3 Brill in Subarea 27.4, Divisions 3.a, 27.7.d and 27.7.e (bll.27.3a47de)

Brill (*Scophthalmus rhombus*) is assessed in the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK) since 2013. Because only official landings and survey data were available, brill in subarea 27.4, divisions 27.3.a, 27.7.d, e was defined as a category 3 stock (ICES, 2021). For this stock, advice is provided based on the LPUE trends of the Dutch beam trawl fleet (vessels > 221 kW). From 2020 onwards, the European Commission requests annual advice for this stock instead of biennial.

3.1 General

3.1.1 Stock definition

The genetic structure of brill over its entire distribution area was characterized by Vandamme (2014). Genetic variation was found to be of mean to high levels, but the results show almost no differentiation between potential biological populations and/or management units. Therefore, we still feel confident in treating brill in 3.a, 4 and 7.d, e as a single stock that could potentially have an even wider geographical spread. More information can be found in the Stock Annex.

3.1.2 Biology and ecosystem aspects

A general description of the available information on the biology and ecosystem aspects can be found in the Stock Annex.

3.1.3 Fisheries

Brill is mainly a high value bycatch species in fisheries for plaice and sole. Nine countries are involved in the fisheries: Belgium, Denmark, France, Germany, Ireland, The Netherlands, Norway, Sweden and UK (England, Northern Ireland, Scotland and the Channel Islands). The Netherlands landed most brill in 2020 (44%), followed by the UK (18.0%) and France (11.4%). Most brill is caught by the TBB fleet (61%), followed by the OTB fleet (29%) and the GTR fleet (8.3%).

3.1.3.1 Management

No explicit management objectives have been defined for the brill stock in 3.a, 4, 7.d, e, and no specific management objectives or plans are known to ICES. As a primarily bycatch species, regulations related to effort restrictions for the most important fleets catching brill (e.g. beam trawlers) are likely to impact the stock. Fishing effort has been restricted in the past for demersal fleets in a number of EC regulations (e.g. EC Council Regulation Nos. 2056/2001, 51/2006, 41/2007, and 40/2008).

A combined EU TAC for turbot and brill is set in areas 2.a and 4 and applies to EU fisheries (see table below).

Historical overview of combined TACs for brill *(Scophthalmus rhombus)* and turbot *(Scophthalmus maximus)* in Division 27.2.a and Subarea 27.4.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TAC	9000	9000	6750	5738	4877	4550	4323	4323	5263	5263	5263
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
TAC	4642	4642	4642	4642	4642	4488	5924*	7102	8122	6498	

*** the TAC was increased from 4937 to 5924 at the end of 2017.**

The management area (particularly the inclusion of Area 2.a) does not correspond to either of the stock areas defined by ICES for turbot and brill. Moreover, turbot (27.4) and brill (27.3a47de) cover different stock areas and have quantitative single species advice, but there is a combined TAC. This impedes sustainable management of one or both stocks. In 2018, ICES was requested to evaluate the role of TAC in the management of turbot and brill in the North Sea (ICES, 2018). It was concluded that turbot and brill should be managed using single-species TACs covering an area appropriate to the relevant stock distribution (for brill: Subarea 4, and divisions 3.a and 7.d–e; for turbot: Subarea 4). A TAC combining two high-value species (turbot and brill) under a low TAC can, in some instances, lead to the highgrading of the lesser-valued species (brill). Additionally, the advised catch for the entire brill stock seems to be used as the advice for Subarea 27.4 and Division 27.2a. This means that the advice is applied in the wrong way, involving a greater risk of overfishing the brill stock.

The combined TAC for brill and turbot has been restrictive in 2007, 2015 and 2016 (average overshoot 218 ± 197 tonnes; Figure 3.1). In 2016, some of the Member States with a share in the TAC, such as Belgium, Germany and The Netherlands asked for an advance of their quota for 2017, in order to prevent further overshooting (±10%). The TAC in 2017 was 4937 tonnes, but at the end of the year, it was increased to 5924 tonnes (±20%; 10% to compensate for the advance from 2016 and 10% for 2017). There were several reasons to justify this increase: a) after the inter-benchmark of turbot, a new advice (for 2018) was given, which meant a 148% increase against the previous TAC (2017)[1], b) similar to 2016, member states were asking an advance of their quota for next year (2018), c) observations and catches of fishermen did not seem to confirm the assessment (delay with data). Although no new advice was given in 2018 (no re-opening), the TAC for 2019 was increased to 8122 tonnes. The reason for this remains unclear. The combined TAC for brill and turbot was not restrictive in 2017, 2018, 2019 and 2020, and was undershot by 14%, 38%, 45% and 33% respectively (Figure 3.1).

No restriction on the minimum length for landing brill is imposed by the EC. Some authorities or producer organizations have however installed Minimum Conservation Reference Sizes (MCRS) for brill. Dutch producer organizations increased the MCRS when the TAC was limiting (e.g. from 27 cm to 30 cm in 2016 and later even to 32 cm). Moreover, weekly landings of turbot and brill are often capped to stay within the TAC (especially when the TAC is limiting). Following increases in advice in 2018-2019, PO measures were relaxed. An overview is shown in the table below.

[1] At WGNSSK 2018, a mistake was discovered in the final inter-benchmark run of turbot. This involved an even higher increase.

Dutch PO-measures			
Year	**Date**	**Max kg per week/trip**	**MCRS**
2016	January - March	-	27 cm
2016	April – May	-	30 cm
2016	May – September	-	32 cm
2016	October – November	375 kg	32 cm
2016	November – December	600 kg	32 cm
2017	January – February	-	32 cm
2017	March – October	800 kg	32 cm
2017	November - December	2000 kg	30 cm
2018	January – August	2000 kg	30 cm
2018	September - October	2500 kg	30 cm
2018	October - December	3000 kg	27 cm
2019	January – December	3000 kg	27 cm
2020	January - December	3000 kg	27 cm

Since 1 January 2019, brill is fully under the landing obligation. In 2020, Dutch producer organisations capped landings weekly for both turbot and brill to 3000 kg and had a MCRS of 27 cm. Belgium applied a MCRS of 30 cm from 1 January 2017. However, this was raised to 32 cm from 23/12/2020 onwards.

3.1.3.2 ICES advice

3.1.3.2.1 ICES advice for 2020

The ICES advice for 2020 was:

ICES advises that when the precautionary approach is applied, catches should be no more than 2559 tonnes in each of the years 2020 and 2021.

The stock status was presented as follows:

	Fishing pressure				Stock size			
		2016	2017	2018		2016	2017	2018
Maximum sustainable yield	F_{MSY}	✓	✓	✓ Below	MSY $B_{trigger}$	✓	✓	✓ Above
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓ Below possible reference points	B_{pa},B_{lim}	✓	✓	✓ Above possible reference points
Management plan	F_{MGT}	–	–	–	B_{MGT}	–	–	–

From 2020 onwards, the European Commission requests annual advice for the brill stock.

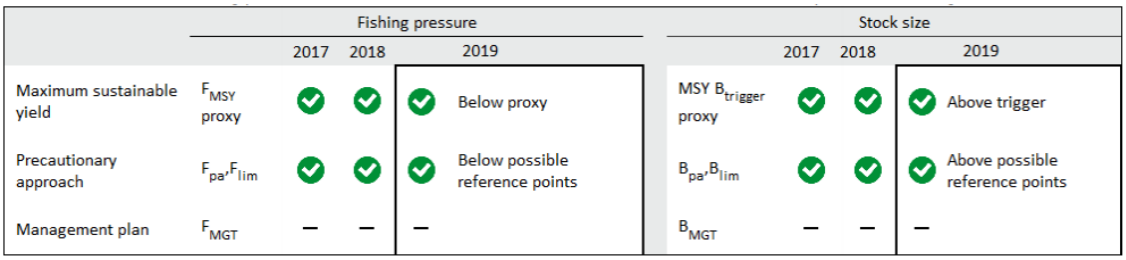
3.1.3.2.2 ICES advice for 2021

From 2020 onwards, the European Commission requests annual advice for the brill stock. Therefore, the previous biennial advice was replaced by the advice below.

The ICES advice for 2021 was:

ICES advises that when the precautionary approach is applied, catches in 2021 should be no more than 2047 tonnes.

The stock status was presented as follows:



		Fishing pressure				Stock size			
		2017	2018	2019			2017	2018	2019
Maximum sustainable yield	F_{MSY} proxy	✓	✓	✓	Below proxy	MSY $B_{trigger}$ proxy	✓	✓	✓ Above trigger
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓	Below possible reference points	B_{pa},B_{lim}	✓	✓	✓ Above possible reference points
Management plan	F_{MGT}	–	–	–		B_{MGT}	–	–	–

3.2 Data

From 2015 onwards, also discards by metier were requested from all countries contributing to this stock through InterCatch. For the WGNSSK data call in 2017 all available age and length data were requested through InterCatch for three years back in time (2014–2016). For the WGNSSK data calls from 2018 onwards, similarly both age and length data were requested from discards and landings.

3.2.1 Landings

Tables 3.1–3 summarize the official brill landings by country for Division 3.a, Subarea 27.4, and divisions 27.7.d-e respectively (Source: ICES Fishstat). The total official landings by area can be consulted in Table 3.4 and Figure 3.2. Over the period 1950–1970, total landings remained constant under 1000 tonnes (range from 582 to 947 tonnes), followed by a gradual increase to 2121 tonnes in 1977. From 1978 onwards, total landings remained higher than 1500 tonnes (range: 1517-3141 tonnes). In 1993, a maximum of 3141 tonnes was caught. From 2010-2020, total annual landings fluctuated around an average of 2209 tonnes (range: 1895-2538 tonnes). In 2015, landings peaked at 2538 tonnes to decrease again to 1895 tonnes in 2020 as lowest point of the last decade.

Subarea 27.4 accounts for the major part of the landings (Figure 3.3), on average generating 67±7% of the total landings over the time series (range: 50–86%). The English Channel and the Skagerrak-Kattegat area are responsible for average contributions to the international brill landings of 20±11% and 12±10% respectively. Skagerrak-Kattegat was responsible for a higher relative importance in the total landings during the first two decades of the time series, and the English Channel has gained importance since the late seventies. In 2020, the relative proportion of landings in Subarea 27.4 consisted of 62% of the total landings, for Division 27.3a 9% and for Division 27.7.d, e 29% (Table 3.5).

From 2014 onwards, data are available in InterCatch. Figure 3.4 shows the ICES catch estimates (both discards and landings provided through InterCatch) and the official catch statistics by country for 2020. The Netherlands fished the majority of the catches (predominantly in Subarea 4), followed by the UK and Denmark (Table 3.6). Denmark is responsible for the majority of the landings in Division 27.3a. Belgium and UK (England) have the highest landings in Division 27.7d and 27.7e respectively (Table 3.6). The most important gear types landing brill are TBB and OTB, followed by GTR and GNS (Table 3.7). Industrial bycatch landings (MIS_MIS_0_0_0_IBC) were uploaded in 2020: 2003 kg from Denmark, Germany and Sweden. No discards were raised for these strata.

For the WGNSSK data call in 2017, available age and length data were requested through InterCatch for three years back in time (2014–2016). From 2018 onwards, the WGNSSK data call also asked for both age and length. For assessment purposes age/length allocations in InterCatch did not need to be performed. Data quality of age readings has been verified in 2019 by an international otolith exchange coordinated by WGBIOP and appeared very successful (ICES, 2019).

3.2.2 Discards

Due to its high value, brill is not expected to be discarded a lot by fishermen as long as the quota have not been fully taken. Since January 2019, the stock is completely under the landing obligation.

Discard data from 2014–2020 are available in InterCatch. The proportion of landings for which discard weights are available in 2020 was 59%, which is comparable to previous years (table below). The proportion of imported discards was however lower than in 2019 (44% in 2020 versus 68% in 2019). It is unclear whether this is due to the Covid-19 pandemic.

Catch category	Survey	CATON (kg)	Percentage
BMS landing	Imported data	9	100
Discards	Imported data	100443	44
	Raised discards	128376	56
Landings	Imported data	1872411	100
Logbook registered discard	Imported data	0	NA
TOTAL		**2101239**	

Discards raising was performed on a gear level, regardless of season or country.

- The following groups were distinguished based on the gear:
  - TBB
  - OTB, SSC and SDN
  - GTR and GNS
- The remaining gears were combined in a REST group

All discard rates were retained during the raising (none were excluded for example due to being higher than average). Raised discards by country for 2020 are shown in Figure 3.4.

An overview of the overall discards and discard rates from 2014–2020 are shown in Table 3.8 and for 2018-2020 broken down by country and Subarea/Division in Table 3.9 and 3.10 respectively. There is no obvious trend over the period 2014–2020. However, discard rates are overall higher in the years 2018-2019. Discard rates higher than the overall rate for e.g. Denmark (28% in 2020), Sweden (26% in 2020) and Norway (23% in 2020). Additionally, higher discard rates seem to be present in the northern part of the stock area (31% in 27.3a). It should however be noted that brill in the greater North Sea is still a data limited stock. This means that countries supply all data they have. For Germany, the larger discard rate in 2019 (41%) was influenced by 1 sampled trip having a very high discard rate. In a future benchmark, InterCatch raising procedures should be investigated. Furthermore, data quality should be checked when considering moving brill up to a category 1 stock.

For assessment purposes age/length allocations in InterCatch did not need to be performed. Data quality of age readings has been verified in 2019 by an international otolith exchange coordinated by WGBIOP and appeared very successful (ICES, 2019).

3.2.3 BMS landings

The brill stock is under the landing obligation since January 2019.

The official catch statistics have reported BMS landings from 2018 onwards, with 681 kg in 2018, 2036 kg in 2019 and 779 kg in 2020.

In InterCatch, only 4 kg were reported in 2019 (0 kg prior to 2019) and 9 kg in 2020. BMS landings are raised together with discards as is described in §3.2.2.

3.2.4 Logbook registered discards

No logbook registered discards were uploaded to InterCatch.

3.2.5 Tuning series

3.2.5.1 Survey Data

General

Catches of brill are generally very low during surveys. These low catch numbers often result in an underrepresentation of some year or length classes (mainly the older or bigger ones), leading to a poor quality of the resulting survey abundance series and indices, and poor agreement among different surveys.

WGNEW 2012 (ICES, 2012) tested four surveys for their potential use in describing stock trends of brill in the greater North Sea. Three of these surveys take place in the North Sea (IBTS_TRI_Q1, BTS_TRI_Q3 and BTS_ISI_Q3) and one in the English Channel (CGFS_Q4). Time series of total numbers of brill caught by the three North Sea surveys and the Channel are depicted in WGNEW 2012 (ICES, 2012), but only the BTS_ISI_Q3 was found to catch a sufficient number of individuals to be useful in the context of evaluating stock trends of North Sea brill. WGNEW 2013 and the following WGNSSK-meetings did not go into these surveys again, with exception for the BTS_ISI_Q3 and BITS_HAF_Q1&4 that were updated because of their use as indicators in the advice in the North Sea and the Skagerrak respectively. Plots and tables for these surveys were also updated during WGNSSK 2021.

