	793459	783294	654865	95741	63443	58532	37438	17449	14218	60502
1976	664145	532389	468857	356922	50866	34440	33487	22732	10854	46140
1977	1026960	422568	318867	266059	196876	28356	20093	20661	14451	36466
1978	873543	637479	253978	185329	150832	112059	16753	12523	13386	33760
1979	916945	555218	374006	141776	103275	84659	64532	10188	8039	31650
1980	1095220	611970	312942	190812	74952	55921	46695	37622	6363	26438
1981	1008700	762694	337888	147213	95148	39593	30545	26822	23049	21450
1982	1927830	718740	428257	156027	70738	50421	22502	18094	16515	28555
1983	1351750	1376230	416820	204705	74376	37904	29860	13870	11366	28766
1984	1291040	944009	818719	211459	99584	39771	22567	18738	8906	26068
1985	1838730	869413	565537	434665	105536	52098	22866	13980	12117	23139
1986	4434690	1204010	510170	299196	217354	52863	27832	13455	8796	23037
1987	1902910	2904700	675555	254405	145191	102636	25518	14993	7915	19716
1988	1745920	1279700	1582610	316440	119350	65462	45743	12756	8290	16210
1989	1251170	1223590	717440	742903	147756	53738	29332	23096	7113	14434
1990	1110280	907073	721887	352446	354688	68384	25325	15672	13506	13134
1991	1001720	811474	542928	363145	173002	166943	32562	13795	9289	16165
1992	839808	717979	468084	267677	181569	80589	74874	16884	7792	14410
1993	535299	590993	402127	226811	134458	83349	34015	36164	8912	11732
1994	575317	383550	346320	201485	112525	62124	36166	16044	18666	11253

year	age									
	1	2	3	4	5	6	7	8	9	10
1995	1001170	430272	240689	180318	97296	53103	29153	17422	8457	17745
1996	925946	777539	272569	120082	84042	46500	25835	14236	9316	16140
1997	2390280	734655	456099	114896	53972	39797	21796	12482	7550	15155
1998	791741	1907960	397031	164393	50255	24902	17836	10765	6775	13040
1999	714473	625754	1084870	158661	71381	22406	11494	9740	6435	11975
2000	891133	553307	398885	540915	70097	31194	11183	6999	6475	12376
2001	638896	679270	369551	220038	249012	31451	16349	7095	4912	13827
2002	1791150	486789	430128	192082	107503	121073	16439	9989	4985	14476
2003	589990	1364880	279549	200241	100318	57558	63892	9661	6989	15515
2004	1308480	441778	762934	132078	111610	58358	33006	39934	7021	18329
2005	913606	951945	262580	409750	78396	69673	37639	23133	30850	21033
2006	927631	660776	602912	156179	259059	52390	49153	28528	18713	43926
2007	1461350	694327	430713	372132	104881	184687	38944	38548	23665	54105
2008	1210210	1132120	463170	272498	261999	78539	142202	31076	32435	68098
2009	1128760	944618	788829	309792	197531	202034	62322	115405	26396	88612
2010	1501900	873162	692367	562503	227746	154292	164010	51495	98781	101587
2011	1641860	1170560	661497	510442	415237	177923	126444	137527	44412	177034
2012	1334070	1324980	894869	484502	375985	321211	145084	107054	119485	195620
2013	1389650	1102860	1007640	640583	355266	287464	259243	123365	93419	278278
2014	1460730	1139330	829946	715873	468327	270905	231357	220094	107584	328208
2015	911173	1149000	846304	594421	521530	358715	219106	195304	191120	384957
2016	952119	689096	837781	601528	427881	398629	290315	184005	169139	509616
2017	1314950	734071	490516	568903	422198	321487	319096	243702	159854	601931
2018	862519	1058220	516620	315584	390004	311515	254141	268448	212670	677106
2019	2147830	713098	762619	333663	216867	289150	247106	214060	234510	791772
2020	1390640	1794520	540325	527815	236439	165636	234226	207947	186365	913237

Table 13.3.4. Plaice in Subarea 4 and Subdivision 20: Stock summary table.

year	recruits	ssb	catch	landings	discards	fbar2-6	fbar hc2-6	fbar dis2-3	Y/ssb
1957	477589	342242.0	79036.17	71457.35	7579	0.242	0.201	0.095	0.21
1958	709851	354957.3	88179.41	73694.47	14485	0.277	0.202	0.172	0.21
1959	875663	362346.4	103825.90	77266.75	26559	0.308	0.196	0.210	0.21
1960	812141	381625.8	118124.88	88881.96	29243	0.325	0.239	0.201	0.23
1961	862591	393621.2	121275.42	86158.12	35117	0.330	0.222	0.258	0.22
1962	612897	483269.9	126872.45	90557.01	36315	0.338	0.214	0.260	0.19
1963	605848	441065.8	139097.23	102495.22	36602	0.361	0.226	0.308	0.23
1964	2471860	431487.8	146393.16	110614.37	35779	0.387	0.247	0.270	0.26
1965	664338	385724.5	153390.84	106798.10	46593	0.390	0.276	0.267	0.28
1966	577369	404834.3	164484.09	99111.31	65373	0.368	0.230	0.294	0.24
1967	428580	472633.7	152056.81	102239.15	49818	0.348	0.203	0.250	0.22
1968	418924	459737.7	147671.06	119515.48	28156	0.347	0.221	0.215	0.26
1969	675320	404958.2	146736.78	123290.55	23446	0.361	0.262	0.181	0.30
1970	677563	373089.9	141874.70	115928.55	25946	0.372	0.270	0.228	0.31
1971	422011	360246.0	143335.53	118807.90	24528	0.377	0.283	0.217	0.33
1972	358303	361648.7	144405.02	126218.90	18186	0.393	0.317	0.164	0.35
1973	1430910	300940.7	146255.33	128782.16	17473	0.431	0.382	0.113	0.43
1974	1103680	302185.2	160410.84	116054.04	44357	0.473	0.394	0.191	0.38
1975	793459	306688.5	174911.26	99485.29	75426	0.484	0.319	0.375	0.32
1976	664145	328091.6	179908.39	125126.13	54782	0.459	0.332	0.276	0.38
1977	1026960	323400.3	160775.42	105045.49	55730	0.442	0.290	0.275	0.32
1978	873543	324663.5	170763.21	123013.06	47750	0.466	0.353	0.232	0.38
1979	916945	305422.1	173685.72	120974.82	52711	0.518	0.375	0.280	0.40
1980	1095220	323063.1	191527.23	155898.28	35629	0.557	0.490	0.163	0.48
1981	1008700	290623.8	188425.91	153720.12	34706	0.557	0.490	0.160	0.53
1982	1927830	280775.2	192238.15	145297.29	46941	0.534	0.456	0.187	0.52
1983	1351750	334268.6	207560.10	140903.91	66656	0.513	0.417	0.225	0.42
1984	1291040	363589.8	221523.66	158217.56	63306	0.508	0.385	0.214	0.44
1985	1838730	396845.2	246113.16	180927.63	65186	0.536	0.447	0.217	0.46

year	recruits	ssb	catch	landings	discards	fbar2-6	fbar hc2-6	fbar dis2-3	Y/ssb
1986	4434690	415131.3	291872.08	172536.27	119336	0.595	0.457	0.278	0.42
1987	1902910	474638.4	322437.30	161323.16	161114	0.645	0.466	0.438	0.34
1988	1745920	416753.0	309030.60	165064.90	143966	0.639	0.403	0.445	0.40
1989	1251170	441587.5	280002.20	181001.97	99000	0.600	0.395	0.391	0.41
1990	1110280	398656.6	247035.63	171565.86	75470	0.581	0.408	0.365	0.43
1991	1001720	365521.0	227780.74	152935.84	74845	0.603	0.409	0.385	0.42
1992	839808	315454.2	199798.75	139008.83	60790	0.627	0.437	0.363	0.44
1993	535299	277411.4	172998.11	136970.43	36028	0.607	0.484	0.257	0.49
1994	575317	233483.3	142756.26	119822.02	22934	0.571	0.489	0.195	0.51
1995	1001170	229063.2	132362.84	109581.79	22781	0.575	0.503	0.171	0.48
1996	925946	214554.6	140475.15	98561.90	41913	0.640	0.508	0.302	0.46
1997	2390280	213890.4	160368.86	85793.69	74575	0.708	0.483	0.553	0.40
1998	791741	241452.4	165705.00	72027.43	93678	0.679	0.403	0.516	0.30
1999	714473	228090.0	162327.70	92833.91	69494	0.597	0.380	0.345	0.41
2000	891133	249438.2	150193.87	103515.09	46679	0.544	0.388	0.277	0.41
2001	638896	255574.2	131986.09	68336.69	63649	0.539	0.276	0.372	0.27
2002	1791150	243596.5	144076.95	87845.65	56231	0.547	0.358	0.397	0.36
2003	589990	273685.9	148008.80	72743.61	75265	0.503	0.308	0.393	0.27
2004	1308480	268931.4	137137.77	80616.44	56521	0.415	0.256	0.332	0.30
2005	913606	299784.3	115413.30	61893.42	53520	0.337	0.175	0.297	0.21
2006	927631	340644.9	112416.30	62340.15	50076	0.289	0.166	0.264	0.18
2007	1461350	353441.9	103987.46	59192.10	44795	0.253	0.131	0.252	0.17
2008	1210210	449571.5	110889.71	63540.60	47349	0.215	0.133	0.188	0.14
2009	1128760	551533.9	112732.80	67811.58	44921	0.182	0.107	0.162	0.12
2010	1501900	673527.0	115935.01	73004.46	42931	0.166	0.097	0.136	0.11
2011	1641860	700043.3	117974.13	73322.40	44652	0.169	0.089	0.139	0.10
2012	1334070	747104.1	129994.05	80945.77	49048	0.180	0.093	0.164	0.11
2013	1389650	850183.8	137796.16	95152.64	42644	0.186	0.104	0.167	0.11
2014	1460730	977691.8	135224.16	84663.02	50561	0.185	0.083	0.183	0.09

year	recruits	ssb	catch	landings	discards	fbar2-6	fbar hc2-6	fbar dis2-3	Y/ssb
2015	911173	905332.3	136029.67	90930.29	45099	0.193	0.090	0.198	0.10
2016	952119	966389.0	137035.81	89218.44	47817	0.218	0.095	0.227	0.09
2017	1314950	1019256.6	131797.52	87326.24	44471	0.242	0.102	0.250	0.09
2018	862519	959080.3	105586.44	61364.66	44222	0.234	0.090	0.246	0.06
2019	2147830	871071.1	95232.79	56444.66	38788	0.194	0.078	0.182	0.06
2020	1390640	905056.2	82933.60	44068.05	38866	0.149	0.058	0.136	0.05

Table 13.5.1. Plaice in Subarea 4 and Subdivision 20: Input to the short-term forecast (F values presented are for Fsq).

2021_ssb	2021_f2–6	2021_f_dis2–3	2021_f_hc2–6	2021_recruits	2021_landings	2021_discards	2021_catch	2021_TAC	2022_ssb		
1002918	0.149	0.145	0.058	1263949	51458	46140	97598		1093696		
age	**year**	**f**	**f.disc**	**f.land**	**stock.n**	**catch.wt**	**landings.wt**	**discards.wt**	**stock.wt**	**mat**	**M**
1	2021	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263948.79436245	0.052054735774307	0.126	0.052	0.028	0	0.1
2	2021	0.13760020251068	0.132518831229392	0.0050813712812881	1166596.42728568	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1
3	2021	0.205331168973982	0.1579625008625	0.0473686681114822	1428408.05615736	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1
4	2021	0.187068911922825	0.0979112196481534	0.0891576922746715	404108.663304055	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1
5	2021	0.129824653290575	0.0457084503639847	0.08411620292659	388937.959410118	0.257906483342958	0.319	0.147	0.221	1	0.1
6	2021	0.0847783633019378	0.0202659510484261	0.0645124122535117	187037.895591254	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1
7	2021	0.0564456719734424	0.0107976905106002	0.0456479814628422	137490.979267804	0.354707238403159	0.401	0.157	0.334	1	0.1
8	2021	0.0306326343248842	0.00337389106324375	0.0272587432616404	196707.855535053	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1
9	2021	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	179880.247809606	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1
10	2021	0.0130794435706331	1.40236432406562e-06	0.0130780412063091	977909.446378149	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1
1	2022	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263949	0.052054735774307	0.126	0.052	0.028	0	0.1
2	2022	0.13760020251068	0.132518831229392	0.0050813712812881	NA	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1
3	2022	0.205331168973982	0.1579625008625	0.0473686681114822	NA	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1
4	2022	0.187068911922825	0.0979112196481534	0.0891576922746715	NA	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1
5	2022	0.129824653290575	0.0457084503639847	0.08411620292659	NA	0.257906483342958	0.319	0.147	0.221	1	0.1
6	2022	0.0847783633019378	0.0202659510484261	0.0645124122535117	NA	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1
7	2022	0.0564456719734424	0.0107976905106002	0.0456479814628422	NA	0.354707238403159	0.401	0.157	0.334	1	0.1
8	2022	0.0306326343248842	0.00337389106324375	0.0272587432616404	NA	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1
9	2022	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	NA	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1
10	2022	0.0130794435706331	1.40236432406562e-06	0.013078041206309	NA	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1
1	2023	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263949	0.052054735774307	0.126	0.052	0.028	0	0.1
2	2023	0.13760020251068	0.132518831229392	0.0050813712812881	NA	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1
3	2023	0.205331168973982	0.1579625008625	0.0473686681114822	NA	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1

2021_ssb	2021_f2–6	2021_f_dis2–3	2021_f_hc2–6	2021_recruits	2021_landings	2021_discards	2021_catch	2021_TAC	2022_ssb		
1002918	0.149	0.145	0.058	1263949	51458	46140	97598		1093696		
age	**year**	**f**	**f.disc**	**f.land**	**stock.n**	**catch.wt**	**landings.wt**	**discards.wt**	**stock.wt**	**mat**	**M**
4	2023	0.187068911922825	0.0979112196481534	0.0891576922746715	NA	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1
5	2023	0.129824653290575	0.0457084503639847	0.08411620292659	NA	0.257906483342958	0.319	0.147	0.221	1	0.1
6	2023	0.0847783633019378	0.0202659510484261	0.0645124122535117	NA	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1
7	2023	0.0564456719734424	0.0107976905106002	0.0456479814628422	NA	0.354707238403159	0.401	0.157	0.334	1	0.1
8	2023	0.0306326343248842	0.00337389106324375	0.0272587432616404	NA	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1
9	2023	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	NA	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1
10	2023	0.0130794435706331	1.40236432406562e-06	0.013078041206309	NA	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1

Table 13.5.2. Plaice in Subarea 4 and Subdivision 20: Results from the short-term forecast assuming $F_{2021} = F_{\text{status quo}}$ (rescaled).

