16 Saithe in the North Sea, Rockall, West of Scotland, Skagerrak and Kattegat

pok.27.3a46 – *Pollachius virens* in subareas 4, 6, and in Division 3.a

The assessment of saithe in Division 3.a and subareas 4 and 6 follows the protocol and updated reference points defined during the benchmark in February-March 2024 (WKBGAD; ICES, 2024), which updated the model and input methods adopted in the former benchmark and interbenchmark protocol (ICES, 2016; ICES, 2019a).

16.1 General

16.1.1 Stock definition

A summary of available information on stock definition can be found in the Stock Annex.

16.1.2 Ecosystem aspects

No new information on ecosystem aspects was presented at WGNSSK in 2024. A summary of available information, prepared during WKBENCH (ICES, 2011), can be found in the Stock Annex.

16.1.3 Fisheries

A general description of the fishery (along with its historical development) is presented in the Stock Annex.

Saithe are taken mainly in directed trawler fisheries by Norway, Germany, and France. Changes in the fishing pattern of these three fleets began in 2009, but all fleets had largely reverted to their original fishing patterns by 2011 (see Stock Annex for years 2000–2015). For the German and Norwegian fleets, the original fishing pattern is mainly along the shelf edge in Subarea 4 and Division 3.a, while French fleets fish along the northern shelf and west of Scotland (subareas 4 and 6).

The German fleet has been restructured during the last 6 years, and two new vessels entered the fleet while older vessels were taken out. The French fishery is currently at capacity for processing the catch at the vessel; this fishery cannot increase their catches.

The Scottish fleets catch many saithe in mixed demersal fisheries in subareas 4 and 6, that represents an increasing proportion of the total catch (around 17% in Subarea 4 and Division 3.a, and 73% in Subarea 6 in 2023). Discarding continued in 2023 according to data submitted to InterCatch in areas 4, 3.a and 6 despite full landing obligations in place in the EU, UK, and Norway.

In 2021 and 2022, part of the Norwegian TR1 fleet relocated north of 62°N, because of the low North Sea saithe quota and perceived large bycatch of cod (while quota was very low as well) on usual fishing grounds. No such feedback was received from the industry for 2023, and, unlike in the two previous years, the Norwegian quota allocated to trawlers was fished that year.

16.1.4 ICES Advice for the previous year

The information in this section is taken from the 2023 Advice sheet.

Advice for 2024
ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 73 815 tonnes.

The agreed TAC (trilateral agreement) was in line with the ICES advice.

16.2 Management

Changes to the stock assessment and reference points during the benchmark in 2024 (WKBGAD; ICES, 2024), imply a need to re-evaluate the former EU-UK-Norway management strategy to ascertain if it can still be considered precautionary under the new stock perception. Until such a re-evaluation is conducted, or a new management strategy evaluated by ICES is in place, advice will be given according to the ICES MSY approach.

16.3 Data available

16.3.1 Catch

Official landings for each country participating in the fishery, together with the corresponding WG estimates and the agreed international quota ("total allowable catch" or TAC) and ICES estimated discards and BMS landings are presented in Table 16.3.1. No resubmission of earlier data to InterCatch occurred, and only 2022 estimates were appended.

In 2023, official landings and ICES estimates were close in both Division 3.a, and subareas 4 and 6. ICES estimates correspond to the sum of products (SOP) uploaded to InterCatch and present a reasonable match for overall catch (102.6%), with an overestimation very close to that obtained in previous year.

In 2023 87% of discards were imported to InterCatch while 13% were raised (Table 16.3.2). Discard observations were not available for some of the fleets landing larger amounts of saithe (Figure 16.3.1). This is mainly the case for the Norwegian fleets. While Norway has a landings obligation policy for all métiers and in all areas, discarding is not monitored and discard information is not collected; therefore, discards for the Norwegian, French, and German trawler fleets (TR1) were raised using provided discard information from the French and German trawler fleets (i.e. targeted saithe fisheries; quarterly stratification). Discards in the trawler fleets (TR1) from other countries were matched for raising by quarter and area (4/6 and 3.a were distinguished); quarter 4 landings in Division 3.a were matched to discard samples in quarter 3, because of missing sampling at the end of the year. Because of lack of sampling data in 2023, all seasons were raised together for all other métiers (all countries) in subareas 4 and 6 together. For other métiers in Division 3.a, discards were still matched per quarter. Information on discarding from Scottish métiers were not included when raising discards for active gears from other countries because rates were typically high (except, in 2023, for TR1 landings declared for the whole year in subarea 6, originating in Scotland and Ireland only, where Scottish discards were used for raising).

The complete time-series of catch, landings, and discards as used in the assessment is summarized in Table 16.3.3 and illustrated in Figure 16.3.2. Catch has been relatively stable from 1990 through 2008 and then declined steadily, with a transient increase between 2017−2019, linked to a short increase in quota. The WG estimates of saithe discards (as a proportion of total catch) has

remained relatively constant since 2003. Discard estimates were lowest for the period when the saithe trawler fleet changed its exploitation pattern (2009–2011). Prior to 2002, discards were estimated using a constant age-specific discarding rate (see WKNSEA; ICES, 2016). Occasional higher discard rates, particularly in 2016, were due to reported discarding by Scottish fisheries.

Targeted saithe fisheries were covered by the EU Landing Obligation since 2016. Since 2018 saithe is under the landing obligation in all fleets in subareas 4 and 6, and in Division3.a. Very few BMS landings and no logbook reported discards were reported into InterCatch since 2018 (Table 16.3.2). Sampled and estimated discard rates in 2019–2021 were particularly low, essentially because of very low recruitments in 2018–2021. In 2022, discard rates were back to 2018 levels (around 8%), due to larger age 3–4 cohorts, but were down to about 6% in 2023.

16.3.2 Age compositions

International catch data were collated and catch-at-age were generated using InterCatch. Age composition in the landings was based on samples, provided by Denmark, France, Scotland, Germany, Ireland, and Norway, which accounted for 71% of the total landings in 2023 (Table 16.3.4; Figure 16.3.3), still down from ≥90% in the years before 2020. This was mostly due to the French OTB_DEF_>=120_0_0 stratum (reported without selectivity device suffix) not being sampled since 2020. Although this may induce some noise, it is not believed to impair substantially the quality of the assessment. In 2023, unlike in 2022, Norwegian landings reported with missing gear information (stratum MIS_MIS_0_0_0_HC), were sampled, which explain the >10% increase in the proportion of landings sampled between the two years. Many fleets do not provide samples for the landings, but these do not usually contribute to a large proportion of the catch. However, the number of samples taken, especially in the targeted trawl fisheries, is an issue (see WKNSEA; ICES, 2016). Stratification for age compositions was by quarter and area for the unsampled landings, as described in ICES (2016). Since 2021 (data year), however, age composition of landings in area 6 have been matched to all seasons due to lack of sufficient seasonal data. The seasonal partition is prioritized because of the seasonal nature of the fishery, which is mostly driven by seasonality in catches from the Norwegian TR1 fleets. This has shifted over the last decade from a fishery dominated by catches in Q1 and Q2 (targeting mainly spawning fish), to a fishery dominated by catches in Q2 and 3, mostly driven by changes in fishing patterns by the Norwegian TR1 fleet. Smaller and younger fish are generally found in Division 3.a.

Ninety-nine percent of the provided discards (corresponding to 86% of the estimated discards) were sampled for age distributions in 2023 (Table 16.3.4). All age information for discards were from Scotland, and Denmark to a lesser extent (Figure 16.3.4) which also have by far the largest amounts of discards. While the proportion of discards sampled for age distribution was high (Table 16.3.4), the number of age samples per métier is often low (WKNSEA; ICES, 2016). Due to a very uneven spatial and temporal coverage, catch-at-age information was estimated per Subarea for all seasons together. This is however believed not to be a critical issue for the quality of assessment as discards are typically low. Catch-at-age for the BMS landings was generated from the discards age information.

Total catch-at-age data are given in Table 16.3.5, while landing-at-age and discard-at-age data are respectively given in Tables 16.3.6 and 16.3.7. Age 3 fish made up a smaller portion of the landings in recent years (Figure 16.3.5). The last strong year class in the catch appears to be the 2009 year class as seen in the discards in 2012 at age 3 and landings in 2013 at age 4. A slightly stronger year class appears to be entering the discards at age 3 in 2016 and at age 4 in the landings in 2017. Weak cohorts entering the fisheries at age 3 resulted in respective low discards from 2018 to 2021.

16.3.3 Weight-at-age and natural mortality

Weight-at-age from the catch, landing and discard components for ages 3–10+ are presented in tables 16.3.8–16.3.10 and Figure 16.3.6.

Stock weights for the years 2003–2023 were estimated as model-based weights-at-age using survey data only, because it was shown that catch weights-at-age overestimated stock weights up to about age 6 (WKBGAD; ICES, 2024). The general additive mixed model (GAMM) used includes age, cohort, seasonal and Subarea/Division effects, and implements bias correction for age-based estimates using length stratified sampling as documented in WKMOG (ICES, 2008) Series from all available seasons—(NS-IBTS [G1022 & G2829], SWC-IBTS [G1179 & G4299], IE-IGFS [G7212] and a dedicated Norwegian acoustic and trawl survey (2017–2022)—were used. Weights-at-age are predicted for January per year and Subarea, and weighted means calculated per year over subareas (and age for the plus group), using absolute index-at-age (1–14+) values per Subarea (delta-GAM approach, see Section 16.3.5) as weights. Stock weights-at-age for the year 1967–2002 were estimated as constant proportions of catch weights-at-age, based on ratios estimated for the period 2003–2022. The estimates, as used in the assessment, are presented in table 16.3.11.

The update of the series triggered very little revision back in time, compared to the one estimated at the benchmark (Figure 16.3.7). There was a decreasing trend in mean weight for ages 6 and older, but that has stopped or been reversed after 2008 (Figure 16.3.6). Weights-at-age for ages 3–5 have been relatively stable, with some variation, over the last decade. The noisy weights-at-age for discards of older age classes during the last decade, reflect a lack of data due to minor discard rates, and should therefore trigger no concern.

Natural mortality-at-age was estimated in the 2024 benchmark based on mean stock weights-at-age, following the equation of Lorenzen (1996), further scaled so that age-9 (≈5 kg) had a natural mortality of about 0.2, as shown in the table below.

Age	3	4	5	6	7	8	9	10+
Natural mortality	0.384	0.335	0.294	0.259	0.232	0.212	0.197	0.177

16.3.4 Maturity

The 2024 benchmark (WKBGAD; ICES, 2024) validated a model-based estimation of proportion mature at age. Because of the documented bias in weight-at-age in catches, only samples from surveys in Q4 and Q1—NS-IBTS (G1022), SWC-IBTS (G1179 & G4299), SCOWCGFS (G4748 & G4815), IE-IGFS (G7212) and a dedicated Norwegian acoustic and trawl survey (2017–2022)—were used. Age and years of the Q4 surveys were forward-shifted to match the closest spawning season. The GAMM—which includes among others quarter and Subarea effects, and implements the same bias correction as mentioned for the stock weights model—was used to make predictions of proportion mature per Subarea, in Q1, for the years 1992–2023. These were further used for population-level inference by calculating weighted means per year over subareas (and age for the plus group), using the absolute index-at-age (1–14+) values per Subarea as weights (see Section 16.3.5). The entire series is updated when a new year of data are added (values used in the assessment are in table 16.3.12), but the 2024 update exhibits very little revision back in time when compared to the benchmark estimates (assessment year 2023; Figure 16.3.8).

16.3.5 Catch per unit effort and research vessel data

Indices used in the final assessment are included in Table 16.3.13. Data for the Norwegian, French, and German commercial trawler fleets were combined into one standardized CPUE index (integrating Year, Month, Country, Power, Vessel effects and spatial and spatio-temporal GRMF, without interactions), which is then tuned to the exploitable biomass (see Stock Annex for details). One fisheries-independent survey index was included for tuning of the assessment; an extended area (including west of Scotland) Q3−4 delta-GAM index (delta-GAM approach: Berg *et al.*, 2014), ages 3–8, 1992–2023 ("Survey index Q3−4"). The same approach was used to update the index per Subarea for ages 1−14+, 1992−2023.

The commercial CPUE index exhibited, in 2023, a plateau when compared to 2022, following an increase after reaching an all-time low in 2021 (Figures 16.3.9 and 16.3.10). Model diagnostics were very similar to those obtained at the 2024 benchmark, with data up to 2022 (not shown). The very modest revisions observed in the previous years of the scaled index (Figure 16.3.10), were mostly due to (1) correction of engine power for some German vessels, following refitting of the engine, and (2) disambiguation of some Norwegian vessel IDs, the model presenting very little retrospective patterns. This new index, based on a spatio-temporal GAMM (WKBGAD; ICES, 2024), is deemed more appropriate to account for changes in fishing patterns, especially those not driven by saithe abundance and distribution (bycatch avoidance, temporary loss of access to some areas), than the former GLM-based index. Thanks to the area-weighting standardization, it is also expected to be more robust to contraction or extension of the spatial distribution of the population. Spatial patterns in the residuals were reasonable for most years—especially in 2023 (Figure 16.3.11)—and the other diagnostics were very similar to those obtained during the benchmark (WKBGAD; ICES, 2024; figures not shown).

The survey index decreased in 2023 for all ages except for ages 4 and 5 (Table 16.3.13, Figure 16.3.12). Age three has been overall increasing in the last four years, after reaching an historic low in 2019, but remained at quite low levels. Age four abundance exhibited a steep increase in 2023, signs of which can be tracked back to a seemingly larger recruiting cohort (age 3) in 2022. Indices at age five and older remained at medium to low levels. The index coefficients of variation (CV) were, in 2023 very similar to most former years, indicating no extra uncertainty that year (Figure 16.3.13). Model diagnostics were very similar to those obtained at the 2024 benchmark, with data up to 2022 (not shown). The model-based index, in particular exhibited hardly any revision of values in 2022 and before when adding one year of data (Figure 16.3.12).

Figure 16.3.14) shows the updated index per Subarea, as absolute sum (over cells in Subarea) of catch predictions used for the weighting of biological parameters among Subareas and ages within age groups. Proportions among Subareas were stable, when compared to previous years (Figure 16.3.15).

16.4 Data analyses

16.4.1 Exploratory survey-based analyses

Numbers-at-age for saithe ages 3 to 8 (Survey index Q3−4) on the log–scale, linked by cohort, showed year effects (for example, consistently high values around 2016; Figure 16.4.1, top-left panel), but not as marked as they used to be with the former design-based index (WGNSSK; ICES, 2023). The ability to track cohorts has been slightly diminished in last 20 years of the survey (Figure 16.4.1, top right panel), but again, has improved compared to the former design-based index (WGNSSK; ICES, 2023). The survey catch-numbers correlate poorly between cohorts for ages 3 and 4, but are stronger for subsequent ages (Figures 16.4.1, top-right panel, and 16.4.2).

This is likely because age 3 fish are not consistently fully represented in the survey ("hook" patterns at age 3 in the abundances of some cohort: Figure 16.4.1, bottom-left); fish begin migrating out of the inshore nursery areas at age 3, but do not fully recruit to the more oceanic population (and fishery) until after age 5. The new delta-GAM approach however appears to have improved representativeness for age 4 (as revealed by better internal consistency with older ages), but also age 3, which has now more consistent hook patterns in recent years.

Despite the improvements brought by the delta-GAM approach (WKBGAD; ICES, 2024), this survey index remains inherently noisy. A high degree of uncertainty in the survey index has been commented on previously (WKNSEA; ICES 2016), and some observations remain relevant to the new index, among which the lack of sampling of un-trawlable areas on the northern part of the shelf where dense aggregations are common, or—to a lesser extent than with the former design-based index—the strong influence of occasional very large single samples. Despite this, the index is still considered the best available information for young saithe, although the assessment places more weight on the CPUE index (estimated observation variance 0.07 vs. 0.47 for the survey index; also highlighted by the leave-one-out analyses in former years; see Section 16.4.4). Survey index Q3−4 values used in the final assessment are in Table 16.3.13.

16.4.2 Exploratory catch-at-age-based analyses

The outcome of WKNSEA 2016 was to remove the 3 CPUE series for the targeted trawl fisheries, partially due to concerns over using information in the catch-at-age matrix in both the CPUE and in the catch-at-age and because more weight was given to 3 indices within the former assessment model (artificially giving higher weighting to the CPUE indices). A standardized combined CPUE index was created for the French, German, and Norwegian trawl fleet targeting saithe, which was then tuned to the exploitable biomass, removing the need to use the information in the catch-at-age matrix twice (see WKBGAD for details; ICES, 2024).

The fit of the CPUE to the exploitable biomass shows limited ability to render annual variations but reflects well the index main trends (Figure 16.4.3). The recent update to an area-weighted index, based on a model with spatio-temporal GMRF, with a vessel random effect, is expected to make it more robust to changes in the spatial distribution of the effort and/or resource, as well as a possible drift in fishing strategy and experience. It however cannot be discounted that, in particularly if fishers are very good at avoiding areas with low density of saithe, the index might lack capacity to properly render the repartition of those and generate an overestimation in periods of low abundance.

16.4.3 Assessments

The assessment of North Sea saithe was carried out using a state-space stock assessment model (SAM; Nielsen and Berg 2014; Berg and Nielsen 2016). This is the first update following revision of the assessment model during a benchmark (WKBGAD; ICES, 2024). Settings used in the final assessment are given in Table 16.4.1.

16.4.4 Final assessment

Estimated fishing mortality-at-age are given in Table 16.4.2 and Figure 16.4.4. F for age 3 has declined drastically from 1990 and is now close to 0.1, while F for the older age classes has also decreased slightly over the same period. The change in F at age 3 occurred when the catches in the purse-seine fishery declined. Age 4 also exhibited a similar decrease in fishing mortality, around the same time, and stabilized around 0.25. For ages 5+, catchability shows a dome shaped pattern, with highest catchability for age 6 in recent years (Figure 16.4.4, right panel). With the

lower fishing mortalities up to 2016, fish have been allowed to increase in size (and age) and are likely targeted more than the younger age classes up to age 4 (as observed in Figure 16.4.4). Fishing mortality, after 2016, has however increased again for age classes 4+, followed by a decrease in 2020–2023. Recruitment was also very low from 2018 to 2021. Estimated population numbers-at-age are in Table 16.4.3.

The survey index-at-age fits are shown in Figure 16.4.5. While accounting for the correlation between ages within years, the IBTS–Q3 residuals show little patterns (one-step ahead residuals, Figure 16.4.6). A slight trend appears in the catch residuals at age 6–9 in the last years of the series, revealing slight systematic overestimations. This might be due to conflicting signals borne by the CPUE index (tuned to the exploitable biomass) and the survey index. The strength of the correlation between subsequent ages in survey residuals, is strong for all ages in the survey index ($\varrho = 0.83$ for successive ages 3–7, and $\varrho = 0.74$ between age 7–8; Figure 16.4.7, right panel). For catch observations, the correlation between successive ages was low between ages 3–6 ($\varrho = 0.15$), while it was more pronounced between ages 6–10+ ($\varrho = 0.72$; Figure 16.4.7, left panel), which can be the sign of correlated errors in catch-at-age estimates. Process residuals (Figure 16.4.8) do not exhibit obvious trends.

The retrospective analysis shows a slight overestimation of SSB for the peels 4 and 5, while F had no obvious pattern. Most of the retrospective in recruitment (Mohn's rho = −0.21) was due to a revision upward of the recruitment in 2022 (Figure 16.4.9). Although SSB tends to be slightly overestimated (Mohn's rho = 0.06), most peels for SSB fell within the confidence intervals of the most recent assessment. For F, the Mohn's rho was low (0.03). The systematic underestimation of F by the model used in the previous years was not observed anymore after the model update (WKBGAD; ICES, 2024), and all peels fell within the now narrower confidence intervals of the final year's assessment.

The leave-one out and final assessment results are in Figures 16.4.10 and 16.5.1 respectively. The two series yielded different trends in the present assessment for SSB and F. Without the CPUE index, the model estimated a lower final SSB, which resulted in higher estimated fishing mortality. This contrast to the former model and inputs, which tended to produce less conservative assessment without the CPUE index. Recruitment estimates, as usual, are little affected by the choice of data.

16.5 Historic stock trends

The historic stock and fishery trends from the final assessment are presented in Figure 16.5.1 and Table 16.5.1. Because of the benchmark in 2024, the historic perception of the stock has changed when compared to previous assessment years. This is mostly due to revision of the reference points, with higher B_{lim} and B_{pa} and lower F_{MSY} and F_{MSY} range, while trends and final year estimates of SSB and F have hardly changed (WKBGAD; ICES, 2024). Recruitment has been low and highly variable since 1990. Both 2015 and 2016 show slightly higher recruitment than the average of the last ten years, while 2018–2023 (except for 2022, again higher than the last 10-year average) were the lowest estimates for the whole time-series. SSB, has fluctuated around 195 000 tonnes in the 2010s, which is below the average of the 2000s (around 234 000 tonnes). Short-term variations exhibit a decline in SSB from 2018 to 2022, down to about 30 000 tonnes below B_{pa} and MSY $B_{trigger}$. The final year estimate however shows signs of recovery of SSB with an increase to just below B_{pa} and MSY $B_{trigger}$, while survivors from 2023 suggest an additional increase of 24 000 tonnes for SSB in 2024 (also dependent on recruitment 2024 short-term forecast, which amount to about 6% of the estimated SSB in 2024). Fishing mortality has generally declined since the mid–1980s but has exhibited a distinct raise from 2016 to 2019. It has since decreased again and is now estimated to lie around F_{MSY} since 2022.