North Sea (Subarea 27.4)

The abundance indices (numbers per hour) for brill in the BTS_ISI_Q3 in 27.4 are spatially plotted per rectangle and for several years in Figure 3.5 and over time in Figure 3.6 and Table 3.11. The recorded numbers per hour are low (max. 2.95 individuals per hour in 2014) and inter-annual variation is large. In the period 2001-2008, however, consistently lower catches were realised (approximately 1 individual per hour). After a low in 2017, the CPUE increased again in 2018 and 2019. However, in 2020 the CPUE decreased again to the level of approximately 1 individual per hour.

The numbers at length are shown in Figure 3.7 and the corresponding age–length key is illustrated in Figure 3.8 (from 1992 onwards). The main part of the catches in this survey represent brill of ages 1–2 and lengths of 20–30 cm. No obvious shifts in length distributions are apparent over the time series (1987–2020), but a decrease in the numbers caught since the 1990s is unmistakable.

Kattegat (Division 27.3.a21)

The abundance indices (numbers per hour) for brill in the BITS_HAF quarter 1 (Q1) and quarter 4 (Q4) are spatially plotted per rectangle and for several years in Figure 3.9 and 3.12 respectively.

The index plotted over time for quarter 1 is shown in Figure 3.10 and Table 3.12 and for quarter 4 in Figure 3.13 and Table 3.13. Note that the quarter 1 survey includes the 2021 data point.

The quarter 1 index shows a gradual increase from 1996 to 2006. Up until 2015, the series fluctuates around 3 fish per hour. In 2017, the index reaches the highest point of the time series (approximately 8 fish per hour) to decrease again in 2018 (around 1 fish per hour). In 2019-2021, approximately 4 fish per hour are caught. The quarter 4 index shows a gradual increase from 1999 to 2007. The period 2007–2013 fluctuates around 4 fish per hour. In 2014–2015, the index increases up to 6 fish per hour to decrease in 2017 to just above 4 fish per hour. The highest point in the time series is observed in 2018 when almost 11 fish per hour are caught. In 2019, the index decreases to approximately 7 fish per hour. In 2020, a small increase to almost 8 fish per hour is observed. Although both indices have been showing more or less the same trend over the time series, the most recent years (2017-2020) show a contradictive pattern (Figure 3.14). The quarter 1 index showed an increase in 2017, while the quarter 4 index showed this peak one year later in 2018.

The corresponding length distributions for the BITS_HAF in quarter 1 and 4 in 27.3.a21 are shown in Figure 3.11 and 3.15. In some years, at least 2 cohorts are visible, e.g. 2018 in Q4.

Note that the BITS is performed using another research vessel since 2016 (Havfisken I and Havfisken II).

English Channel (Divisions 27.7.d, e)

Unfortunately, no useful survey index could be identified for the evaluation of the brill sub-stock in the English Channel during previous WGNEW meetings (ICES, 2010; 2012; 2013).

3.2.5.2 Commercial LPUE series

Although the survey indices presented above are useful indicators when evaluating the state of the brill stock in (parts of) the stock area, the spatial coverage of both surveys was evaluated as insufficiently spanning the stock area, and the catches too low, to use these surveys as a basis for catch advice by previous WGNEW and WGNSSK meetings.

A corrected Landings Per Unit of Effort (LPUE) series from the Dutch beam trawl fleet > 221 kW was presented and discussed for the first time during WGNEW 2013 (ICES, 2013 for interpretation), and has been used as the basis for the advice since. This LPUE was standardized for engine power and corrected for targeting behaviour. The standardisation for engine power is relevant as trawlers are likely to have higher catches with higher engine powers, as they can trawl heavier gear or fish at higher speeds. The correction for targeting behaviour relies on reducing the effects of spatial shifts in fishing effort by calculating the fishing effort by ICES rectangle and subsequently averaging these over the entire fishing area. More information on the data that were used (EU logbook auction data and market sampling data), the calculation of the LPUE's, the standardization of engine power, the correction for targeting behaviour and the results can be found in van der Hammen *et al*. (2011).

The Dutch LPUE series used during the WGNSSK 2021 is shown in Figure 3.16 and Table 3.14. The series shows a gradual increase in the LPUE (kg/day) up to 2012, dropping slightly over the period 2013–2014, but increasing again in 2015. In the period 2016–2018, a stronger decrease is observed (from 56 to 40 kg/day). While in 2019, an increase in the LPUE index is observed up to 48 kg/day, 2020 noted again a decrease up to 41 kg/day.

3.2.5.3 Dutch industry survey

Available fisheries independent surveys have a low catchability for large flatfish, which does not benefit the turbot and brill assessments. In 2018, the Dutch fishermen's association, VisNed,

together with Wageningen Marine Research initiated an industry survey to monitor turbot and brill in the North Sea.

After a trial year (2018), the survey design was optimised. The survey area in the central and southern North Sea was selected based on CPUE data. Areas not available for fishing (e.g. N2000, wind parks) were excluded (Figure 3.17). A 5 by 5 km grid was applied to the survey area and 60 grid cells were randomly selected from this grid (new selection every year). These 60 grid cells were divided among 3 vessels based on their regular fishing grounds (Figure 3.17). All vessels fished with the same gear (beam trawl) in autumn (quarter 3). Fishermen were allowed to start fishing at any location in the selected grid cell, they could fish any route and were allowed to exit the cell, but not the survey area. The haul duration was the same as for regular commercial hauls, 100-120 minutes.

In every haul, all turbot and brill were counted. Length, weight and sex were registered. Otoliths were collected per length class to determine age (the number of otoliths depended on sex and length class; Schram *et al.,* 2021). Fishing conditions were recorded, including a description of the gear and a list of all hauls.

In 2020, an alternative approach was used because no scientists could board the fishing vessels due to the Covid-19 pandemic. All sampled fish were therefore processed by the scientific team at the auction. In 2020, 59 of the 60 hauls could be realised, catching 454 brill. A comparison with previous years and surveys with research vessels is given in the table below (source Schram *et al.,* 2021). The numbers of brill caught during this industry survey were approximately 10 times higher than caught during the BTS (ISI/TRI Q3) survey.

Species	Survey	Year	Total N° caught	Total N° hauls	Occurrence (%)	CPUE (N°/h)
Brill	BSAS	2018	518	45	58.7	14.9
		2019	785	50	100	26.4
		2020	454	59	81.4	17.3
	BTS	2018	67	82	35.4	1.8
		2019	85	73	53.4	2.7
		2020	47	74	33.8	1.7
	SNS	2018	30	45	31.1	0.8
		2019	10	44	14	0.4
		2020	0	46	0	0.0

Length measurements ranged from 21 cm to 53 cm for brill in 2020 (Figure 3.18). Ageing was done for 454 brill, with most of them age 1 and 2 in 2020 (Schram *et al.,* 2021).

Once a period of 5 years is covered, the index of this new survey is a potential candidate to include in the brill assessment (indicative of trends).

3.3 Advice

3.3.1 Analyses of stock trends and potential status indicators

Advice is given based on the Dutch commercial LPUE series and the outcome of the Surplus Production in Continuous Time (SPiCT) model.

During the WGNSSK 2017, this stock showed to be a potential candidate to upgrade to a higher category (*i.e.* category 1). However, for an age or length-based assessment more data as well as resources are needed.

3.3.2 Dutch commercial LPUE series

As basis for the advice, the commercial LPUE series from the Dutch beam trawl fleet > 221 kW was used being the most reliable time series currently available. Last year, during the WGNSSK 2020, there was a 21% decrease when applying the 2:3 rule (capped by uncertainty cap, this resulted in a 20% decrease). This year (WGNSSK 2021), applying the 2:3 rule led to a 8.3% decrease. No uncertainty cap needed to be applied as the ratio did not imply a more than 20% change.

In order to decide whether the precautionary buffer should be applied, the Surplus Production in Continuous Time (SPiCT) model was run (see §3.3.3).

3.3.3 SPiCT

A Surplus Production Model in Continuous Time (SPiCT, Pedersen and Berg, 2017) was run during the WGNSSK 2021 to estimate the status of the stock against MSY proxy reference points. The procedure and settings of the SPiCT analysis were identical to the agreed method of the WGNSSK 2017 (ICES, 2017a), using the default priors.

A fishery independent survey time series (BTS_ISI_Q3 1987–2020; Table 3.11), a standardized LPUE from the Dutch beam-trawl fleet (with vessels > 221 kW; including age 0 and 1; 1995–2020; Table 3.14), and a catch time series (trimmed to 1987-2020; Table 3.15) were used as input for the model. The catch series includes official landings from 1987–2013 and InterCatch landings from 2014 onwards. The BITS surveys in quarter 1 and 4 were not used in the SPiCT run as was decided during WGNSSK 2017 (ICES, 2017a).

A summary of the SPiCT assessment is given in Figure 3.19 and in Table 3.16. The model diagnostics are shown in Figure 3.20. These results suggest that the relative fishing mortality is below the reference F_{MSY} proxy and the relative biomass is well-above the reference B_{MSY}* 0.5 proxy. Therefore, the Precautionary Approach Buffer (PA Buffer) was not applied for the advice for this stock.

The retrospective analysis shows a stable pattern, with all peels within the confidence bounds (Figure 3.21). Moreover, the Mohn's Rho values for F/F_{MSY} (0.005) and B/B_{MSY} (-0.023) were low. It was concluded that the model performed well and that the estimated stock status with respect to reference points is consistent.

3.3.4 2022 catch advice summary

An overview of the 2022 catch advice for brill 27.3a47de is shown in the table below. The change in advice is the result of a decline in the biomass index.

Index A (2019–2020)		45 kg d^{-1}
Index B (2016–2018)		49 kg d^{-1}
Index ratio (A/B)		0.92
Uncertainty cap	Not applied	-
Advised catch for 2021		2047 tonnes
Discard rate (2018–2020)		14.1%
Precautionary buffer	Not applied	-
Catch advice **		**1878** tonnes
Projected landings corresponding to catch advice ***		1613 tonnes
% advice change^		-8.3%

*** The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.**
**** [Advised catch for 2021] × [Index ratio].**
***** [Advised catch for 2021] × [Index ratio] × [1 – discard rate].**
^ Advice value for 2022 relative to the advice value for 2021.

3.3.5 Alternative advice using SPiCT forecast

WKLIFE X (ICES, 2020) investigated the performance of harvest control rules across life-history types through simulation and management strategy evaluation (MSE) for data-limited stocks. Recommendations include the application of the SPiCT forecast to provide advice. For exploratory purposes only, the current way of providing advice for brill in 27.3a47de (2 over 3 rule) was compared with the recommendations from WKLIFE X.

More specifically, WKLIFE X recommends using the fractile rule with 35th percentile of the predicted catch distribution for stocks with an accepted SPiCT assessment. In theory, this should be more precautionary than the median rule suggested by WKMSYCat34 and the 2 over 3 rule (ICES, 2017b; 2020).

Four catch scenarios were explored, not specifying any intermediate year assumptions. Considering that the input data are only landings, the output of the forecast will also be landings advice. An overview is given in the table below. The Fsq scenario implies that the F process continues after the intermediate year. F_{MSY} is defined as F/F_{MSY} equal to 1.

F in 2022-2023	Landings advice 2022	B/B_{MSY} (2023)	F/F_{MSY} (2023)
F = 0	0	2.2	0.00
F = Fsq	2069	1.32	0.72
F_{MSY}	2592	1.08	1.00
F_{MSY} 35% fractile	**2444**	1.15	0.91

The SPiCT forecast resulted in a landings advice of 2444 tonnes, which is 52% higher than the current landings advice based on the 2:3 rule (1610 tonnes). The output of the SPiCT assessment suggest that the brill stock is currently in a good state compared to proxy reference points. Consequently, it is not unusual to expect higher advice using the SPiCT forecast. Furthermore, the Dutch LPUE index currently used for advice only covers a part of the stock area (only 27.4). It is also a raw index (not modelled), which could be improved considering the changes in the Dutch beam trawl fleet (introduction and phasing-out of pulse trawlers).

More information on this alternative advice can be found in the Working Document 2 (Annex 9).

3.4 Biological reference points

The table below summarises all known reference points for brill in area 27.3a47de and their technical basis. No reference points are defined for this stock in terms of absolute values. The SPiCT-estimated values of the ratios F/F_{MSY} and B/B_{MSY} are used to estimate stock status relative to the proxy MSY reference points.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger_{proxy}}$	$\frac{B}{B_{MSY}} = 0.5$	Relative value from SPiCT model. B_{MSY} is estimated directly from the SPiCT assessment model and changes when the assessment is updated.	ICES (2017a)
	$F_{MSY_{proxy}}$	$\frac{F}{F_{MSY}} = 1$	Relative value from SPiCT model. F_{MSY} is estimated directly from the SPiCT assessment model and changes when the assessment is updated.	ICES (2017a)
Precautionary approach	B_{lim}	Not defined		
	B_{pa}	Not defined		
	F_{lim}	Not defined		
	F_{pa}	Not defined		
Management plan	SSB_{mgt}	Not defined		
	F_{mgt}	Not defined		

3.5 Quality of the assessment

→ The advice is based on a commercial biomass index (Dutch beam-trawl fleet, vessels > 221 kW) used as an indicator of stock size. Between 2014 and 2018 the use of pulse trawls in the Dutch fishery operating in the North Sea has increased to 76 vessels (65 of which are > 221 kW) and a handful of vessels operating with traditional beam trawls were left. The increased use of pulse trawls and other adaptations, like fuel-saving wings, may affect catchability and selectivity of North Sea brill. The effect of these changes on the LPUE as an index has not yet been quantified. As a result of the ban on the use of pulse gear from 2019 onwards, the composition of the Dutch fleet has gradually changed again. A modelled LPUE including these fleet characteristics as parameters in the model would benefit the brill assessment.

→ When the TAC is limiting, Dutch producer organizations increase the minimum market landing size and cap the weekly landings to stay within the TAC, which has likely biased the commercial biomass index downwards for 2016. These measures were relaxed in 2018 and 2019 following an upward revision in the TAC at the end of 2017 (§3.1.3.1 Management).

→ The current surveys in this area are not designed for catching brill, especially large brill. A survey, both with adequate catchability of large flatfish and covering the entire

distribution area of the stock, would improve the assessment. The Dutch industry survey initiative is a step in the right direction.

3.6 Management considerations

Brill is mainly a bycatch species in fisheries for plaice and sole. ICES was requested to evaluate the role of the TAC in the management of turbot and brill in the North Sea (ICES, 2018). ICES concluded that turbot and brill should be managed using single-species TACs covering an area appropriate to the relevant stock distribution (for brill: ICES Division 3.a, Subarea 4, and divisions 7.d and 7.e). A TAC combining two high-value species (turbot and brill) under a low TAC can, in some instances, lead to highgrading of the lesser-valued species (brill).

The assessment uses a commercial biomass index based only on landings; as a result, the index and the advice may be affected by the discard pattern.