Basis	Total catch (2022)	Projected landings * (2022)	Projected discards ** (2022)	F_{total} ages 2–6 ^^^ (2022)	$F_{projected\ landings}$ ages 2–6 (2022)	$F_{projected\ discards}$ ages 2–3 (2022)	SSB (2023)	% SSB change ***	% advice change ^^
ICES advice basis									
MSY approach: F_{MSY}	142508	82622	59886	0.21	0.082	0.20	1112676	1.74	-15.1
Other scenarios									
$F = F_{MSY\ upper}$	195622	113764	81858	0.30	0.117	0.29	1063091	-2.8	16.6
$F = F_{MSY\ lower}$	101854	58940	42914	0.146	0.057	0.142	1150784	5.2	-39
F = 0	0	0	0	0.00	0.00	0.00	1247700	14.1	-100
F_{pa}	411268	243345	167923	0.77	0.30	0.75	864628	-21	145
~~$F_{p.05}$ without AR~~	~~263213~~	~~153754~~	~~109459~~	~~0.427~~	~~0.166~~	~~0.42~~	~~1000256~~	~~-8.5~~	~~57~~
~~F_{lim}~~	~~306148~~	~~179427~~	~~126721~~	~~0.516~~	~~0.20~~	~~0.50~~	~~960638~~	~~-12.2~~	~~82~~
SSB (2023) = B_{lim}	1198527	860596	337931	11.3	4.4	11.0	207288	-81	610
SSB (2023) = B_{pa}	1093596	759527	334069	7.8	3.0	7.6	290203	-73	550
SSB (2023) = MSY $B_{trigger}$	753542	470359	283183	2.3	0.91	2.3	564599	-48	350
Rollover advice	167785	97392	70393	0.25	0.098	0.25	1089081	-0.42	0
$F_{2022} = F_{2021}$	103816	60080	43736	0.149	0.058	0.145	1148941	5.1	-38

*** "projected" landing and discards are used to describe fish that would be landed and discarded in the absence of the EU landing obligation, based on average discard rate estimates for 2018–2020. Both projected landing and projected discards refer to Subarea 4 and Subdivision 20, calculated as the projected total stock catch (including Division 7.d) deducted by the catch of plaice from Subarea 4 taken in Division 7.d in 2022. The subtracted value (445 t of projected landing and 530 t of projected discards) is estimated based on the plaice catch advice for Division 7.d for 2022.**

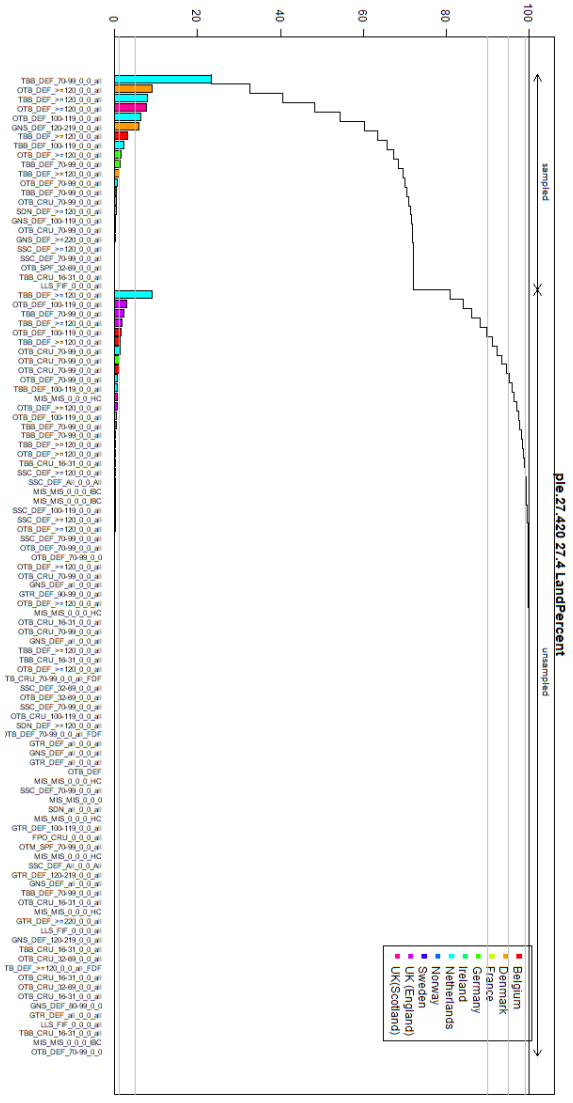
*** Marketable landings.**

Table 13.5.3. Plaice in Subarea 4 and Subdivision 20: Detailed STF table by age, assuming $F_{2021} = F_{\text{-status quo}}$, rescaled.

age	year	f	f.disc	f.land	stock.n	catch.wt	landings.wt	discards.wt	stock.wt	mat	M	catch.n	landings.n	discards.n
1	2021	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263948.79436245	0.052054735774307	0.126	0.052	0.028	0	0.1	73916	28	73888
2	2021	0.13760020251068	0.132518831229392	0.0050813712812881	1166596.42728568	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1	142878	5276	137602
3	2021	0.205331168973982	0.1579625008625	0.0473686681114822	1428408.05615736	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1	252750	58308	194442
4	2021	0.187068911922825	0.0979112196481534	0.0891576922746715	404108.663304055	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1	65713	31319	34394
5	2021	0.129824653290575	0.0457084503639847	0.08411620292659	388937.959410118	0.257906483342958	0.319	0.147	0.221	1	0.1	45111	29229	15883
6	2021	0.0847783633019378	0.0202659510484261	0.0645124122535117	187037.895591254	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1	14478	11017	3461
7	2021	0.0564456719734424	0.0107976905106002	0.0456479814628422	137490.979267804	0.354707238403159	0.401	0.157	0.334	1	0.1	7184	5810	1374
8	2021	0.0306326343248842	0.00337389106324375	0.0272587432616404	196707.855535053	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1	5649	5027	622
9	2021	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	179880.247809606	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1	2225	2224	0
10	2021	0.0130794435706331	1.40236432406562e-06	0.0130780412063091	977909.446378149	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1	12094	12093	1
1	2022	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263949	0.052054735774307	0.126	0.052	0.028	0	0.1	73916	28	73888
2	2022	0.13760020251068	0.132518831229392	0.0050813712812881	1073423.35212914	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1	131467	4855	126612
3	2022	0.205331168973982	0.1579625008625	0.0473686681114822	919882.1364693	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1	162769	37550	125219
4	2022	0.187068911922825	0.0979112196481534	0.0891576922746715	1052564.33198777	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1	171161	81576	89585
5	2022	0.129824653290575	0.0457084503639847	0.08411620292659	303267.392075142	0.257906483342958	0.319	0.147	0.221	1	0.1	35175	22791	12384
6	2022	0.0847783633019378	0.0202659510484261	0.0645124122535117	309078.469181684	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1	23925	18206	5719
7	2022	0.0564456719734424	0.0107976905106002	0.0456479814628422	155482.453067496	0.354707238403159	0.401	0.157	0.334	1	0.1	8124	6570	1554
8	2022	0.0306326343248842	0.00337389106324375	0.0272587432616404	117579.257447241	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1	3376	3005	372
9	2022	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	172619.029897456	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1	2135	2135	0
10	2022	0.0130794435706331	1.40236432406562e-06	0.013078041206309	1033998.48184487	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1	12787	12786	1

age	year	f	f.disc	f.land	stock.n	catch.wt	landings.wt	discards.wt	stock.wt	mat	M	catch.n	landings.n	discards.n
1	2023	0.0633878483001354	0.0633639062645193	2.39420356161043e-05	1263949	0.052054735774307	0.126	0.052	0.028	0	0.1	73916	28	73888
2	2023	0.13760020251068	0.132518831229392	0.0050813712812881	1073423.52676924	0.0879775846510634	0.242666666666667	0.082	0.0616666666666667	0.5	0.1	131467	4855	126612
3	2023	0.205331168973982	0.1579625008625	0.0473686681114822	846413.501188268	0.151879960232242	0.260333333333333	0.119333333333333	0.115666666666667	0.5	0.1	149769	34551	115218
4	2023	0.187068911922825	0.0979112196481534	0.0891576922746715	677842.107027169	0.206148271618396	0.283666666666667	0.135	0.167	1	0.1	110226	52534	57692
5	2023	0.129824653290575	0.0457084503639847	0.08411620292659	789907.440596167	0.257906483342958	0.319	0.147	0.221	1	0.1	91618	59362	32257
6	2023	0.0847783633019378	0.0202659510484261	0.0645124122535117	240998.388116879	0.30805714153338	0.359	0.149333333333333	0.261666666666667	1	0.1	18655	14196	4459
7	2023	0.0564456719734424	0.0107976905106002	0.0456479814628422	256933.379338993	0.354707238403159	0.401	0.157	0.334	1	0.1	13425	10857	2568
8	2023	0.0306326343248842	0.00337389106324375	0.0272587432616404	132965.169606823	0.420562832660396	0.452333333333333	0.171666666666667	0.369333333333333	1	0.1	3818	3398	421
9	2023	0.0130794435706331	1.41232803661026e-06	0.0130780312425965	103180.512549431	0.464635376037072	0.464666666666667	0.179	0.417	1	0.1	1276	1276	0
10	2023	0.0130794435706331	1.40236432406562e-06	0.013078041206309	1077605.6148818	0.594833927777538	0.5948981792046	0	0.499404488100942	1	0.1	13327	13325	1

(a)


0
20
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60
80
100
sampled
unsampled
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Denmark
France
Germany
Ireland
Netherlands
Norway
Sweden
UK (England)
UK(Scotland)

(b)

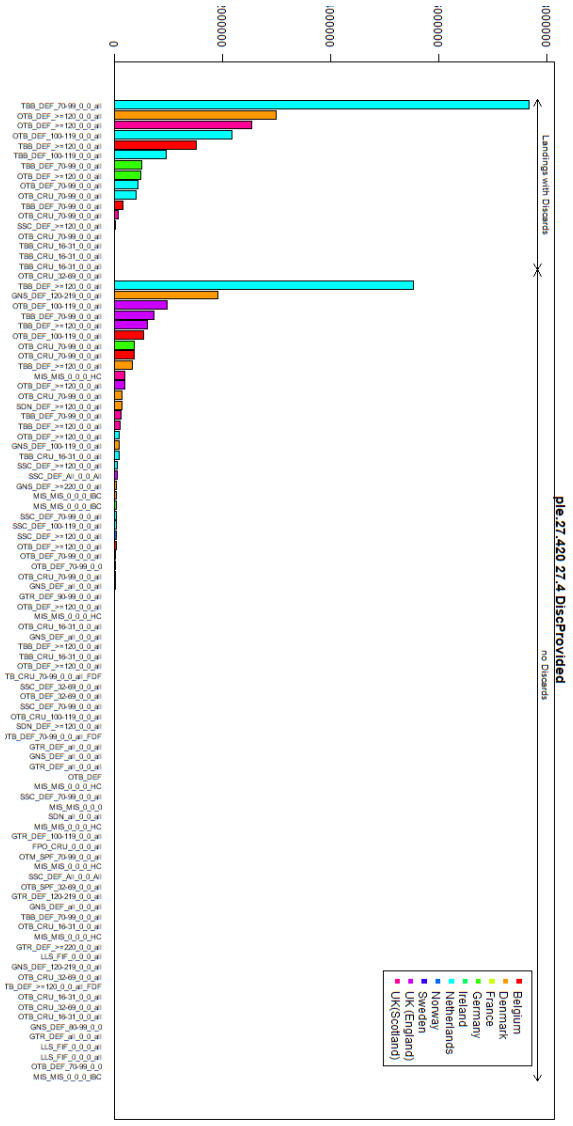
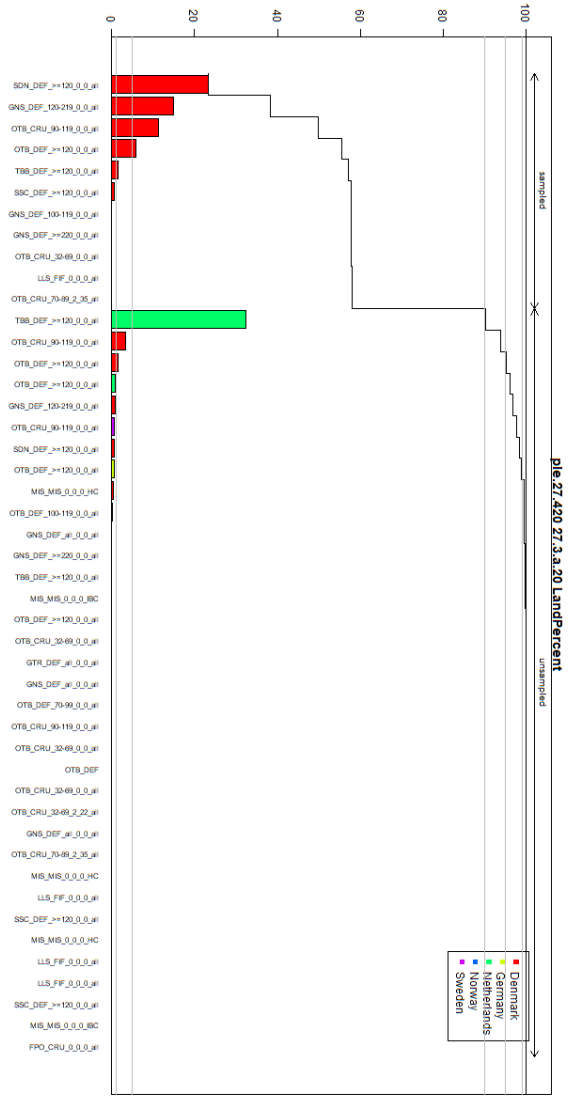


Figure 13.2.1. Summary of data upload in Intercatch for Subarea 4: (a) Percentage of landings. Sampled and unsampled refers to availability of age-composition information. (b) Percentage of landings provided with discards, by country by métier.