16.6 Recruitment estimates

Currently, no independent survey provides an estimate of incoming recruitment. The resampling among 2014–2023 Age-3 estimates (with a geometric mean about 94 million individuals) used in the short-term forecast is a conservative assumption taking into account recent low recruitment.

16.7 Short-term forecasts

A short-term forecast was carried out based on the final assessment.

Weight-at-age in the stock and catch were the mean values for the last 3 years. The exploitation pattern (selectivity pattern) was chosen as the mean exploitation pattern over the last three years scaled to $F_{4–7}$ in 2023. The fishing mortality in the intermediate year was based on a F *status quo* assumption ($F_{4–7,\ 2024} = F_{4–7,\ 2023} = 0.320$) as it would lead to an overshoot of the 2024 TAC of about 6%, close to the about 4% overshoot estimated for catches in 2023. The F *status quo* assumption, used in the previous assessment, moreover, proved quite reasonable (table 16.7.1), and the situation in 2024 was expected to be similar. A TAC constraint 73 815 tonnes, $F_{4–7,\ 2024} = 0.300$; Council Regulation, 2024), would have led to less conservative forecast and advice. Population numbers-at-age for ages 4 and older in 2024 were survivor estimates, while numbers-at-age 3 were resampled from the past 10 years (2014–2023). The short-term projection was run in SAM.

The intermediate year assumptions for the short-term forecast are given in Table 16.7.2. The options above result in catches in 2024 of 78 251 tonnes and a SSB in 2025 (2024 survivors plus STF recruitment assumption) of 195 899 tonnes, above MSY $B_{trigger}$ (180 770 tonnes), in the rise compared to 2024 (177 053 tonnes forecasted in 2023; 185 632 tonnes estimated in the current assessment). Reference points and their technical basis are in Table 16.7.3.

The management options are given in Table 16.7.4. Because reference points were re-estimated during the 2024 benchmark and because of Brexit, the management plan for this shared stock (EU, Norway and the UK—as of early 2021) is no longer in use (a new EU-Norway-UK management plan is under discussion); therefore, the MSY approach is used as the basis for advice. The total catch in 2025 is advised to be no more than 79 071 tonnes, where corresponding landings are 75 880 tonnes; this is a 7.1% increase when compared to the advised total catch in 2024. More catch options can be found in Table 16.7.4.

The simultaneous revision—in the 2024 benchmark (WKBGAD; ICES, 2024)—of stock weight-at-age (now substantially lower up to age 6, than in the previous assessment; Figure 16.7.1), maturity ogive (larger proportion mature at age 3 and 4 than formerly, slightly lower for latter ages; Figure 16.7.2), and natural mortality (greater mortality of younger fish implies on average larger abundance estimates for those age classes; Figure 16.7.3) had competing effects that little affected the overall SSB estimates on average, but made it difficult to pinpoint precisely the reason(s) of the change in the advice, because of contrasted effects on the SSB at age (Figure 16.7.4). A substantial upward revision of the recruitment of the 2019 cohort in 2022—approximately doubling its estimated abundance (Figure 16.7.3)—however stood out as one of the main drivers of the increase in the advice, despite a rather more conservative revision of the reference points estimates (WKBGAD; ICES, 2024). This, along with reduced estimates of F at ages 3 to 5 (Figure 16.7.5; also an indirect consequence of larger natural mortality implying larger underlying abundances), strongly increased the forecasted contribution of the 2019 cohort to the SSB in 2025 (Figure 16.7.6). Changes in the estimated relative catchability (Figure 16.7.7) at age may also have played a role, although direction of their effect is not clear.

The contribution of the 2016–2022 year classes to landings in 2025 are shown in Table 16.7.5. The 2019–2022 year classes are expected to contribute the most to the landings in numbers, while landings weights should be dominated by the year classes 2018–2021, with a particularly large contribution of the 2019 cohort. Recruitment-at-age 3 in 2025 is not expected to contribute greatly to the catches in 2025; rather, ages 4–7 are the main contributors (76% of projected landings for 2025).

16.8 Medium-term and long-term forecasts

No medium-term or long-term forecasts were carried out.

16.9 Quality and benchmark planning

The assessment was revised during a benchmark in 2024. Some former issues were not addressed and remain relevant, while some considerations for future research arose and are now listed below.

16.9.1 Quality of the assessment and forecast

Conflicting signals between the survey and fishable biomass index contributes to the assessment uncertainty and a (reasonable) retrospective pattern observed.

The fraction of fish at age 3 migrating into the survey area (and the fishery) is low and varying between years with no obvious trend. Observations of saithe at age 3 are not suitable for predicting year-class strength. This means that estimated recruitment values in the final assessment year are highly uncertain. Estimates of recruitment for a given year class tend to be revised considerably with successive assessments (see Section 16.4.4).

16.9.2 Issues for future benchmark

16.9.2.1 Data

Stock definition

The North Sea saithe stock is influenced by migrations to and from the North Sea. This can potentially lead to the observed year effects in survey indices. It needs to be analysed if the inclusion of spawning grounds north of 62°N could improve the assessment. A tagging study (IMR) is underway and may help inform on this issue. The question of whether the population in ICES subareas 7–10 is connected to the North Sea stock, and should be merged to it, was also raised by the last benchmark (WKBGAD; ICES, 2024), that concluded that there is weak, though somewhat inconclusive, evidence that the population west of Ireland is derived from the North Sea stock. It is however unclear if west of Ireland is a sink population or if it contributes to the spawning of the overall stock, and the benchmark recommended that the matter should be evaluated by SIMWG.

Biological sampling

The 2024 benchmark pointed out possible effects on biological parameters estimates of the lack of biological sampling along Norwegian coastal areas (in and east of the Norwegian trench)—where younger and possibly less mature fish reside—that should be examined. This is believed to be potentially more critical for maturity estimates but might also affect stock weights-at-age estimates.

Commercial CPUE index

A significant relationship between commercial CPUE residuals and the percentage of saithe in the catch, persisted after revision of the index model during the 2024 benchmark. This extra information at the catch operation level (likely variable spatially, and not definable in each cell of the prediction grid) cannot be used as a covariate in the context of an area-weighted index. It could however potentially be co-modelled with the CPUE, and help better predict very large and/or very small catch rates, which remain poorly fitted, and result in heavy-tailed residual distribution.

Recreational catches

Although not expected to be important within the North Sea, the magnitude of recreational saithe catches should be formally investigated to inform the assessment quality. In the context of uncertain geographical stock limits, the NS saithe dynamics might, for instance, be influenced by comparatively more important recreational fisheries in the Norwegian Sea.

16.9.2.2 Assessment

The assessment model was revised in the 2024 WKBGAD benchmark (ICES, 2024). The group pointed out that, despite the model behaving appropriately, the correlation structure in catch observation across ages over 6-year-old was somewhat unusual and hinted at correlated errors in catch-at-age. It therefore recommended disentangling the sources of such assumed correlated errors, or the identification of any other process that could generate the observed correlation in catch residuals across ages.

16.9.2.3 Forecast and reference points

Forecast

The SAM forecast assumption for recruitment is based on resampling from historical recruitment values from a defined number of historical years. Depending on the time-series, this may result in a bimodal distribution for the assumed recruitment in forecasted years. Forecasted numbers (and SSB) are likely to be smoother in their distribution due to forecast stochasticity, but the effect of this behaviour on advice should be investigated further. Use of a geometric mean of historical recruitment is not currently possible in SAM but could be suggested in order to reduce this effect. Adequacy and implementability of recruitment forecasted as a random effect with autocorrelation (RW, AR1…), was not considered at the last benchmark, but should also be evaluated in future.

The setting of a random seed value is important for comparing between forecast scenarios. Forecast scenarios involving a prescribed F had consistent median recruitment; however, scenarios that solve for an F that results in a given stock size (e.g. $SSB_{2025} = B_{pa}$ or B_{lim} scenarios), which involve a further iteration process with additional random number generation, resulted in different median recruitment values. This is a reporting issue that arise from instability of the median value resampled from an even number of values (while a reported geometric mean would be more stable, and often more informative). It does not affect the quality of the assessment, only the consistency of reported figures. We have therefore made the choice, since the 2020 assessment, to report the geometric mean of resampled recruitments values in the forecast assumption (not to be mistaken for the use of a geometric mean as point estimate in the forecast).

16.10 Status of the stock

Fishing pressure on the stock is above F_{MSY} and spawning-stock size is above MSY $B_{trigger}$, B_{pa} and B_{lim}. That is considering SSB in 2024, which now includes the STF assumption on recruitment in

2024 (contributing to about 6% of SSB), as the proportion mature for age 3 is around 17% (last three years average), following update of the maturity ogive during the 2024 benchmark.

16.11 Management considerations

The assessment is sensitive to relatively small changes in the input data. Because this stock suffers from 'poor data', the assessment is relatively uncertain. Recruitment is currently at a low level, and it appears that strong recruitment pulses are more sporadic than in the past.

The reported landings have been relatively stable since the early 1990s; with the exception of the last three years, when a drastic reduction occurred. Landings have been substantially lower than the TAC between 2017 and 2021, despite consecutive reductions in the quota. Since 2022, the TAC is taken again.

Bycatch of other demersal fish species does occur in the target trawl fishery for saithe. Saithe is also taken as unintentional bycatch in other fisheries, and discards do occur.

16.11.1 Evaluation of the management plan

Because reference points were re-estimated during the 2024 benchmark (and before that following an interbenchmark in 2019), the management plan is no longer valid. New EU/Norway management strategies have been proposed and evaluated (ICES, 2019b). However, these evaluations also are now outdated and would need to be at least re-evaluated.

16.12 References

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16.13 Tables and figures

Table 16.3.1. Saithe in subareas 4 and 6 and in Division 3.a. Official nominal landings (tonnes) of saithe by nation, 2008–2023. ICES estimates are landings reported to ICES and the Working Group.

Subarea 4 and Division 3.a																
Country	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022***	**2023***
Belgium	7	27	15	2	2	3	5	6	16	15	14	6	5	11	5	7
Denmark	8068	8802	8018	6331	5171	5695	4913	4512	4084	5690	7017	5275	3777	2946	2280	2261
Faroe Isl.	108	841	146	2	8	3	1	0	18	16	4	14	28	0	<1	1
France	15881	7203	4582*	13856*	14093*	8475	7910	11574	10794	10334	12598	11361	9487	9133	9557	11534
Germany	14140	13410	11193	10234	8052	9690	8602	7954	6279	7943	7952	7055	6858	4460	4280	4152
Greenland	888	927	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	1	0	0	0	0	0	0	0	0	0	<1	4*	0	1	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	5
Netherlands	3	16	3	24	34	168	43	75	112	191	267	178	181	140	51	127
Norway	61464	57708	52712	46809	33288	35701	37519	35631	31596	49580	38787	50306	39558	20442	20806	28066
Poland	1407	988	654	584	0	0	0	0	0	0	0	0	0	0	0	0
Portugal											0	0	0	0	0	0
Russia	5	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweden	1639	1363	1545	1335	1306	1402	1329	1156	1198	1186	1316	1413	1181	1001	1087	1082

Subarea 4 and Division 3.a																
Country	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022***	**2023***
UK (E/W/NI)	11804**	12584**	11887**	10250**	7287**	10379**	687	8888**	8561**	8640**	12575**	11868**	8657**	8037**	6748**	7788**
UK (Scotland)							7686									
Total reported	115414	103883	90755	89427	69241	71516	68695	69796	62658	83594	80531	87476	69739	46150	44815	55023
Unallocated	57	2090	6012	2101	1623	−110	677	−393	-154	−2024	1335	173	119	797	1332	1628
BMS landings										< 1	11	20	10	4	4	6
ICES estimate	115471	105973	96767	91528	70864	71406	69372	69403	62504#	81570#	81866#	87649#	69858#	46947#	46147#	56651#
TAC	135900	125934	107000	93600	79320	91220	77536	66006	65696	100287##	105793##	93614	79813	59512	44950	53374

*** Official values are preliminary.**

**** Scotland+E/W/NI combined.**

 # Since 2016, landings include the Norwegian component of BMS landings.

Includes top-up (4.1% in 2017, 12.57% in 2018).

Table 16.3.1. Saithe in subareas 4 and 6 and in Division 3.a. Official nominal landings (tonnes) of saithe by country, 2008–2023. ICES estimates are landings reported to ICES and the Working Group. (continued)

Subarea 6																
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
Denmark	0	0	0	0	0	0	20	0	0	5	1	7	0	0	0	<1
Faroe Islands	23	60	24	5	6	25	29	3	7	13	21	7	3	2	0	<1
France	4170	2102	2008	2357	2612	3814	2904	3484	2299	3968	3626	1336	1263	1316	1247	547
Germany	148	298	257	0	9	0	0	0	9	< 1	<1	0	0	1	0	<1
Ireland	288	407	520	359	364	313	128	105	185	171	231*	109*	125*	72*	133	115
Netherlands	1	0	0	0	0	0	0	6	12	3	100	4	< 1	3	0	10
Norway	78	68	121	240	5	715	442	677	555	633	955	478	1	0	<1	1
Poland														1	0	0
Russia	50	4	2	0	0	0	9	1	0	2	0	2	0	0	0	0
Spain	4	8	18	31	13	21	9	15	15	4	7	24	15	38	21	5
Sweden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UK (E/W/NI)	2955**	3491**	3168**	4500**	4549**	3646**	97	3286**	2770**	2652**	2764**	2824**	2666**	2001**	2049**	1583**
UK (Scotland)							3191									
Total reported	7717	6438	6118	7492	7558	8534	6829	7577	5852	7453	7706	4791	4074	3434	3450	2262
Unallocated	−1005	−144	145	−575	−9	119	191	−43	−279	−337	−1065	84	7	100	83	78
BMS landings										0	31	< 1	< 1	<1	<1	<1

ICES estimate	6712	6294	6263	6917	7549	8653	7020	7534	5573	7116#	6641#	4875#	4081#	3534#	3533#	2340#
TAC	14100	13066	11000	9570	8230	9464	8045	6848	6816	10404##	10215##	9713	8280	6175	4664	5538

*** Official values are preliminary.**

**** Scotland+E/W/NI combined.**

 # Does not include BMS landings.

Includes top-up (4.1% in 2017, 4.76% in 2018).

Table 16.3.1. Saithe in subareas 4 and 6 and in Division 3.a. Official nominal landings (tonnes) of saithe by nation, 2008–2023. ICES estimates are landings reported to ICES and the Working Group. (continued)

Subareas 4 and 6 and Division 3.a																
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
ICES estimate #	122184	112267	103030	98446	78414	80059	76392	76936	68077	88686	88507	92524	73938	50482	49680	58991
TAC	150000	139000	118000	103170	87550	100684	85581	72854	72512	110691##	116008##	103327	88093##	65687	49614	58912

 # Since 2016, landings include Norwegian component of BMS landings.

Agreed upon TAC, including landings top-up.

Table 16.3.2. Saithe in subareas 4 and 6 and in Division 3.a. Catch data (2023; all ages, not the sum over products for ages 3–10+ used in the assessment) imported into InterCatch and percentage of sampling strata for discards raised within InterCatch.

Catch Category	Raised or Imported	2023	
		Weight (tonnes)	Percentage
BMS landing	Imported data	0. 548	100
Discards	Imported data	3165	87
Discards	Raised discards	482	13
Landings	Imported data	57384	100
Logbook registered discard	Imported data	0	0

Table 16.3.3. Saithe in subareas 4 and 6 and in Division 3.a. Working Group estimates of catch components by weight (t) for ages 3–10+, as used in the assessment. Norway was under landings obligations since 1988, but records are unclear whether saithe was fully in the landing obligation from that time.

Year	Catches	Landings[#]	BMS Landings	Discards[##]	Percentage discards
1967	101331	88339		12992	13
1968	134559	113741		20818	15
1969	150293	130580		19713	13
1970	270829	235012		35817	13
1971	309177	265356		43821	14
1972	296481	261914		34567	12
1973	275164	242513		32651	12
1974	337021	298347		38674	11
1975	304645	271610		33035	11
1976	423347	343898		79449	19
1977	239913	216393		23520	10
1978	176851	155124		21727	12
1979	142647	128352		14295	10
1980	145289	131897		13392	9
1981	148244	132273		15971	11
1982	202111	174336		27775	14
1983	203018	180040		22978	11
1984	240566	200843		39723	17

Year	Catches	Landings[#]	BMS Landings	Discards[##]	Percentage discards
1985	273672	220870		52802	19
1986	232795	198605		34190	15
1987	192380	167503		24877	13
1988	154252	135176		19076	12
1989	124599	108892		15707	13
1990	124450	103831		20619	17
1991	130973	108071		22902	17
1992	115537	99745		15792	14
1993	132618	111499		21119	16
1994	126759	109621		17138	14
1995	141190	121795		19395	14
1996	128896	114968		13928	11
1997	120103	107348		12755	11
1998	117222	106126		11096	9
1999	119467	110531		8936	7
2000	93795	85781		8014	9
2001	102859	91741		11118	11
2002	129847	110911		18936	15
2003	121656	110282		11374	9
2004	113792	107356		6436	6
2005	121217	118625		2592	2
2006	128711	120414		8297	6
2007	106333	94958		11375	11
2008	129887	121618		8269	6
2009	114520	110972		3548	3
2010	104723	102128		2595	2
2011	102006	98034		3972	4
2012	87049	78144		8905	10
2013	87271	79859		7412	8

Year	Catches	Landings#	BMS Landings	Discards##	Percentage discards
2014	82172	76057		6115	7
2015	81445	76748		4697	6
2016	77672	67620	0	10052	13
2017	94581.5	88010	0.5	6571	7
2018	95447	88328	42	7076	7
2019^	96634	92390	20	4224	4
2020	76820	73791	10	3019	4
2021	50951	50124	0.4	827	1.9
2022	53805	49548	0.2	4246	8
2023	60896	57573	0.6	3322	5

 # Since 2016, landings include the Norwegian component of BMS landings.

Since 2016, discards minus BMS landings from EU fleets officially reported in logbooks.

^ Includes 937 tonnes of missing Swedish landings and corresponding 109 tonnes of discards (based on discard rate estimated in division 4.a).

Table 16.3.4. Saithe in subareas 4 and 6 and in Division 3.a. Amount (weight and percentage) of sampled or estimated age distributions of catch data (2023) imported or raised in InterCatch. Weight in tonnes corresponds to the catch in tonnes imported for all ages, and not to the SOP used in the assessment for ages 3–10+.

Catch Category	Raised or Imported	Sampled or Estimated	2023	
			Weight	Percentage
Logbook Registered Discard	Imported Data	Estimated Distribution	0	0
Landings	Imported Data	Sampled Distribution	40560	71
Landings	Imported Data	Estimated Distribution	16824	29
Discards	Imported Data	Sampled Distribution	3126	86
Discards	Raised Discards	Estimated Distribution	482	13
Discards	Imported Data	Estimated Distribution	39	1
BMS landing	Imported Data	Sampled Distribution	0	0
BMS landing	Imported Data	Estimated Distribution	0.55	100

Table 16.3.5. Saithe in subareas 4 and 6 and in Division 3.a. Catch numbers (thousands) at age for the age range used in the assessment.

Year/Age	3	4	5	6	7	8	9	10+
1967	26948	19395	16672	2358	1610	299	203	185
1968	36111	25387	14153	6166	433	247	127	147
1969	47014	21142	11869	7790	5795	810	642	151
1970	57920	91668	16102	12416	3932	1834	326	270
1971	108549	69105	35143	4848	4290	2910	1922	782
1972	74755	79033	27178	21711	3709	3014	1682	1625
1973	84484	45078	28822	16443	8511	2047	1391	2407
1974	104086	40345	15160	21179	14810	5321	1514	1977
1975	88613	30927	11077	7746	13792	9577	3591	2717
1976	323156	63447	12556	6401	4016	5488	3678	3528
1977	42701	65727	15839	5620	3814	3528	3909	4753
1978	54515	32608	19389	3390	1149	1057	788	3522
1979	25395	16999	12004	8906	2833	750	554	2112
1980	27203	14757	9677	6878	5714	1177	522	2327
1981	40705	9971	7235	3763	3368	3475	674	2564
1982	49595	48533	9848	6120	2166	1489	1007	1268
1983	43916	24637	27924	5813	4942	1529	1062	1342
1984	125848	38470	13910	13320	1673	1281	344	653
1985	208401	66489	14257	4878	3034	698	409	750
1986	86198	109080	16302	5509	2629	1490	457	910
1987	48545	116551	15019	3233	1829	1269	933	707
1988	50657	31577	37919	3918	1927	1130	796	687
1989	34408	36772	14156	11211	1572	757	430	493
1990	63454	23416	12154	4826	2803	762	288	368
1991	71710	35719	8016	3669	1733	976	376	463
1992	28617	40193	13691	3269	1539	712	531	426
1993	58813	24905	12715	3199	1583	1547	835	1037
1994	31034	48062	13992	4399	957	354	438	803

Year/Age	3	4	5	6	7	8	9	10+
1995	41461	31130	15884	3864	3529	690	566	809
1996	17208	46468	12653	7915	3194	827	215	496
1997	23380	23077	32395	3763	2666	1036	299	292
1998	16113	37088	17570	16459	2253	1234	581	280
1999	14661	16588	28645	8588	10169	2401	914	665
2000	10985	20680	9597	12632	3190	3302	657	446
2001	24961	21100	24068	3429	3621	1814	1655	248
2002	17570	37489	14736	13731	2309	2544	1321	1575
2003	28296	31752	20631	6836	6855	1535	2000	2042
2004	13642	24479	15649	15220	2037	2164	1300	1066
2005	12690	15473	19060	20042	7956	1628	1188	1151
2006	17313	31972	10381	11286	8395	3824	1008	1281
2007	24614	13314	20919	7175	5564	3610	1218	930
2008	7620	30911	12540	14941	5088	3285	3551	3118
2009	7438	15507	14222	5847	8512	2994	1519	2945
2010	8766	9249	9440	6511	2671	4773	1679	2707
2011	12786	24269	8980	3674	2867	1208	1564	3877
2012	14334	13053	16948	4075	1977	1268	541	2611
2013	7267	30318	5312	7869	1890	1241	616	1658
2014	4055	14322	15195	3957	4124	1040	429	1389
2015	8369	8323	14259	8254	1862	1623	715	977
2016	7382	14241	9661	5729	2758	1430	853	1317
2017	4977	18989	9773	6247	5364	1876	820	1113
2018	2603	16250	18858	7376	2142	2027	978	1178
2019	6240	8570	14841	10394	2881	1127	1027	1236
2020	2511	11823	7627	7436	4246	967	381	627
2021	6129	6236	4910	2899	2924	1061	347	695
2022	4787	7700	4804	3499	2046	1262	725	582
2023	6365	18666	7788	2562	1857	823	674	811

Table 16.3.6. Saithe in subareas 4 and 6 and in Division 3.a. Landings numbers (thousands) at age for the age range used in the assessment.