3.7 Benchmark issue list

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be considered and/or quantified	Additional M - predator relations	Not at the moment		
	Prey relations	Not at the moment		
	Ecosystem drivers	Not at the moment		
	Other ecosystem parameters that may need to be explored?	Not at the moment		
New data	Currently a limited amount of brill data is available in InterCatch. Ask all countries involved in the fisheries to provide all available brill data on landings, discards, @age, @length including historical data.	Process data in InterCatch, use model to bridge gaps in time series (cfr. Turbot assessment)	Data from all countries involved in brill fisheries.	Expert in modelling (cfr. Turbot assessment)
Tuning series	Check whether BITS and BTS ISI still give an adequate estimation of the stock trends (cfr earlier analysis by WGNEW in 2012). Check whether there is survey information available in the 7d, e part of the stock area.	Analyse DATRAS data	Data available in DATRAS.	Survey experts
	Make the Dutch commercial tuning series more robust to changes in the fleet composition. Check whether this series can be extended, should be age-structured and should include age 0 and 1.	Model Dutch LPUE series	Dutch catch, effort and fleet information	Dutch experts in LPUE modelling

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
	Check whether any commercial tuning series could be used in the assessment (besides the Dutch LPUE series currently used)	Analyse data and construct index	Catch and effort information from all countries involved in the brill fisheries	Experts from each Member State providing the data
	Check the potential use of the recently initiated Dutch industry survey.	Analyse data	Data from the Dutch industry survey	Dutch experts on the brill-turbot industry survey
Discards	Discards are not included in the 'assessment' (LPUE biomass index)	Considering that discarding of larger length classes occurs when the TAC is restrictive, it should be verified whether the NL LPUE could be revised to a CPUE index.	Discard data from all countries involved in the brill fisheries	Dutch experts to revise the LPUE index
Biological Parameters	When using length-based indicators, correct information on length at maturity (L_{mat}), and length von Bertalanffy growth curve ($L_{inifinity}$) are needed. Determine the sex ratio in the stock area.	van der Hammen et al (2011) suggested values for L_{inf} and L_{mat} based on Dutch market samples; check whether these are representative for the entire fleet fishing on brill	Data from surveys and commercial sampling on maturity (at age/length per sex) and on individual weights (at age/length per sex)	Experts on biological parameters, stock coordinator
Assessment method	Currently a biomass index is calculated in combination with a SPiCT assessment. Explore whether other assessment methods can be used/further developed (SPiCT/SAM).	Investigate all available data and use them in SPiCT, SAM or length-based indicator analyses	A longer time-series of age and/or length data is needed from all countries involved in the fisheries.	Experts on length-based indicators, SPiCT and SAM; experts on the Dutch biomass index currently used
Biological Reference Points	Determine MSY (proxy) reference points	Depending on the assessment method and available data	See issue 'assessment method'	Experts in computation of reference points

3.8 References

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11-15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21. 185 pp.

ICES. 2012. Report of the Working Group on Assessment of New MoU Species (WGNEW), 5-9 March 2012. ICES CM 2012/ACOM: 20. 258 pp.

ICES. 2013. Report of the Working Group on Assessment of New MoU Species (WGNEW), 18-22 March 2013, ICES HQ, Copenhagen, Denmark. ACOM.

ICES. 2017a. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). ICES Scientific Reports. https://doi.org/10.17895/ices.pub.5323

ICES, 2017b. Report of the Workshop on the Development of the ICES approach to providing MSY advice for category 3 and 4 stocks (WKMSYCat34), 6–10 March 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:47. 53 pp.

ICES. 2018. EU request for ICES to provide advice on a revision of the contribution of TACs to fisheries management and stock conservation. ICES Special Request Advice Northeast Atlantic ecoregions sr.2018.15, https://doi.org/10.17895/ices.pub.4531

ICES. 2019. Working Group on Biological Parameters (WGBIOP). ICES Scientific Reports. 1:85. 93 pp. http://doi.org/10.17895/ices.pub.5682

ICES. 2020. Tenth Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE X). ICES Scientific Reports. 2:98. 72 pp. http://doi.org/10.17895/ices.pub.5985

ICES. 2021. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. https://doi.org/10.17895/ices.advice.7720.

Pedersen, M. W., and Berg, C. W. 2017. A stochastic surplus production model in continuous time. Fish and Fisheries, 18: 226–243. doi: 10.1111/faf.12174.

Schram, E., Hintzen, N., Batsleer, J., Wilkes, T., Bleeker, K., Amelot, M., van Broekhoven, W., Ras, D., de Boer, E., Trapman, B., Steins, N.A., 2021. Industry survey turbot and brill in the North Sea. Wageningen University & Research report C037/21.

Vandamme, S., 2014. Seascape genetics in support of sustainable fisheries management of flatfish. Doctoral thesis. 304 pp.

van der Hammen, T., Poos, J.J., Quirijns, F.J., 2011. Data availability for the evaluation of stock status of species without catch advice: Case study: turbot (*Psetta maxima*) and brill (*Scophthalmus rhombus*). IMARES Wageningen UR, Report number C109/11.

Table 3.1: BLL 27.3a47de – Official landings (tonnes) of brill in Subdivision 27.3a (Skagerrak/Kattegat) by country, over the period 1950–2020 (Source: ICES Fishstat); *Preliminary.

Year	BEL	GER	DNK	NLD	NOR	SWE	BMS	TOTAL
1950	0	0	234	0	0	85		319
1951	0	0	260	0	4	73		337
1952	0	0	170	0	1	65		236
1953	0	0	175	0	0	71		246
1954	0	0	155	0	1	78		234
1955	0	0	150	0	0	62		212
1956	0	0	163	0	0	50		213
1957	0	0	110	0	0	38		148
1958	0	0	166	0	0	37		203
1959	0	0	175	0	0	58		233
1960	0	0	272	0	0	46		318
1961	0	0	255	0	0	50		305
1962	0	0	207	0	0	0		207
1963	0	0	120	0	0	0		120
1964	0	0	106	0	0	0		106
1965	0	0	155	0	0	0		155
1966	0	0	187	0	0	0		187
1967	0	0	106	0	0	0		106
1968	0	0	100	0	0	0		100
1969	0	0	99	0	0	0		99
1970	0	0	97	0	0	0		97
1971	0	0	104	0	0	0		104
1972	0	0	120	0	0	0		120
1973	0	0	131	0	0	0		131
1974	0	0	200	0	0	0		200
1975	0	0	167	1	0	19		187
1976	1	0	185	26	0	12		224
1977	1	0	276	99	0	12		388
1978	0	0	178	27	0	11		216
1979	0	0	156	17	0	11		184
1980	2	0	69	1	0	10		82
1981	0	0	54	0	0	5		59
1982	1	0	64	1	0	8		74
1983	0	0	73	3	0	7		83
1984	0	0	89	0	0	8		97
1985	0	0	100	0	0	10		110
1986	0	0	94	0	0	13		107
1987	0	0	93	0	0	12		105
1988	0	0	91	0	0	10		101

Year	BEL	GER	DNK	NLD	NOR	SWE	BMS	TOTAL
1989	0	0	88	0	0	9		97
1990	1	0	116	0	0	11		128
1991	1	0	81	0	7	10		99
1992	1	0	123	0	7	15		146
1993	2	0	184	0	10	16		212
1994	0	0	191	0	12	19		222
1995	0	0	124	0	13	14		151
1996	0	0	94	0	12	6		112
1997	0	0	83	0	11	12		106
1998	0	0	108	0	10	14		132
1999	0	0	126	0	13	18		157
2000	0	0	112	0	12	17		141
2001	0	0	73	0	13	12		98
2002	0	0	66	0	12	12		90
2003	0	0	99	1	12	16		128
2004	0	0	119	4	15	18		156
2005	0	0	101	3	16	13		133
2006	0	1	105	3	16	14		140
2007	0	1	119	3	15	22		160
2008	0	2	138	1	13	28		181
2009	0	1	98	1	14	32		146
2010	0	1	95	1	9	16		122
2011	0	1	103	0	15	12		131
2012	0	0	89	0	16	15		120
2013	0	0	70	0	9	13		92
2014	0	0	59	0	8	11		79
2015	0	0	104	11	8	21		145
2016	0	0	125	7	8	28		168
2017	0	0	131	4	8	27		170
2018	0	0	90	9	9	17	<1	125
2019*	0	2	93	25	3	15	<1	139
2020*	0	1	112	29	3	17	<1	162

Table 3.2: BLL 27.3a47de – Official landings (tonnes) of brill in Subarea 27.4 by country, over the period 1950–2020 (Source: ICES Fishstat); *Preliminary.

Year	BEL	GER	DNK	FRA	GBR	NLD	NOR	SWE	BMS	TOTAL
1950	34	0	39	0	183	108	1	19		384
1951	23	0	53	0	322	93	1	19		511
1952	21	0	65	0	350	117	3	9		565
1953	23	0	49	0	376	130	0	11		589
1954	19	0	53	0	330	106	14	7		529
1955	23	0	51	0	357	137	3	0		571
1956	28	0	47	0	276	156	0	9		516
1957	32	0	27	0	247	154	0	8		468
1958	43	0	42	0	223	162	0	10		480
1959	41	0	30	0	219	125	0	9		424
1960	55	0	37	0	235	150	1	8		486
1961	102	0	40	0	264	166	0	9		581
1962	97	0	42	0	238	214	0	0		591
1963	79	0	59	0	307	175	0	0		620
1964	79	0	46	0	161	279	0	0		565
1965	71	0	56	0	127	281	0	0		535
1966	100	0	63	0	119	264	0	0		546
1967	138	0	29	0	105	137	0	0		409
1968	152	0	43	0	110	274	0	0		579
1969	145	0	47	0	102	364	0	0		658
1970	114	0	42	0	76	386	0	0		618
1971	187	0	72	0	94	720	0	0		1073
1972	213	0	65	0	51	665	0	0		994
1973	185	0	55	0	39	710	0	0		989
1974	135	0	68	0	44	905	0	0		1152
1975	164	0	76	13	44	925	0	0		1222
1976	148	0	65	10	45	940	0	0		1208
1977	166	0	88	17	60	1079	0	0		1410
1978	175	0	123	26	84	967	0	0		1375
1979	188	0	154	10	103	908	0	0		1363
1980	129	0	104	8	45	747	0	0		1033
1981	148	0	66	5	42	957	0	0		1218
1982	182	0	53	11	41	1007	0	0		1294
1983	182	0	62	23	28	1153	0	0		1448
1984	190	0	73	30	29	1200	0	0		1522
1985	187	0	71	35	46	1370	0	0		1709
1986	131	0	76	4	46	950	0	0		1207
1987	140	0	50	17	48	715	0	0		970
1988	102	0	33	18	52	880	0	0		1085

Year	BEL	GER	DNK	FRA	GBR	NLD	NOR	SWE	BMS	TOTAL
1989	112	0	43	9	58	1080	0	0		1302
1990	168	0	139	24	82	480	0	0		893
1991	205	38	145	28	147	1111	8	0		1682
1992	203	59	77	34	218	1196	22	1		1810
1993	291	63	118	38	268	1647	14	0		2439
1994	208	90	109	28	235	1235	11	0		1916
1995	194	67	55	24	145	943	6	0		1434
1996	206	47	64	15	175	732	8	0		1247
1997	129	48	38	1	135	590	16	0		957
1998	160	58	58	11	172	808	16	0		1283
1999	161	51	91	0	156	805	16	0		1280
2000	167	77	93	16	141	998	16	0		1508
2001	182	66	67	12	158	1075	13	0		1573
2002	145	58	52	10	120	907	10	0		1302
2003	145	70	57	9	119	934	12	0		1346
2004	140	66	77	7	168	772	19	0		1249
2005	120	62	89	7	138	716	28	0		1160
2006	105	55	75	9	154	765	12	0		1175
2007	110	47	52	12	156	854	9	0		1239
2008	117	42	86	5	93	650	11	0		1004
2009	109	54	96	8	105	786	4	0		1162
2010	104	75	97	12	136	1072	4	0		1499
2011	101	57	122	13	137	1061	6	0		1496
2012	110	71	126	12	122	1084	7	0		1532
2013	101	63	123	10	118	972	4	0		1390
2014	99	69	96	9	117	857	9	0		1255
2015	154	115	122	7	136	1159	1	0		1695
2016	175	90	131	8	156	965	1	0		1526
2017	138	76	121	7	116	1000	2	0		1460
2018	98	80	96	6	100	805	2	0	<1	1188
2019*	116	132	90	5	110	922	1	0	2	1378
2020*	84	99	95	2	91	809	1	0	<1	1183

Table 3.3: BLL 27.3a47de – Official landings (tonnes) of brill in Subdivisions 27.7.d, e (English Channel) by country, over the period 1950–2020 (Source: ICES Fishstat); *Preliminary.

Year	BEL	DNK	FRA	GBR	IRL	NLD	XCI	BMS	TOTAL
1950	11	0	0	48	0	0	0		59
1951	8	0	0	70	0	0	0		78
1952	6	0	0	66	0	0	0		72
1953	2	0	0	60	0	0	0		62
1954	1	0	0	59	0	0	0		60
1955	4	0	0	57	0	0	0		61
1956	2	0	0	58	0	0	0		60
1957	4	0	0	66	0	0	0		70
1958	2	0	0	65	0	0	0		67
1959	1	0	0	58	0	0	0		59
1960	6	0	0	46	0	0	0		52
1961	1	0	0	46	0	0	0		47
1962	3	0	0	52	0	0	0		55
1963	1	0	0	50	0	0	0		51
1964	0	0	0	60	0	0	0		60
1965	2	0	0	46	0	0	0		48
1966	0	0	0	53	0	0	0		53
1967	1	0	0	66	0	0	0		67
1968	3	0	0	54	0	0	0		57
1969	2	0	121	67	0	0	0		190
1970	10	0	0	49	0	0	0		59
1971	18	0	0	48	0	0	0		66
1972	20	0	0	52	0	3	0		75
1973	20	0	0	70	0	0	0		90
1974	25	0	0	56	0	0	0		81
1975	24	0	55	56	0	0	2		137
1976	41	0	170	72	0	0	2		285
1977	45	0	197	77	0	0	4		323
1978	58	3	227	120	0	0	3		411
1979	55	0	262	140	0	0	2		459
1980	64	2	213	118	3	0	2		402
1981	83	0	271	130	0	0	6		490
1982	105	0	225	149	0	1	7		487
1983	107	0	234	181	0	1	3		526
1984	114	0	226	186	0	0	5		531
1985	94	0	213	177	0	0	10		494
1986	115	0	183	147	0	0	11		456
1987	126	0	216	141	0	0	10		493
1988	112	0	202	133	0	0	5		452

Year	BEL	DNK	FRA	GBR	IRL	NLD	XCI	BMS	TOTAL
1989	89	0	213	121	0	0	2		425
1990	99	0	249	187	0	0	8		543
1991	81	0	249	140	0	0	0		470
1992	82	0	223	151	0	0	7		463
1993	78	0	256	152	0	0	4		490
1994	88	0	227	170	0	0	5		490
1995	91	0	248	200	1	0	18		558
1996	105	0	240	253	0	0	10		608
1997	107	0	185	198	1	0	10		501
1998	70	0	196	173	0	2	10		451
1999	97	0	0	127	0	3	13		240
2000	164	0	260	232	1	4	17		678
2001	212	0	256	251	0	2	17		738
2002	204	0	268	227	0	1	16		716
2003	217	0	287	238	1	1	15		759
2004	165	0	259	223	1	3	15		666
2005	138	0	267	183	0	2	21		611
2006	180	0	281	170	0	3	14		648
2007	205	0	325	199	0	1	13		743
2008	155	0	224	199	0	2	16		595
2009	131	0	278	171	0	1	13		594
2010	145	0	340	198	0	1	15		700
2011	141	0	304	202	0	0	18		665
2012	120	0	263	228	0	1	12		624
2013	142	0	238	213	0	1	11		605
2014	166	0	245	219	0	1	13		645
2015	162	0	278	248	0	2	9		698
2016	143	0	286	284	0	1	6		721
2017	135	0	276	246	0	2	3		663
2018	128	0	280	248	1	2	55		714
2019*	103	0	284	262	0	3	2	<1	655
2020*	91	0	209	246	0	2	1	<1	550

Table 3.4: BLL 27.3a47de – Total official landings (tonnes) of brill in the 27.3a47de (Greater North Sea) over the period 1950–2020, subdivided into Subarea 27.4 and Divisions 27.3.a and 27.7.d, e (Source: ICES Fishstat). *Preliminary.