(a)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20
40
60
80
100
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GNS_DEF_120-219_0_0_all
OTB_CRU_90-119_0_0_all
OTB_DEF_>=120_0_0_all
TBB_DEF_>=120_0_0_all
SSC_DEF_>=120_0_0_all
GNS_DEF_100-119_0_0_all
GNS_DEF_>=220_0_0_all
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OTB_CRU_90-119_0_0_all
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OTB_DEF_>=120_0_0_all
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GNS_DEF_>=220_0_0_all
TBB_DEF_>=120_0_0_all
MIS_MIS_0_0_0_IBC
OTB_DEF_>=120_0_0_all
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GNS_DEF_all_0_0_all
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OTB_DEF
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GNS_DEF_all_0_0_all
OTB_CRU_70-89_2_35_all
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MIS_MIS_0_0_0_IBC
FPO_CRU_0_0_0_all
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unsampled
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Denmark
Germany
Netherlands
Norway
Sweden

(b)

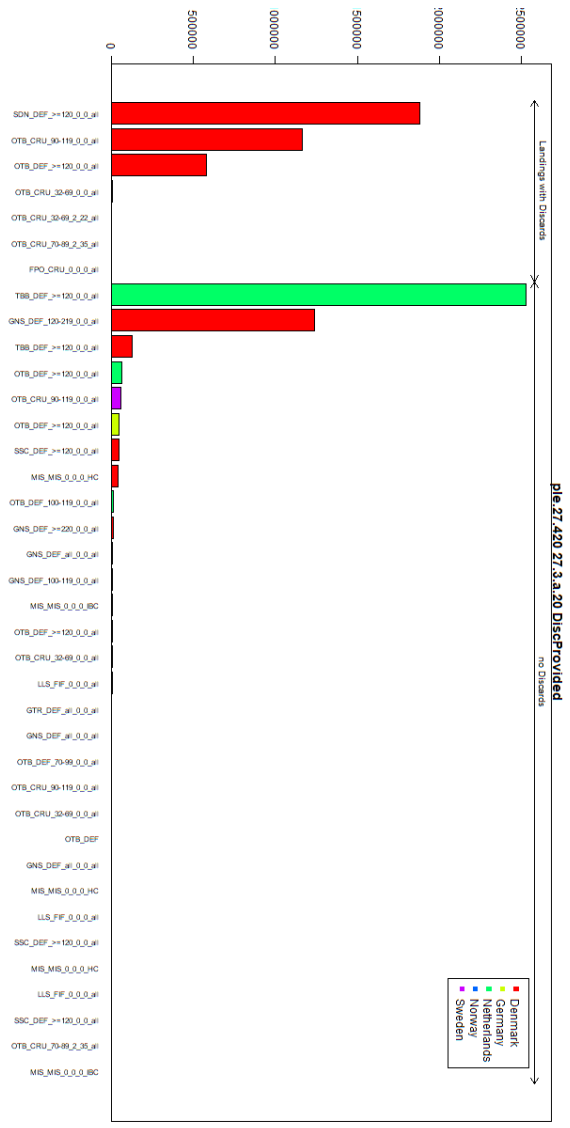


Figure 13.2.2. Summary of data upload in Intercatch for Subdivision 20: (a) Percentage of landings. Sampled and unsampled refers to availability of age-composition information. (b) Percentage of landings provided with discards, by country by métier.

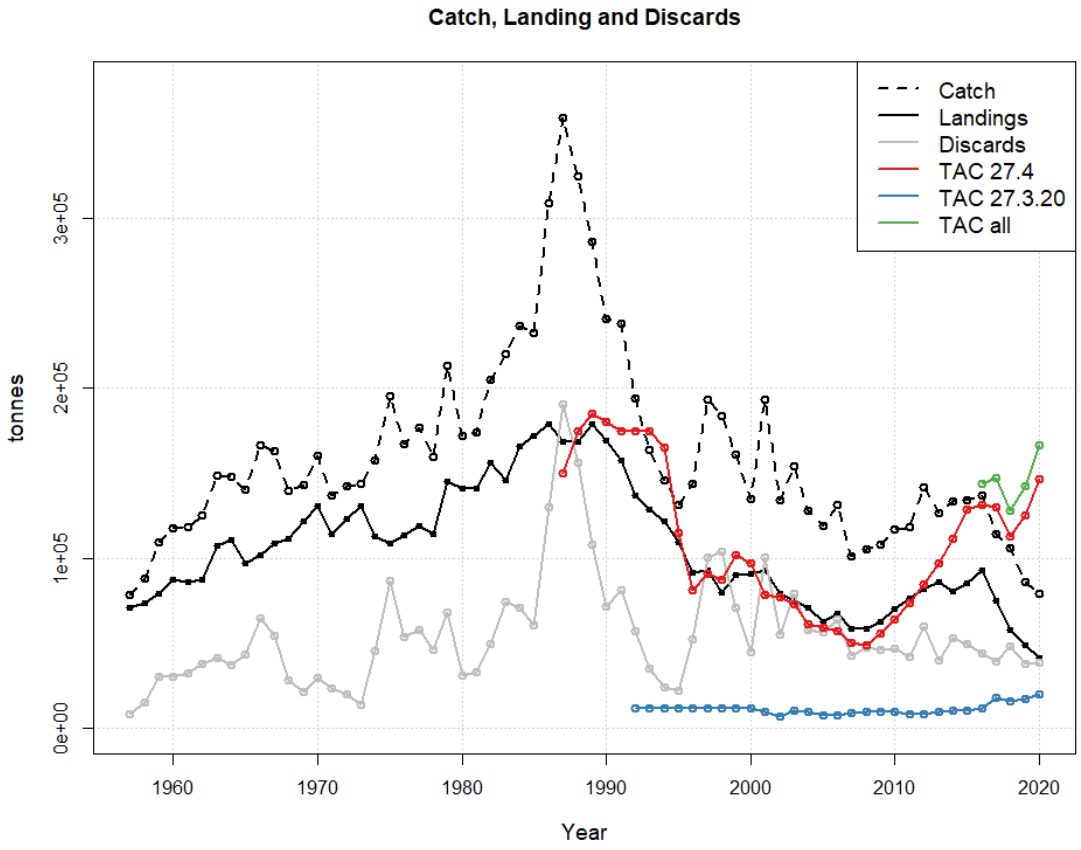


Figure 13.2.3. Plaice in Subarea 4 (including Subdivision 20 and 7.d Q1): Time series of catch (dashed line), landings (solid black line) and discards (gray line) estimates. TAC for Subarea 4 (red) , Subdivision 20 (blue) and combined area (green) are also plotted,. Discards before 2000 were reconstructed using a model-based method. Landing TAC was given before 2019 and catch TAC was given since 2019.

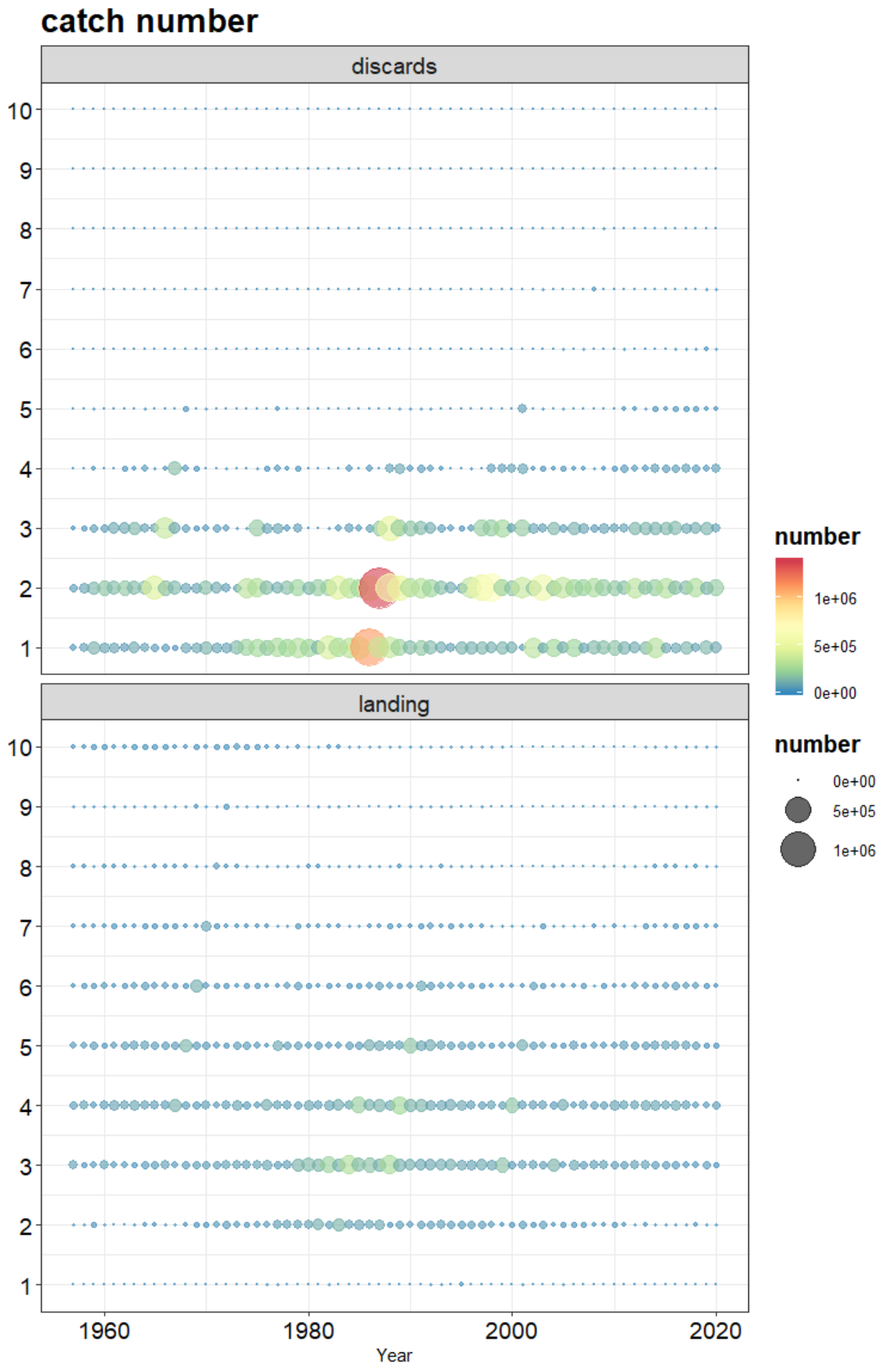


Figure 13.2.4. Plaice in Subarea 4 and Subdivision 20: Discards numbers-at-age (top) and landings numbers-at-age (down). Discards before 2000 were reconstructed using a model-based method.

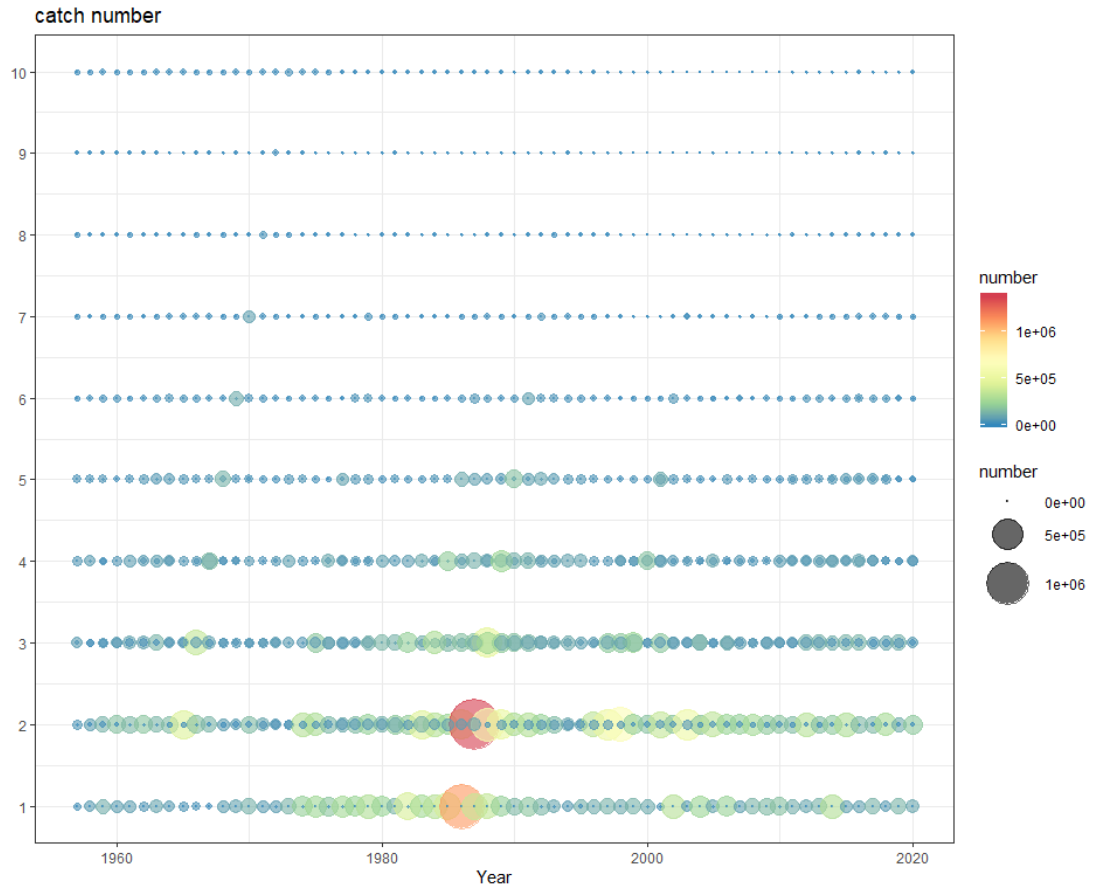


Figure 13.2.5. Plaice in Subarea 4 and Subdivision 20. Catch numbers-at-age: Discards before 2000 were reconstructed using a model-based method.