Year/Age	3	4	5	6	7	8	9	10+
1967	17330	16220	15531	2303	1594	292	198	183
1968	23223	21231	13184	6023	429	242	123	145
1969	30235	17681	11057	7609	5738	791	626	150
1970	37249	76661	15000	12128	3894	1792	318	267
1971	69808	57792	32737	4736	4248	2843	1874	774
1972	48075	66095	25317	21207	3672	2944	1641	1607
1973	54332	37698	26849	16061	8428	2000	1357	2381
1974	66938	33740	14123	20688	14666	5199	1477	1955
1975	56987	25864	10319	7566	13657	9357	3501	2687
1976	207823	53060	11696	6253	3976	5362	3586	3490
1977	27461	54967	14755	5490	3777	3447	3812	4701
1978	35059	27269	18062	3312	1138	1033	768	3484
1979	16332	14216	11182	8699	2805	733	540	2089
1980	17494	12341	9015	6718	5658	1150	509	2302
1981	26178	8339	6739	3675	3335	3396	657	2536
1982	31895	40587	9174	5978	2145	1454	982	1254
1983	28242	20604	26013	5678	4893	1494	1036	1327
1984	80933	32172	12957	13011	1657	1252	335	646
1985	134024	55605	13281	4765	3005	682	399	742
1986	55435	91223	15186	5381	2603	1456	445	900
1987	31220	97470	13990	3158	1811	1240	910	700
1988	32578	26408	35323	3828	1908	1104	776	680
1989	22128	30752	13187	10951	1557	739	419	488
1990	40808	19583	11322	4714	2776	745	281	364
1991	46117	29871	7467	3583	1716	953	367	458
1992	18404	33614	12753	3193	1524	696	518	422
1993	37823	20828	11845	3125	1568	1511	814	1026
1994	19958	40193	13034	4297	947	346	427	794

Year/Age	3	4	5	6	7	8	9	10+
1995	26664	26034	14797	3774	3494	674	552	800
1996	11066	38861	11786	7731	3163	808	210	491
1997	15036	19299	30177	3676	2640	1012	291	288
1998	10363	31017	16367	16077	2231	1206	567	277
1999	9429	13872	26684	8389	10070	2346	891	657
2000	7064	17295	8940	12339	3159	3226	641	441
2001	16052	17646	22421	3349	3586	1772	1614	245
2002	9131	31779	12286	13307	2245	2220	1199	1479
2003	13009	24646	20397	6836	6855	1535	2000	2042
2004	8037	20071	15649	15220	2037	2164	1300	1066
2005	9191	15473	19060	20042	7956	1628	1188	1151
2006	12200	26690	9986	11286	8395	3824	1008	1281
2007	15181	10163	19157	7078	5564	3610	1218	930
2008	6924	23230	10930	14196	4977	3276	3551	3118
2009	6607	14349	13827	5817	8419	2978	1505	2934
2010	7880	8859	9174	6394	2670	4762	1679	2669
2011	10150	22799	8852	3630	2860	1183	1563	3869
2012	7029	11712	15572	4016	1971	1267	537	2610
2013	4999	25516	4974	7645	1886	1241	616	1658
2014	3099	12117	13380	3737	4047	1036	429	1388
2015	6206	7392	13555	8021	1844	1621	715	975
2016	3508	10374	8756	5156	2732	1423	852	1317
2017	3033	15139	8795	6179	5362	1876	820	1111
2018	2017	12994	16936	7043	2125	2016	976	1177
2019	5456	8125	13826	9797	2842	1116	1025	1235
2020	1997	10870	7243	7326	4113	959	377	619
2021	5693	6073	4859	2863	2924	1061	347	695
2022	3295	6142	4417	3302	2010	1260	725	582
2023	5472	16841	7459	2531	1852	822	673	810

Table 16.3.7. Saithe in subareas 4 and 6 and in Division 3.a. Discards numbers (thousands) at age for the age range used in the assessment.

Year/Age	3	4	5	6	7	8	9	10+
1967	9617	3175	1141	55	16	7	5	2
1968	12888	4156	969	143	4	6	3	2
1969	16779	3461	813	181	57	19	16	2
1970	20671	15007	1102	288	38	42	8	3
1971	38741	11313	2406	112	42	67	48	9
1972	26680	12938	1861	504	36	69	42	18
1973	30152	7380	1973	381	83	47	35	26
1974	37148	6605	1038	491	144	122	38	22
1975	31626	5063	758	180	135	220	89	30
1976	115333	10387	860	148	39	126	92	38
1977	15240	10760	1084	130	37	81	97	52
1978	19456	5338	1327	79	11	24	20	38
1979	9063	2783	822	207	28	17	14	23
1980	9709	2416	662	160	56	27	13	25
1981	14527	1632	495	87	33	80	17	28
1982	17700	7945	674	142	21	34	25	14
1983	15673	4033	1912	135	48	35	26	15
1984	44915	6298	952	309	16	29	9	7
1985	74378	10885	976	113	30	16	10	8
1986	30764	17857	1116	128	26	34	11	10
1987	17326	19080	1028	75	18	29	23	8
1988	18079	5169	2596	91	19	26	20	7
1989	12280	6020	969	260	15	17	11	5
1990	22647	3833	832	112	27	18	7	4
1991	25593	5847	549	85	17	22	9	5
1992	10213	6580	937	76	15	16	13	5
1993	20990	4077	871	74	15	36	21	11
1994	11076	7868	958	102	9	8	11	9

Year/Age	3	4	5	6	7	8	9	10+
1995	14797	5096	1087	90	34	16	14	9
1996	6141	7607	866	184	31	19	5	5
1997	8344	3778	2218	87	26	24	7	3
1998	5751	6072	1203	382	22	28	14	3
1999	5233	2716	1961	199	99	55	23	7
2000	3920	3386	657	293	31	76	16	5
2001	8908	3454	1648	80	35	42	41	3
2002	8439	5710	2451	425	64	324	121	96
2003	15288	7106	234	0	0	0	0	0
2004	5605	4407	0	0	0	0	0	0
2005	3498	0	0	0	0	0	0	0
2006	5114	5282	394	0	0	0	0	0
2007	9433	3152	1762	97	0	0	0	0
2008	696	7682	1610	745	111	9	0	0
2009	831	1158	395	30	93	16	14	11
2010	886	390	266	117	1	11	0	38
2011	2636	1470	129	44	7	25	1	8
2012	7305	1341	1377	58	7	1	4	1
2013	2268	4801	339	224	4	0	0	1
2014	955	2205	1816	220	77	4	0	1
2015	2163	931	704	232	17	3	0	2
2016	3874	3867	905	573	26	7	1	0
2017	1943	3850	978	69	2	0	0	2
2018	586	3256	1922	333	17	11	2	1
2019	785	445	1016	597	39	11	1	1
2020	514	953	383	110	133	8	4	8
2021	436	163	51	36	0	0	0	0
2022	1492	1558	387	197	36	2	0	0
2023	892	1825	329	31	4	1	0	0

Table 16.3.8. Saithe in subareas 4 and 6 and in Division 3.a. Catch weight-at-age (kg).

Year/Age	3	4	5	6	7	8	9	10+
1967	0.898	1.339	2.094	3.183	3.753	5.316	5.891	7.719
1968	1.234	1.624	1.979	3.007	4.039	4.428	6.136	7.406
1969	0.933	1.530	2.251	2.711	3.558	4.406	5.220	6.767
1970	0.908	1.416	2.049	2.716	3.599	4.463	5.687	6.845
1971	0.811	1.325	2.167	2.934	3.765	4.634	5.172	6.163
1972	0.780	1.175	1.952	2.367	3.793	4.228	4.630	6.326
1973	0.792	1.382	1.633	2.569	3.356	4.684	4.814	6.445
1974	0.831	1.534	2.372	2.751	3.428	4.498	5.713	7.857
1975	0.862	1.472	2.479	3.298	3.764	4.296	5.540	7.562
1976	0.678	1.287	2.250	3.068	4.034	4.383	5.112	7.147
1977	0.733	1.234	1.926	3.108	4.161	4.605	4.859	6.542
1978	0.793	1.304	2.145	3.338	4.521	4.900	5.449	7.400
1979	1.069	1.595	2.228	3.093	4.049	5.274	6.308	7.955
1980	0.921	1.790	2.380	3.028	4.089	5.126	5.939	8.148
1981	0.927	1.790	2.705	3.584	4.535	5.478	6.980	8.724
1982	1.048	1.548	2.518	3.218	4.206	5.125	5.905	8.823
1983	0.992	1.688	2.139	3.135	3.690	4.632	5.505	8.453
1984	0.767	1.586	2.286	2.688	3.895	4.665	6.183	8.474
1985	0.640	1.244	1.941	2.769	3.406	4.950	5.865	8.854
1986	0.670	1.018	1.786	2.430	3.571	4.209	5.651	8.218
1987	0.650	0.861	1.815	3.072	4.209	5.330	6.128	8.603
1988	0.752	0.964	1.379	2.789	4.023	5.254	6.322	8.649
1989	0.864	1.018	1.413	1.997	3.913	5.017	6.430	8.431
1990	0.815	1.175	1.575	2.245	3.241	4.858	6.315	8.416
1991	0.764	1.138	1.744	2.363	3.165	4.222	6.066	8.191
1992	0.930	1.169	1.599	2.240	3.667	4.330	5.412	7.045
1993	0.868	1.239	1.746	2.634	3.184	3.980	5.080	6.891
1994	0.911	1.100	1.594	2.432	3.617	4.787	6.548	8.326
1995	0.967	1.272	1.807	2.560	3.554	4.767	5.267	7.891

Year/Age	3	4	5	6	7	8	9	10+
1996	0.933	1.167	1.798	2.366	2.951	4.705	6.092	8.382
1997	0.873	1.125	1.445	2.585	3.555	4.525	6.158	8.866
1998	0.861	0.949	1.386	1.743	2.948	3.883	4.996	7.227
1999	0.850	1.042	1.206	1.752	2.337	3.493	4.844	6.745
2000	0.992	1.107	1.532	1.683	2.593	3.084	4.773	7.461
2001	0.774	1.053	1.307	2.093	2.546	3.485	4.141	6.141
2002	0.776	1.014	1.495	1.791	2.961	3.761	4.638	5.750
2003	0.636	0.889	1.167	1.810	2.368	3.176	3.768	5.065
2004	0.794	1.010	1.392	1.896	2.860	3.687	4.814	7.059
2005	0.715	1.155	1.325	1.710	2.132	3.026	3.622	5.713
2006	0.904	1.012	1.489	1.906	2.424	3.058	4.318	5.734
2007	0.769	1.124	1.286	1.834	2.328	2.887	3.600	4.975
2008	0.916	1.065	1.488	1.692	2.210	2.792	3.206	4.565
2009	1.033	1.333	1.672	1.994	2.566	3.086	3.651	4.790
2010	1.037	1.474	2.033	2.597	3.163	3.488	3.968	5.223
2011	0.955	1.192	1.787	2.571	3.068	3.418	3.718	4.289
2012	0.910	1.287	1.383	2.196	3.221	3.536	4.181	4.482
2013	0.878	1.132	1.586	1.957	3.076	3.841	4.541	5.648
2014	1.091	1.265	1.568	2.334	2.607	4.010	5.530	6.679
2015	0.951	1.253	1.621	2.180	3.037	3.793	4.228	7.285
2016	0.937	1.239	1.611	2.231	2.888	3.450	4.331	6.208
2017	0.956	1.228	1.755	2.356	2.987	4.232	4.473	6.287
2018	1.095	1.239	1.549	2.234	3.112	3.867	4.465	6.708
2019	1.133	1.442	1.809	2.320	3.081	3.897	4.677	6.613
2020	1.061	1.529	1.914	2.439	3.106	4.038	4.918	6.985
2021	1.043	1.413	1.899	2.365	2.984	4.038	5.179	6.852
2022	1.079	1.459	1.919	2.541	3.263	3.959	4.796	7.130
2023	0.787	1.170	1.641	2.288	2.901	3.589	4.094	5.310

Table 16.3.9. Saithe in subareas 4 and 6 and in Division 3.a. Landings weight-at-age (kg).

Year/Age	3	4	5	6	7	8	9	10+
1967	0.931	1.362	2.104	3.186	3.754	5.316	5.891	7.719
1968	1.278	1.652	1.989	3.009	4.040	4.428	6.136	7.406
1969	0.966	1.557	2.261	2.713	3.559	4.406	5.220	6.768
1970	0.941	1.441	2.059	2.718	3.600	4.463	5.687	6.845
1971	0.840	1.348	2.178	2.936	3.766	4.634	5.173	6.163
1972	0.808	1.196	1.961	2.369	3.794	4.228	4.630	6.326
1973	0.821	1.406	1.641	2.571	3.357	4.684	4.814	6.445
1974	0.861	1.561	2.383	2.753	3.429	4.498	5.713	7.857
1975	0.893	1.498	2.490	3.300	3.765	4.296	5.540	7.562
1976	0.702	1.309	2.260	3.071	4.035	4.383	5.112	7.147
1977	0.760	1.256	1.935	3.111	4.162	4.605	4.859	6.542
1978	0.822	1.327	2.155	3.340	4.522	4.901	5.449	7.400
1979	1.107	1.623	2.238	3.095	4.050	5.274	6.308	7.955
1980	0.955	1.821	2.391	3.030	4.090	5.126	5.939	8.148
1981	0.961	1.821	2.718	3.587	4.536	5.478	6.980	8.724
1982	1.086	1.575	2.529	3.220	4.207	5.125	5.905	8.823
1983	1.028	1.718	2.149	3.138	3.691	4.632	5.505	8.453
1984	0.795	1.614	2.297	2.690	3.896	4.665	6.183	8.474
1985	0.663	1.265	1.951	2.772	3.407	4.950	5.865	8.854
1986	0.694	1.035	1.794	2.432	3.572	4.209	5.651	8.218
1987	0.674	0.876	1.824	3.075	4.210	5.330	6.128	8.603
1988	0.779	0.981	1.386	2.791	4.024	5.254	6.322	8.649
1989	0.895	1.036	1.420	1.998	3.914	5.018	6.430	8.431
1990	0.844	1.196	1.583	2.247	3.242	4.858	6.315	8.416
1991	0.791	1.158	1.752	2.365	3.165	4.222	6.066	8.191
1992	0.964	1.189	1.607	2.242	3.668	4.330	5.413	7.046
1993	0.899	1.260	1.754	2.636	3.185	3.980	5.080	6.891
1994	0.944	1.119	1.601	2.434	3.618	4.787	6.548	8.326
1995	1.002	1.294	1.816	2.562	3.555	4.767	5.267	7.891

Year/Age	3	4	5	6	7	8	9	10+
1996	0.967	1.187	1.807	2.368	2.952	4.705	6.092	8.382
1997	0.905	1.145	1.452	2.587	3.556	4.525	6.158	8.866
1998	0.892	0.966	1.393	1.744	2.949	3.883	4.996	7.227
1999	0.881	1.061	1.211	1.754	2.337	3.493	4.844	6.745
2000	1.027	1.127	1.539	1.684	2.594	3.084	4.773	7.462
2001	0.802	1.072	1.313	2.095	2.546	3.485	4.141	6.141
2002	0.923	1.035	1.478	1.769	2.947	3.426	4.407	5.674
2003	0.833	0.980	1.173	1.810	2.368	3.176	3.768	5.065
2004	0.918	1.084	1.392	1.896	2.860	3.687	4.814	7.059
2005	0.921	1.155	1.325	1.710	2.132	3.026	3.622	5.713
2006	0.945	1.069	1.514	1.906	2.424	3.058	4.318	5.734
2007	0.837	1.143	1.317	1.840	2.328	2.887	3.600	4.975
2008	0.944	1.193	1.565	1.720	2.226	2.795	3.206	4.565
2009	1.036	1.340	1.664	1.992	2.563	3.085	3.648	4.793
2010	1.036	1.479	2.034	2.597	3.164	3.488	3.968	5.199
2011	1.007	1.207	1.783	2.573	3.068	3.404	3.717	4.284
2012	1.015	1.321	1.408	2.201	3.223	3.536	4.177	4.482
2013	0.898	1.156	1.614	1.976	3.078	3.841	4.541	5.648
2014	1.126	1.300	1.607	2.384	2.617	4.013	5.530	6.679
2015	0.977	1.244	1.625	2.190	3.043	3.796	4.228	7.287
2016	0.998	1.292	1.628	2.283	2.892	3.453	4.333	6.208
2017	1.047	1.302	1.809	2.361	2.988	4.232	4.473	6.292
2018	1.153	1.287	1.575	2.266	3.107	3.868	4.463	6.707
2019	1.147	1.448	1.829	2.343	3.094	3.905	4.680	6.616
2020	1.066	1.542	1.938	2.447	3.132	4.043	4.912	6.984
2021	1.044	1.416	1.903	2.362	2.984	4.038	5.179	6.852
2022	1.160	1.530	1.955	2.574	3.277	3.959	4.796	7.130
2023	0.772	1.177	1.651	2.299	2.903	3.590	4.094	5.311

Table 16.3.10. Saithe in subareas 4 and 6 and in Division 3.a. Discards weight-at-age (kg). Landing weight-at-age is reported and used when zero discards (Table 16.3.7).

Year/Age	3	4	5	6	7	8	9	10+
1967	0.748	1.076	1.818	2.972	3.590	5.316	5.891	7.719
1968	1.028	1.306	1.719	2.808	3.864	4.428	6.136	7.406
1969	0.777	1.230	1.955	2.531	3.403	4.406	5.220	6.767
1970	0.757	1.139	1.780	2.536	3.442	4.463	5.687	6.845
1971	0.676	1.065	1.882	2.739	3.601	4.634	5.172	6.163
1972	0.650	0.945	1.695	2.210	3.628	4.228	4.630	6.326
1973	0.660	1.111	1.419	2.399	3.210	4.684	4.814	6.445
1974	0.692	1.233	2.060	2.568	3.279	4.498	5.713	7.857
1975	0.718	1.184	2.153	3.079	3.600	4.296	5.540	7.562
1976	0.565	1.035	1.954	2.865	3.858	4.383	5.112	7.147
1977	0.611	0.993	1.673	2.902	3.980	4.605	4.859	6.542
1978	0.661	1.049	1.862	3.116	4.325	4.900	5.449	7.400
1979	0.890	1.283	1.935	2.888	3.873	5.274	6.308	7.955
1980	0.768	1.439	2.067	2.827	3.911	5.126	5.939	8.148
1981	0.773	1.439	2.349	3.346	4.338	5.478	6.980	8.724
1982	0.873	1.245	2.186	3.004	4.023	5.125	5.905	8.823
1983	0.826	1.358	1.858	2.927	3.529	4.632	5.505	8.453
1984	0.639	1.276	1.985	2.510	3.726	4.665	6.183	8.474
1985	0.533	1.000	1.686	2.586	3.258	4.950	5.865	8.854
1986	0.558	0.818	1.551	2.269	3.416	4.209	5.651	8.218
1987	0.542	0.693	1.576	2.869	4.026	5.330	6.128	8.603
1988	0.626	0.775	1.198	2.604	3.848	5.254	6.322	8.649
1989	0.720	0.819	1.227	1.865	3.743	5.017	6.430	8.431
1990	0.679	0.945	1.368	2.097	3.100	4.858	6.315	8.416
1991	0.636	0.915	1.515	2.206	3.027	4.222	6.066	8.191
1992	0.775	0.940	1.389	2.092	3.508	4.330	5.412	7.045
1993	0.723	0.996	1.517	2.460	3.046	3.980	5.080	6.891
1994	0.759	0.884	1.384	2.271	3.459	4.787	6.548	8.326

Year/Age	3	4	5	6	7	8	9	10+
1995	0.806	1.023	1.570	2.390	3.400	4.767	5.267	7.891
1996	0.778	0.938	1.562	2.209	2.823	4.705	6.092	8.382
1997	0.728	0.905	1.255	2.413	3.400	4.525	6.158	8.866
1998	0.717	0.764	1.204	1.627	2.820	3.883	4.996	7.227
1999	0.708	0.838	1.047	1.636	2.235	3.493	4.844	6.745
2000	0.826	0.890	1.330	1.571	2.480	3.084	4.773	7.461
2001	0.645	0.847	1.135	1.955	2.435	3.485	4.141	6.141
2002	0.616	0.896	1.580	2.483	3.469	6.058	6.935	6.927
2003	0.469	0.571	0.641	1.689	2.265	3.176	3.768	5.065
2004	0.617	0.676	1.203	1.769	2.735	3.687	4.814	7.059
2005	0.741	0.913	1.146	1.595	2.038	3.026	3.622	5.713
2006	0.808	0.724	0.859	1.778	2.318	3.058	4.318	5.734
2007	0.660	1.062	0.949	1.365	2.227	2.887	3.600	4.975
2008	0.633	0.680	0.967	1.161	1.495	1.820	3.206	2.797
2009	1.010	1.253	1.946	2.403	2.838	3.388	3.934	3.911
2010	1.046	1.374	1.987	2.561	3.025	3.351	3.968	6.895
2011	0.756	0.971	2.054	2.445	3.170	4.072	4.369	6.618
2012	0.808	0.997	1.101	1.831	2.675	3.411	4.804	5.313
2013	0.835	1.003	1.180	1.300	2.298	3.841	4.541	5.861
2014	0.977	1.072	1.274	1.487	2.077	3.223	5.530	7.568
2015	0.877	1.326	1.531	1.848	2.410	2.184	4.228	5.911
2016	0.882	1.096	1.440	1.764	2.384	2.864	2.634	4.282
2017	0.815	0.937	1.269	1.907	2.484	4.232	4.473	2.817
2018	0.894	1.049	1.318	1.554	3.770	3.715	5.371	7.697
2019	1.033	1.336	1.537	1.932	2.162	2.991	2.816	2.969
2020	1.042	1.379	1.456	1.937	2.306	3.448	5.480	7.101
2021	1.025	1.305	1.466	2.583	2.984	4.038	5.179	6.852
2022	0.900	1.178	1.498	1.988	2.474	4.033	4.796	7.130
2023	0.882	1.101	1.419	1.415	2.218	2.876	3.753	3.482

Table 16.3.11. Saithe in subareas 4 and 6 and in Division 3.a. Stock weight-at-age (kg).