Year	3.a	4	7.de	TOTAL
1950	319	384	59	762
1951	337	511	78	926
1952	236	565	72	873
1953	246	589	62	897
1954	234	529	60	823
1955	212	571	61	844
1956	213	516	60	789
1957	148	468	70	686
1958	203	480	67	750
1959	233	424	59	716
1960	318	486	52	856
1961	305	581	47	933
1962	207	591	55	853
1963	120	620	51	791
1964	106	565	60	731
1965	155	535	48	738
1966	187	546	53	786
1967	106	409	67	582
1968	100	579	57	736
1969	99	658	190	947
1970	97	618	59	774
1971	104	1073	66	1243
1972	120	994	75	1189
1973	131	989	90	1210
1974	200	1152	81	1433
1975	187	1222	137	1546
1976	224	1208	285	1717
1977	388	1410	323	2121
1978	216	1375	411	2002
1979	184	1363	459	2006
1980	82	1033	402	1517
1981	59	1218	490	1767
1982	74	1294	487	1855
1983	83	1448	526	2057
1984	97	1522	531	2150
1985	110	1709	494	2313
1986	107	1207	456	1770
1987	105	970	493	1568
1988	101	1085	452	1638

Year	3.a	4	7.de	TOTAL
1989	97	1302	425	1824
1990	128	893	543	1564
1991	99	1682	470	2251
1992	146	1810	463	2419
1993	212	2439	490	3141
1994	222	1916	490	2628
1995	151	1434	558	2143
1996	112	1247	608	1967
1997	106	957	501	1564
1998	132	1283	451	1866
1999	157	1280	240	1677
2000	142	1508	678	2327
2001	98	1573	738	2409
2002	89	1302	716	2108
2003	129	1346	759	2233
2004	156	1249	666	2071
2005	133	1160	611	1904
2006	140	1175	648	1963
2007	160	1239	743	2142
2008	181	1004	595	1781
2009	146	1162	594	1902
2010	122	1499	700	2321
2011	131	1496	665	2292
2012	120	1532	624	2276
2013	92	1390	605	2088
2014	79	1255	645	1978
2015	145	1695	698	2537
2016	168	1526	721	2415
2017	170	1460	663	2292
2018	125	1188	714	2027
2019*	139	1378	655	2172
2020*	162	1183	550	1895

Table 3.5: BLL 27.3a47de – Overview of absolute landings per area over the last 11 years with an indication of the relative proportion by area (Source: ICES Fishstat).

	Absolute landings (tonnes)				Relative proportion		
Year	**3a**	**4**	**7de**	**TOTAL**	**3a**	**4**	**7de**
2010	122	1499	700	2321	0.05	0.65	0.30
2011	131	1496	665	2292	0.06	0.65	0.29
2012	120	1532	624	2276	0.05	0.67	0.27
2013	92	1390	605	2087	0.04	0.67	0.29
2014	79	1255	645	1979	0.04	0.63	0.33
2015	145	1695	698	2538	0.06	0.67	0.28
2016	168	1526	721	2415	0.07	0.63	0.30
2017	170	1460	663	2293	0.07	0.64	0.29
2018	125	1188	714	2027	0.06	0.59	0.35
2019	139	1378	655	2172	0.06	0.63	0.30
2020	162	1183	550	1895	0.09	0.62	0.29

Table 3.6: BLL 27.3a47de – Overview of 2020 catches reported to InterCatch (ICES) by country and area.

	3a		4			7d			7e		Total			
COUNTRY	**DIS**	**LAN**	**BMS**	**DIS**	**LAN**	**BMS**	**DIS**	**LAN**	**DIS**	**LAN**	**BMS**	**DIS**	**LAN**	**ALL**
Belgium	0	0		12	69		3	106	0	0		15	175	190
Denmark	66	112		15	95		0	0	0	0		81	207	288
France	0	0		1	3		4	37	45	173		50	213	263
Germany	0	1		14	99		0	0	0	0		14	100	114
Ireland	0	0		0	0		0	0	0	0		0	0	0
Netherlands	2	33		40	784		0	2	0	0		42	819	861
Norway	1	3		0	1		0	0	0	0		1	4	5
Sweden	6	17		0	0		0	0	0	0		6	17	22
UK (England)	0	0	0	5	69	0	3	13	10	232	0	18	314	332
UK (Northern Ireland)	0	0		0	0		0	0	0	0		0	0	0
UK (Scotland)	0	0		1	22		0	1	0	0		1	23	24
Total	74	166	0	89	1142	0	10	159	56	406	0	229	1872	**2101**

Table 3.7: BLL 27.3a47de – Overview of 2020 landings for the most important gear types per area (Source: InterCatch).

Gear type	3a	4	7d	7e	Total
DRB	0	0	5	1	6
FPO	0	0	0	0	0
GNS	12	43	5	8	68
GTR	1	2	6	80	88
LLS	0	0	0	0	0
MIS	4	12	8	14	38
OTB	116	283	17	112	528
SDN	2	1	0	0	3
SSC	0	4	2	0	6
TBB	32	796	116	190	1134
Total	**166**	**1142**	**159**	**406**	**1872**

Table 3.8: BLL 27.3a47de – Overall discards and discard rates (all countries and métiers) for brill over the period 2014–2020 (Source: InterCatch).

Year	Discards	Discard rate
2014	231	0.107
2015	230	0.085
2016	267	0.099
2017	208	0.086
2018	349	0.151
2019	417	0.163
2020	229	0.109

Table 3.9: BLL 27.3a47de – Discard rates for brill by country for 2018-2020 (source: InterCatch).

Country	Discard rate 2018	Discard rate 2019	Discard rate 2020
Belgium	0.090	0.063	0.079
Denmark	0.30	0.197	0.28
France	0.180	0.154	0.192
Germany	0.167	0.41	0.125
Ireland			
Netherlands	0.107	0.160	0.049
Norway	0.191	0.169	0.23
Sweden	0.30	0.40	0.26
UK (England)	0.128	0.065	0.053
UK (Northern Ireland)	0.34		0.21
UK(Scotland)	0.28	0.066	0.041
Overall	**0.151**	**0.163**	**0.109**

Table 3.10: BLL 27.3a47de – Discard rates for brill by area for 2018-2020 (Source: InterCatch).

Subarea/ Division	Discard rate 2018	Discard rate 2019	Discard rate 2020
27.3.a	0.41	0.28	0.31
27.4	0.120	0.186	0.072
27.7.d	0.20	0.073	0.059
27.7.e	0.092	0.087	0.121
Overall	**0.151**	**0.163**	**0.109**

Table 3.11: BLL 27.3a47de – Survey index (N°/h) for brill in the BTS_ISI_Q3, Subarea 27.4.

Year	N°/hr	Year	N°/hr
1985	0.400	2003	1.084
1986	0.297	2004	0.938
1987	2.104	2005	0.696
1988	0.686	2006	0.963
1989	1.037	2007	1.244
1990	2.362	2008	0.588
1991	1.731	2009	1.556
1992	2.819	2010	2.435
1993	2.326	2011	2.677
1994	1.719	2012	1.177
1995	1.294	2013	0.833
1996	0.585	2014	2.950
1997	1.422	2015	1.930
1998	1.666	2016	1.070
1999	0.894	2017	0.870
2000	2.554	2018	1.448
2001	0.886	2019	2.000
2002	0.881	2020	0.935

Table 3.12: BLL 27.3a47de – Survey index (N°/h) for brill in the BITS_HAF_Q1, Division 27.3a21 (Kattegat).

Year	N°/hr
1996	1.778
1997	0.273
1998	0.500
1999	0.714
2000	1.071
2001	0.643
2002	1.929
2003	1.379
2004	2.000
2005	1.714
2006	3.867
2007	3.214
2008	2.733
2009	2.038
2010	2.897
2011	3.286
2012	2.533
2013	1.571
2014	2.857
2015	3.556
2016	4.857
2017	7.923
2018	1.077
2019	4.279
2020	3.619
2021	3.714

Table 3.13: BLL 27.3a47de – Survey index (N°/h) for brill in the BITS_HAF_Q4, Division 27.3a21 (Kattegat).

Year	N°/hr
1999	2.857
2000	0.316
2001	1.800
2002	2.071
2003	1.929
2004	3.310
2005	2.897
2006	4.759
2007	5.117
2008	4.400
2009	3.750
2010	4.839
2011	5.034
2012	3.000
2013	3.831
2014	6.090
2015	6.636
2016	4.667
2017	4.273
2018	10.870
2019	7.137
2020	7.815

Table 3.14: BLL 27.3a47de – Commercial LPUE (kg/day) for brill by the Dutch beam trawl fleet > 221 kW, Subarea 27.4.

Year	LPUE (kg/day)
1995	19.670
1996	19.187
1997	13.387
1998	23.752
1999	22.973
2000	24.077
2001	26.099
2002	22.150
2003	26.463
2004	27.062
2005	25.861
2006	26.557
2007	32.379
2008	39.580
2009	40.467
2010	50.008
2011	52.385
2012	55.820
2013	53.553
2014	45.612
2015	62.160
2016	56.210
2017	49.554
2018	39.956
2019	47.745
2020	41.360

Table 3.15: BLL 27.3a47de – Commercial landings (tonnes) for brill as input for SPiCT. Note that from 1987–2013 landings represent official landings. From 2014 onwards, landings as reported in InterCatch were used.

Year	Landings (tonnes)
1987	1568
1988	1638
1989	1824
1990	1564
1991	2251
1992	2419
1993	3141
1994	2628
1995	2143
1996	1967
1997	1564
1998	1866
1999	1677
2000	2328
2001	2409
2002	2107
2003	2234
2004	2071
2005	1904
2006	1963
2007	2142
2008	1781
2009	1902
2010	2321
2011	2292
2012	2276
2013	2088
2014	1920
2015	2470
2016	2444
2017	2207
2018	1956
2019	2147
2020	1872

Table 3.16: BLL 27.3a47de – SPiCT summary output from the analyses performed during the WGNSSK 2021.

```
Convergence: 0  MSG: both X-convergence and relative convergence (5)
Objective function at optimum: 6.3785146
Euler time step (years):  1/16 or 0.0625
Nobs C: 34,  Nobs I1: 34,  Nobs I2: 26

Priors
     logn  ~  dnorm[log(2), 2^2]
 logalpha  ~  dnorm[log(1), 2^2]
  logbeta  ~  dnorm[log(1), 2^2]

Model parameter estimates w 95% CI
            estimate        cilow        ciupp    log.est
 alpha1    3.5607788    1.3688684 9.262502e+00  1.2699793
 alpha2    0.4778991    0.0491669 4.645147e+00 -0.7383556
 beta      0.1387485    0.0244980 7.858250e-01 -1.9750920
 r         0.7902021    0.2484809 2.512947e+00 -0.2354665
 rc        2.2076350    1.3626447 3.576613e+00  0.7919218
 rold      2.7812373    0.0753871 1.026075e+02  1.0228959
 m      2221.7690127 2078.3120859 2.375128e+03  7.7060590
 K      6526.9656512 3092.0564207 1.377765e+04  8.7836974
 q1        0.0007227    0.0004516 1.156500e-03 -7.2325430
 q2        0.0188862    0.0118365 3.013470e-02 -3.9693241
 n         0.7158811    0.2629858 1.948720e+00 -0.3342412
 sdb       0.1315298    0.0537620 3.217902e-01 -2.0285216
 sdf       0.2096083    0.1464058 3.000948e-01 -1.5625148
 sdi1      0.4683486    0.3635571 6.033453e-01 -0.7585423
 sdi2      0.0628580    0.0144104 2.741863e-01 -2.7668772
 sdc       0.0290828    0.0054610 1.548815e-01 -3.5376068

Deterministic reference points (Drp)
          estimate        cilow       ciupp   log.est
 Bmsyd 2012.804622 1228.3794562 3298.152233 7.6072844
 Fmsyd    1.103817    0.6813224    1.788306 0.0987746
 MSYd  2221.769013 2078.3120859 2375.128153 7.7060590
Stochastic reference points (Srp)
          estimate        cilow      ciupp   log.est  rel.diff.Drp
 Bmsys 2001.363309 1216.8773442 3291.58490 7.6015839 -0.0057167599
 Fmsys    1.103182    0.6835372    1.78046 0.0981989 -0.0005759005
 MSYs  2207.861016 2068.6619097 2356.42675 7.6997795 -0.0062993083

States w 95% CI (inp$msytype: s)
                   estimate        cilow       ciupp    log.est
 B_2020.94      2385.9432034 1364.1031577 4173.236414  7.7773498
 F_2020.94         0.7893766    0.4354516    1.430964 -0.2365117
 B_2020.94/Bmsy    1.1921590    0.8627742    1.647294  0.1757659
 F_2020.94/Fmsy    0.7155451    0.4884693    1.048182 -0.3347106

Predictions w 95% CI (inp$msytype: s)
                  prediction        cilow       ciupp    log.est
 B_2022.00      2585.0374213 1441.7208789 4635.029268  7.8574953
 F_2022.00         0.7893769    0.3803339    1.638339 -0.2365114
 B_2022.00/Bmsy    1.2916383    0.8994567    1.854819  0.2559114
 F_2022.00/Fmsy    0.7155454    0.4045980    1.265467 -0.3347102
 Catch_2021.00  1976.4125636 1500.7469008 2602.841705  7.5890386
 E(B_inf)       2691.2676216           NA          NA  7.8977676
```

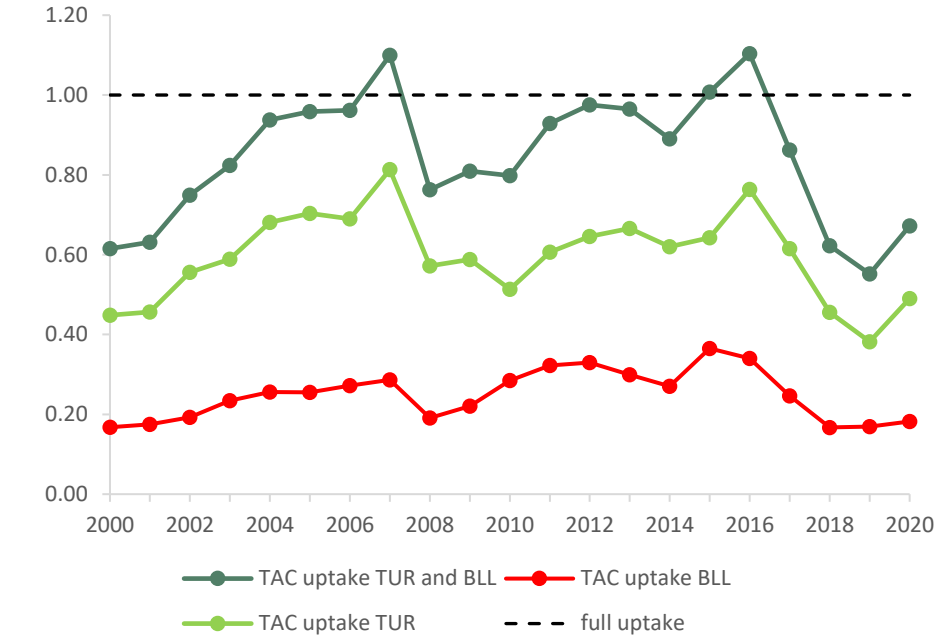


Figure 3.1: BLL 27.3a47de – TAC uptake for both brill and turbot in area 2.a and 4.