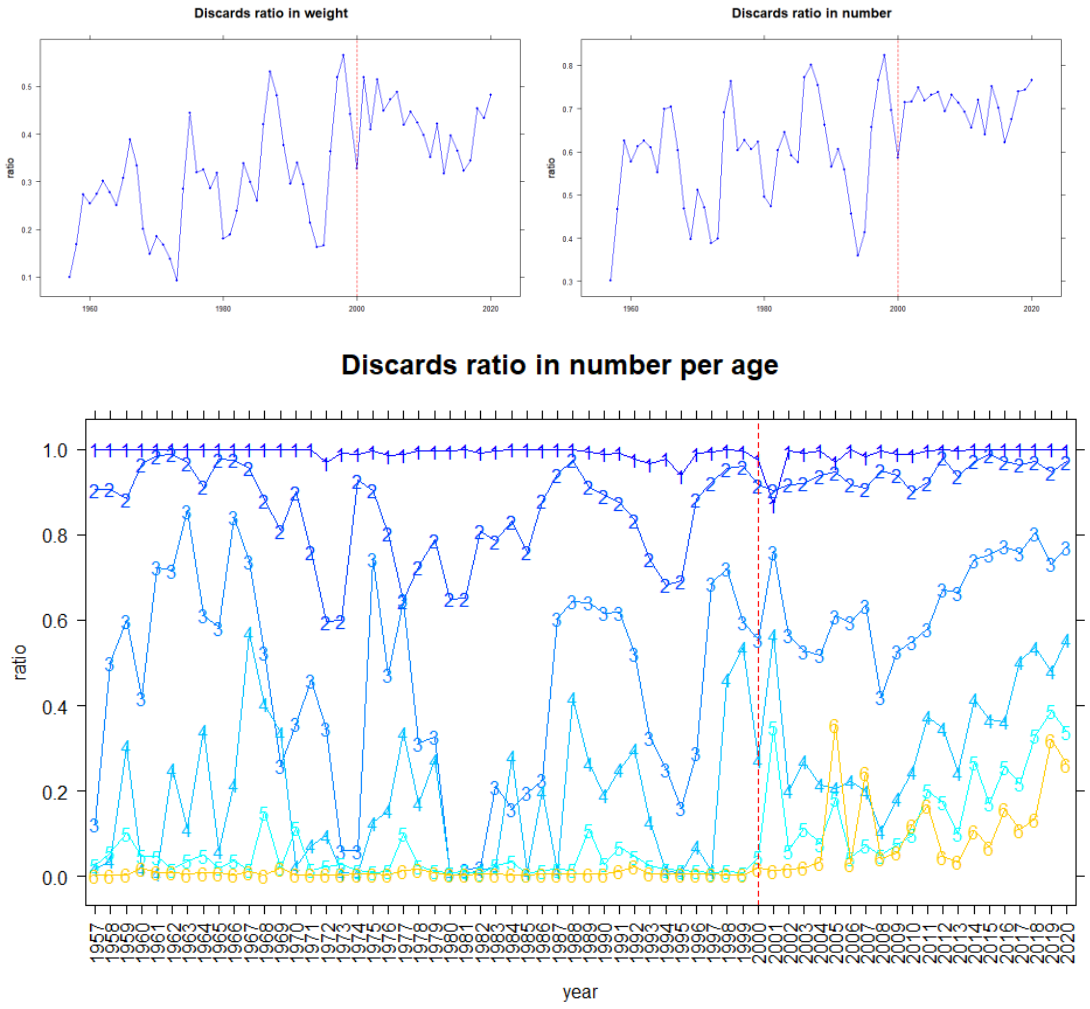


Figure 13.2.6. Discards ratio. Discards before 2000 were reconstructed using a model-based method.

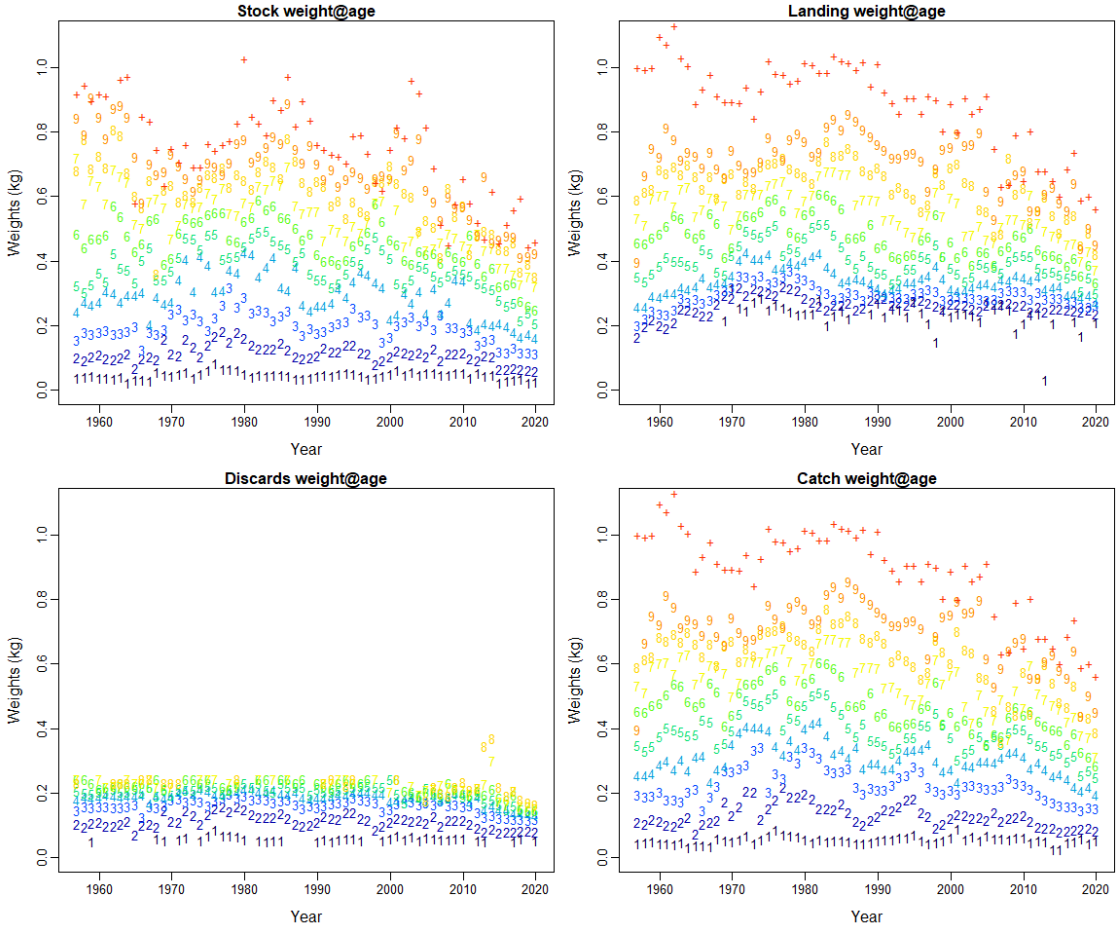


Figure 13.2.7. Plaice in Subarea 4 and Subdivision 20: Stock weight-at-age (top left), landings weight-at-age (top right), discards weight-at-age (bottom left) and catch weight-at-age (bottom right).

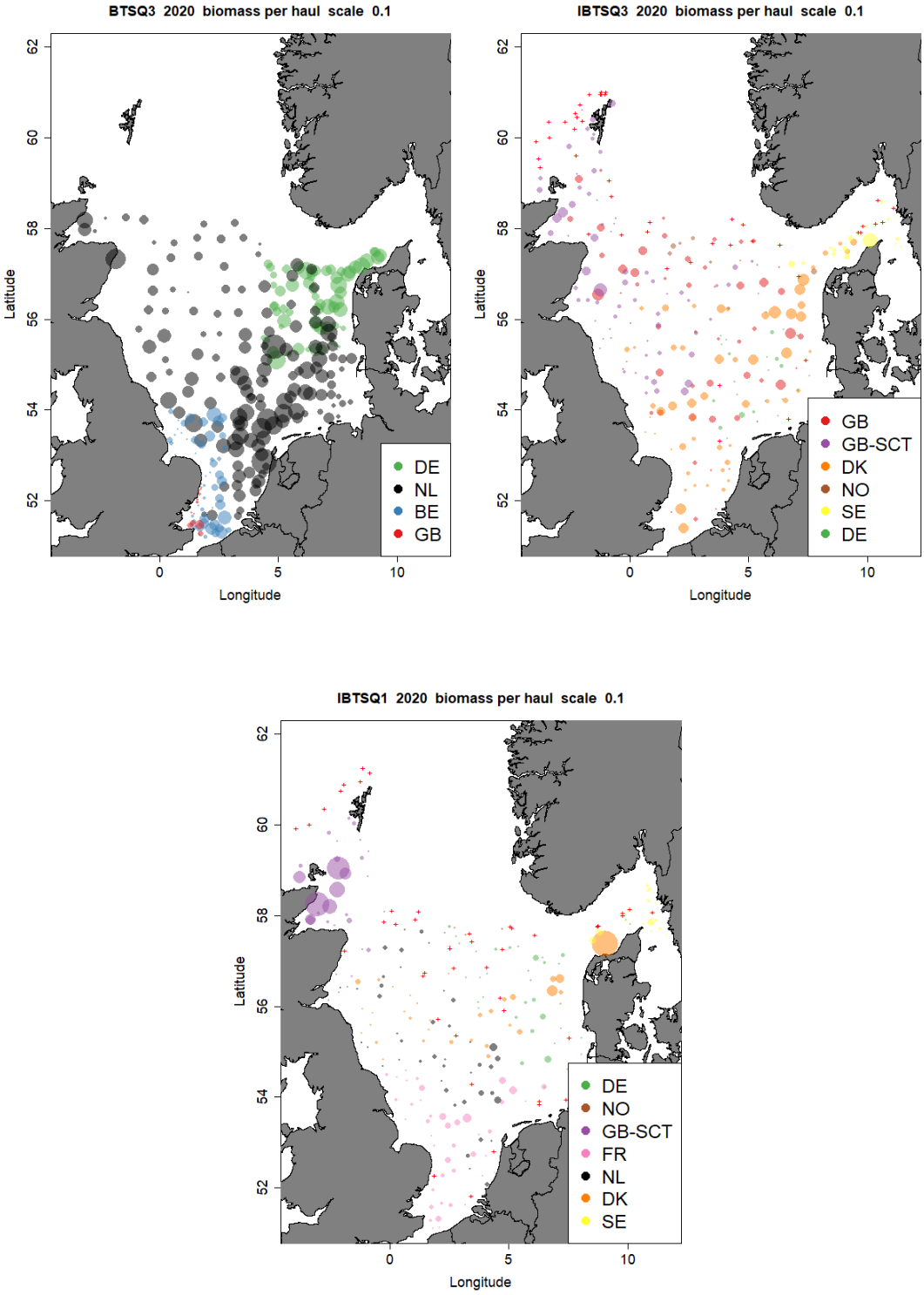
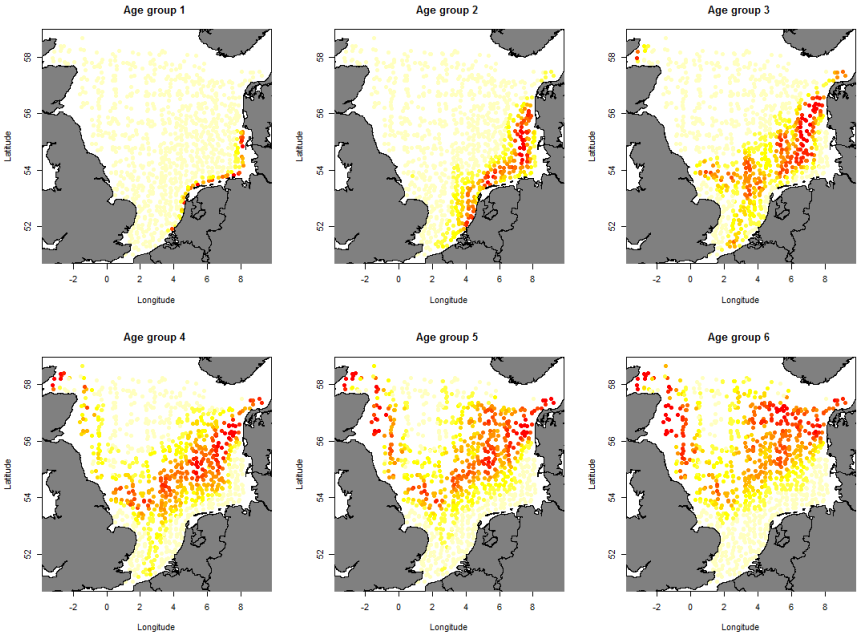
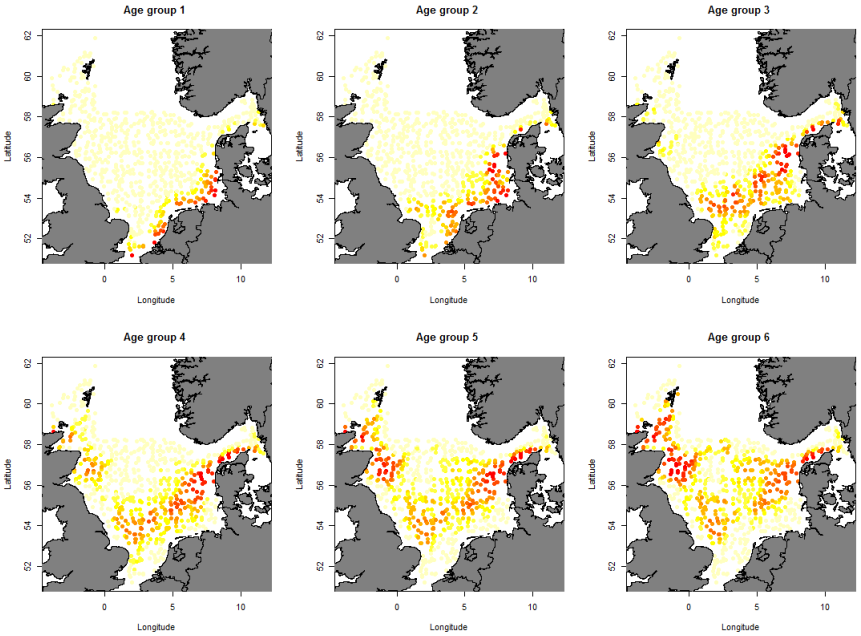


Figure 13.2.8. Spatial distribution of biomass per haul for BTS-Q3, IBTS-Q3 and IBTS-Q1 surveys in 2020. Indices for these 3 surveys were extracted using the delta-GAM method. Samples in grey area were excluded due to low coverage.

(a) BTS-Q3



(b) IBTS-Q3



(c) IBTS-Q1

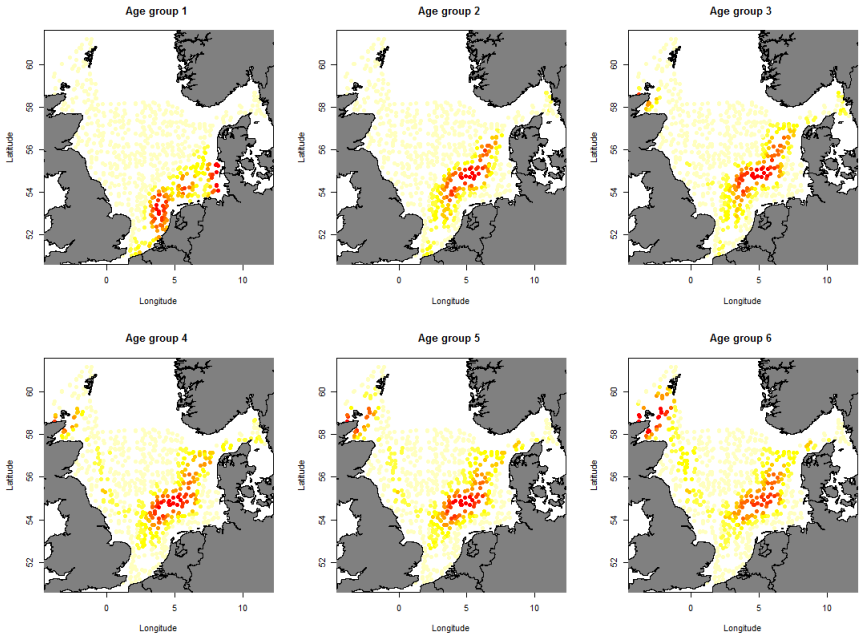


Figure 13.2.9. The estimated spatial age distribution for (a) BTS-Q3, (b) IBTS-Q3 and (c) IBTS-Q1, estimated using delta-GAM method. Age group 1–6 refers to age 0–5. Abundance decreasing from red to white colour.