Year/Age	3	4	5	6	7	8	9	10+
1967	0.600	0.971	1.659	2.746	3.485	5.259	6.013	8.227
1968	0.824	1.178	1.568	2.594	3.751	4.380	6.263	7.893
1969	0.623	1.110	1.783	2.339	3.304	4.359	5.329	7.213
1970	0.607	1.027	1.623	2.343	3.341	4.415	5.806	7.295
1971	0.541	0.961	1.717	2.531	3.496	4.584	5.280	6.568
1972	0.521	0.852	1.546	2.042	3.522	4.182	4.727	6.742
1973	0.529	1.002	1.294	2.216	3.116	4.634	4.914	6.869
1974	0.555	1.112	1.880	2.373	3.183	4.449	5.832	8.374
1975	0.575	1.067	1.964	2.845	3.495	4.249	5.655	8.059
1976	0.453	0.933	1.783	2.647	3.745	4.336	5.218	7.617
1977	0.490	0.895	1.526	2.681	3.863	4.555	4.960	6.972
1978	0.529	0.946	1.699	2.879	4.198	4.848	5.563	7.887
1979	0.713	1.157	1.765	2.668	3.760	5.217	6.439	8.478
1980	0.615	1.298	1.886	2.612	3.796	5.071	6.063	8.683
1981	0.619	1.298	2.143	3.092	4.211	5.419	7.126	9.297
1982	0.700	1.122	1.995	2.776	3.905	5.070	6.028	9.403
1983	0.662	1.224	1.695	2.704	3.426	4.582	5.620	9.009
1984	0.512	1.150	1.811	2.319	3.617	4.614	6.312	9.031
1985	0.427	0.902	1.538	2.389	3.162	4.897	5.987	9.437
1986	0.447	0.738	1.415	2.096	3.316	4.164	5.768	8.759
1987	0.434	0.625	1.438	2.650	3.908	5.273	6.256	9.168
1988	0.502	0.699	1.093	2.405	3.735	5.198	6.454	9.218
1989	0.577	0.739	1.120	1.722	3.633	4.963	6.564	8.985
1990	0.544	0.852	1.248	1.937	3.009	4.806	6.446	8.970
1991	0.510	0.825	1.382	2.038	2.938	4.177	6.192	8.730
1992	0.621	0.848	1.267	1.932	3.405	4.283	5.525	7.509
1993	0.580	0.898	1.384	2.272	2.957	3.937	5.186	7.344
1994	0.608	0.797	1.263	2.098	3.358	4.735	6.684	8.873
1995	0.646	0.922	1.432	2.208	3.300	4.716	5.377	8.410

Year/Age	3	4	5	6	7	8	9	10+
1996	0.623	0.846	1.425	2.041	2.740	4.655	6.219	8.933
1997	0.583	0.816	1.145	2.230	3.301	4.476	6.286	9.449
1998	0.575	0.689	1.098	1.503	2.737	3.841	5.100	7.703
1999	0.568	0.756	0.955	1.512	2.170	3.456	4.945	7.189
2000	0.662	0.803	1.214	1.452	2.408	3.051	4.873	7.952
2001	0.517	0.764	1.035	1.806	2.364	3.447	4.227	6.545
2002	0.518	0.735	1.184	1.545	2.750	3.721	4.735	6.129
2003	0.538	0.744	1.039	1.728	2.414	3.717	4.533	7.474
2004	0.532	0.709	0.963	1.386	2.260	2.943	4.187	5.226
2005	0.548	0.771	1.062	1.419	2.016	3.086	3.727	5.990
2006	0.656	0.769	1.156	1.598	2.132	2.949	3.911	5.712
2007	0.582	0.901	1.053	1.649	2.138	2.890	3.570	5.821
2008	0.673	0.884	1.373	1.632	2.518	2.974	3.686	5.164
2009	0.788	1.073	1.417	2.122	2.455	3.508	3.890	5.788
2010	0.765	1.198	1.708	2.253	3.225	3.613	4.702	6.055
2011	0.526	0.851	1.486	2.126	2.759	3.641	3.901	5.386
2012	0.488	0.814	1.107	2.115	2.942	3.704	4.405	5.196
2013	0.605	0.765	1.179	1.592	2.990	3.897	4.667	6.066
2014	0.672	0.893	1.196	1.821	2.411	4.208	5.027	6.508
2015	0.609	0.950	1.318	1.866	2.594	3.381	5.306	7.099
2016	0.552	0.852	1.269	1.853	2.609	3.515	4.174	6.701
2017	0.567	0.786	1.276	2.065	2.851	3.674	4.592	6.781
2018	0.643	0.822	1.146	1.838	2.782	3.569	4.247	6.250
2019	0.743	0.995	1.292	1.817	2.668	3.710	4.487	6.176
2020	0.753	1.155	1.482	2.018	2.855	3.770	4.808	7.136
2021	0.666	1.075	1.595	2.149	2.842	3.845	4.609	6.462
2022	0.594	0.883	1.382	2.068	2.771	3.473	4.578	6.840
2023	0.590	0.862	1.201	2.001	2.917	3.677	4.376	6.282

Table 16.3.12. Saithe in subareas 4 and 6 and in Division 3.a. Proportion mature-at-age.

Year/Age	3	4	5	6	7	8	9	10+
1967	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1968	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1969	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1970	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1971	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1972	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1973	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1974	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1975	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1976	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1977	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1978	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1979	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1980	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1981	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1982	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1983	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1984	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1985	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1986	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1987	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1988	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1989	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1990	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1991	0.1841	0.3554	0.5907	0.8216	0.9442	0.9809	0.9918	0.9968
1992	0.1743	0.3687	0.6082	0.8367	0.9448	0.9818	0.9923	0.9968
1993	0.2055	0.3816	0.6112	0.8339	0.9469	0.9818	0.9930	0.9964
1994	0.1852	0.3517	0.5751	0.8266	0.9455	0.9817	0.9915	0.9966
1995	0.1785	0.3398	0.5899	0.8256	0.9475	0.9799	0.9902	0.9973

Year/Age	3	4	5	6	7	8	9	10+
1996	0.1729	0.3398	0.5850	0.8162	0.9405	0.9814	0.9918	0.9976
1997	0.1912	0.3667	0.5994	0.8250	0.9479	0.9824	0.9929	0.9974
1998	0.1895	0.3568	0.5915	0.8208	0.9430	0.9806	0.9920	0.9970
1999	0.1744	0.3478	0.5763	0.8055	0.9410	0.9795	0.9915	0.9962
2000	0.1858	0.3457	0.5801	0.8038	0.9407	0.9786	0.9914	0.9962
2001	0.1975	0.3513	0.5800	0.8282	0.9458	0.9813	0.9917	0.9966
2002	0.2235	0.3772	0.5824	0.7893	0.9388	0.9803	0.9867	0.9965
2003	0.2224	0.4094	0.6117	0.8213	0.9403	0.9824	0.9916	0.9970
2004	0.2184	0.4169	0.6610	0.8417	0.9445	0.9835	0.9866	0.9964
2005	0.1999	0.3556	0.6170	0.8357	0.9411	0.9798	0.9908	0.9970
2006	0.2402	0.3742	0.5780	0.8303	0.9525	0.9826	0.9919	0.9963
2007	0.2370	0.4034	0.5839	0.8028	0.9484	0.9845	0.9912	0.9962
2008	0.2604	0.4783	0.6896	0.8517	0.9468	0.9862	0.9941	0.9970
2009	0.2193	0.3679	0.6566	0.8528	0.9499	0.9804	0.9917	0.9972
2010	0.1153	0.2980	0.5302	0.8306	0.9447	0.9761	0.9892	0.9968
2011	0.2177	0.3064	0.5950	0.8205	0.9547	0.9842	0.9915	0.9967
2012	0.1678	0.3137	0.4775	0.7989	0.9294	0.9812	0.9917	0.9953
2013	0.1653	0.2881	0.4978	0.7270	0.9307	0.9755	0.9917	0.9961
2014	0.1828	0.3447	0.5271	0.7832	0.9259	0.9818	0.9916	0.9967
2015	0.1953	0.3826	0.6070	0.7999	0.9328	0.9764	0.9923	0.9970
2016	0.1333	0.2944	0.5336	0.7828	0.9118	0.9690	0.9855	0.9954
2017	0.1460	0.2410	0.4745	0.7681	0.9173	0.9604	0.9848	0.9946
2018	0.2588	0.3259	0.5053	0.7973	0.9394	0.9792	0.9885	0.9952
2019	0.2492	0.4277	0.5687	0.7769	0.9366	0.9791	0.9916	0.9950
2020	0.1626	0.3708	0.5966	0.7751	0.9133	0.9760	0.9898	0.9953
2021	0.1728	0.3273	0.6303	0.8372	0.9276	0.9717	0.9887	0.9957
2022	0.1679	0.2916	0.5301	0.8181	0.9399	0.9720	0.9839	0.9960
2023	0.1589	0.3463	0.5447	0.8067	0.9493	0.9827	0.9888	0.9946

Table 16.3.13. Saithe in subareas 4 and 6 and in Division 3.a. Data available for calibration of the final assessment. Indices include one commercial standardized CPUE index (year effects), tuned to the exploitable biomass within SAM, and indices for age 3–8 from combined research surveys in quarters 3 and 4 (delta-GAM approach for divisions 3.a and 6.a, and Subarea 4).

Year	Survey index–Q3–4 (delta-GAM) at age						CPUE
	3	4	5	6	7	8	
1992	1.317	0.912	0.186	0.047	0.046	0.051	
1993	4.067	0.783	0.321	0.076	0.020	0.035	
1994	1.125	0.682	0.177	0.134	0.028	0.014	
1995	3.636	0.844	0.319	0.078	0.068	0.029	
1996	1.879	2.259	0.213	0.134	0.044	0.011	
1997	2.050	1.042	1.433	0.143	0.119	0.046	
1998	1.348	2.405	0.633	0.678	0.079	0.082	
1999	1.453	0.683	1.058	0.178	0.161	0.037	
2000	2.051	3.793	0.468	0.326	0.063	0.067	1.000
2001	8.518	2.660	1.643	0.192	0.208	0.053	1.245
2002	3.486	4.518	0.613	0.487	0.082	0.108	1.014
2003	5.379	4.258	1.804	0.164	0.137	0.064	0.909
2004	2.281	1.997	1.311	0.462	0.054	0.051	1.066
2005	4.048	2.055	1.256	0.515	0.264	0.040	1.174
2006	2.648	5.018	0.927	0.425	0.193	0.113	1.140
2007	4.630	0.907	1.608	0.290	0.172	0.085	1.049
2008	1.798	1.629	0.306	0.618	0.147	0.126	1.101
2009	1.316	0.844	0.326	0.066	0.105	0.068	0.957
2010	3.856	1.065	0.437	0.214	0.040	0.129	0.892
2011	4.399	3.256	0.586	0.376	0.124	0.026	0.985
2012	5.243	1.442	1.460	0.286	0.215	0.124	0.957
2013	3.914	4.333	0.622	0.647	0.164	0.077	0.996
2014	1.867	1.670	1.160	0.213	0.253	0.056	0.845
2015	3.644	2.107	2.104	0.671	0.134	0.149	1.022
2016	5.878	3.940	1.344	1.015	0.367	0.102	0.948
2017	5.270	6.024	1.594	0.464	0.319	0.156	1.040

Year	Survey index–Q3–4 (delta-GAM) at age						CPUE
	3	4	5	6	7	8	
2018	1.045	1.983	1.800	0.468	0.124	0.058	1.073
2019	0.567	0.725	0.847	0.351	0.096	0.036	0.908
2020	0.843	1.480	0.813	0.485	0.266	0.075	0.827
2021	1.178	0.496	0.394	0.194	0.118	0.063	0.736
2022	1.701	1.042	0.475	0.252	0.160	0.113	0.856
2023	1.215	3.101	0.592	0.139	0.078	0.042	0.857

Table 16.4.1. Saithe in subareas 4 and 6 and in Division 3.a. Model configuration for the SAM assessment.

```
# Configuration saved: Tue Mar 12 15:05:46 2024
#
# Where a matrix is specified, rows corresponds to fleets and columns to ages.
# Same number indicates same parameter used
# Numbers (integers) starts from zero and must be consecutive
# Negative numbers indicate that the parameter is not included in the model
#
$minAge
# The minimium age class in the assessment
 3

$maxAge
# The maximum age class in the assessment
 10

$maxAgePlusGroup
# Is last age group considered a plus group for each fleet (1 yes, or 0 no).
 1 0 1

$keyLogFsta
# Coupling of the fishing mortality states processes for each age (normally
only
# the first row (= fleet) is used).
# Sequential numbers indicate that the fishing mortality is estimated indi-
vidually
# for those ages; if the same number is used for two or more ages, F is bound
for
# those ages (assumed to be the same). Binding fully selected ages will result
in a
# flat selection pattern for those ages.
   0   1   2   3   4   5   6   6
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$corFlag
# Correlation of fishing mortality across ages (0 independent, 1 compound
symmetry,
# 2 AR(1), 3 separable AR(1).
# 0: independent means there is no correlation between F across age
# 1: compound symmetry means that all ages are equally correlated;
# 2: AR(1) first order autoregressive - similar ages are more highly correlated
than
# ages that are further apart, so similar ages have similar F patterns over
time.
# if the estimated correlation is high, then the F pattern over time for each
age
# varies in a similar way. E.g if almost one, then they are parallel (like a
# separable model) and if almost zero then they are independent.
```

```
# 3: Separable AR - Included for historic reasons . . .  more later
 2

$keyLogFpar
# Coupling of the survey catchability parameters (nomally first row is
# not used, as that is covered by fishing mortality).
  -1  -1  -1  -1  -1  -1  -1  -1
   0   1   2   3   4   5  -1  -1
   6  -1  -1  -1  -1  -1  -1  -1

$keyQpow
# Density dependent catchability power parameters (if any).
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$keyVarF
# Coupling of process variance parameters for log(F)-process (Fishing mortality
# normally applies to the first (fishing) fleet; therefore only first row is
used)
   0   1   2   3   3   3   3   3
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$keyVarLogN
# Coupling of the recruitment and survival process variance parameters for the
# log(N)-process at the different ages. It is advisable to have at least the
first age
# class (recruitment) separate, because recruitment is a different process
than
# survival.
 0 1 1 1 1 1 1 1

$keyVarObs
# Coupling of the variance parameters for the observations.
# First row refers to the coupling of the variance parameters for the catch
data
# observations by age
# Second and further rows refers to coupling of the variance parameters for
the
# index data observations by age
   0   1   1   2   2   2   2   2
   3   3   3   3   3   3  -1  -1
   4  -1  -1  -1  -1  -1  -1  -1

$obsCorStruct
# Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US"
for unstructured). | Possible values are: "ID" "AR" "US"
 "AR" "AR" "ID"
```

```
$keyCorObs
# Coupling of correlation parameters can only be specified if the AR(1) struc-
ture is chosen above.
# NA's indicate where correlation parameters can be specified (-1 where they
cannot).
#V1 V2 V3 V4 V5 V6 V7
   0   0   0   1   1   1   1
   2   2   2   2   3  -1  -1
  NA  -1  -1  -1  -1  -1  -1

$stockRecruitmentModelCode
# Stock recruitment code (0 for plain random walk, 1 for Ricker, 2 for Beverton-
Holt,
#  3 piece-wise constant, 61 for segmented regression/hockey stick, 62 for
AR(1),
#  63 for bent hyperbola / smooth hockey stick, 64 for power function with
degree < 1,
# 65 for power function with degree > 1, 66 for Shepher, 67 for Deriso,
# 68 for Saila-Lorda, 69 for sigmoidal Beverton-Holt, 90 for CMP spline,
# 91 for more flexible spline, and 92 for most flexible spline).
 0

$noScaledYears
# Number of years where catch scaling is applied.
 0

$fbarRange
# lowest and higest age included in Fbar
 4 7

$keyBiomassTreat
# To be defined only if a biomass survey is used (0 SSB index, 1 catch index,
# 2 FSB index, 3 total catch, 4 total landings, 5 TSB index, 6 TSN index, and
10 Fbar idx).
 -1 -1 2

$obsLikelihoodFlag
# Option for observational likelihood | Possible values are: "LN" "ALN"
 "LN" "LN" "LN"

$fixVarToWeight
# If weight attribute is supplied for observations this option sets the treat-
ment
# (0 relative weight, 1 fix variance to weight). Can be specified fleetwise.
 0

$fracMixF
# The fraction of t(3) distribution used in logF increment distribution
```

```
 0

$fracMixN
# The fraction of t(3) distribution used in logN increment distribution
# (for each age group)
 0

$fracMixObs
# A vector with same length as number of fleets, where each element is the
fraction
# of t(3) distribution used in the distribution of that fleet
 0 0 0

$predVarObsLink
# Coupling of parameters used in a prediction-variance link for observations.
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  NA  NA
  NA  NA  NA  NA  NA  NA  NA  NA

$stockWeightModel
# Integer code describing the treatment of stock weights in the model (0 use
as known,
# 1 use as observations to inform stock weight process (GMRF with cohort and
# within year correlations)), 2 to add extra correlation to plusgroup
 0

$keyStockWeightMean
# Coupling of stock-weight process mean parameters (not used if stockWeight-
Model==0)
 NA NA NA NA NA NA NA NA

$keyStockWeightObsVar
# Coupling of stock-weight observation variance parameters
# (not used if stockWeightModel==0)
 NA NA NA NA NA NA NA NA

$catchWeightModel
# Integer code describing the treatment of catch weights in the model (0 use
as known,
# 1 use as observations to inform catch weight process (GMRF with cohort and
within
# year correlations)), 2 to add extra correlation to plusgroup
 0

$keyCatchWeightMean
# Coupling of catch-weight process mean parameters (not used if catchWeight-
Model==0)
  NA  NA  NA  NA  NA  NA  NA  NA
```

```
$keyCatchWeightObsVar
# Coupling of catch-weight observation variance parameters
# (not used if catchWeightModel==0)
  NA  NA  NA  NA  NA  NA  NA  NA

$matureModel
# Integer code describing the treatment of proportion mature in the model (0
use as
# known, 1 use as observations to inform proportion mature process (GMRF with
cohort
# and within year correlations on logit(proportion mature))),
# 2 to add extra correlation to plusgroup
 0

$keyMatureMean
# Coupling of mature process mean parameters (not used if matureModel==0)
 NA NA NA NA NA NA NA NA

$mortalityModel
# Integer code describing the treatment of natural mortality in the model (0
use as
# known, 1 use as observations to inform natural mortality process (GMRF with
cohort
# and within year correlations)), 2 to add extra correlation to plusgroup
 0

$keyMortalityMean
#
 NA NA NA NA NA NA NA NA

$keyMortalityObsVar
# Coupling of natural mortality observation variance parameters
# (not used if mortalityModel==0)
 NA NA NA NA NA NA NA NA

$keyXtraSd
# An integer matrix with 4 columns (fleet year age coupling),
# which allows additional uncertainty to be estimated for the specified ob-
servations

$logNMeanAssumption
#
 0 0

$initState
#
 0
```

Table 16.4.2. Saithe in subareas 4 and 6 and in Division 3.a. Fishing mortalities at age for the final assessment model. F at age 9 and 10+ are coupled in the model (9+).