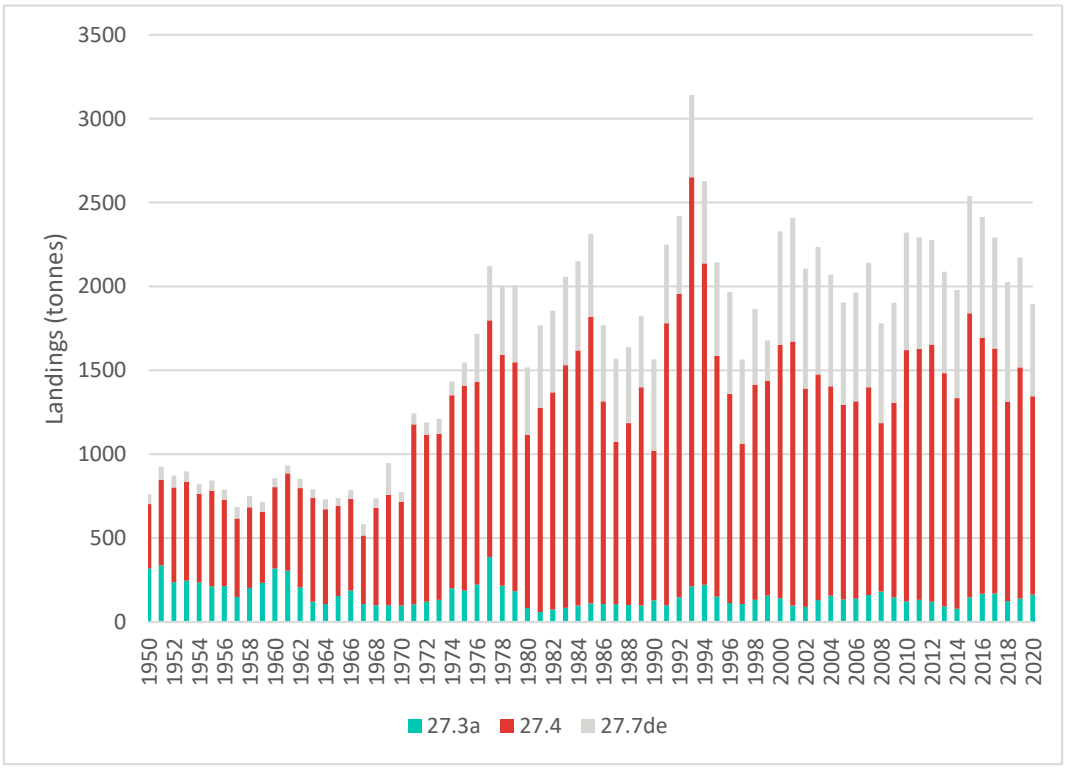


Figure 3.2: BLL 27.3a47de – Official landings (tonnes) over the period 1950–2020, as officially reported (Rec 12; ICES Fishstat).

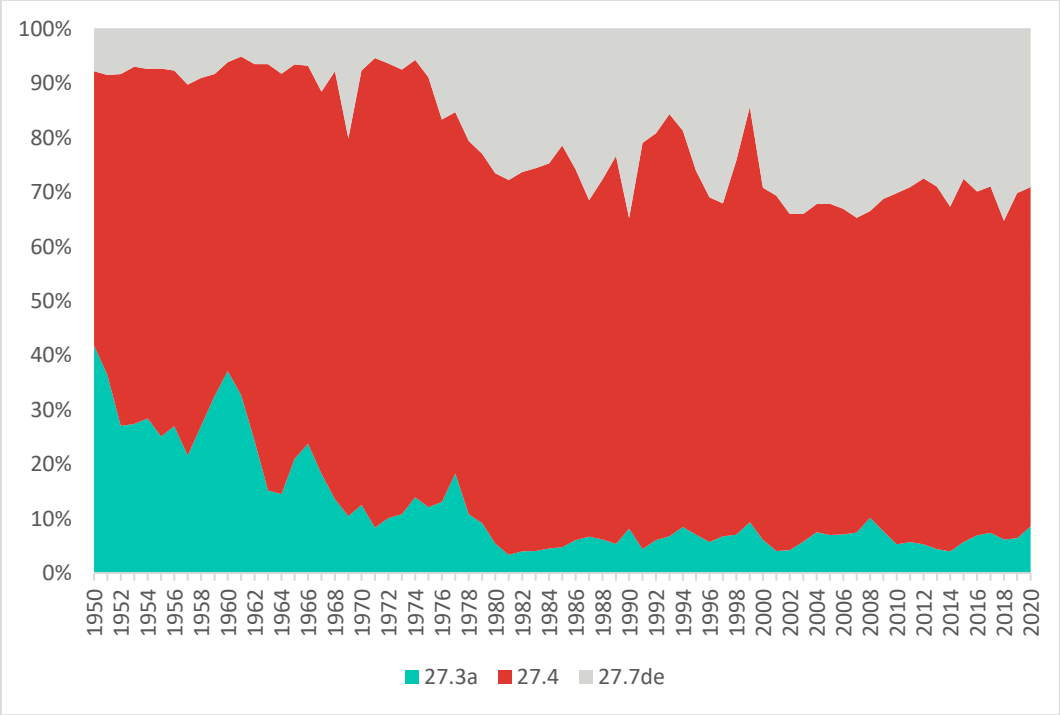


Figure 3.3: BLL 27.3a47de – Relative contribution of the official landings for brill from Subarea 27.4, Division 27.3.a and 27.7.d,e to the total international landings (tonnes) in the Greater North Sea over the period 1950–2020 (Source: ICES Fishstat).

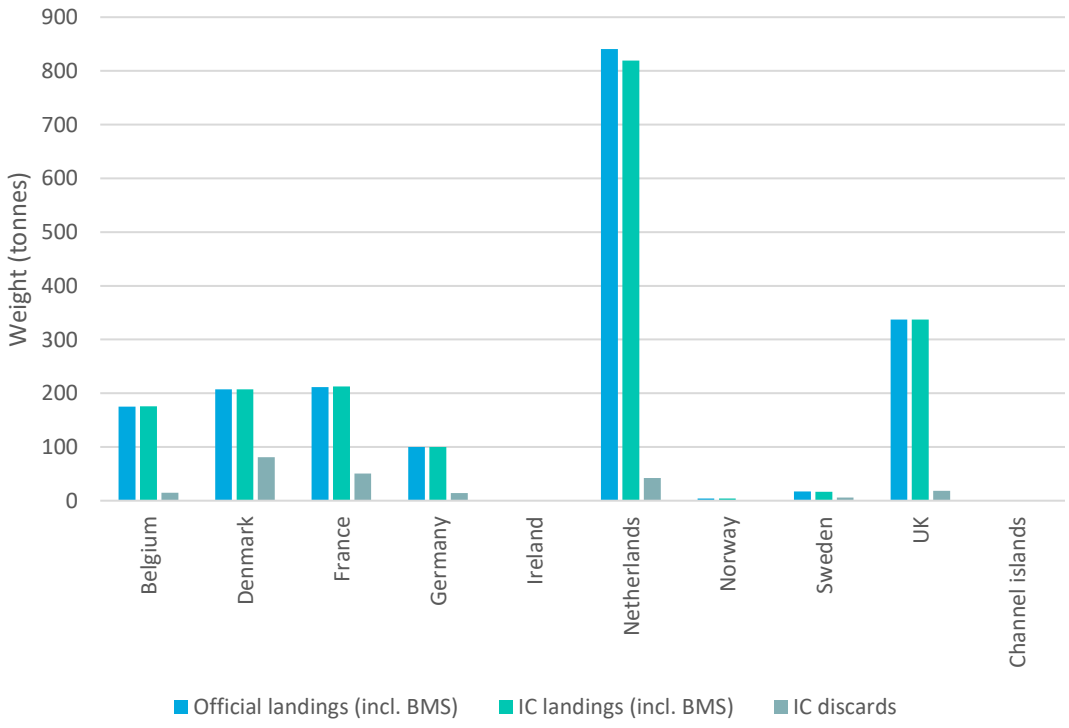


Figure 3.4: BLL 27.3a47de – Comparing ICES catch estimates (InterCatch, IC) to the official catch statistics by country for 2020.

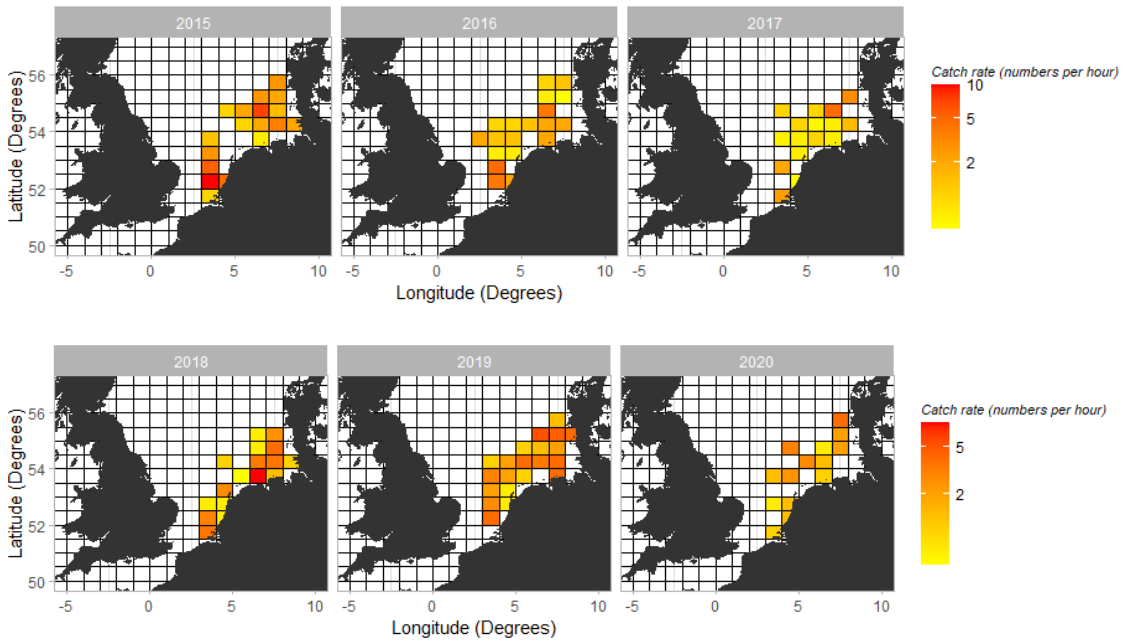


Figure 3.5: BLL 27.3a47de – Average numbers of brill caught per hour and rectangle by BTS_ISI_Q3 in the North Sea (27.4) for 2015-2020; note the slightly different scales for the different graphs.

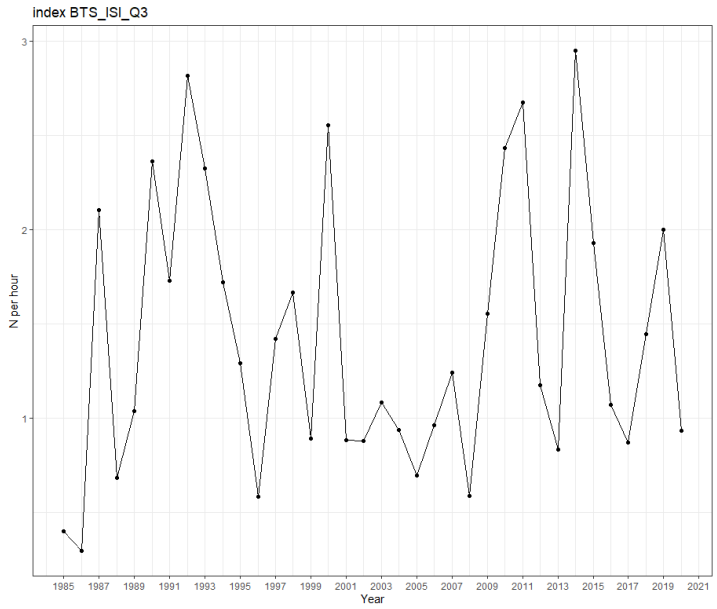


Figure 3.6: BLL 27.3a47de – Abundance index (numbers caught per hour) of brill for the BTS_ISI_Q3 in the North Sea (27.4) over the period 1985–2020.