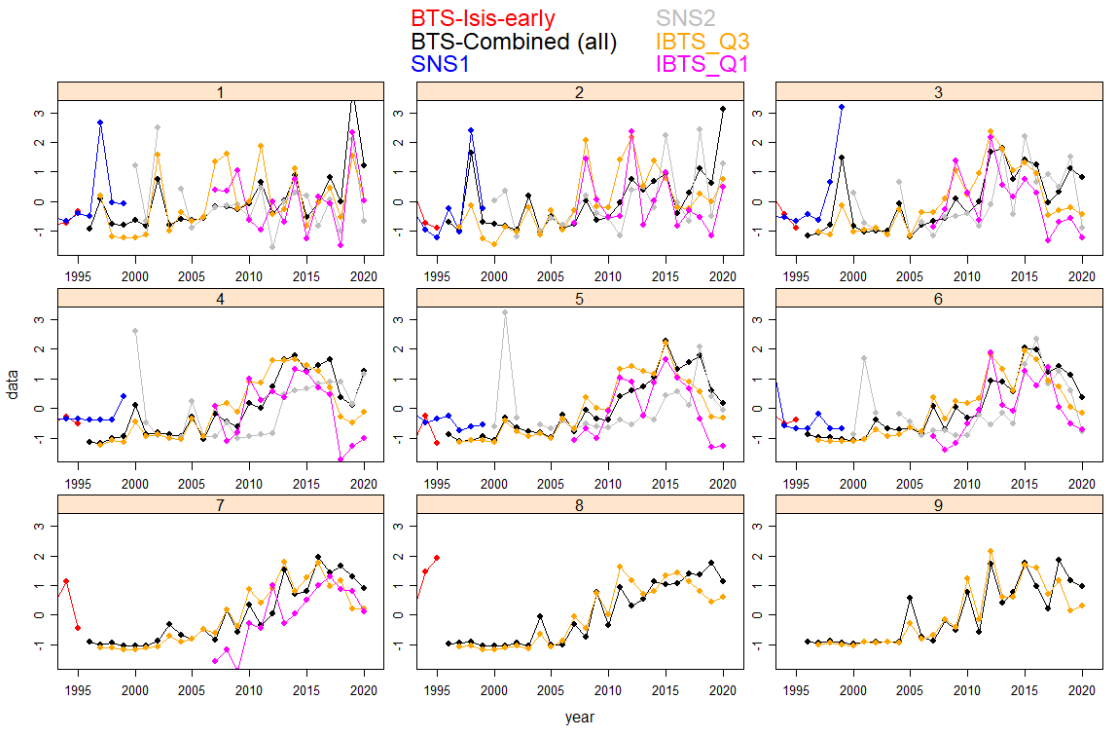


Figure 13.2.10. Plaice in Subarea 4 and Subdivision 20. Standardized survey tuning indices used for tuning stock assessment model: BTS–combined (1996–2020, black), BTS–Isis-early (1985–1995, red) SNS–1 (1970–1999, blue), SNS–2 (2000–2020, grey), IBTS–Q3 (1997–2020, yellow) and IBTS–Q1 (2007-2020, pink). Note: only ages used in the assessment are presented. The BTS–combined index combines BTS–Tridens and BTS–Isis indices.

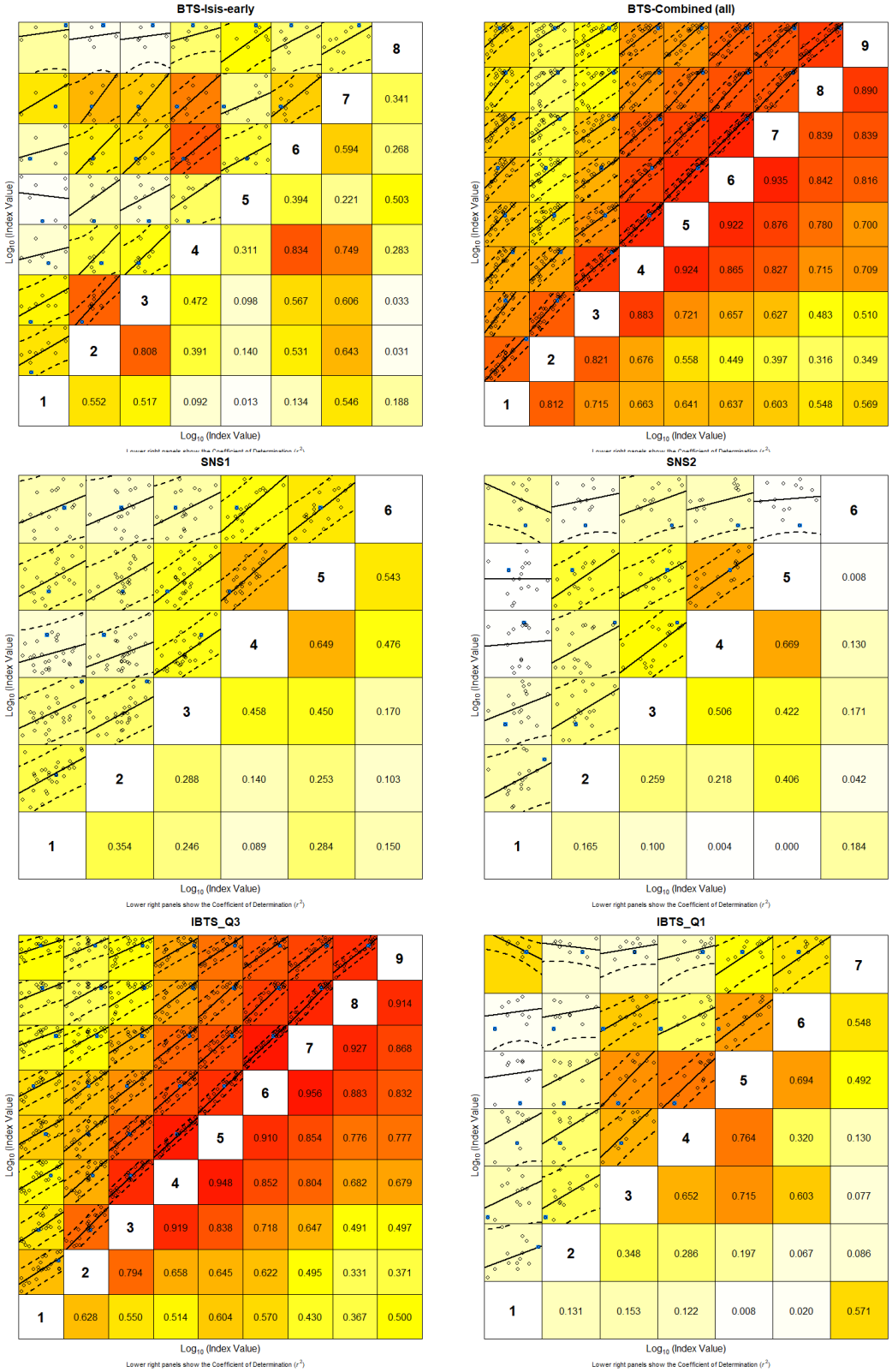


Figure 13.2.11. Plaice in Subarea 4 and Subdivision 20: Internal consistency plot for surveys.

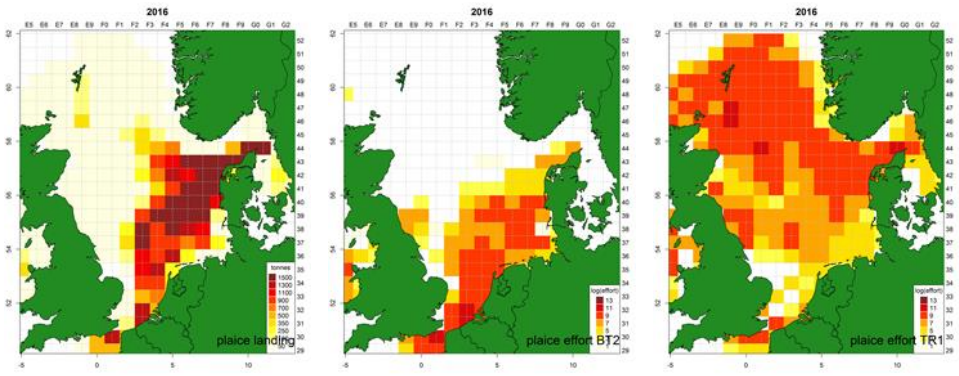


Figure 13.2.12. (a) Spatial distribution (by ICES rectangle) of landed plaice in 2016; (b) Spatial distribution of log-transformed TB2 fishing effort in 2016; (c) Spatial distribution of log-transformed TR1 fishing effort in 2016. Data were extracted from STECF FDI dataset. TB2 and TR1 are the two major gears in catching plaice in North Sea.

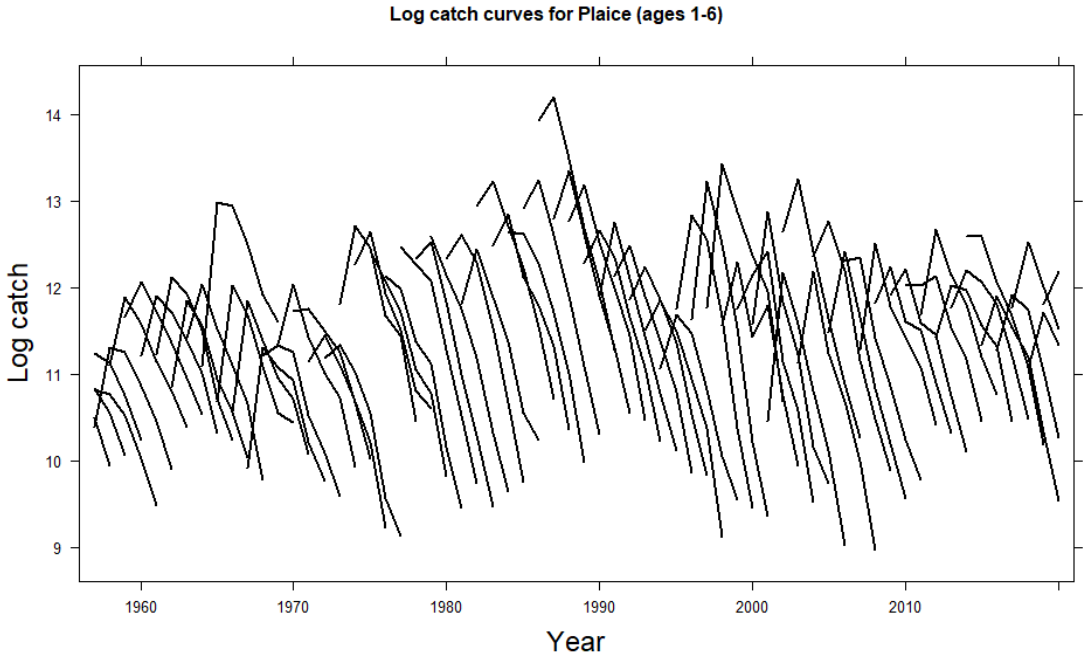


Figure 13.2.13. Catch curves for catches in age 1–6.