Year/Age	3	4	5	6	7	8	9+
1967	0.190	0.279	0.298	0.362	0.339	0.320	0.342
1968	0.205	0.300	0.307	0.366	0.341	0.322	0.343
1969	0.199	0.293	0.299	0.363	0.340	0.322	0.341
1970	0.270	0.393	0.352	0.386	0.360	0.339	0.355
1971	0.316	0.435	0.368	0.394	0.369	0.349	0.362
1972	0.370	0.481	0.386	0.403	0.378	0.359	0.369
1973	0.442	0.548	0.419	0.417	0.393	0.372	0.379
1974	0.516	0.623	0.462	0.435	0.410	0.388	0.391
1975	0.507	0.615	0.475	0.443	0.419	0.398	0.398
1976	0.603	0.731	0.545	0.469	0.443	0.419	0.415
1977	0.499	0.624	0.519	0.464	0.441	0.419	0.413
1978	0.434	0.538	0.489	0.456	0.436	0.414	0.408
1979	0.350	0.440	0.452	0.447	0.430	0.409	0.402
1980	0.322	0.412	0.451	0.450	0.434	0.414	0.407
1981	0.270	0.358	0.425	0.444	0.430	0.413	0.406
1982	0.347	0.478	0.513	0.478	0.459	0.437	0.427
1983	0.375	0.545	0.561	0.497	0.473	0.449	0.437
1984	0.457	0.698	0.643	0.522	0.493	0.464	0.450
1985	0.532	0.879	0.735	0.548	0.512	0.480	0.466
1986	0.528	0.962	0.789	0.562	0.524	0.489	0.477
1987	0.453	0.827	0.740	0.550	0.513	0.481	0.472
1988	0.400	0.725	0.703	0.540	0.504	0.472	0.466
1989	0.397	0.721	0.700	0.539	0.502	0.469	0.463
1990	0.390	0.713	0.696	0.537	0.499	0.464	0.460
1991	0.380	0.720	0.707	0.539	0.502	0.465	0.462
1992	0.356	0.716	0.725	0.544	0.507	0.469	0.467
1993	0.305	0.644	0.689	0.536	0.504	0.468	0.469
1994	0.295	0.661	0.711	0.542	0.513	0.476	0.478

Year/Age	3	4	5	6	7	8	9+
1995	0.234	0.550	0.648	0.526	0.503	0.470	0.473
1996	0.174	0.415	0.563	0.501	0.482	0.454	0.458
1997	0.151	0.361	0.514	0.485	0.468	0.444	0.449
1998	0.147	0.352	0.507	0.484	0.465	0.443	0.448
1999	0.133	0.326	0.480	0.476	0.458	0.438	0.444
2000	0.111	0.270	0.428	0.456	0.439	0.422	0.429
2001	0.129	0.315	0.455	0.467	0.446	0.428	0.432
2002	0.125	0.309	0.446	0.466	0.447	0.429	0.434
2003	0.119	0.290	0.406	0.452	0.436	0.419	0.425
2004	0.104	0.256	0.363	0.433	0.419	0.404	0.408
2005	0.102	0.258	0.362	0.430	0.417	0.401	0.401
2006	0.112	0.286	0.378	0.434	0.422	0.405	0.401
2007	0.117	0.320	0.404	0.442	0.430	0.410	0.403
2008	0.127	0.377	0.462	0.462	0.448	0.426	0.414
2009	0.110	0.339	0.440	0.452	0.441	0.420	0.406
2010	0.091	0.291	0.404	0.437	0.428	0.409	0.394
2011	0.099	0.323	0.423	0.442	0.432	0.412	0.394
2012	0.092	0.312	0.405	0.434	0.423	0.403	0.385
2013	0.079	0.274	0.371	0.420	0.410	0.392	0.374
2014	0.064	0.223	0.336	0.405	0.398	0.379	0.362
2015	0.061	0.212	0.329	0.401	0.394	0.374	0.357
2016	0.062	0.222	0.340	0.406	0.399	0.377	0.358
2017	0.060	0.215	0.331	0.403	0.397	0.373	0.353
2018	0.068	0.241	0.351	0.411	0.404	0.376	0.354
2019	0.077	0.262	0.361	0.414	0.407	0.375	0.352
2020	0.079	0.268	0.355	0.408	0.401	0.366	0.342
2021	0.071	0.231	0.317	0.389	0.382	0.347	0.325
2022	0.064	0.203	0.295	0.376	0.370	0.335	0.314
2023	0.071	0.219	0.309	0.381	0.373	0.336	0.315

Table 16.4.3. Saithe in subareas 4 and 6 and in Division 3.a. Estimated population numbers-at-age for the final assessment model (thousands).

Year/Age	3	4	5	6	7	8	9	10+
1967	197864	98274	71916	7004	4683	1026	631	573
1968	213132	111787	57864	38454	3719	2323	657	655
1969	423882	106027	58704	29827	19380	2487	1773	607
1970	392566	286277	54904	37265	16623	9874	1632	1378
1971	444017	220634	134691	24239	18482	10176	6009	2096
1972	277116	234605	105097	68610	12921	9998	5793	5233
1973	241606	123443	104734	62931	32934	7799	5074	7205
1974	235093	99508	47885	58152	39419	16781	4773	6860
1975	306385	84745	36042	22326	32921	22431	9346	7124
1976	451472	128281	32083	17575	12129	17305	11694	10096
1977	199696	165227	41994	12790	8492	6978	9268	12332
1978	145444	88249	61087	16647	5547	4497	3358	12776
1979	110948	59504	37954	28445	8277	2799	2321	9077
1980	107127	52487	28018	18392	15310	3582	1585	7177
1981	228703	45918	26490	12070	9093	7940	1705	5659
1982	172614	139252	25220	15517	6000	4677	3549	4026
1983	193567	75533	68180	10869	8378	2956	2430	3615
1984	312395	89258	33646	28914	4832	3962	1410	2959
1985	450340	125954	32562	14743	10762	2522	1688	2556
1986	417199	176040	33654	12751	7037	4591	1273	2319
1987	187723	220154	35949	10643	5632	3544	2322	1782
1988	177005	78067	76847	11054	4904	2756	1878	1859
1989	129672	82000	31162	26189	4786	2332	1379	1711
1990	181886	54997	28674	13039	9282	2577	1129	1506
1991	201054	79911	19228	11333	6035	3960	1340	1474
1992	135147	91570	26680	7727	5324	2967	2083	1536
1993	237644	62569	31290	8242	3351	2965	1631	2104
1994	162587	109327	27372	13822	3377	1555	1476	2150

Year/Age	3	4	5	6	7	8	9	10+
1995	283103	78522	38932	10264	6504	1417	993	1747
1996	159353	173792	29780	17051	6511	2347	649	1405
1997	208834	89230	94914	12554	8368	3409	1058	1003
1998	119410	144958	45975	46459	6769	3929	1828	974
1999	171205	64376	84468	20214	21254	4168	1823	1420
2000	143052	124653	31221	37049	10773	11372	2020	1453
2001	290364	88093	78306	14066	16696	6678	6831	1384
2002	191678	167152	37918	34935	6977	7943	3649	4310
2003	208768	133874	79998	14717	14817	4185	4236	4172
2004	152364	121363	71787	40869	6830	6695	3123	3590
2005	208379	86133	70183	42452	21196	4306	3527	3625
2006	116083	151383	42833	33901	21812	10490	2671	3857
2007	208944	54782	86042	23593	17743	12434	5326	3848
2008	110667	111583	29993	47612	13724	8864	7870	6290
2009	88286	63713	44388	14236	21626	8082	4559	8542
2010	151409	47049	31703	19386	6682	11181	4611	8077
2011	136251	102151	26785	17209	9660	3636	5137	9584
2012	214496	57291	59250	13932	8229	4869	1980	8921
2013	138565	135690	23305	29887	7489	4152	2420	6325
2014	95108	83600	59822	12804	14756	4149	1898	5112
2015	135031	55994	59148	29707	7268	6762	2710	4020
2016	168534	82478	34351	30201	13101	4824	3212	4225
2017	130200	118020	42403	17228	14636	6384	2836	4109
2018	65234	87598	71049	22878	7686	6876	3444	4038
2019	67769	44945	51955	30745	9339	3789	3491	4035
2020	48124	50150	28359	24664	14484	4185	2015	3682
2021	86922	33544	24624	15267	12936	6493	2087	3441
2022	133485	53501	21651	14280	8755	6473	3838	3144
2023	77815	115672	32585	11409	8044	4356	3684	4203

Table 16.5.1. Saithe in subareas 4 and 6 and in Division 3.a. Estimated recruitment, total-stock biomass (TSB, tonnes), spawning-stock biomass (SSB, tonnes), and average fishing mortality for ages 4 to 7 ($F_{4–7}$), 1967–2023. Low and High refer to the lower and upper 95% confidence interval estimates.

Year	$R_{(age\ 3)}$			SSB			$F_{4–7}$			TSB		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
1967	197864	138440	282796	171179	139567	209951	0.320	0.257	0.397	382788	310283	472237
1968	213132	151682	299477	247040	201788	302440	0.329	0.268	0.404	531100	433722	650342
1969	423882	301339	596259	294367	242077	357951	0.324	0.265	0.396	644701	525256	791308
1970	392566	281820	546832	387322	322330	465418	0.373	0.310	0.448	827205	687495	995307
1971	444017	321284	613635	458550	382575	549613	0.392	0.327	0.468	901680	756599	1074580
1972	277116	201536	381039	455046	378062	547707	0.412	0.346	0.491	796876	673123	943381
1973	241606	175749	332141	468554	386325	568284	0.444	0.374	0.527	739738	624884	875703
1974	235093	170302	324534	506431	415105	617851	0.483	0.408	0.570	754466	636212	894700
1975	306385	223349	420292	470363	385247	574285	0.488	0.416	0.573	721640	609609	854260
1976	451472	322374	632268	405831	335430	491008	0.547	0.464	0.645	686123	580176	811417
1977	199696	144671	275650	330042	273706	397974	0.512	0.437	0.601	540595	460824	634176
1978	145444	105420	200664	306853	254399	370123	0.480	0.410	0.561	476680	405137	560857
1979	110948	80265	153360	276191	229193	332827	0.442	0.378	0.517	428479	363321	505321
1980	107127	77156	148740	251366	208592	302911	0.437	0.374	0.510	383106	324722	451987
1981	228703	164878	317236	254289	212518	304270	0.415	0.353	0.487	441345	372471	522956
1982	172614	125443	237523	247210	209734	291383	0.482	0.416	0.559	476813	406068	559884

Year	$R_{(age\ 3)}$			SSB			$F_{4–7}$			TSB		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
1983	193567	141339	265095	235274	200803	275661	0.519	0.447	0.603	454083	388983	530078
1984	312395	227566	428844	226911	194030	265365	0.589	0.508	0.683	462023	394448	541173
1985	450340	326929	620336	212632	183154	246855	0.669	0.574	0.778	471948	399876	557010
1986	417199	298519	583061	198924	171763	230380	0.709	0.599	0.839	461008	388975	546381
1987	187723	136482	258202	187395	160558	218718	0.658	0.567	0.763	370490	319193	430031
1988	177005	129391	242141	167649	142894	196693	0.618	0.534	0.715	315870	271322	367731
1989	129672	94582	177782	145040	122958	171088	0.616	0.533	0.711	268765	230670	313150
1990	181886	132645	249404	135972	115763	159708	0.611	0.529	0.706	267954	228253	314560
1991	201054	147370	274295	131006	112414	152671	0.617	0.536	0.711	273571	233228	320893
1992	135147	103091	177170	128823	111184	149260	0.623	0.541	0.718	264189	227900	306255
1993	237644	182472	309497	136459	118038	157755	0.593	0.516	0.682	301429	256794	353823
1994	162587	122760	215335	139566	120226	162017	0.607	0.523	0.704	297271	254714	346938
1995	283103	213220	375888	155660	133762	181143	0.557	0.481	0.644	381819	320058	455498
1996	159353	119652	212225	164388	140813	191910	0.490	0.425	0.565	368932	313066	434768
1997	208834	153604	283923	195446	167187	228482	0.457	0.398	0.526	390242	331241	459752
1998	119410	88429	161246	184805	157378	217011	0.452	0.394	0.519	339196	289826	396977
1999	171205	127532	229834	181590	155446	212131	0.435	0.379	0.499	336810	288763	392850

Year	$R_{(age\ 3)}$			SSB			$F_{4–7}$			TSB		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
2000	143052	105361	194225	197028	170721	227389	0.398	0.346	0.458	368500	318815	425927
2001	290364	218760	385406	218922	189779	252541	0.421	0.366	0.484	424298	365176	492993
2002	191678	146647	250537	227648	197483	262420	0.417	0.362	0.481	413482	358367	477074
2003	208768	159349	273514	236530	205100	272777	0.396	0.345	0.455	422210	365432	487808
2004	152364	115458	201068	212493	184664	244517	0.368	0.318	0.425	359877	312352	414633
2005	208379	156561	277348	230691	200179	265854	0.367	0.318	0.423	406264	352294	468502
2006	116083	87609	153812	242465	210636	279103	0.380	0.329	0.438	406171	354504	465369
2007	208944	158269	275846	245378	213570	281923	0.399	0.346	0.459	415747	362373	476981
2008	110667	83731	146267	281082	244106	323658	0.437	0.377	0.506	414382	362792	473308
2009	88286	65669	118692	252576	217924	292737	0.418	0.362	0.482	379660	331795	434431
2010	151409	114167	200798	225123	192640	263084	0.390	0.338	0.449	402572	349291	463979
2011	136251	103589	179212	205738	176447	239892	0.405	0.351	0.467	346527	301500	398278
2012	214496	163710	281035	182007	156214	212058	0.394	0.340	0.455	343557	297651	396542
2013	138565	105717	181619	178075	153270	206895	0.369	0.319	0.427	350869	304003	404961
2014	95108	71590	126352	186113	160751	215477	0.340	0.294	0.394	329338	285579	379803
2015	135031	102169	178461	210704	182980	242629	0.334	0.289	0.386	353450	307188	406678
2016	168534	128948	220273	189143	163498	218810	0.342	0.295	0.396	355647	308446	410072

Year	$R_{(age\ 3)}$			SSB			$F_{4–7}$			TSB		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
2017	130200	98488	172123	187475	161663	217409	0.337	0.291	0.390	362389	314853	417103
2018	65234	48668	87438	192678	167302	221904	0.352	0.304	0.407	323213	282648	369599
2019	67769	50141	91593	190689	165740	219394	0.361	0.311	0.418	297629	260132	340532
2020	48124	35511	65216	179925	155713	207902	0.358	0.307	0.417	279057	243913	319264
2021	86922	64423	117278	164030	141425	190247	0.330	0.282	0.386	259575	225283	299087
2022	133485	94159	189235	150472	128156	176674	0.311	0.261	0.370	271756	229739	321457
2023	77815	49383	122617	161756	135060	193729	0.320	0.264	0.390	289508	236389	354564
2024	94047*			185632**	144054**	238551**						

*** Recruitment in 2024 is the geometric mean of resampled recruitment estimates from 2014 to 2023.**

**** SSB 2024 is the STF, composed of 2023 survivors (age 4–10+) and stochastic recruitment assumption 2024 (age 3; ≈ 6% of SSB**

Table 16.7.1. Saithe in subareas 4 and 6 and in Division 3.a. Comparisons of forecast assumptions in the previous assessment (WGNSSK 2023) with estimates (and assumption for R 2024) in the current assessment. Assumptions or technical basis for catch and F given in brackets. Catches are given for age 3−10+.

Variable	Year*	Previous assessment (2023)	Current assessment (2024)
Recruitment** (thousands)	2023	64 170	77 815^
	2024	64 186	93 961
SSB (tonnes)	2024	177 053	185 632^
Catch (tonnes)	2023	61 635 (F_{sq})	60 896^^
$F_{ages\ 4–7}$	2023	0.327 (F_{sq})	0.320^
	2024	0.363 (F_{MSY} advice)	0.320 (F_{sq})

*** '2023' = Intermediate year in the previous assessment; '2024' = advice year in the previous assessment, intermediate year in the current assessment.**

**** Not comparable between assessment years, because of a substantial natural mortality update in the 2024 assessment model.**

^ Model estimate.

^^ InterCatch estimate.

Table 16.7.2. Saithe in subareas 4 and 6 and in Division 3.a. The basis for the catch options.

Variable	Value	Notes
$F_{ages\ 4–7}$ (2024)	0.32	Average exploitation pattern (2021–2023) rescaled to $F_{ages\ 4–7}$ (2023).
SSB (2025)	195 899	Short-term forecast (STF); tonnes
$R_{age\ 3}$ (2024)	93 961 (94 047)	Geometric mean of recruitment resampled from the years 2014–2023 (geometric mean of unique recruitment estimates, or geometric mean expectation, reported in the advice); thousands
$R_{age\ 3}$ (2025)	94 086 (94 047)	Geometric mean of recruitment resampled from the years 2014–2023 (geometric mean of unique recruitment estimates, or geometric mean expectation, reported in the advice); thousands
Total catch (2024)	78 251	STF, F *status quo* assumption; tonnes
Landings (2024)	74 968	STF, assuming 2021–2023 average landings fraction by age; tonnes
Discards (2024)	3283	STF, assuming 2021–2023 average discards fraction by age; tonnes

Table 16.7.3. Saithe in subareas 4 and 6 and in Division 3.a. Reference points and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	180 770	B_{pa}; in tonnes.	ICES (2024)
	F_{MSY}	0.316	EqSim analysis based on the recruitment period 2002–2022, using a segmented regression with a breakpoint fixed at B_{lim}.	ICES (2024)
Precautionary approach	B_{lim}	130 090	B_{loss} (SSB in 1992); in tonnes.	ICES (2024)
	B_{pa}	180 770	$B_{lim} \times \exp(1.645 \times 0.2) \approx 1.4 \times B_{lim}$; in tonnes.	ICES (2024)
	F_{lim}	0.464	The F that on average leads to B_{lim} from EqSim (recruitment period 2002–2022).	ICES (2024)
	F_{pa}	0.392	The F that provides a 95% probability for SSB to be above B_{lim} ($F_{P.05}$ with advice rule [AR]).	ICES (2024)
EU Management plan*	MAP MSY $B_{trigger}$	180 770	MSY B_{trigge}; in tonnes.	ICES (2024)
	MAP B_{lim}	130 090	B_{lim}; in tonnes.	ICES (2024)
	MAP F_{MSY}	0.316	F_{MSY}	ICES (2024)
	MAP range F_{lower}	0.192–0.316	Consistent with ranges provided by ICES, resulting in no more than 5% reduction in long-term yield compared with MSY	ICES (2024)
	MAP range F_{upper}	0.316–0.392	Consistent with ranges provided by ICES, resulting in no more than 5% reduction in long-term yield compared with MSY. Capped at F_{pa}.	ICES (2024)

*** EU multiannual plan (MAP) for the North Sea (EU, 2018)**

Table 16.7.4. Saithe in subareas 4 and 6, and in Division 3.a. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards^^ (2025)	Projected landings# 3.a4	Projected landings# 6	F_{total} (ages 4–7) (2025)	$F_{projected\ landings}$ (ages 4–7) (2025)	$F_{projected\ discards}$ (ages 4–7) (2025)	SSB (2026)	% SSB change *	% TAC change **	% advice change ^
ICES advice basis												
MSY approach: F_{MSY}	79 071	75 880	3191	68 747	7133	0.316	0.30	0.0120	197 298	0.71	7.1	7.1
Other scenarios												
$F_{MSY\ lower}$	50 775	48 717	2058	44 138	4579	0.192	0.184	0.0080	220 301	12.5	−31	−31
$F_{MSY\ upper}$	94 916	91 018	3898	82 462	8556	0.392	0.38	0.0150	184 452	−5.8	29	29
F = 0	0	0	0	0	0	0	0	0	262 351	34	−100	−100
F_{pa}	94 916	91 018	3898	82 462	8556	0.392	0.38	0.0150	184 452	−5.8	29	29
F_{lim}	108 957	104 433	4524	94 616	9817	0.464	0.45	0.0180	173 248	−11.6	48	48
SSB (2026) = B_{lim}	165 496	158 342	7154	143 458	14 884	0.81	0.78	0.032	130 090	−34	124	124
SSB (2026) = B_{pa}= MSY $B_{trigger}$	100 488	96 286	4202	87 235	9051	0.42	0.40	0.0160	180 770	−7.7	36	36
F = F_{2024}	80 031	76 778	3253	69 561	7217	0.32	0.31	0.0120	196 519	0.32	8.4	8.4
TAC_{2024}	73 814	70 868	2946	64 206	6662	0.29	0.28	0.0110	201 560	2.9	0	0
TAC_{2024} −15%	62 743	60 201	2542	54 542	5659	0.24	0.23	0.0100	210 501	7.5	−15.0	−15.0
TAC_{2024} +15%	84 889	81 427	3462	73 773	7654	0.34	0.33	0.0130	192 614	−1.68	15.0	15.0
TAC_{2024} −20%	59 051	56 653	2398	51 328	5325	0.23	0.22	0.0090	213 442	9.0	−20	−20
TAC_{2024} +25%	92 269	88 462	3807	80 147	8315	0.38	0.36	0.0150	186 579	−4.8	25	25

*** SSB_{2026} relative to SSB_{2025}.**

**** Total catch in 2025 relative to the TAC in 2024 (73 815 t).**

 # Projected landings split according to the average in 1993–1998, as agreed by the relevant management authorities, i.e. 90.6% in Subarea 4 and Subdivision 3.a.20 and 9.4% in Subarea

^ Total catch 2025 relative to the advice value 2024 (73 815 t).