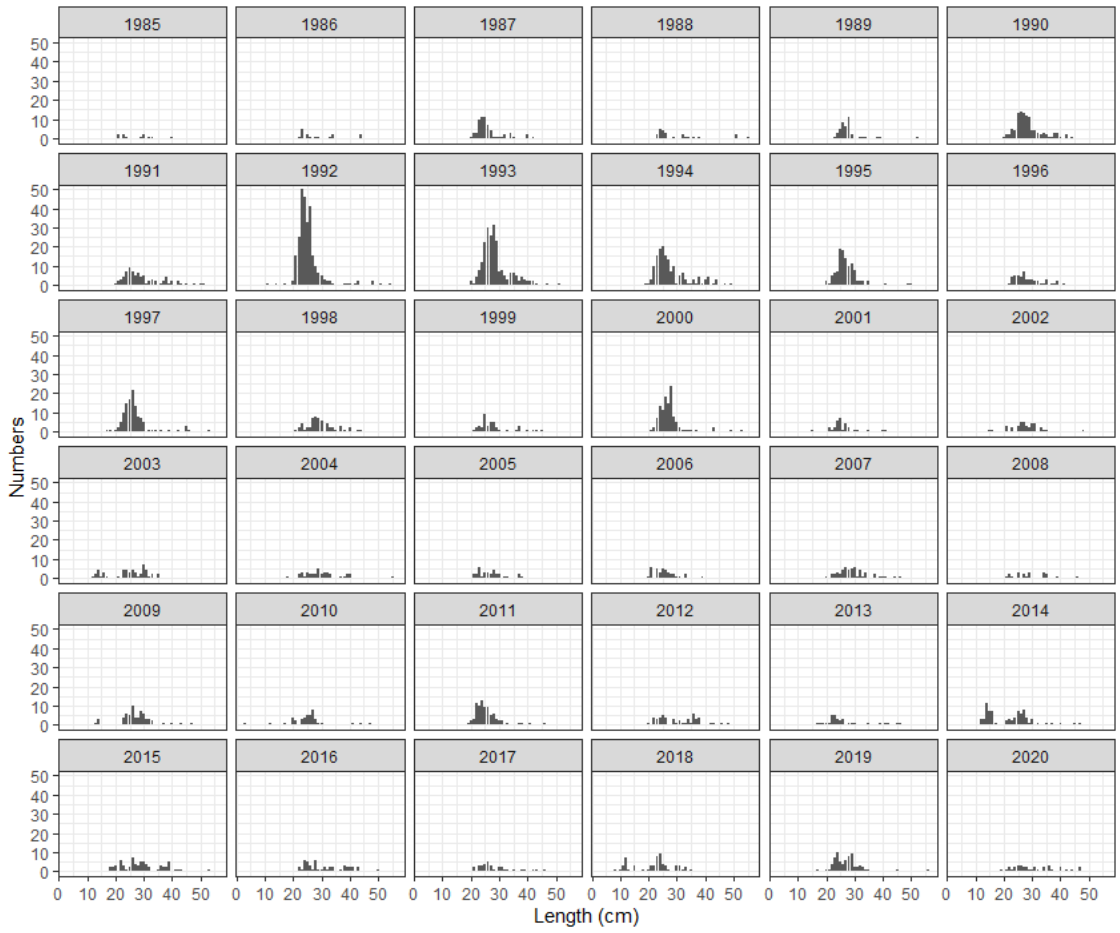


Figure 3.7: BLL 27.3a47de – Length distributions of brill in the North Sea (27.4) as documented in the BTS_ISI_Q3 (1985–2020).

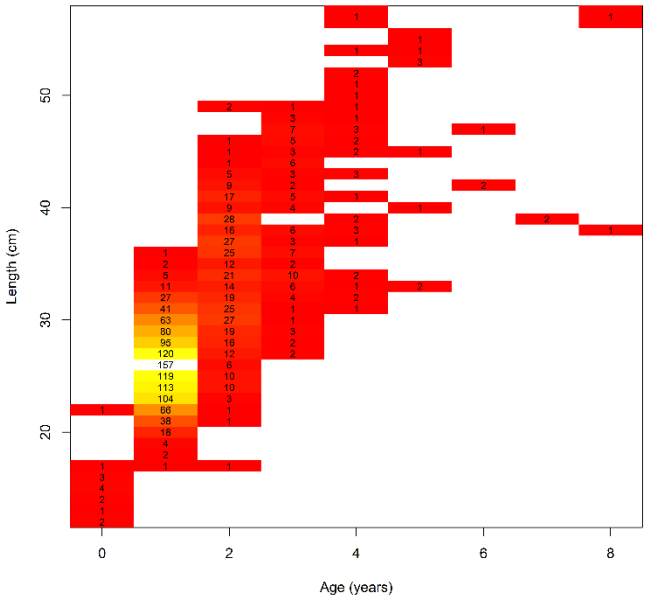


Figure 3.8: BLL 27.3a47de – Age-length key of brill in the North Sea (27.4) as documented by the BTS_ISI_Q3 (1992–2020).

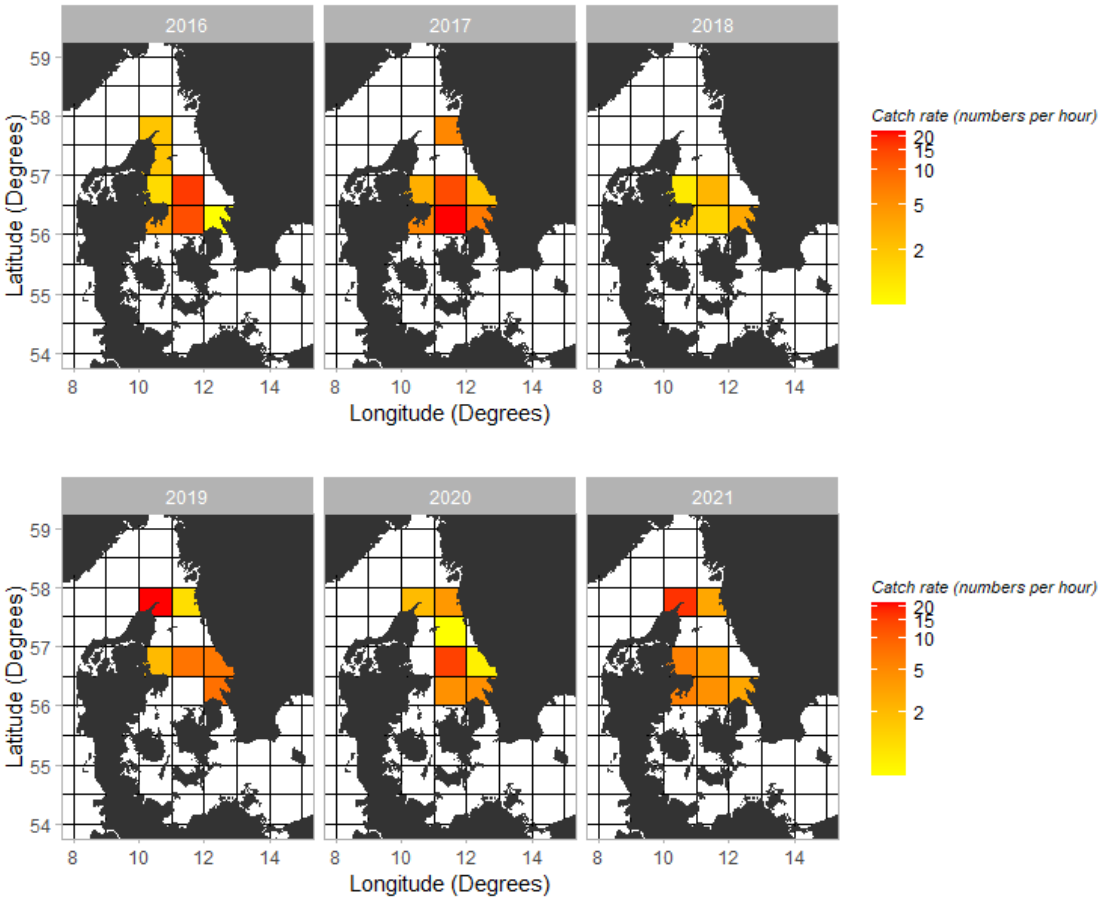


Figure 3.9: BLL 27.3a47de – Numbers of brill caught per hour and rectangle by BITS_HAF_Q1 in the Kattegat (27.3.a21) in 2016-2021.

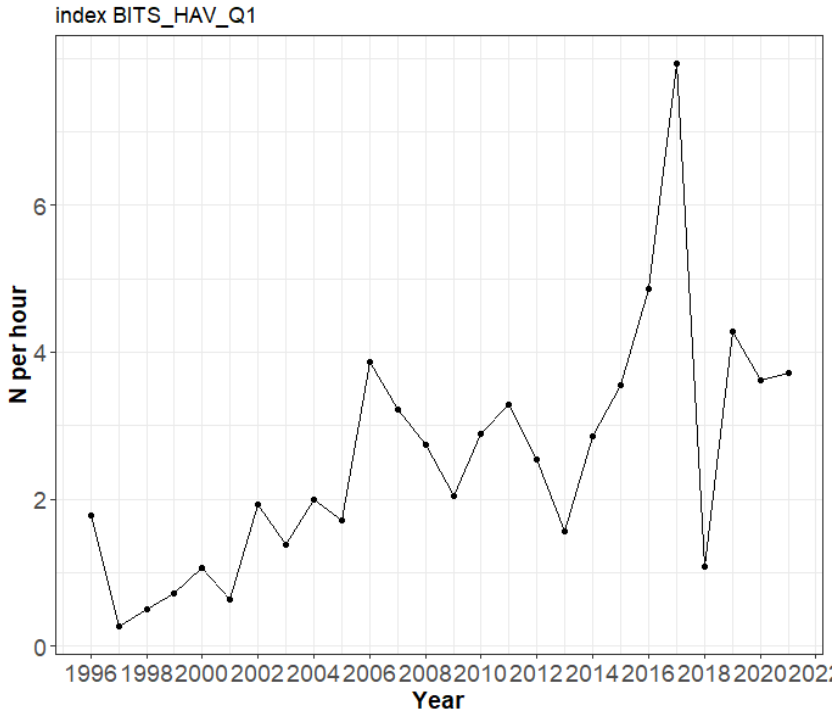


Figure 3.10: BLL 27.3a47de – Abundance index (numbers caught per hour) of brill for the BITS_HAF in the Kattegat (Q1) over the period 1996–2021.

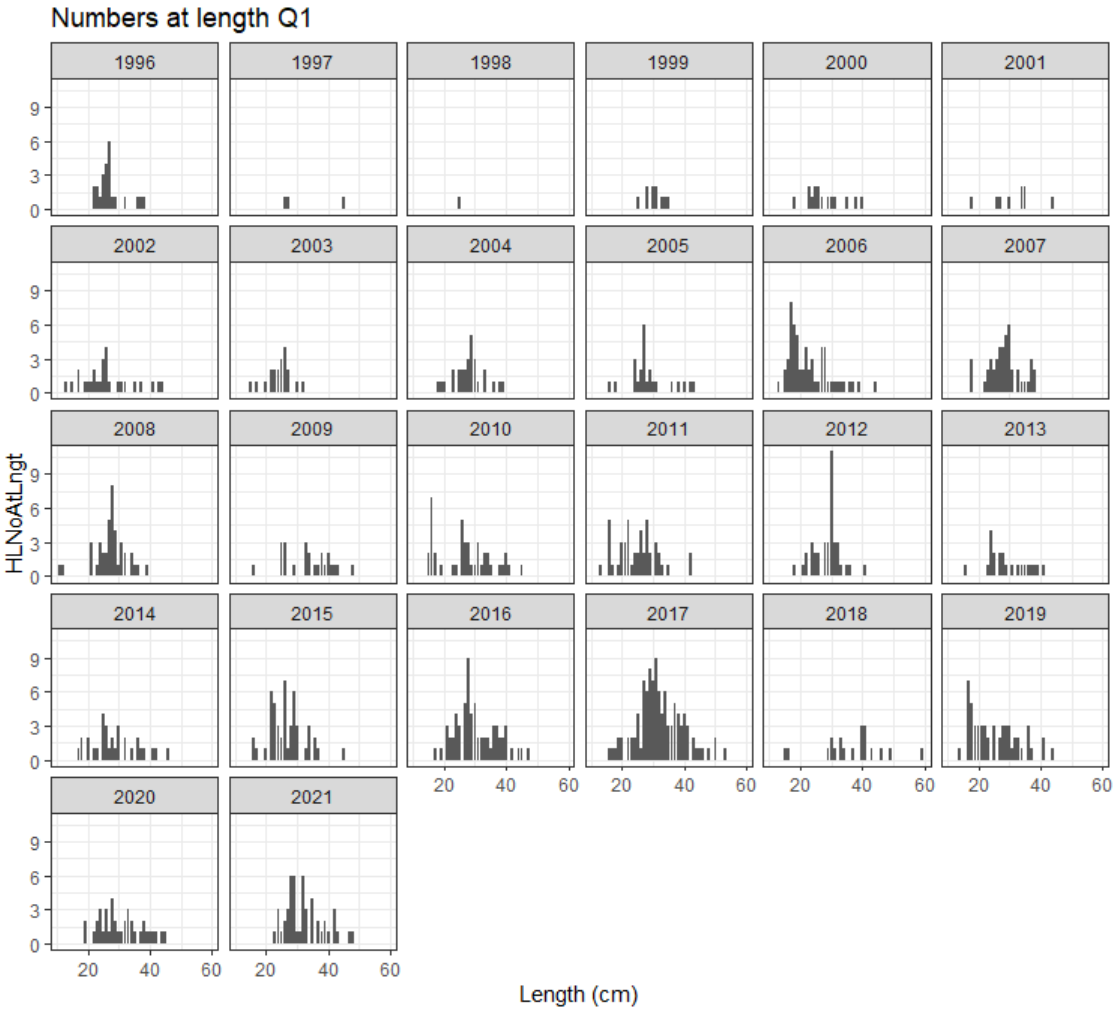


Figure 3.11: BLL 27.3a47de – Length distributions of brill in the Kattegat as documented in the BITS_HAF_Q1 (1996–2021).

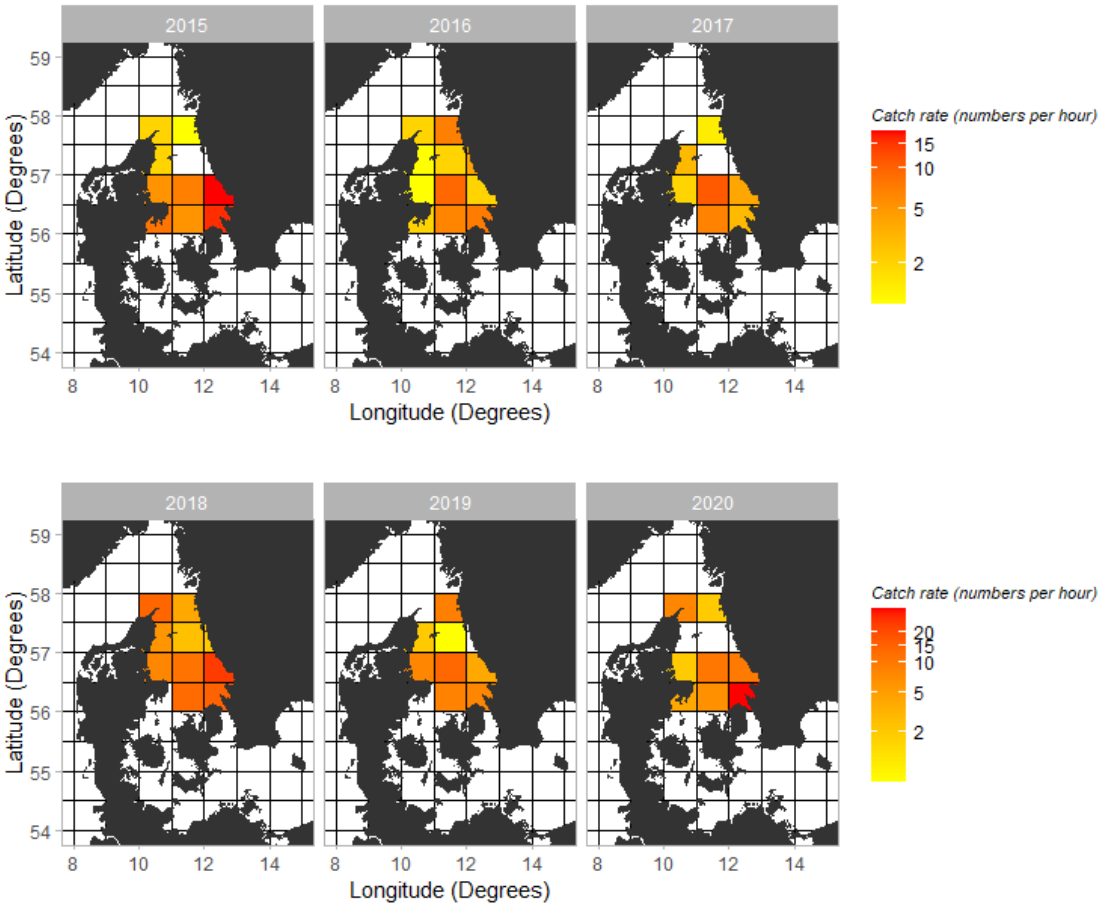


Figure 3.12: BLL 27.3a47de – Numbers of brill caught per hour and rectangle by BITS_HAF_Q4 in the Kattegat (27.3.a21) in 2015-2020; note the slightly different scales for the different graphs.