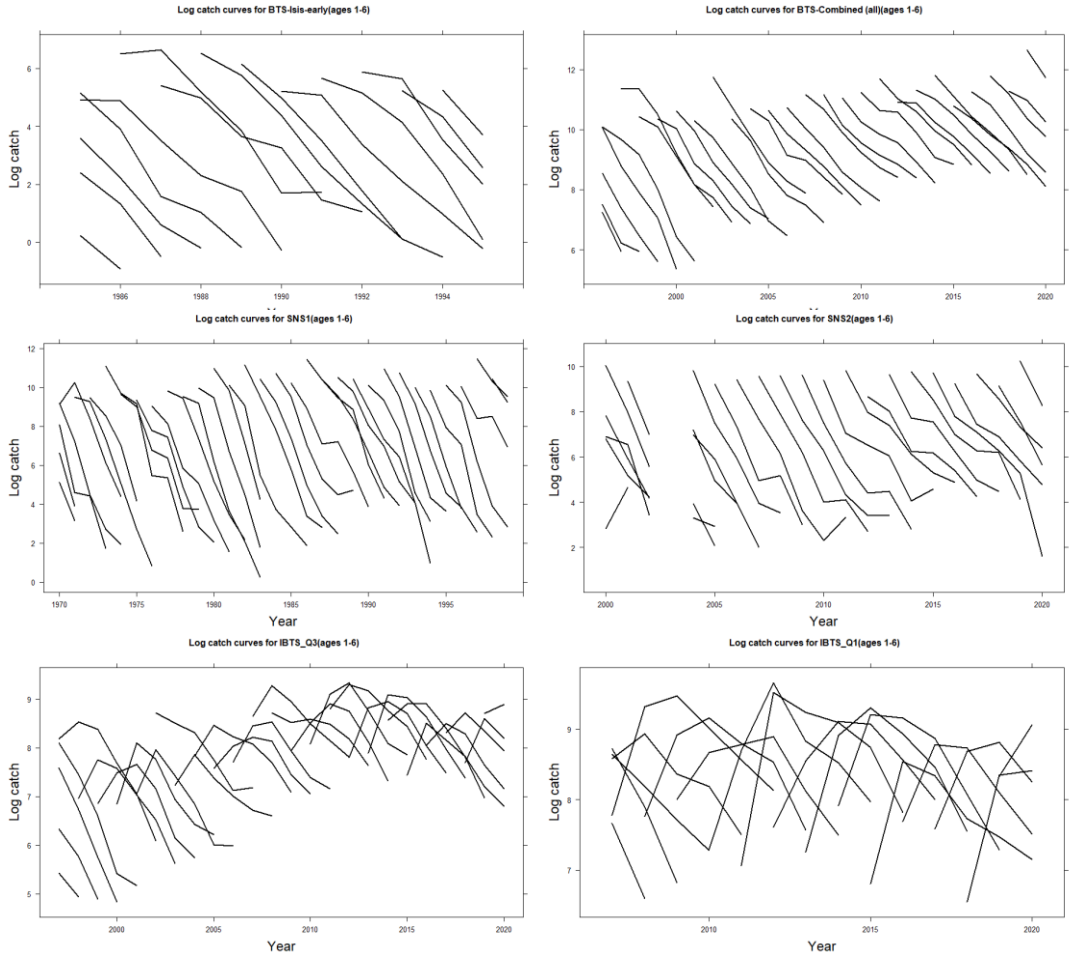
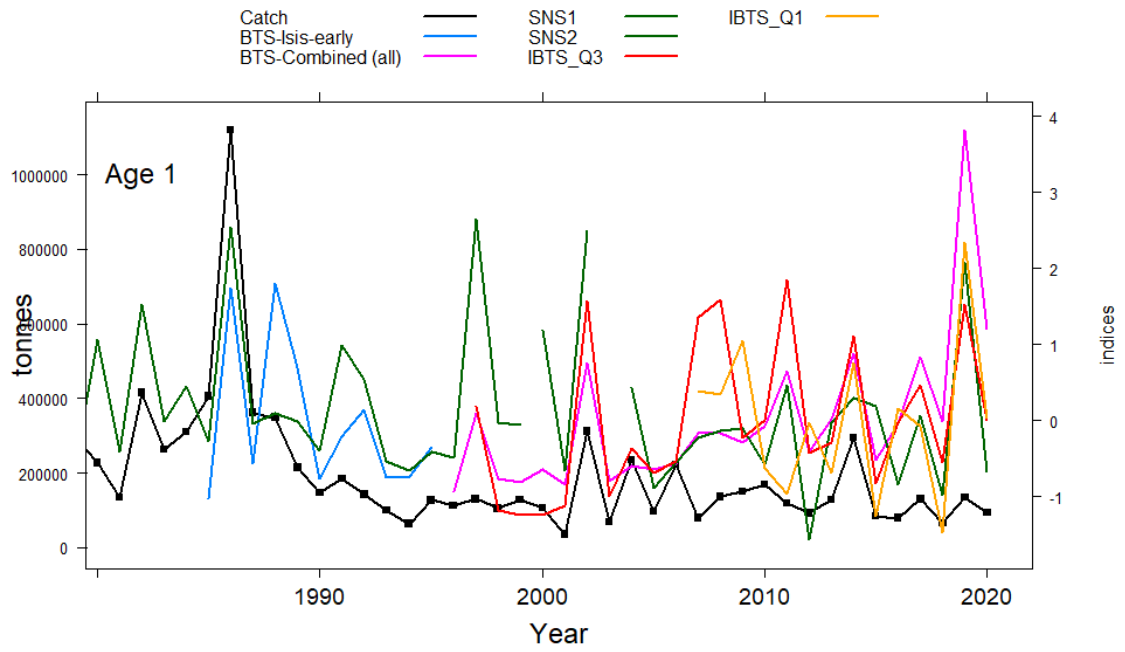
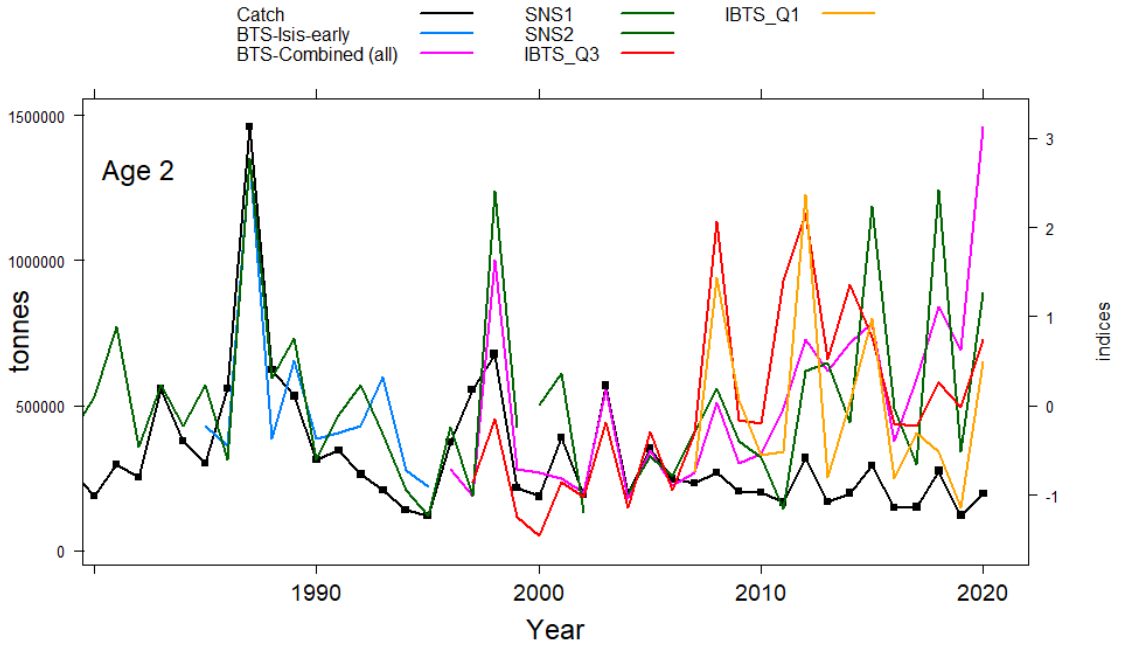
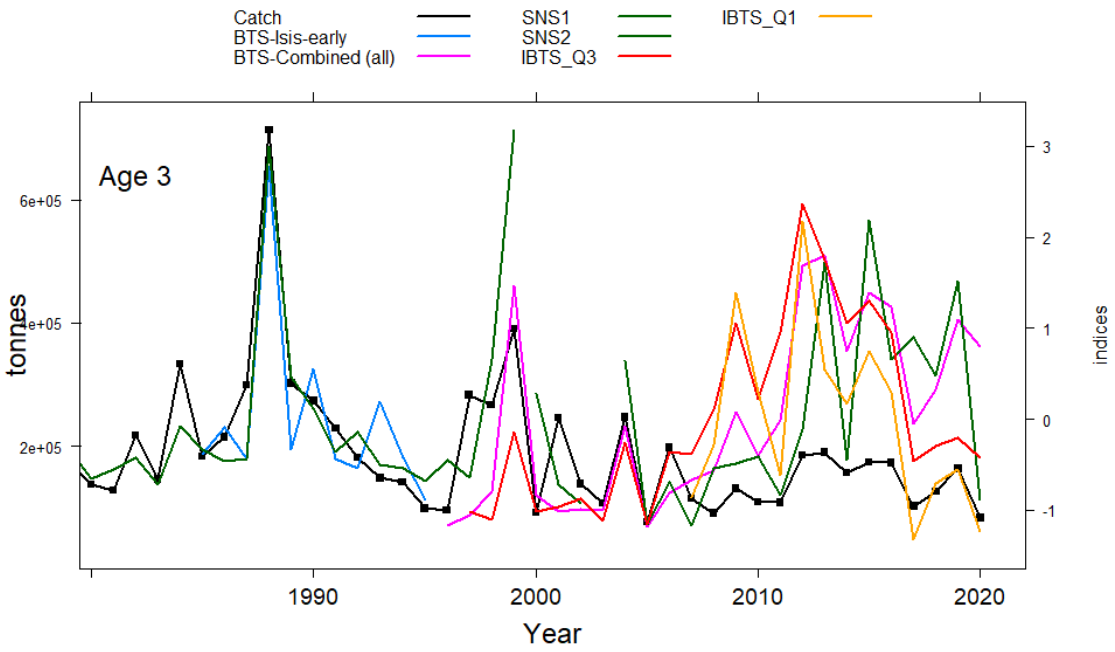
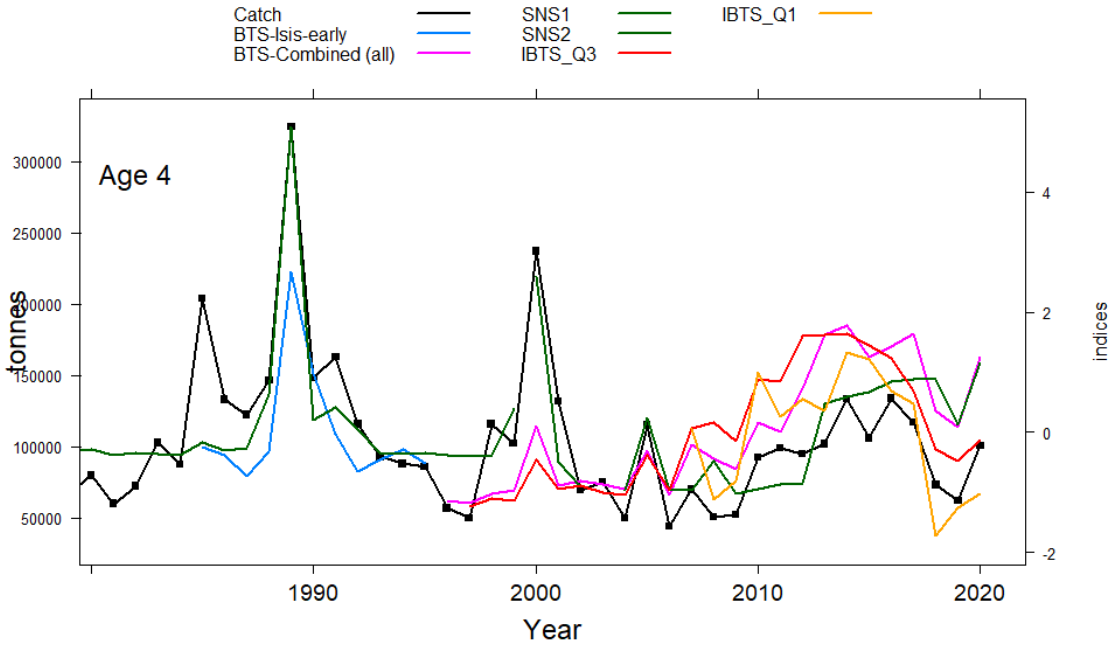


Figure 13.2.14. Catch curves for Surveys in age 1–6.


Catch
BTS-Isis-early
BTS-Combined (all)
SNS1
SNS2
IBTS_Q3
IBTS_Q1
Age 1
tonnes
indices
Year
0
200000
400000
600000
800000
1000000
1990
2000
2010
2020
-1
0
1
2
3
4


Catch
BTS-Isis-early
BTS-Combined (all)
SNS1
SNS2
IBTS_Q3
IBTS_Q1
Age 2
tonnes
indices
Year
0
500000
1000000
1500000
1990
2000
2010
2020
-1
0
1
2
3


Catch
BTS-Isis-early
BTS-Combined (all)
SNS1
SNS2
IBTS_Q3
IBTS_Q1
Age 3
tonnes
indices
Year
1990
2000
2010
2020


Catch
BTS-Isis-early
BTS-Combined (all)
SNS1
SNS2
IBTS_Q3
IBTS_Q1
Age 4
tonnes
indices
Year
1990
2000
2010
2020

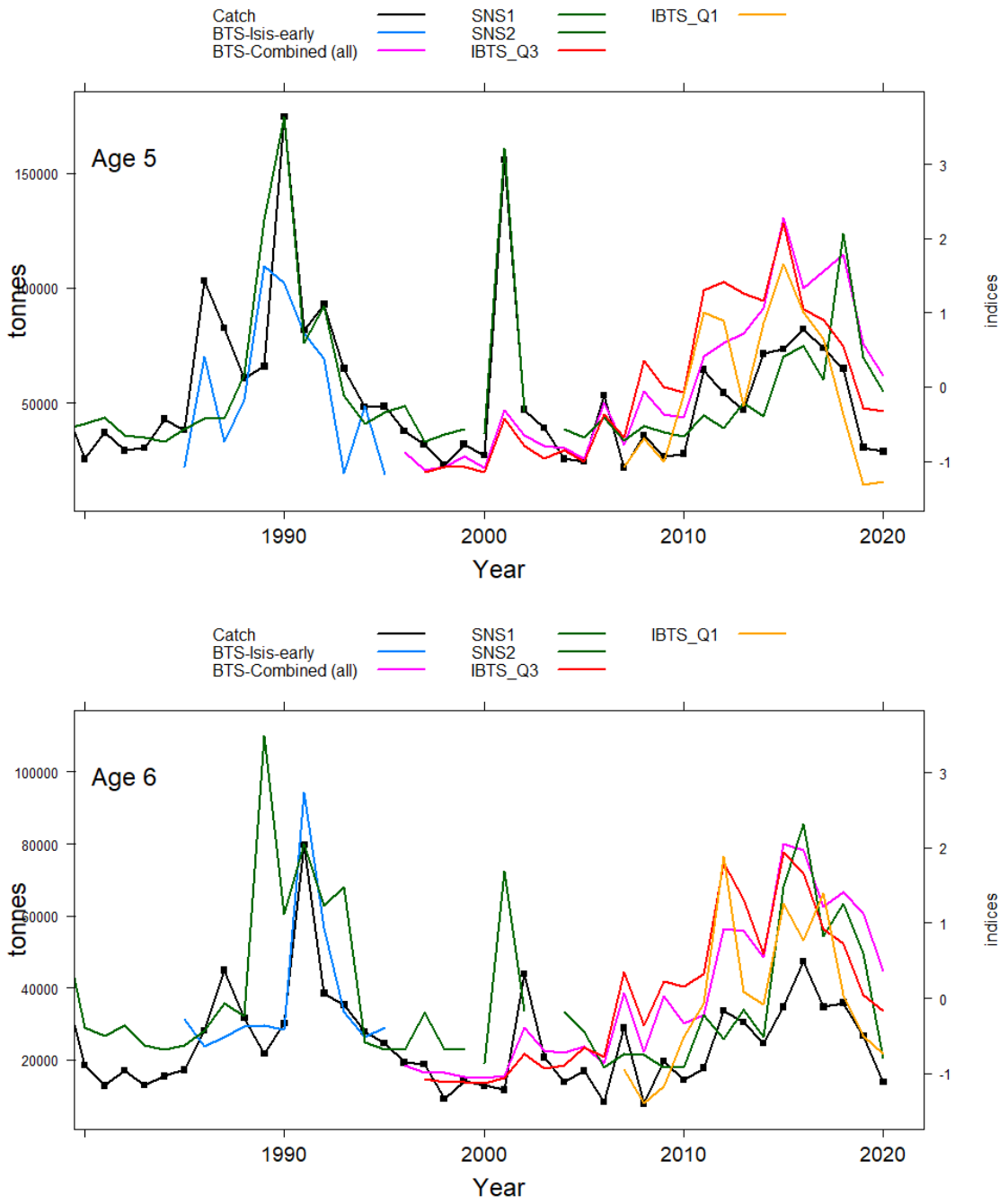


Figure 13.2.15: Catches vs. standardized survey indices by age (1–6).