^^ Including BMS landings. Assuming recent discard rate.

Table 16.7.5. Saithe in subareas 4 and 6 and in Division 3.a. Contribution of the year classes to the landings in 2025.

Year class	Age	Contribution to landings (%)	
		Numbers	Weight
2022	3	12.8	6
2021	4	25.8	16.8
2020	5	18.0	15.7
2019	6	28.6	32.7
2018	7	7.4	10.8
2017	8	2.4	4.4
2016	9	1.8	4.0
	10+	3.2	9.6

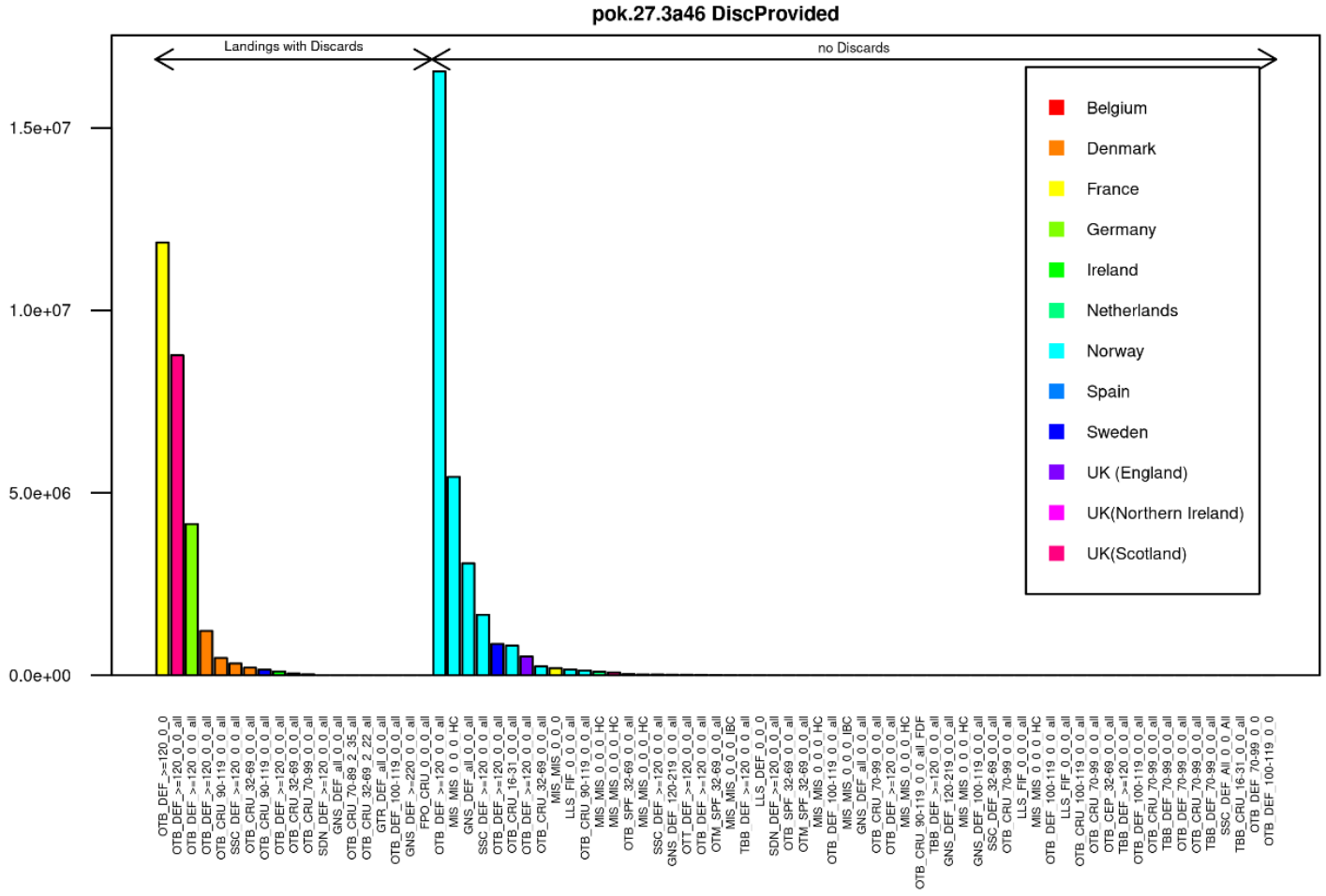


Figure 16.3.1. Saithe in subareas 4 and 6 and in Division 3.a. Landings with associated discards for areas and quarters combined by métier for 2023.

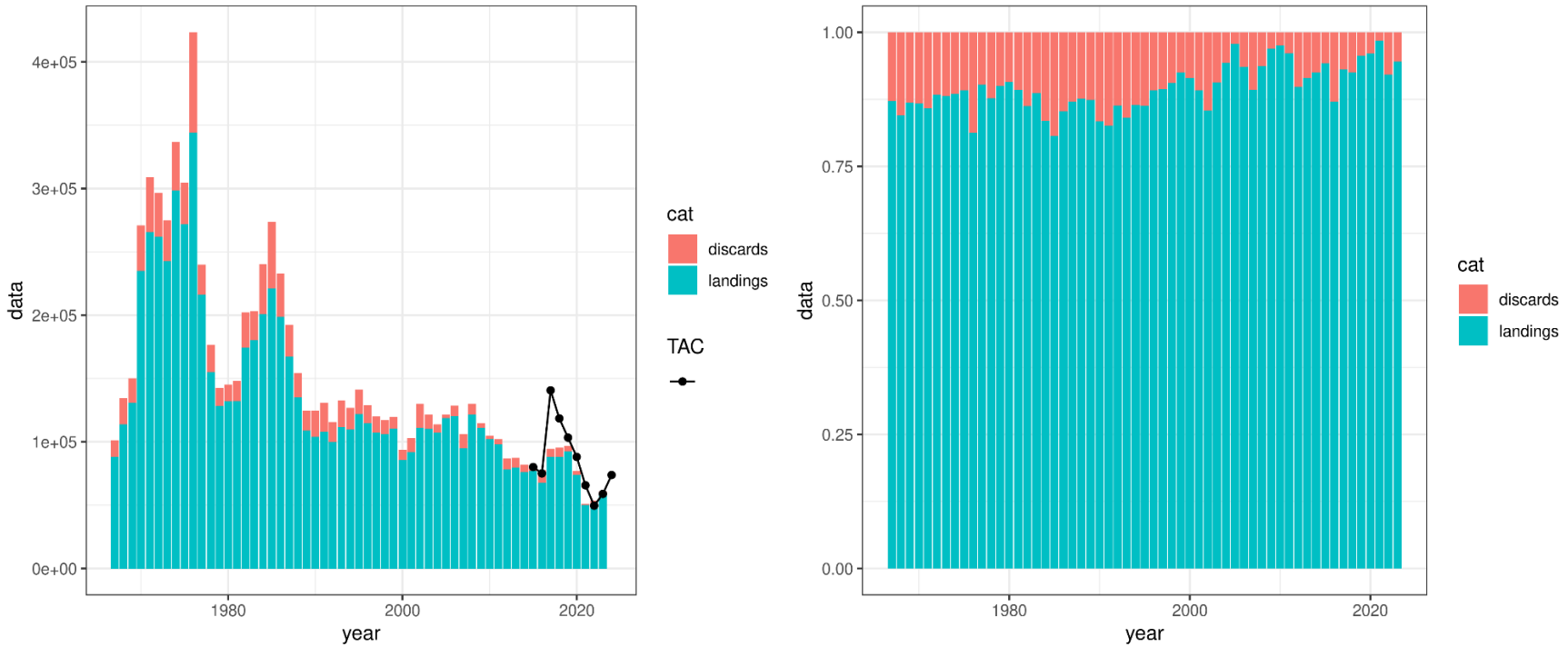


Figure 16.3.2. Saithe in subareas 4 and 6 and in Division 3.a. Yield as stacked plot for landings and discards in tonnes (left panel) and as percent (right panel). Landings include BMS landings from Norway since 2016. Discards correspond to unwanted catch (discards + EU/UK BMS) since 2016.

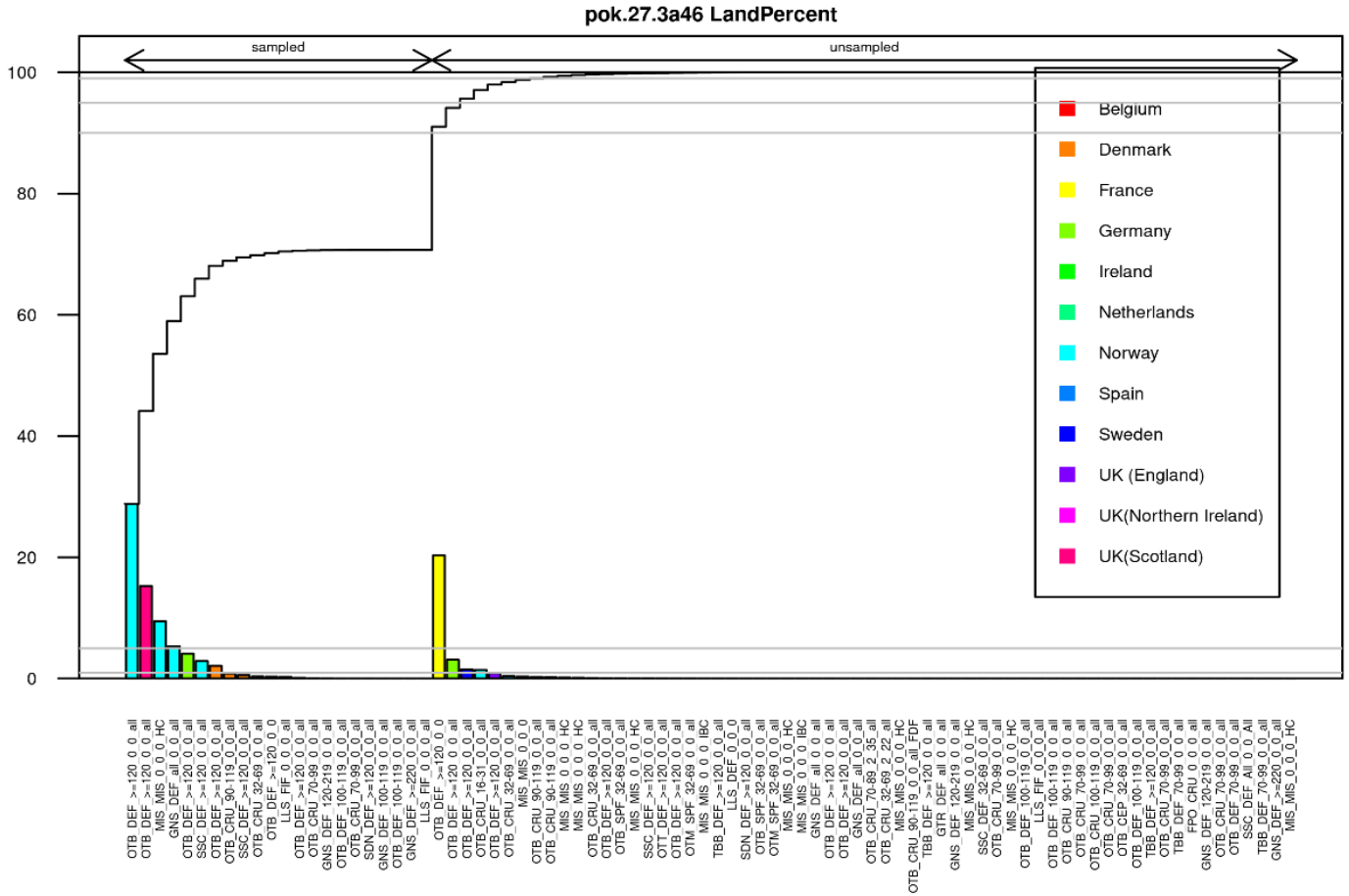


Figure 16.3.3. Saithe in subareas 4 and 6 and in Division 3.a. Overview of percent of sampled and unsampled landings by country and métier for 2023.

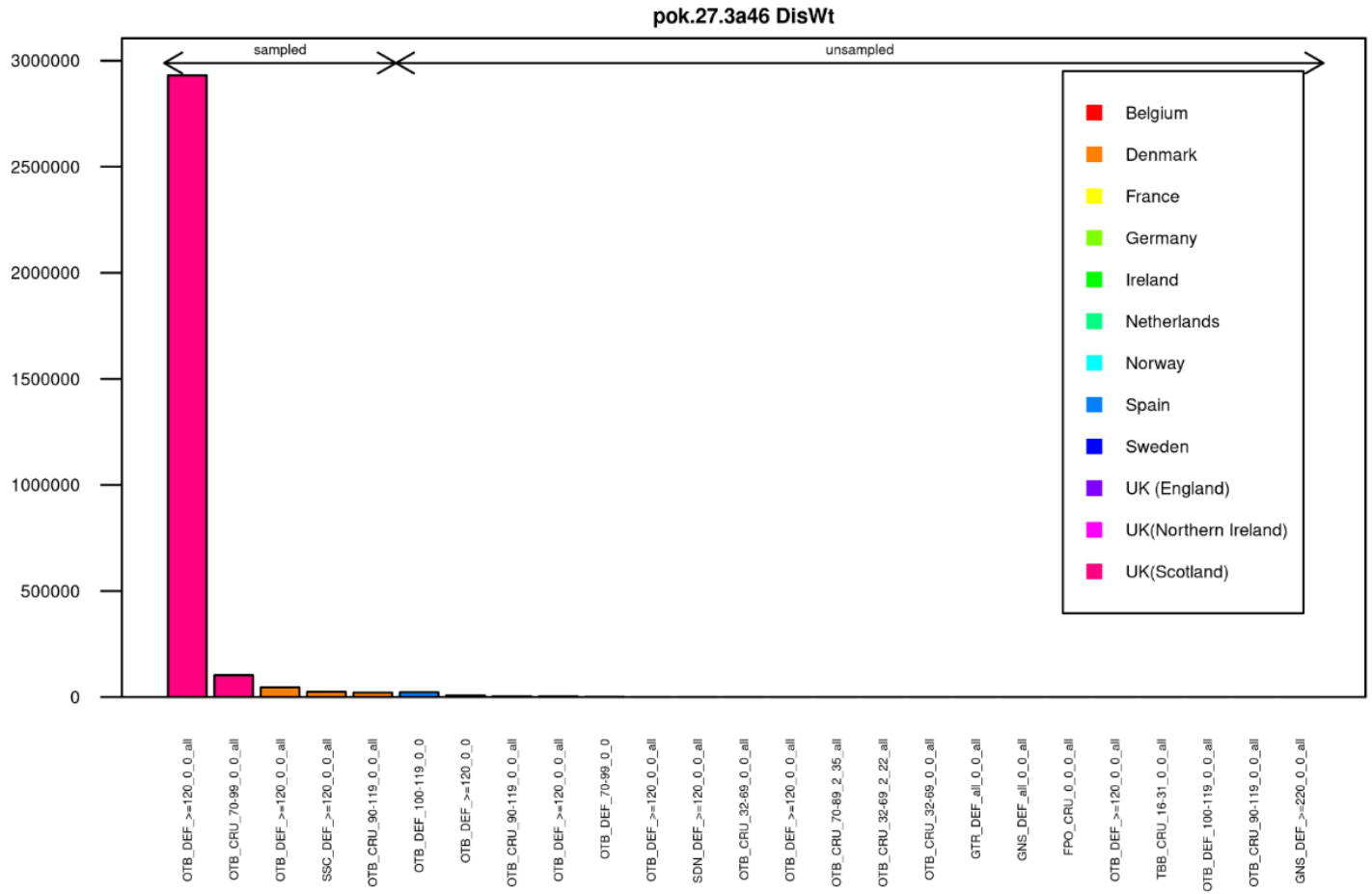


Figure 16.3.4. Saithe in subareas 4 and 6 and in Division 3.a. Overview of age sampled and unsampled imported discards by country and métier for 2023.

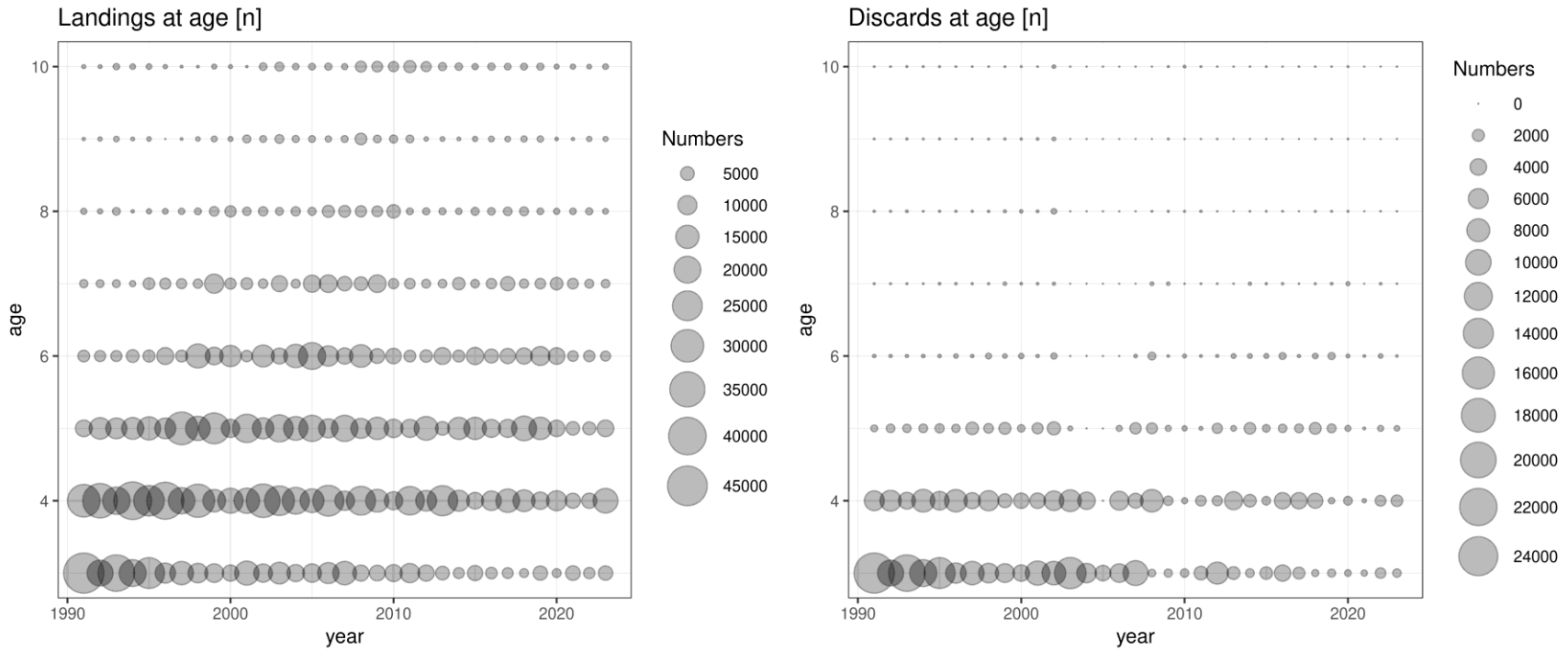


Figure 16.3.5. Saithe in subareas 4 and 6 and in Division 3.a. (left) Landings-at-age (x10^3) for saithe ages 3–10+, 1990–2023. (Right) Discard numbers (x10^3) at age for saithe ages 3–10+, 1990–2023.

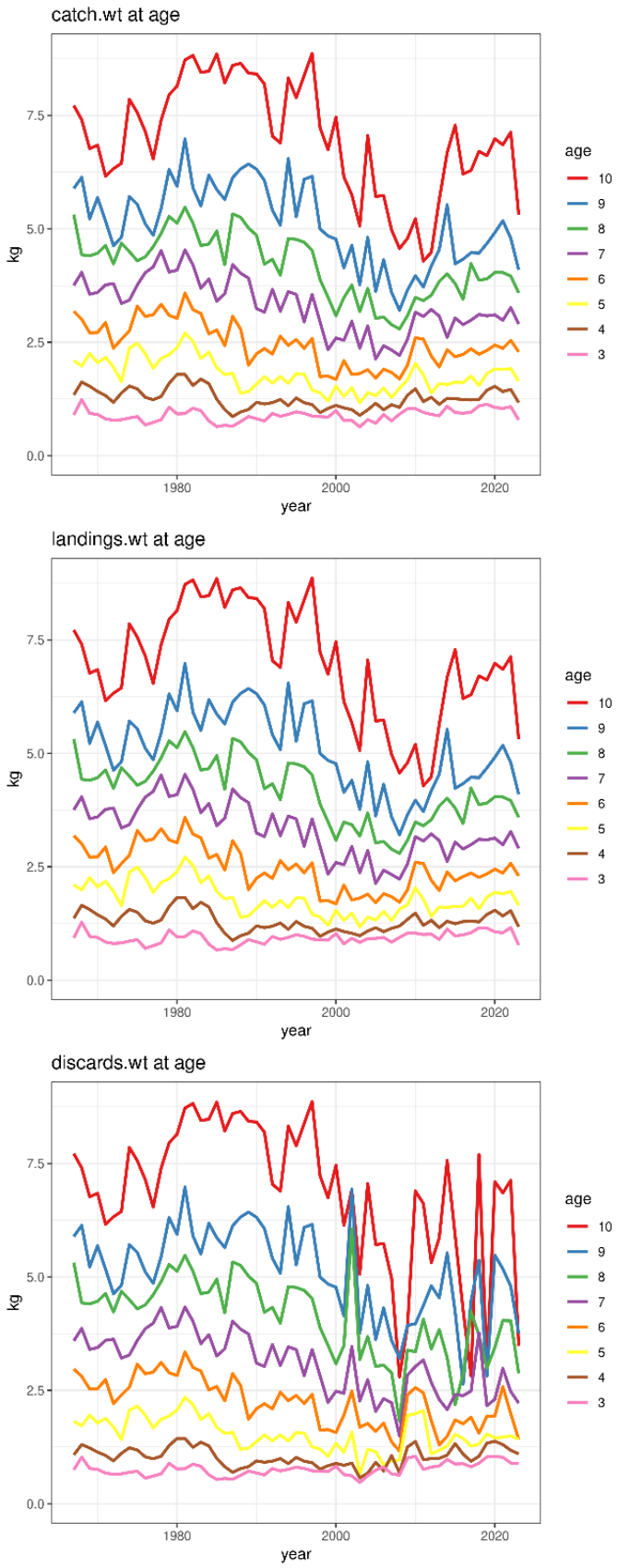


Figure 16.3.6. Saithe in subareas 4 and 6 and in Division 3.a. Catch weight-at-age (top left panel), landing weight-at-age (bottom left panel) and discard weights-at-age (bottom right panel), in kilograms, for saithe ages 3–10+, 1967–2023.