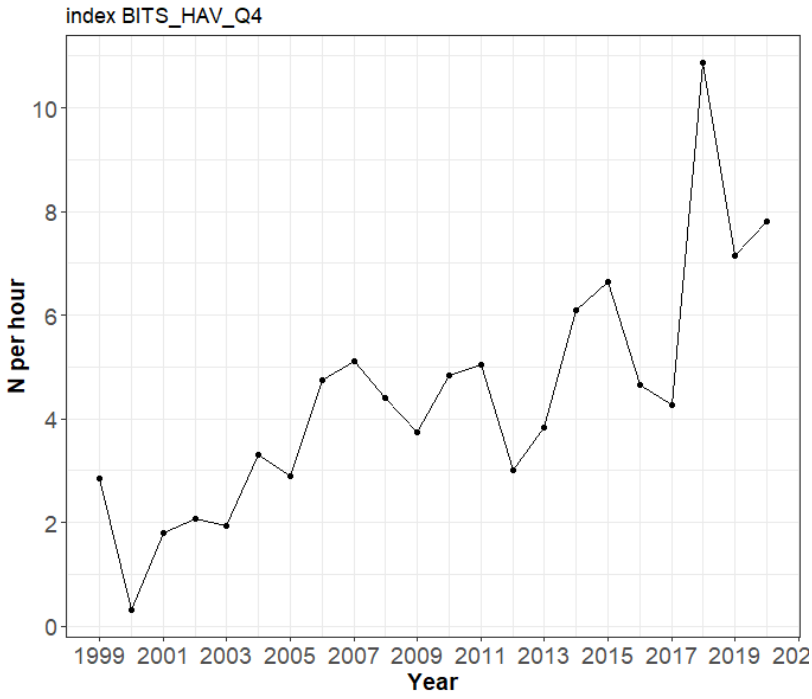


Figure 3.13: BLL 27.3a47de – Abundance index (numbers caught per hour) of brill for the BITS_HAF in the Kattegat (Q4) over the period 1999–2020.

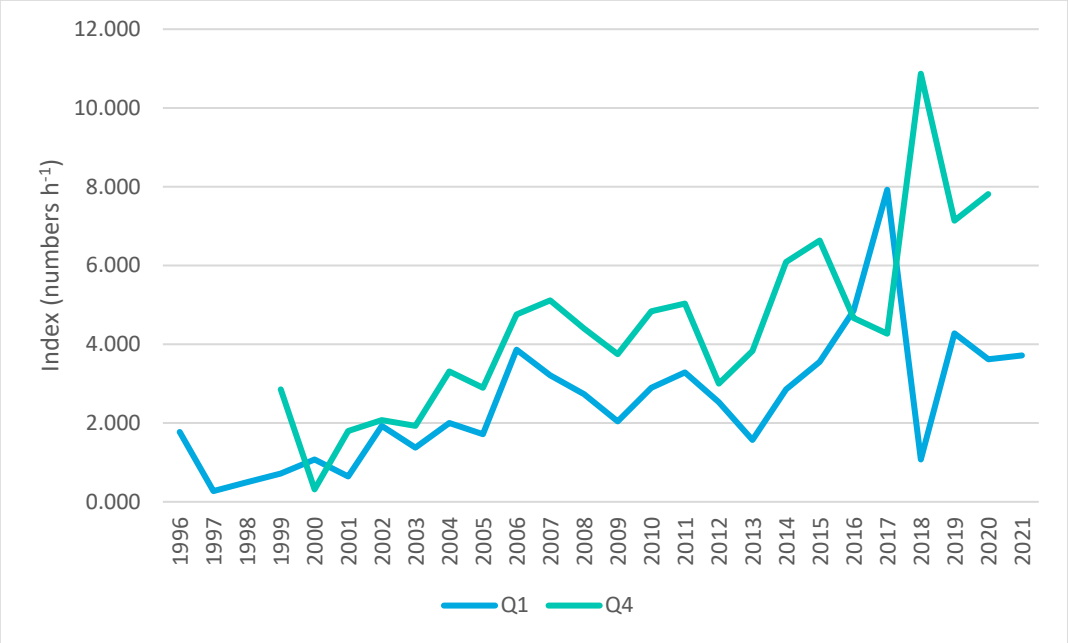


Figure 3.14: BLL 27.3a47de – Abundance indices (numbers caught per hour) of brill for both quarters (Q1 and Q4) of the BITS_HAF in the Kattegat over the period 1996–2021.

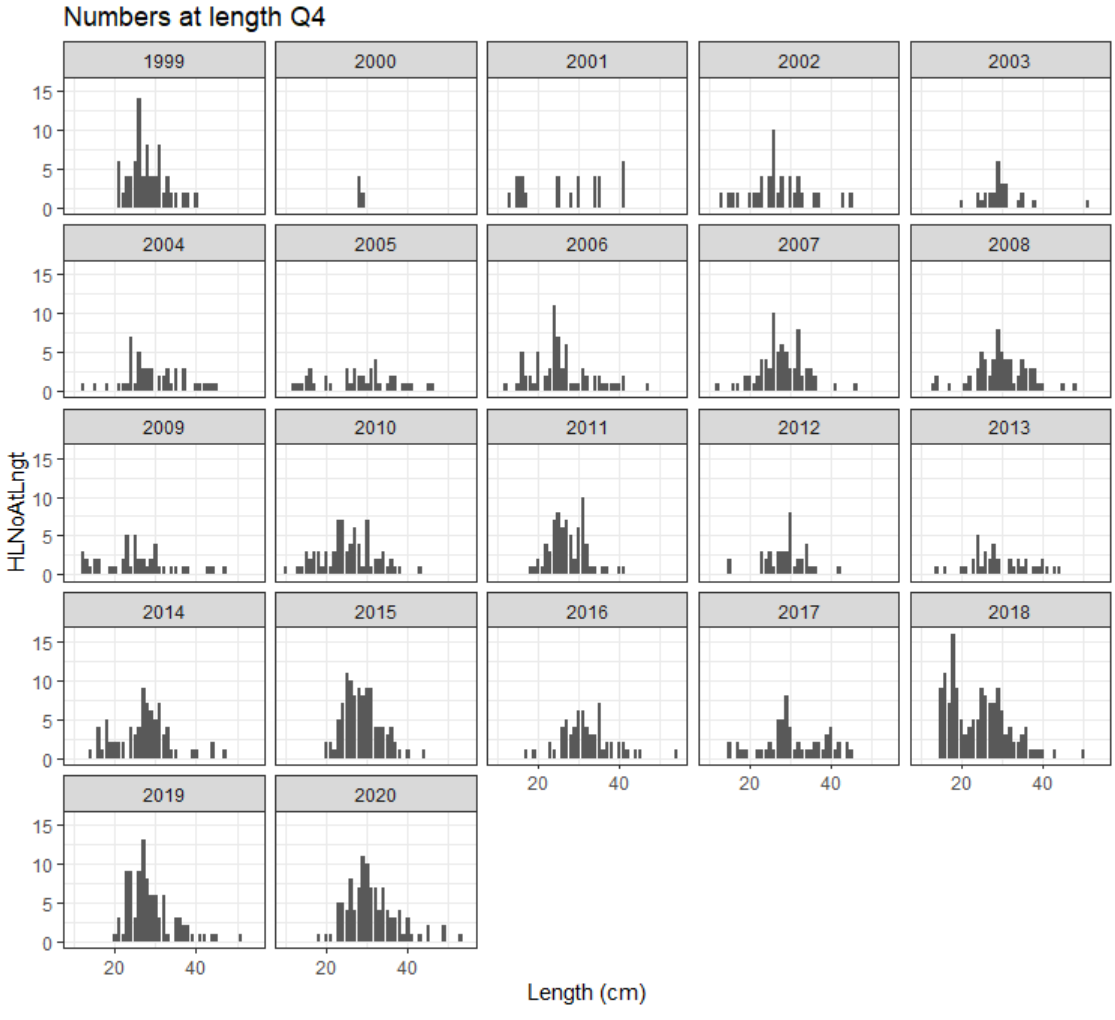


Figure 3.15: BLL 27.3a47de – Length distributions of brill in the Kattegat as documented in the BITS_HAF_Q4 (1996–2020).

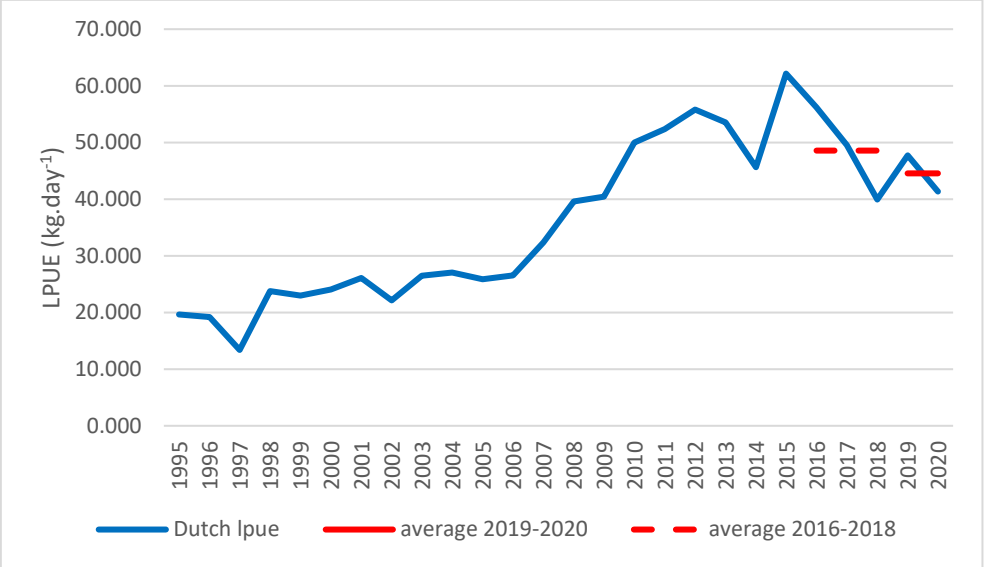


Figure 3.16: BLL 27.3a47de – Commercial LPUE (kg/day) of brill by the Dutch beam trawl fleet > 221 kW (standardized for engine power and corrected for targeting behaviour). The red lines are the averages of the last two (2019–2020) and the previous three (2016–2018) years.

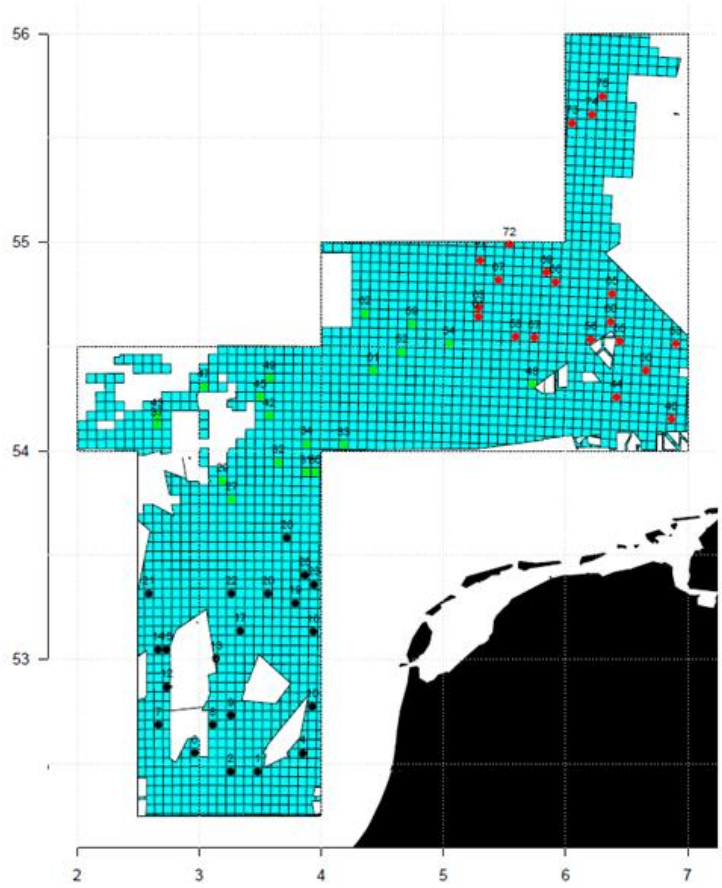


Figure 3.17: BLL 27.3a47de – Map showing the central and southern North Sea subject to monitoring by the Dutch industry survey. The area is divided in grid cells (5 x 5 km) and areas where no fishing is allowed are excluded (white areas). Twenty randomly selected grid cells were allocated to each of three vessels (vessel 1 = red, vessel 2 = black and vessel 3 = green). The selection of the grid cell varies every year. Map shows location of sampled stations for 2020. (source Schram *et al.,* 2021).