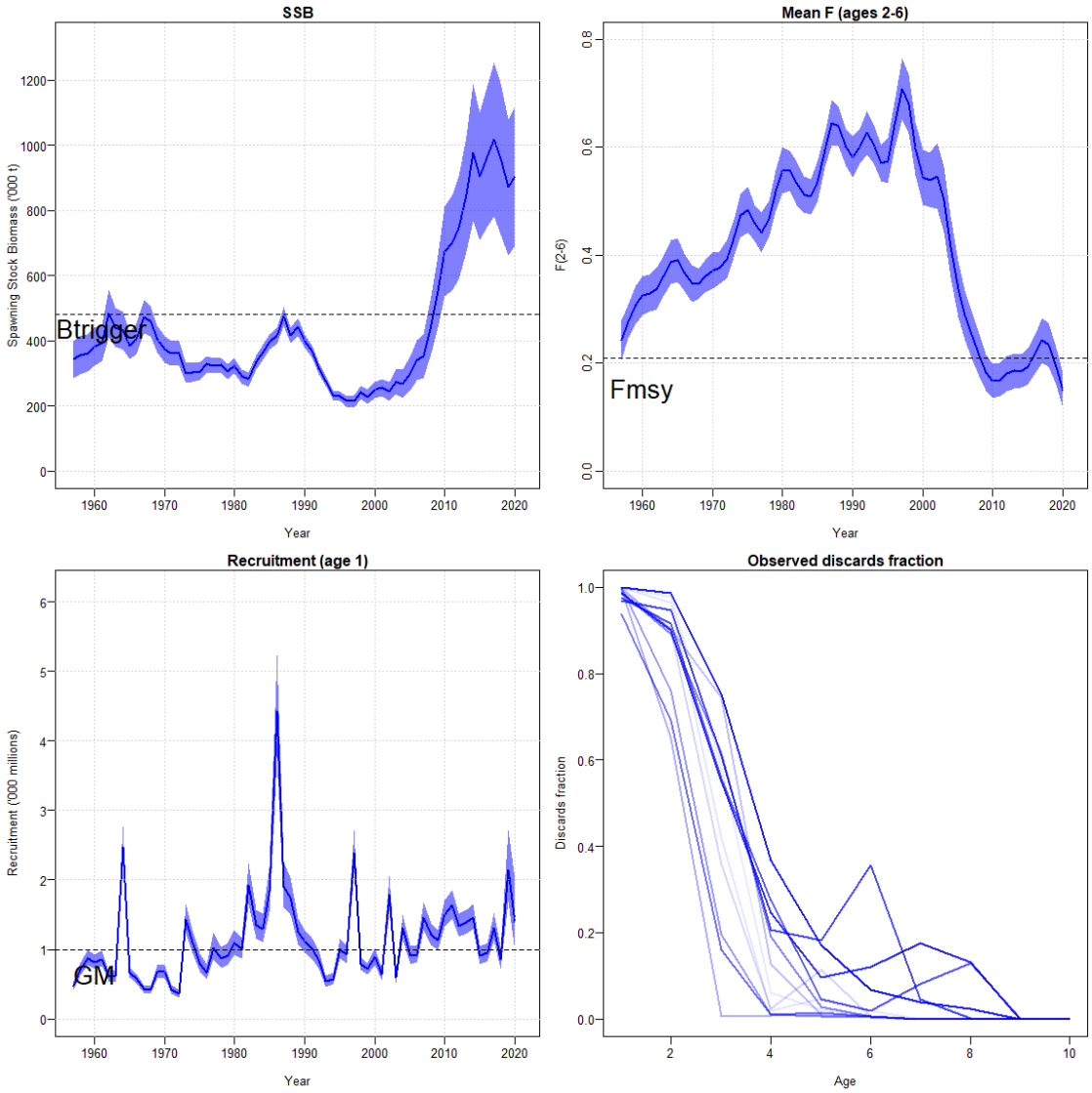


Figure 13.3.1. Stock assessment output for ple.27.420. SSB (top left), fishing mortality (top right), recruitment (bottom left) estimates of the assessment and the observed discards fraction (bottom right).

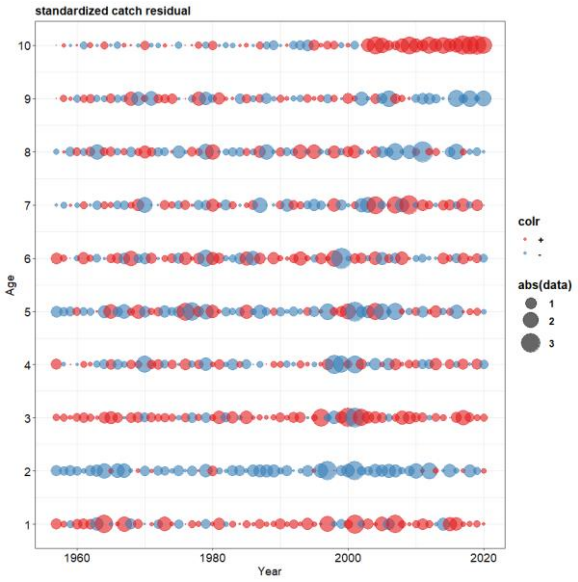


Figure 13.3.2. Log-catch residuals (observed minus estimated), standardized by the standard error of catch. Positive values are in red and negative values are in blue.

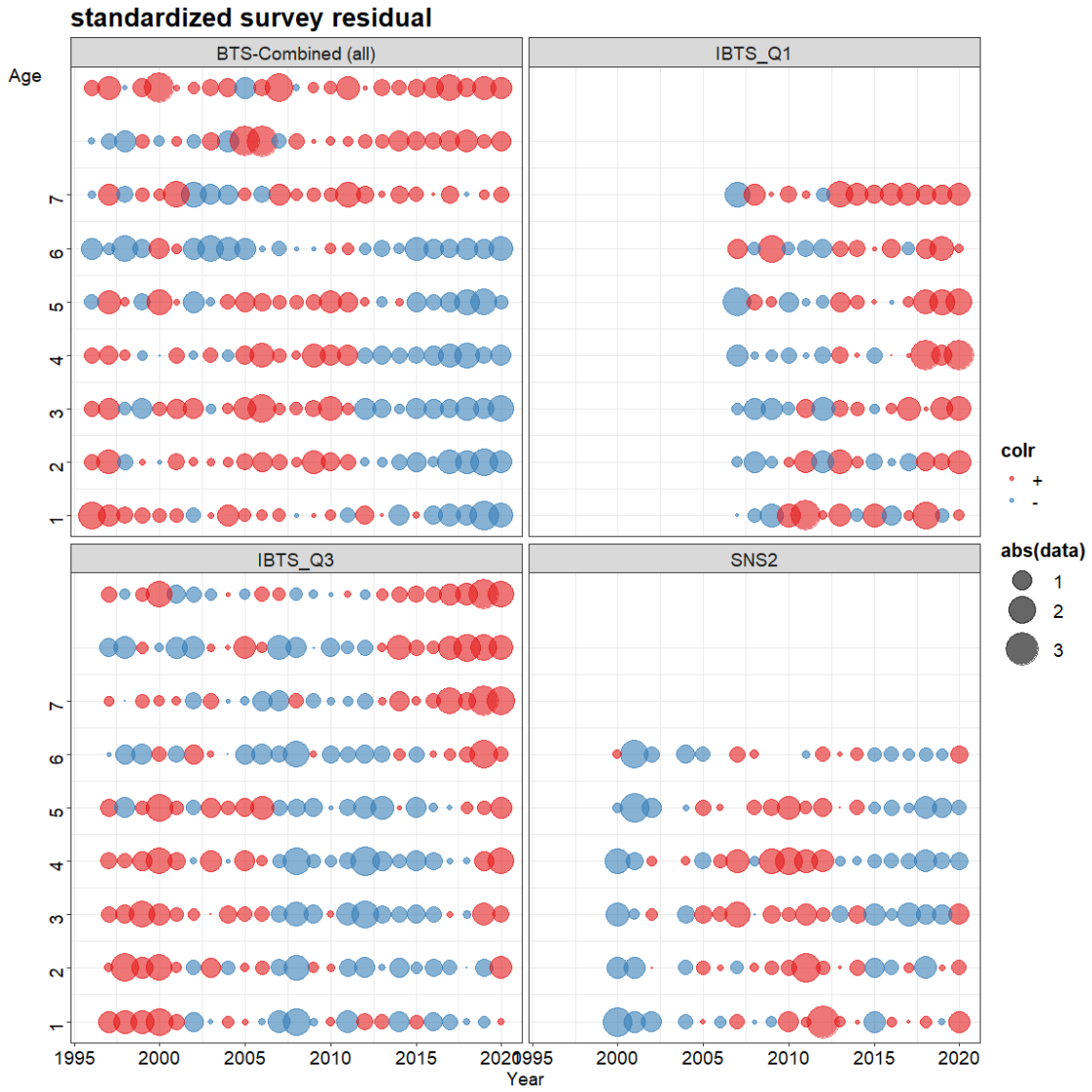


Figure 13.3.3. Log-survey indices residuals (observed minus estimated), standardized by the standard error of indices. Positive values are in red and negative values are in blue.

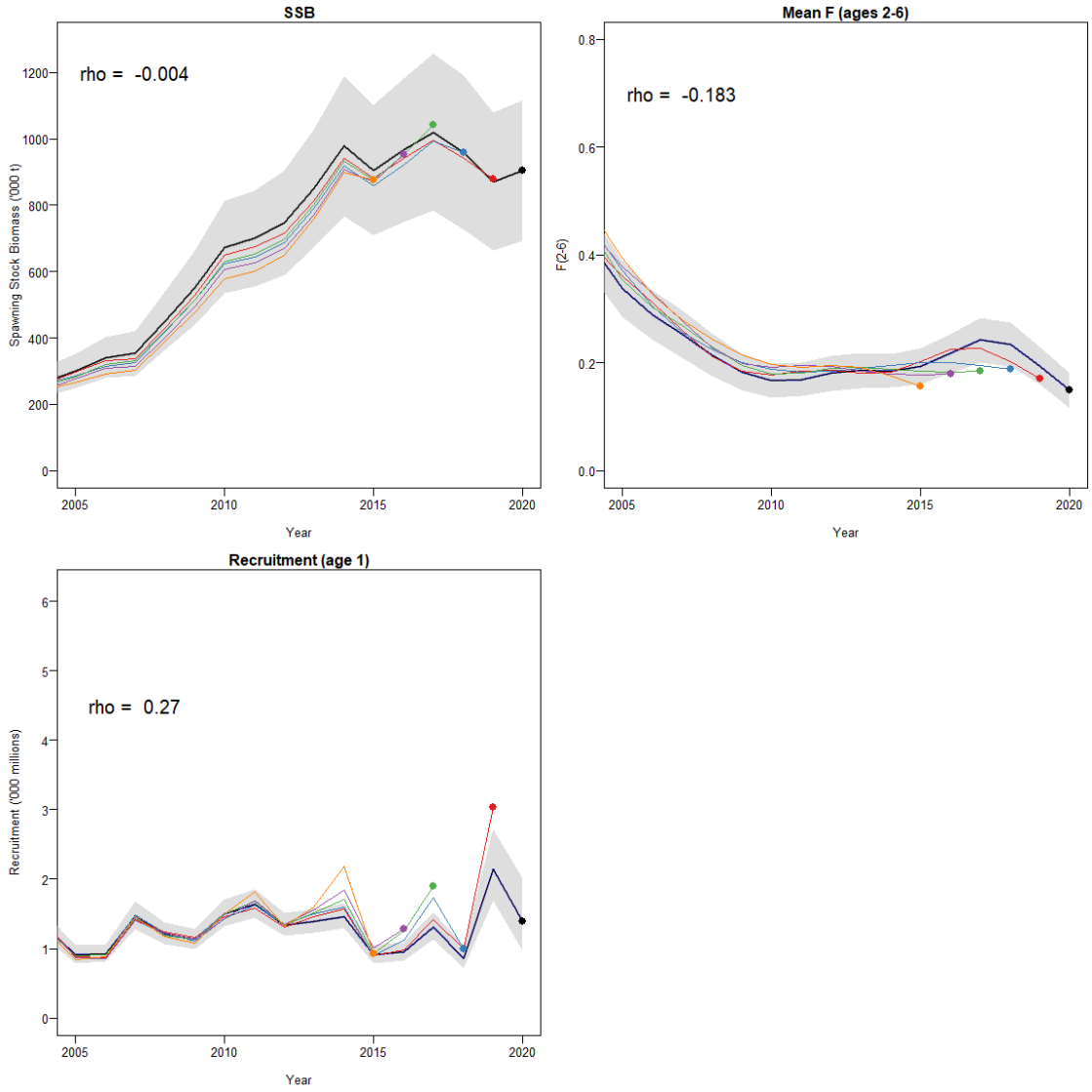


Figure 13.3.4. Retrospective pattern of the final AAP run with respect to SSB, recruitment and F.

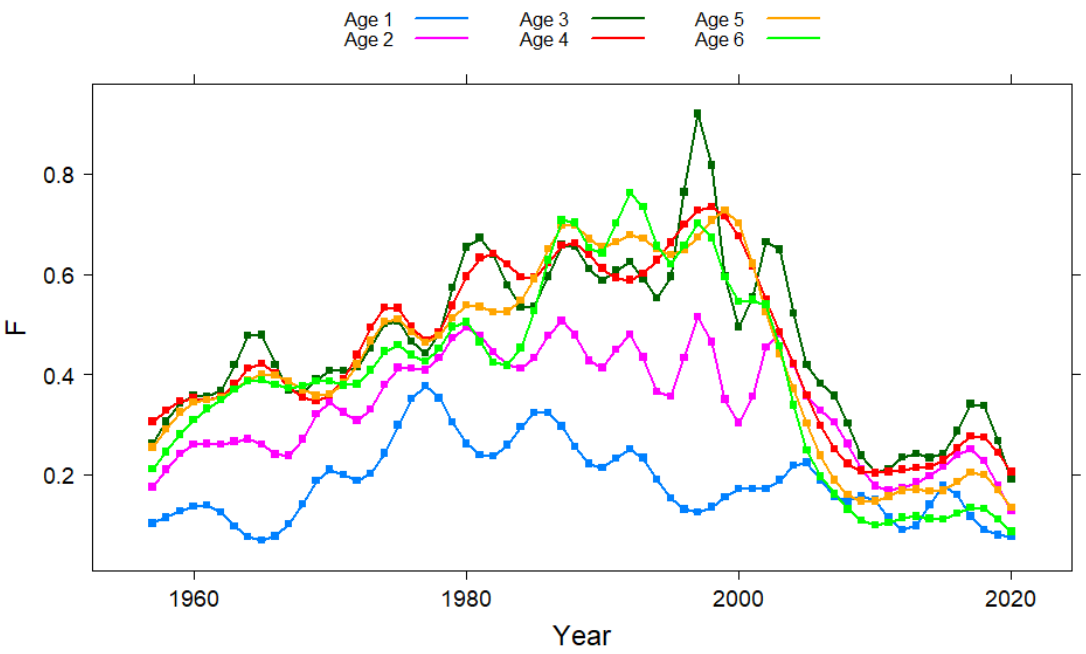


Figure 13.3.5. Estimated fishing mortality by age.