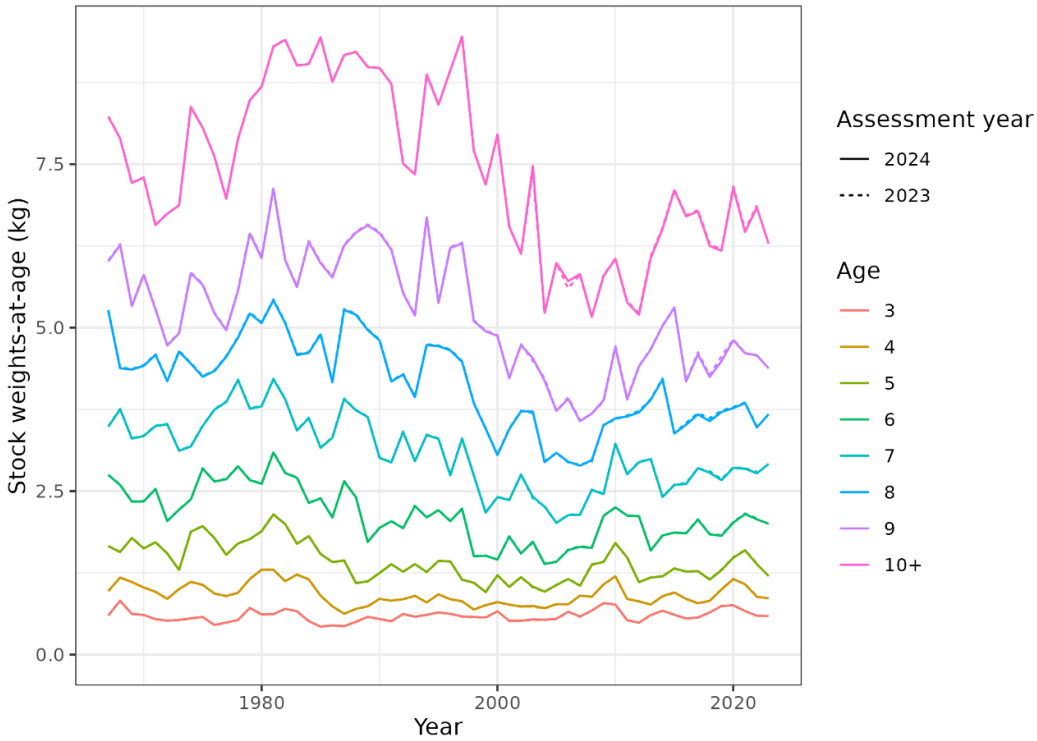


Figure 16.3.7. Saithe in subareas 4 and 6 and in Division 3.a. Model-based stock weights-at-age, for saithe ages 3–10+, 1967–2023. Comparison with the benchmark series (assessment year 2023) shows very little revisions of former years' estimates with the extra year of data.

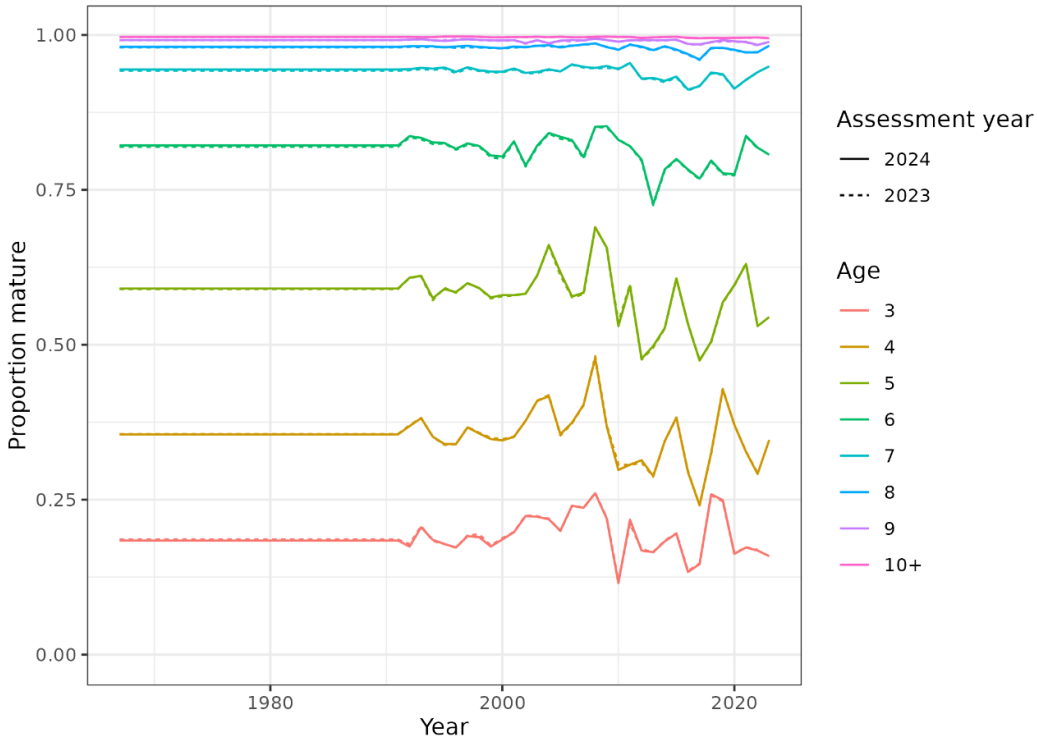


Figure 16.3.8. Saithe in subareas 4 and 6 and in Division 3.a. Model-based proportion mature-at-age, for saithe ages 3–10+, 1967–2023. Comparison with the benchmark series (assessment year 2023) shows very little revisions of former years' estimates with the extra year of data.

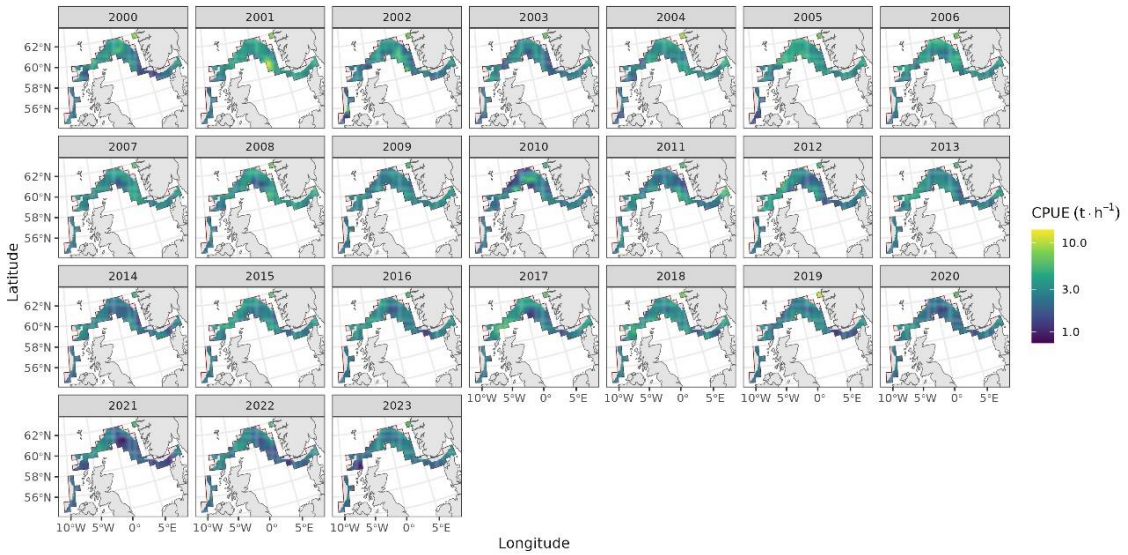


Figure 16.3.9. Saithe in subareas 4 and 6 and in Division 3.a. Yearly CPUE predictions on a fine grid (10x10 km cells), for a typical Norwegian vessel of power category >6020 kW in January, as used in calculation of the area-weighted CPUE index (Figure 16.3.10).

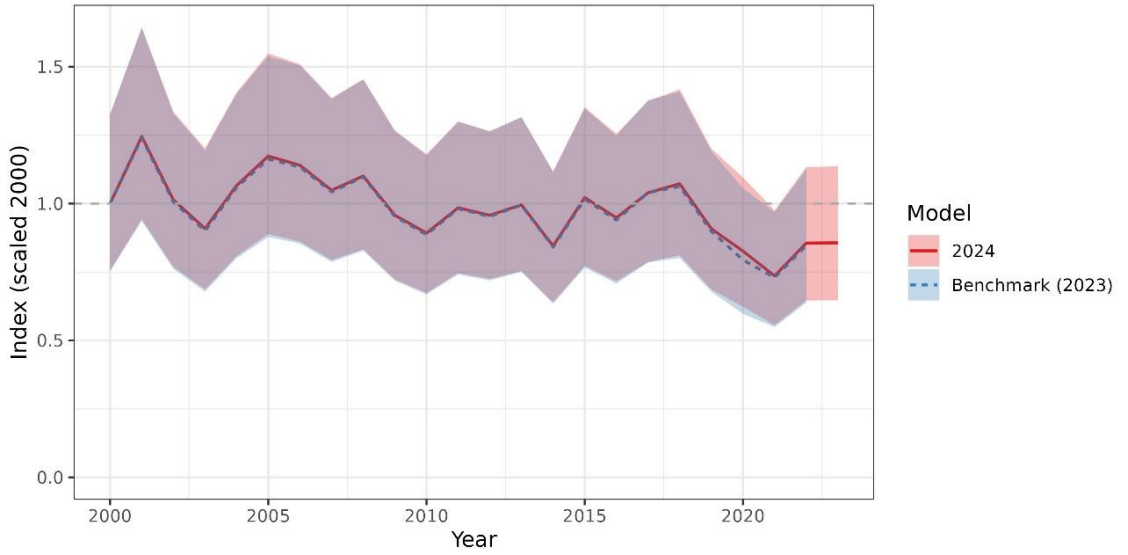


Figure 16.3.10. Saithe in subareas 4 and 6 and in Division 3.a. Scaled standardized commercial CPUE index time-series and 95% confidence interval, 2000–2023. Based on logbook data from France, Germany, and Norway. Comparison of the updated index (data 2023 and some corrections back in time; solid red line) to the previous 2000–2022 index, as used in the benchmark (blue dashed line).

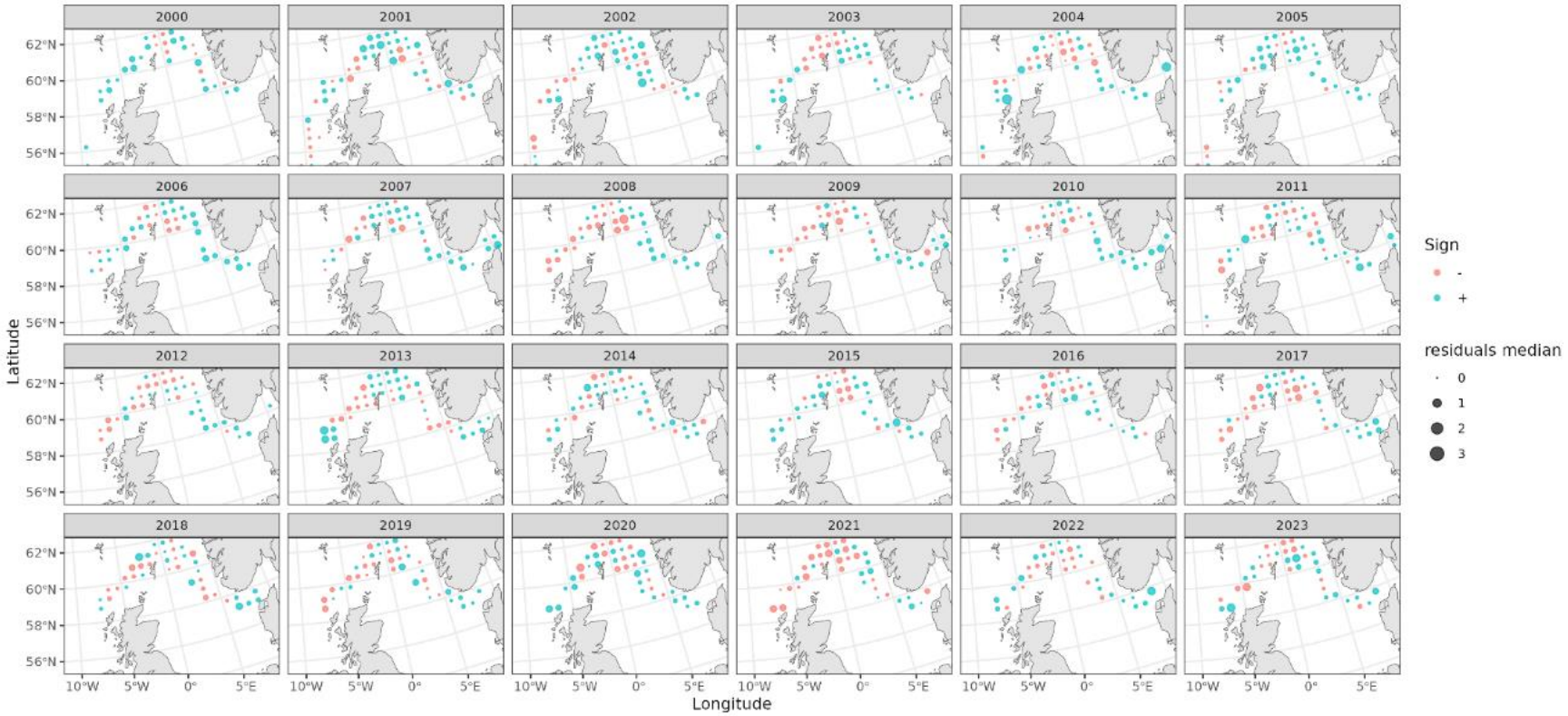


Figure 16.3.11. Saithe in subareas 4 and 6 and in Division 3.a. Maps of mean residuals from the CPUE index model per 0.5°x0.5° grid cell, per year (2000–2023).

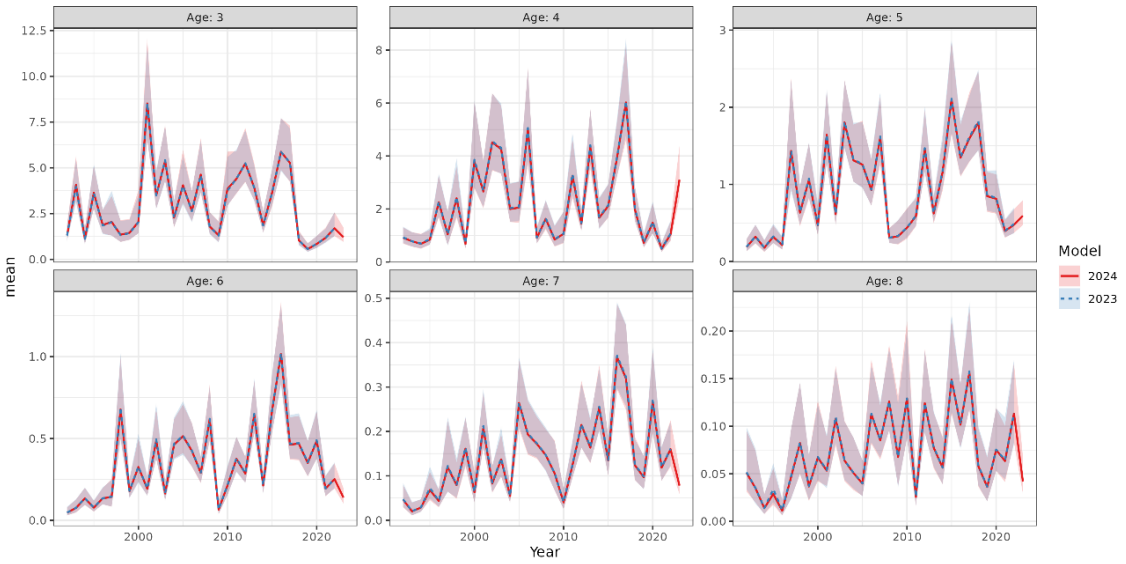


Figure 16.3.12. Saithe in subareas 4 and 6 and in Division 3.a. Relative standardized Q3–4 delta-GAM index of abundance-at-age, based on surveys in west of Scotland (Division 6.a), North Sea (Subarea 4) and Skagerrak (Division 3.a), for saithe ages 3–8, 1992–2023. Comparison of the updated index (red solid line, with 2023 data) to the previous 1992–2022 index, as used in the benchmark (blue dashed line).

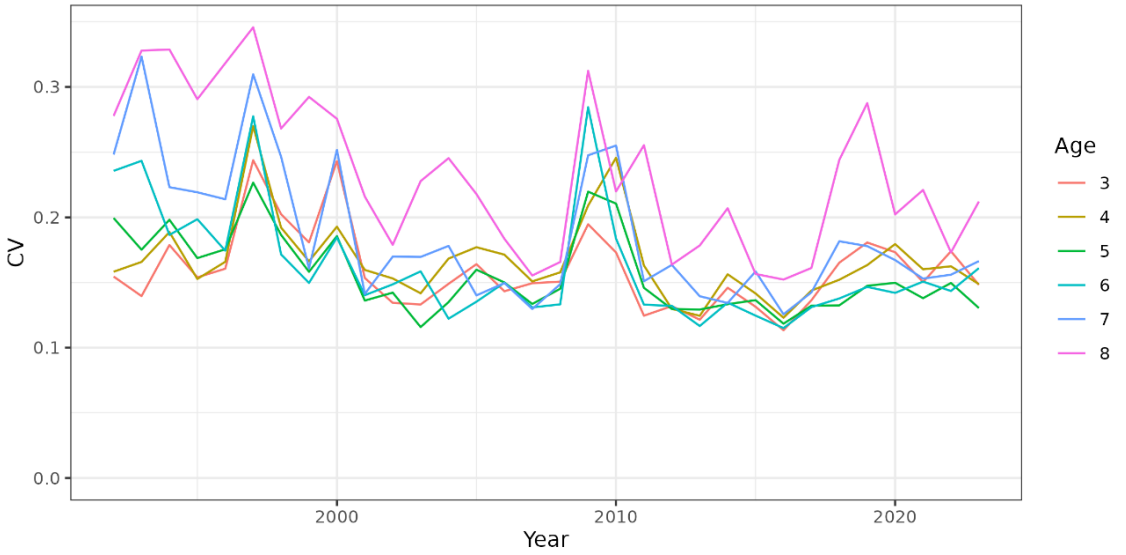


Figure 16.3.13. Saithe in subareas 4 and 6 and in Division 3.a. Yearly coefficients of variation of the standardized Q3–4 delta-GAM index of abundance-at-age, for saithe ages 3–8, 1992–2023.

Figure 16.3.14. Saithe in subareas 4 and 6 and in Division 3.a. Stacked standardized Q3–4 delta-GAM index of abundance-at-age 1–14+ per subareas, 1992–2023. Values are sum of predictions over grid cells in a Subarea, as used for the weighting of biological estimates at age per Subarea in the weighted mean per age group.

Figure 16.3.15. Saithe in subareas 4 and 6 and in Division 3.a. Relative abundance per Subarea at age 1–14+, 1992–2023. Based on the standardized Q3–4 delta-GAM index of abundance-at-age per subareas, age 1–14+, 1992–2023 (Figure 16.3.14).