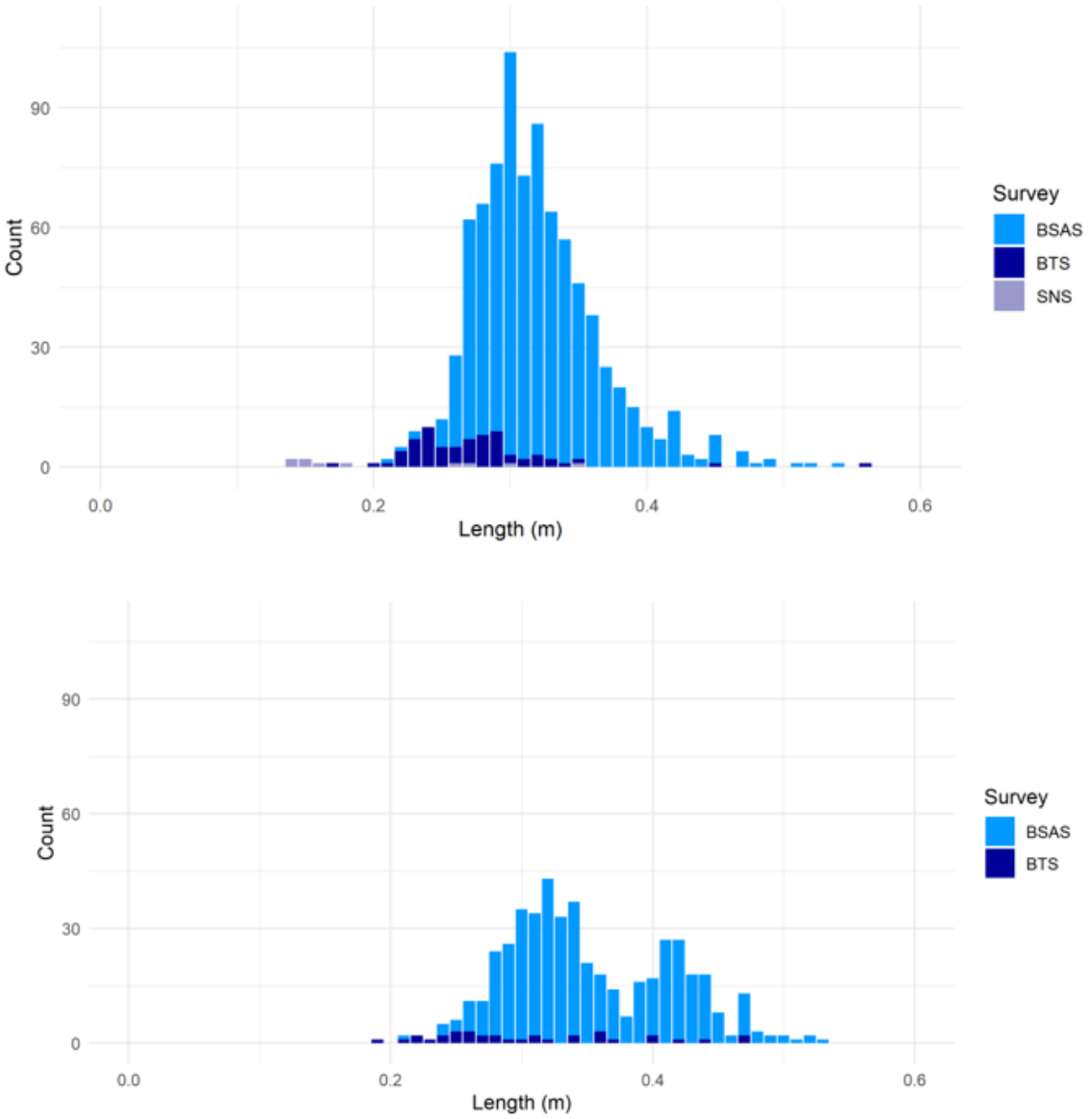


Figure 3.18: BLL 27.3a47de – Length distribution plot for brill as sampled during the Dutch industry survey (BSAS) in 2019 (top) and 2020 (bottom), Dutch BTS ISI/TRI Q3 (BTS) and Dutch coastal sole net survey (SNS).

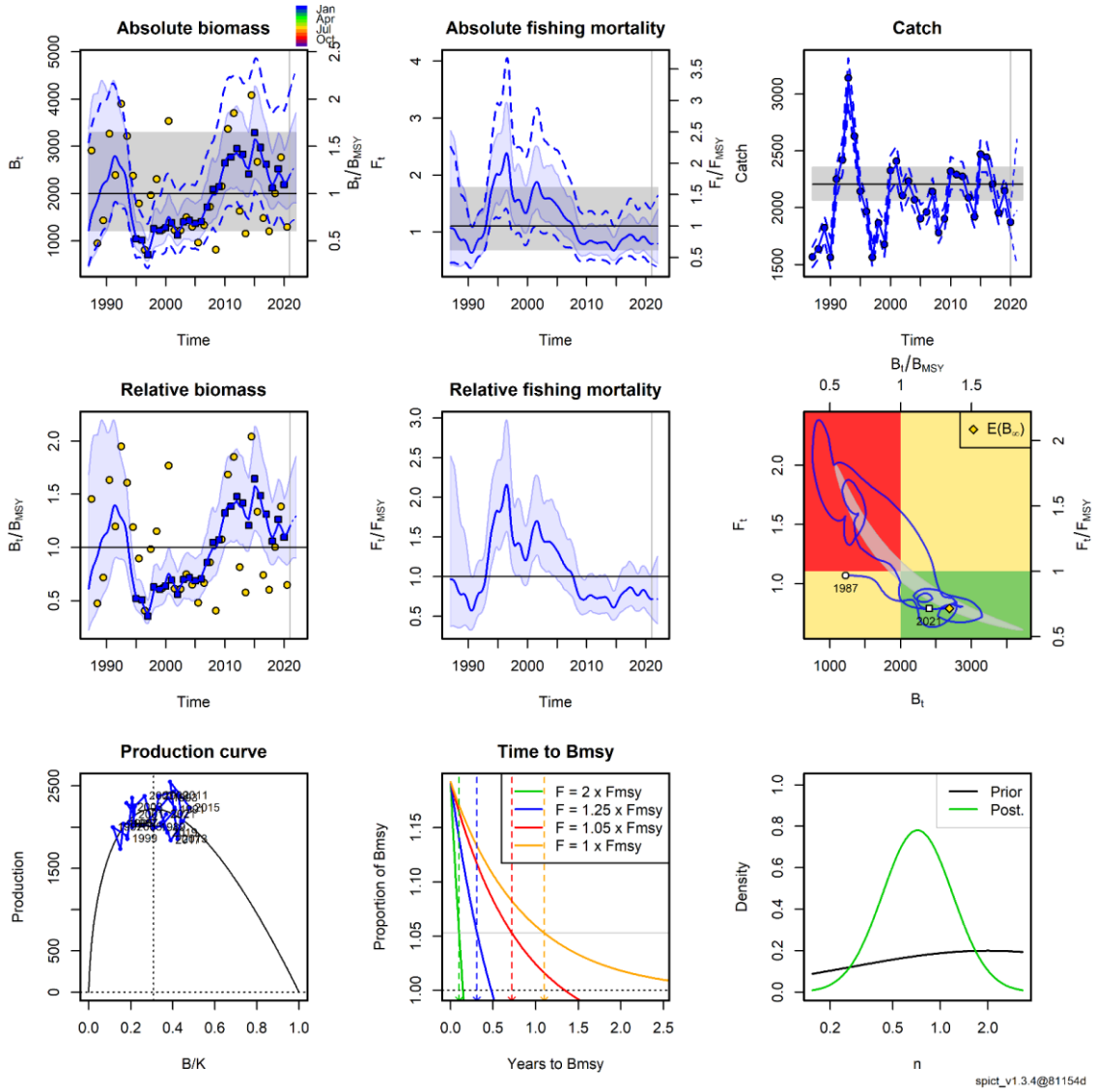


Figure 3.19: BLL 27.3a47de – SPiCT model results from WGNSSK 2021. Top row: absolute biomass, absolute F estimates, and fitted catch. Middle row: relative biomass and F, and a Kobe plot comparing biomass and F. The grey area in the Kobe plot represents the uncertainty in the relative biomass and F estimates. Bottom row: production curve, estimated time to B_{MSY}, and prior and posterior parameter distributions. The dashed lines are 95% CI bounds for absolute estimated values, shaded blue regions are 95% CIs for relative estimates, shaded grey regions are 95% CIs for estimated absolute reference points (horizontal lines).

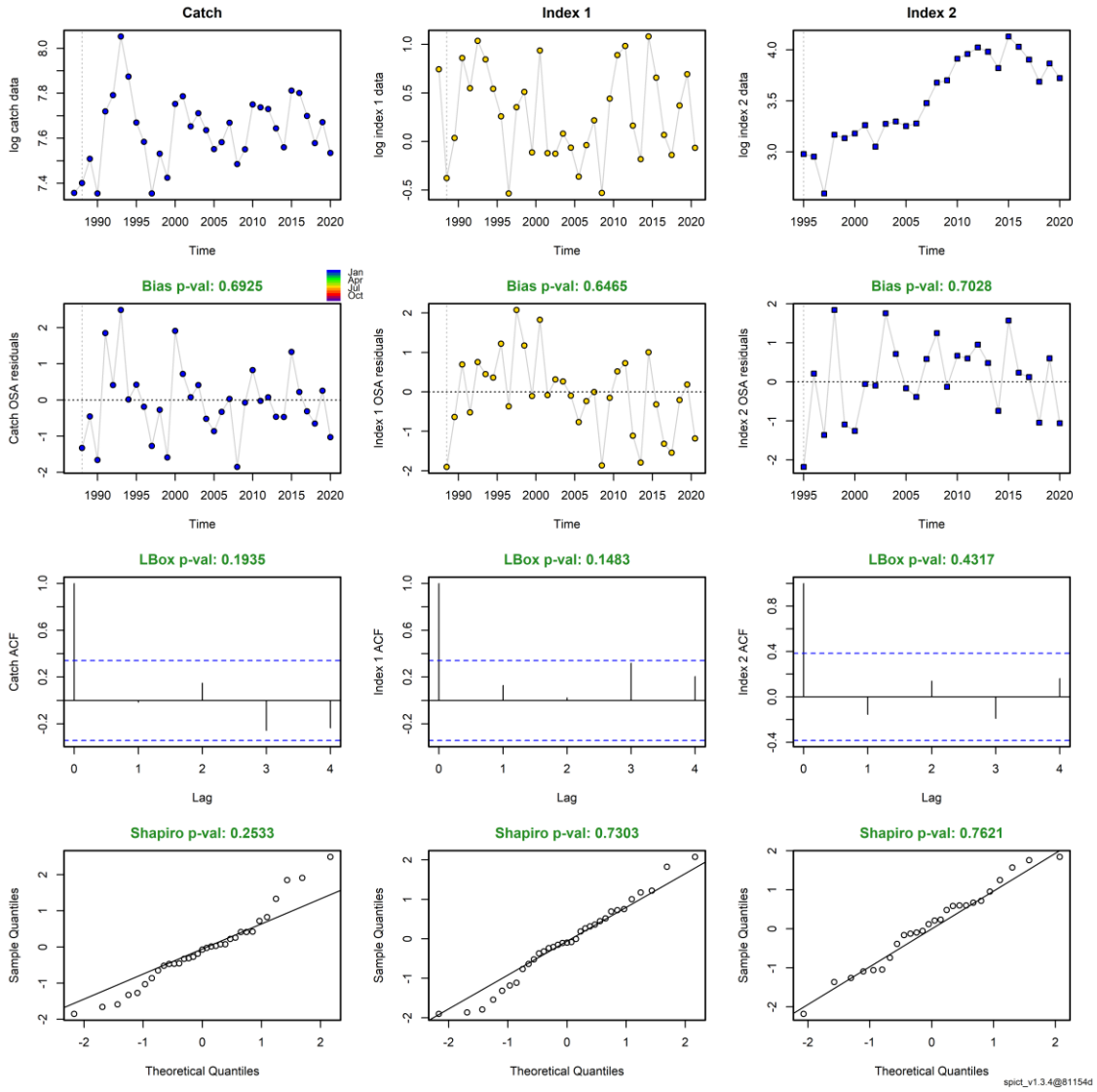


Figure 3.20: BLL 27.3a47de – SPiCT model diagnostics.

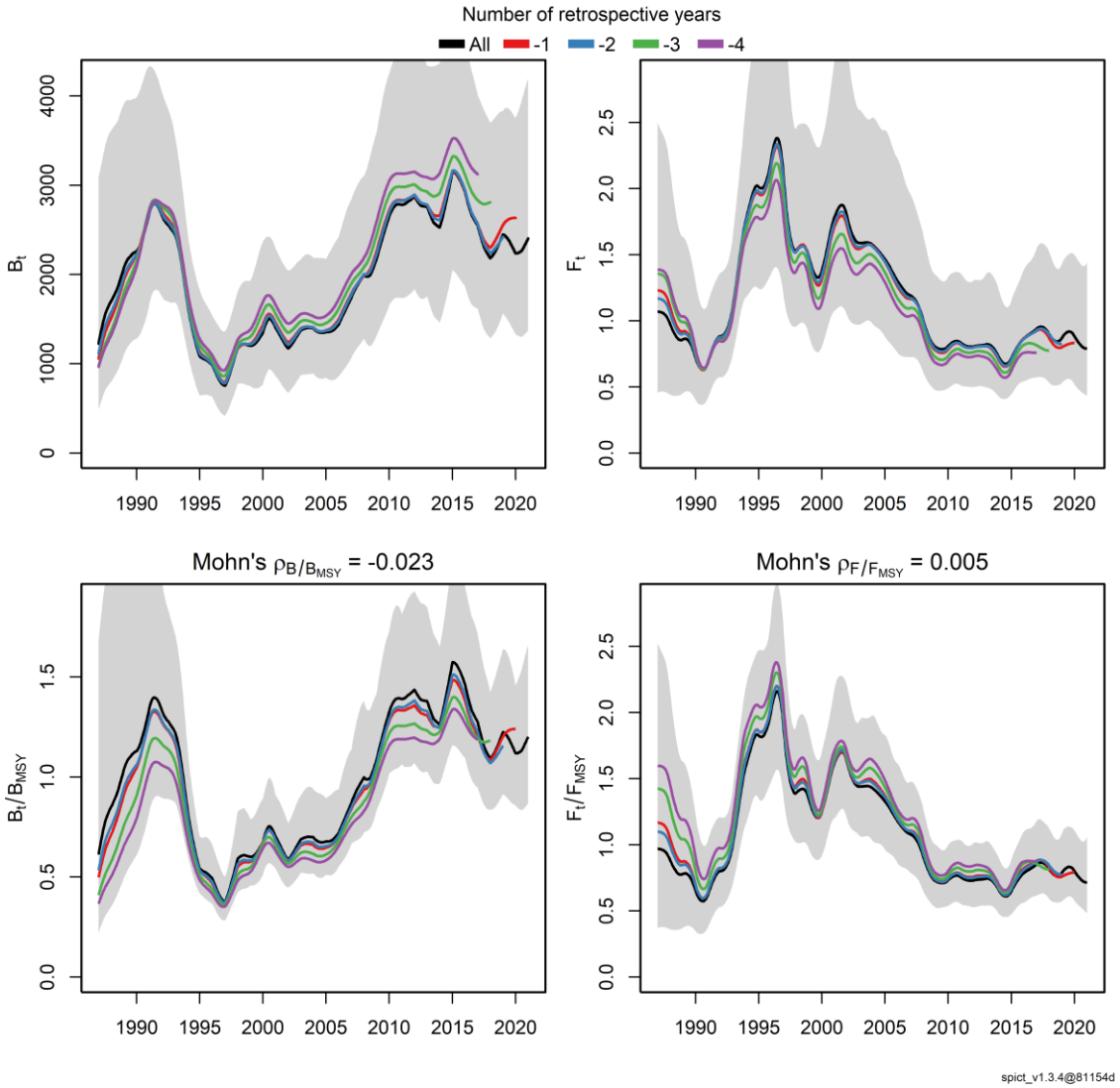


Figure 3.21: BLL 27.3a47de – Retrospective analysis of the SPiCT model from WGNSSK 2021. Top row: absolute biomass and absolute F; bottom row: relative biomass and relative F.