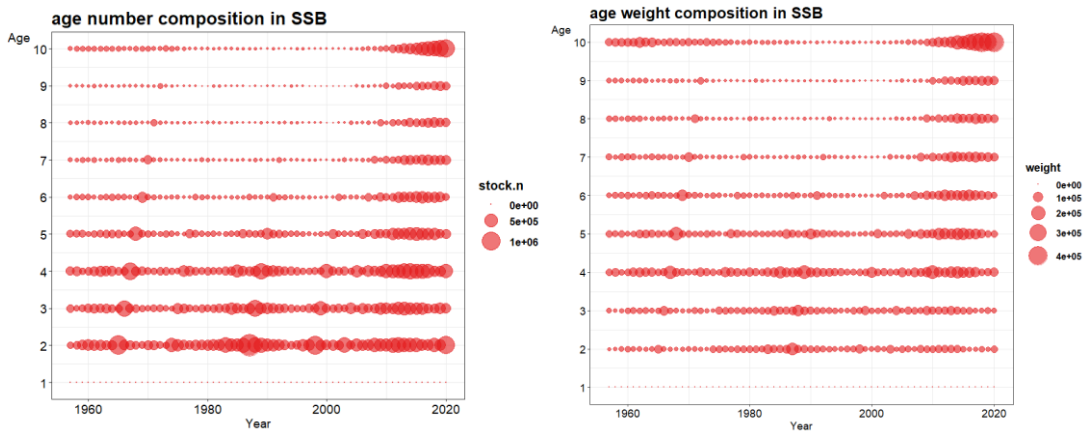
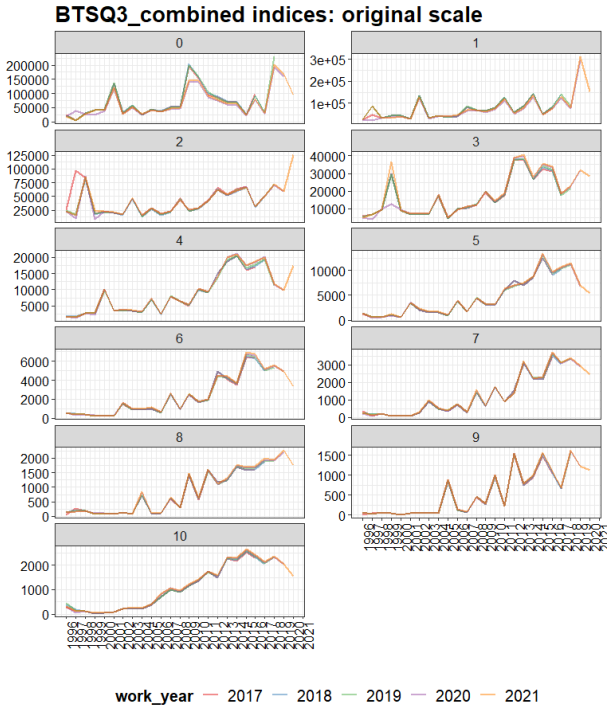
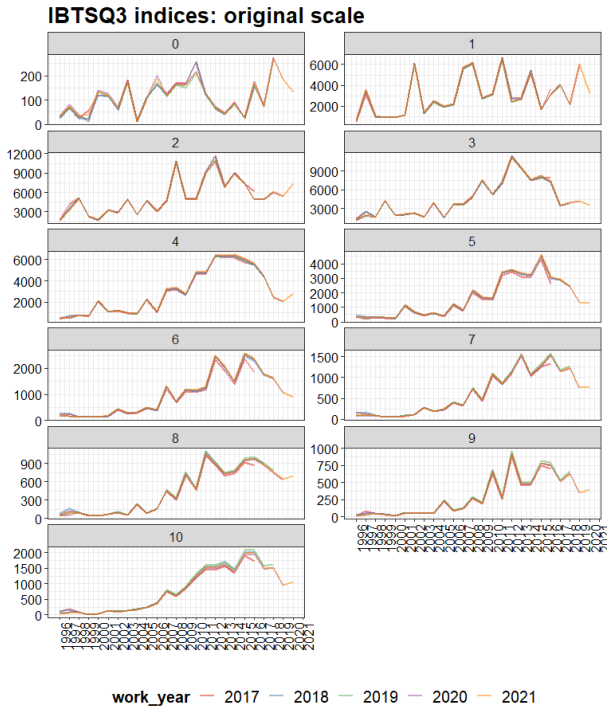


Figure 13.3.6. Age compositions in the estimated SSB.


BTSQ3_combined indices: original scale
0
1
2
3
4
5
6
7
8
9
10
work_year 2017 2018 2019 2020 2021


IBTSQ3 indices: original scale
0
1
2
3
4
5
6
7
8
9
10
work_year 2017 2018 2019 2020 2021

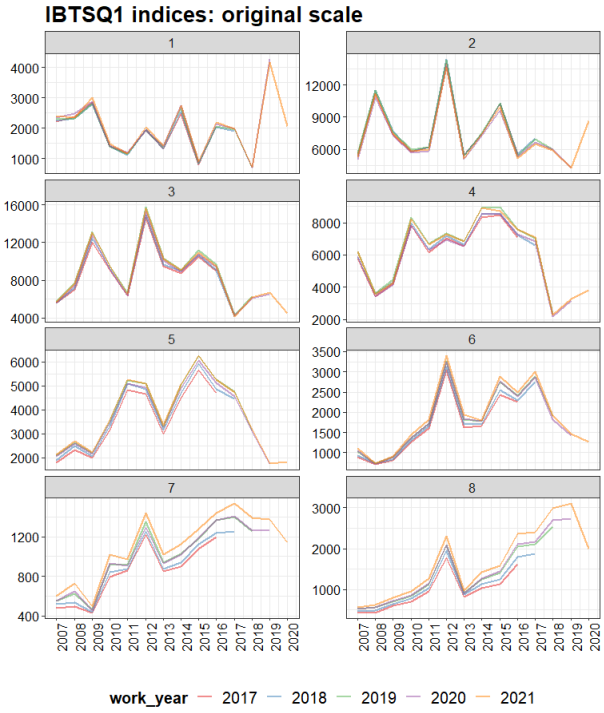
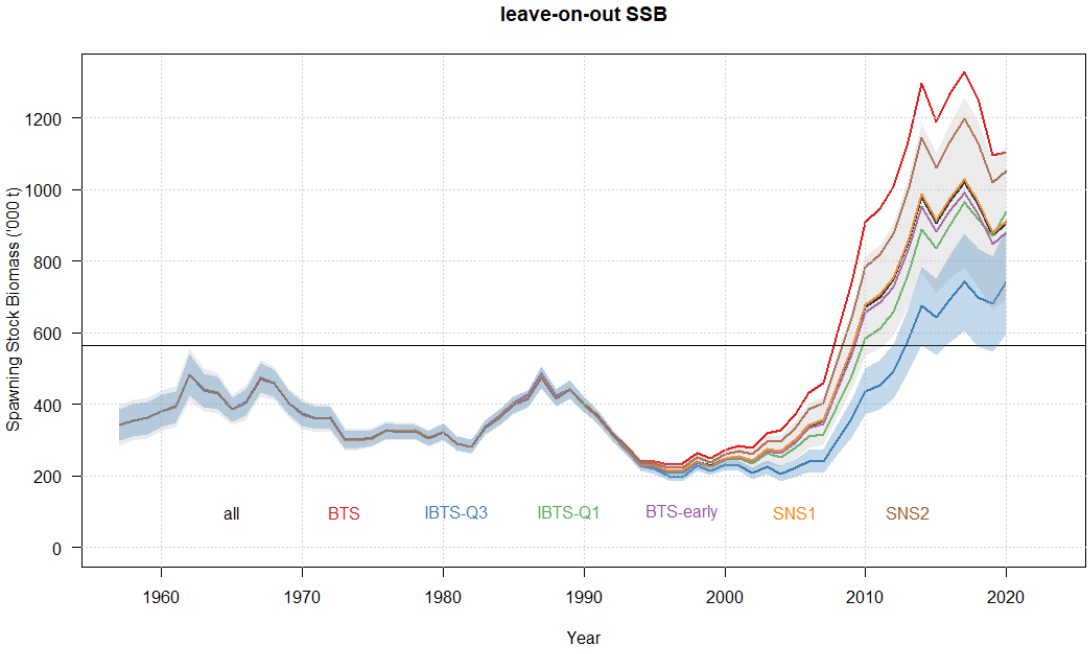
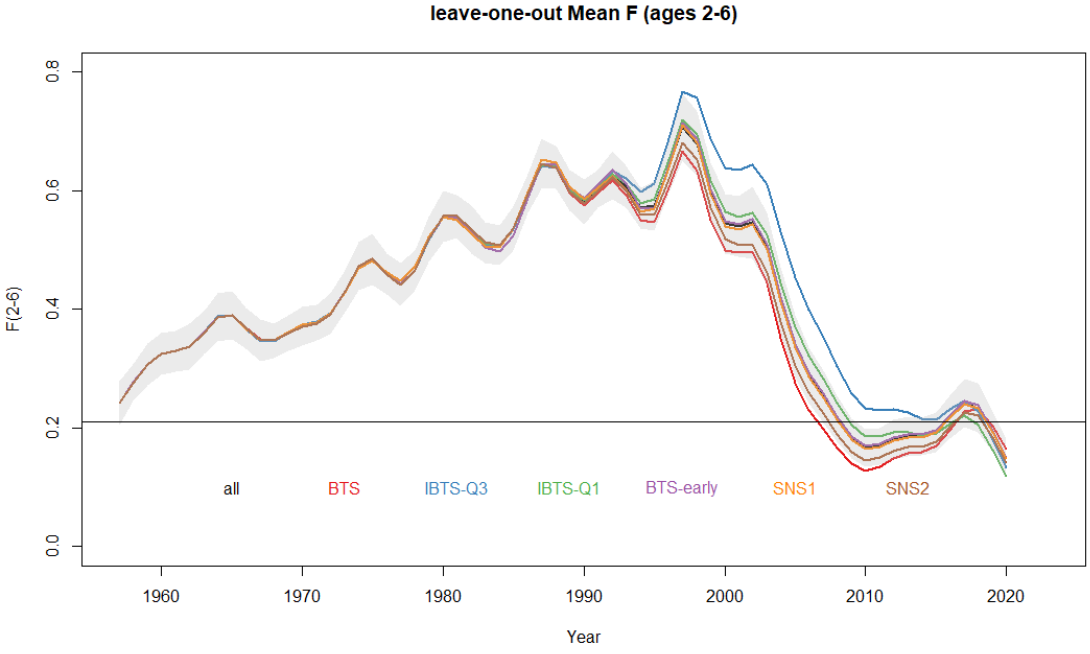


Figure 13.3.7. Yearly estimated delta-GAM indices for BTS, IBTS-Q3 and IBTS-Q1 since 2017.


leave-on-out SSB
Spawning Stock Biomass ('000 t)
0
200
400
600
800
1000
1200
all
BTS
IBTS-Q3
IBTS-Q1
BTS-early
SNS1
SNS2
1960
1970
1980
1990
2000
2010
2020
Year


leave-one-out Mean F (ages 2-6)
F(2-6)
0.0
0.2
0.4
0.6
0.8
all
BTS
IBTS-Q3
IBTS-Q1
BTS-early
SNS1
SNS2
1960
1970
1980
1990
2000
2010
2020
Year

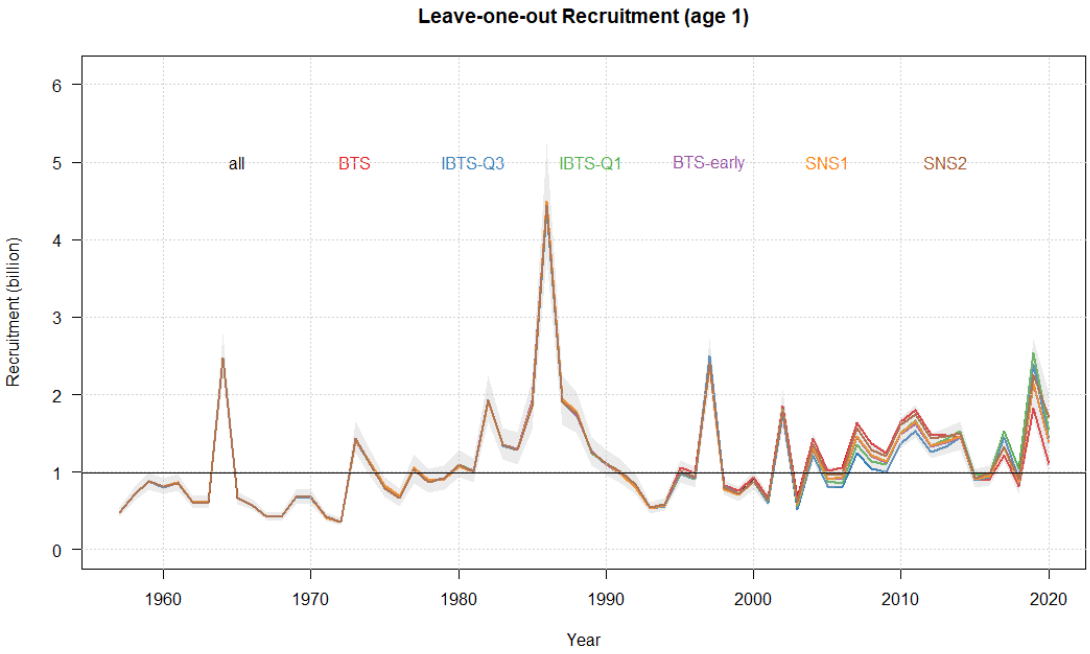


Figure 13.3.8. Leave one out runs.