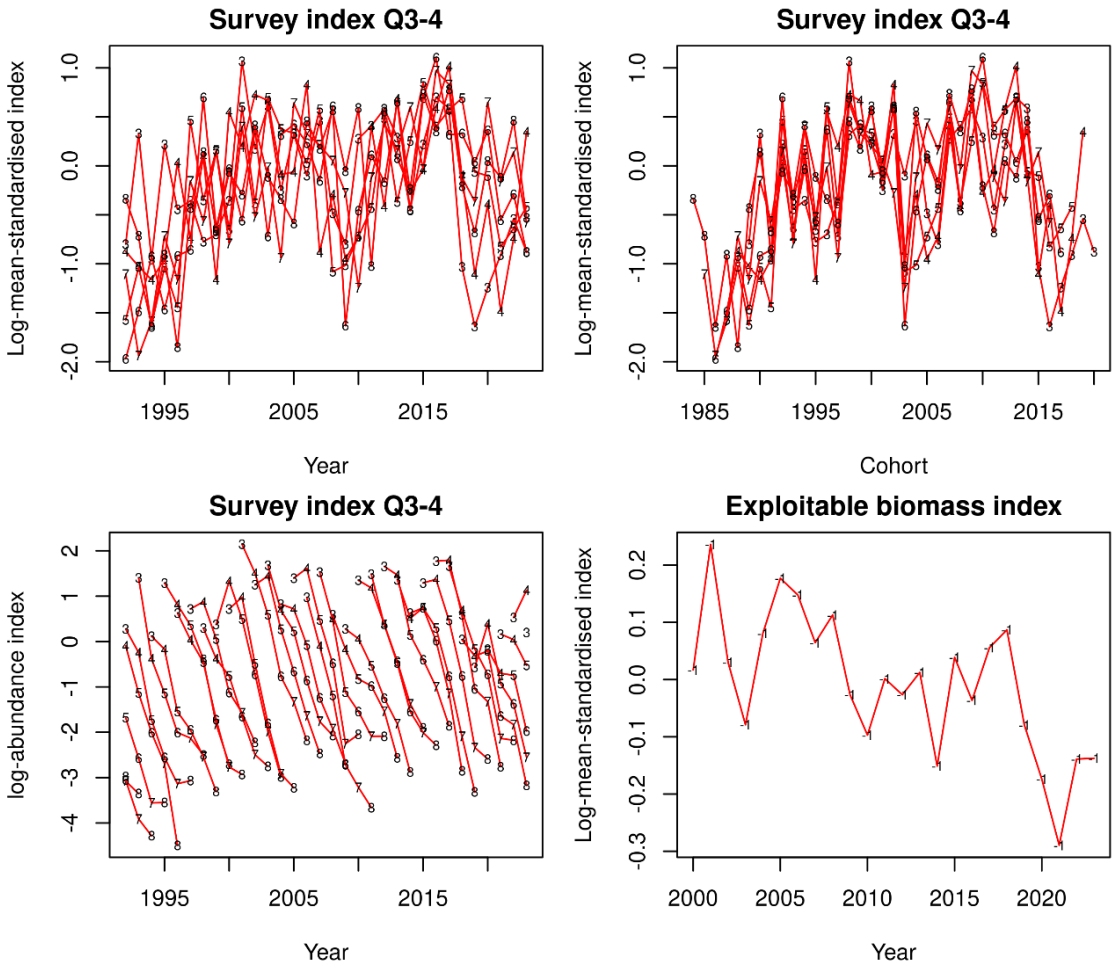


Figure 16.4.1. Saithe in subareas 4 and 6 and in Division 3.a. Research survey index, Q3–4, for ages 3 to 8, 1992–2023 is shown in terms of indices by age and year (top-left panel), indices by age and cohort (top-right panel), and log-catch curves by cohort (bottom-left panel). Commercial catch-per-unit-effort (CPUE) is shown in the bottom-right panel.

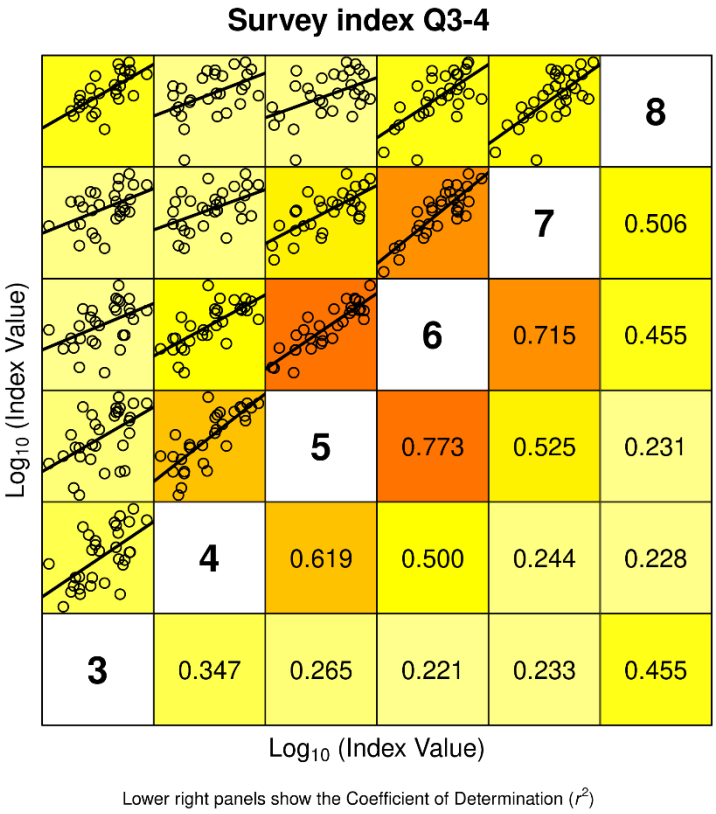


Figure 16.4.2. Saithe in subareas 4 and 6 and in Division 3.a. Internal consistencies for the survey index Q3–4, 1992–2023 ages 3 to 8.

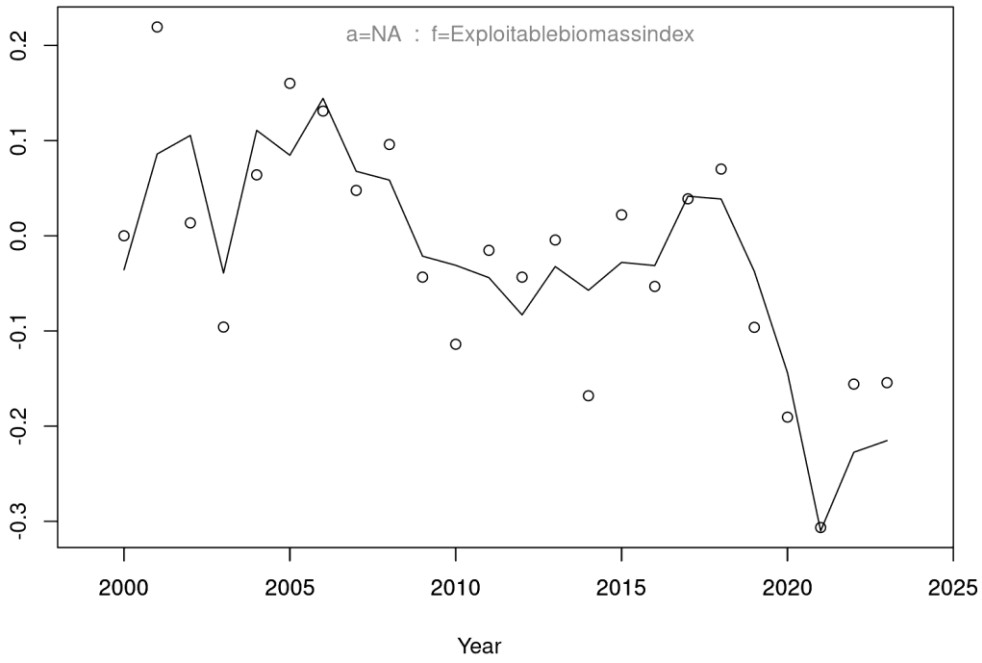


Figure 16.4.3. Saithe in subareas 4 and 6 and in Division 3.a. Standardized combined CPUE index (year effects, open circles) and fit of model after tuning to the exploitable biomass (solid line), 2000–2023.

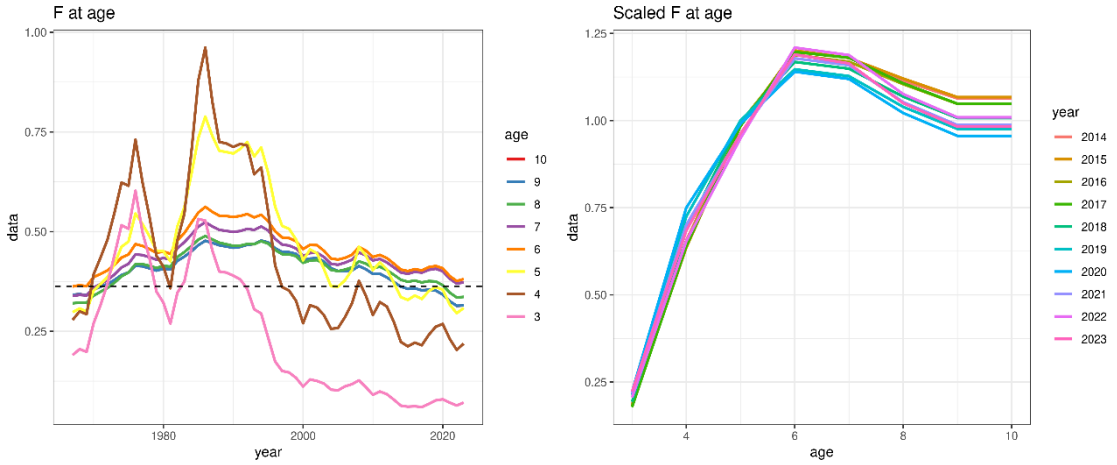


Figure 16.4.4. Saithe in subareas 4 and 6 and in Division 3.a. Fishing mortality-at-age for the final assessment model (1967–2023). Time-series (left panel) and scaled at F_{4-7} for the last 10 years (right panel). F at age 9 and 10+, which are coupled in the model (9+), perfectly overlap.

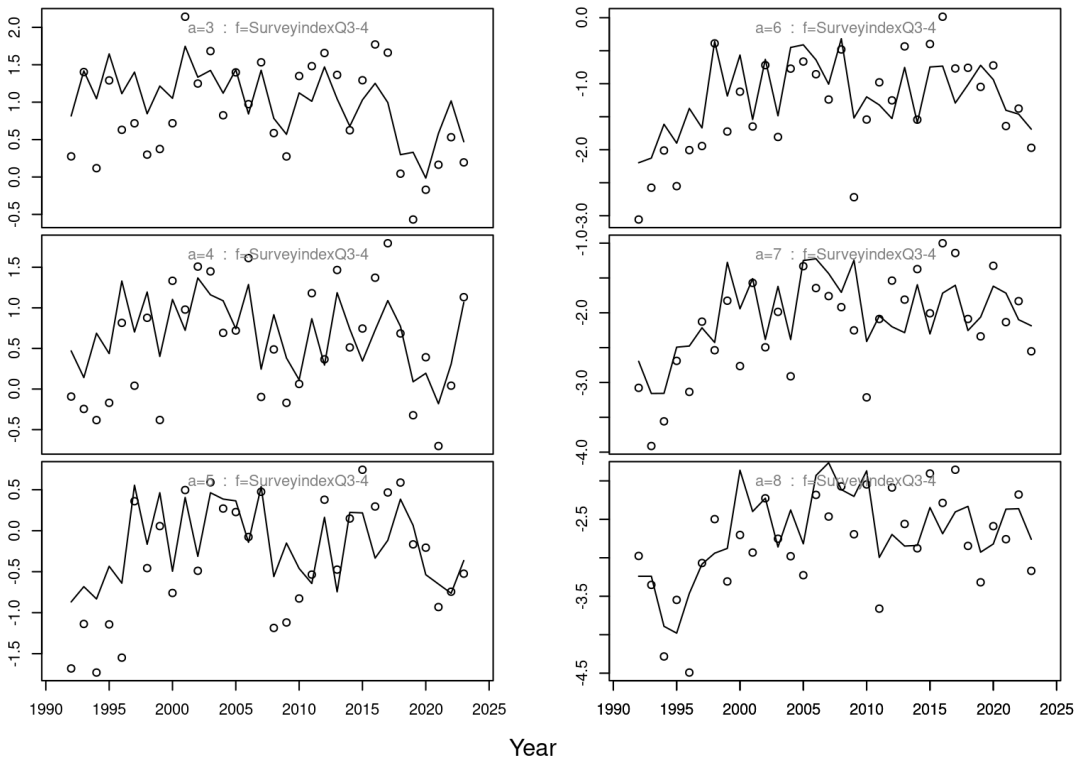


Figure 16.4.5. Saithe in subareas 4 and 6 and in Division 3.a. Survey Q3–4 index at age (age 3–8, open circles) and model fit (solid line), 1992–2023.

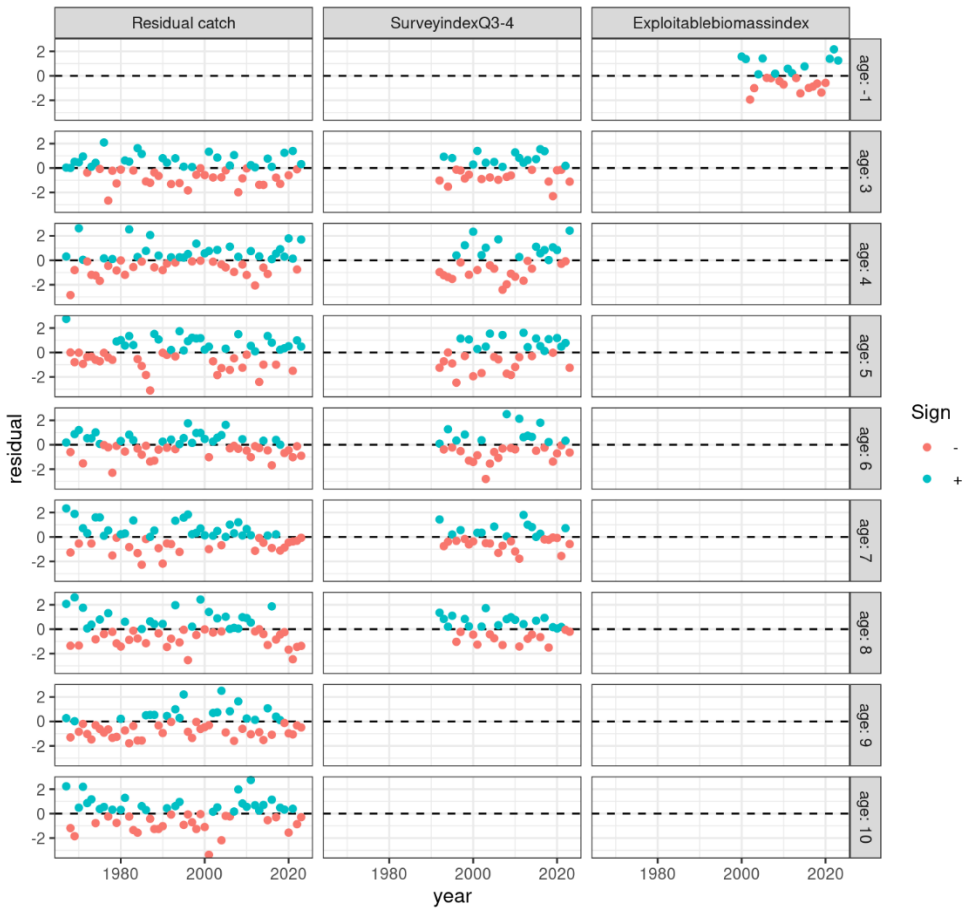


Figure 16.4.6. Saithe in subareas 4 and 6 and in Division 3.a. One-step ahead (serially independent) residual patterns of observations for the final SAM model. Plus-group: age 10+ for catch. Age: -1 indicates no age information.

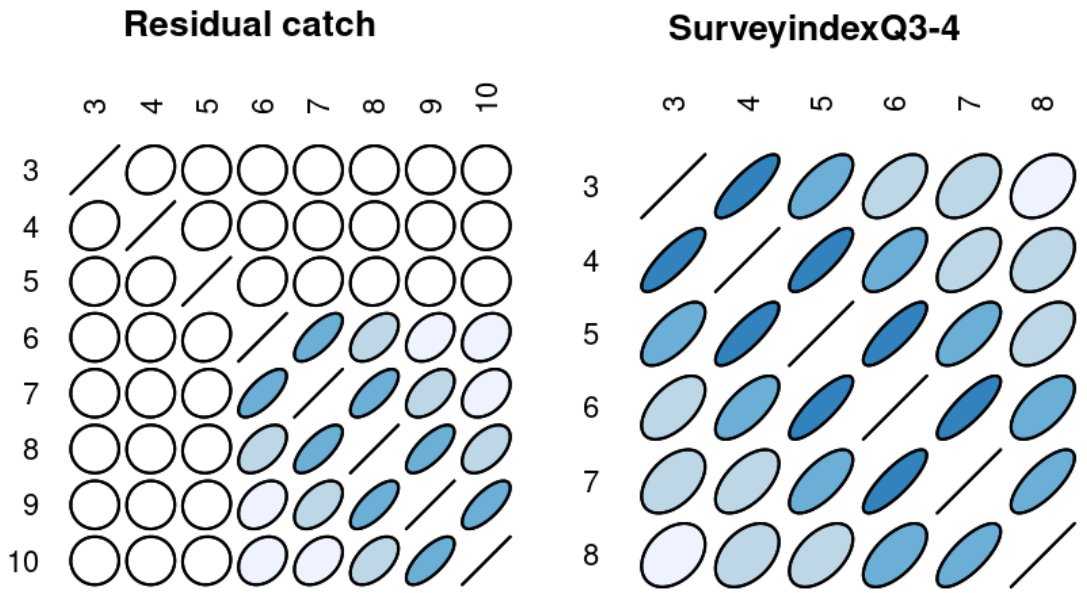


Figure 16.4.7. Saithe in subareas 4 and 6 and in Division 3.a. Correlation between age classes within years for catches (ages 3–10+; left panel) and survey index Q3–4 (ages 3–8; right panel) observations. The darker the blue colour, the stronger the positive correlation.

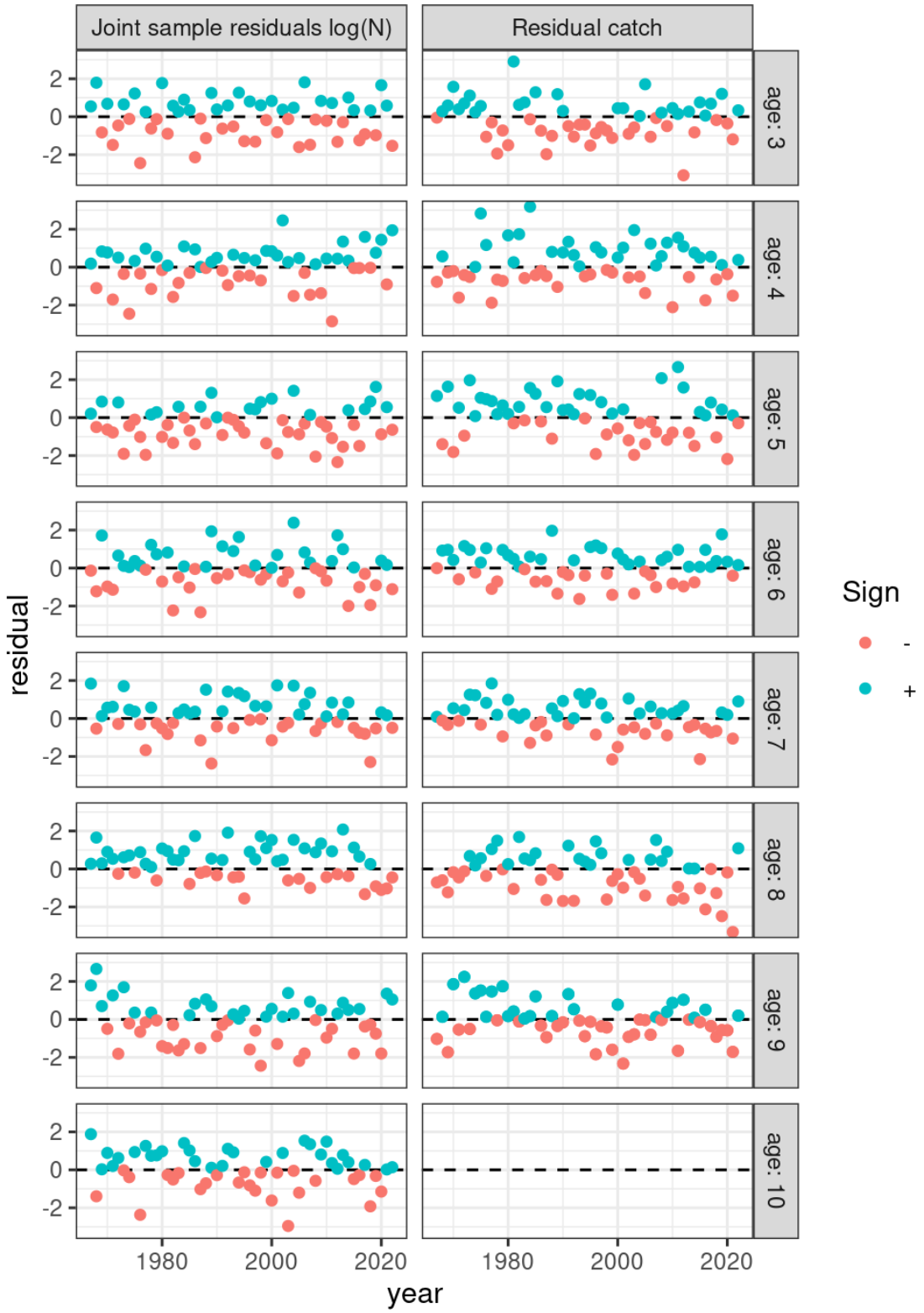


Figure 16.4.8. Saithe in subareas 4 and 6 and in Division 3.a. One-step ahead (serially independent) process error. Plus-groups: age 10+ for N, 9+ for catches (F process).

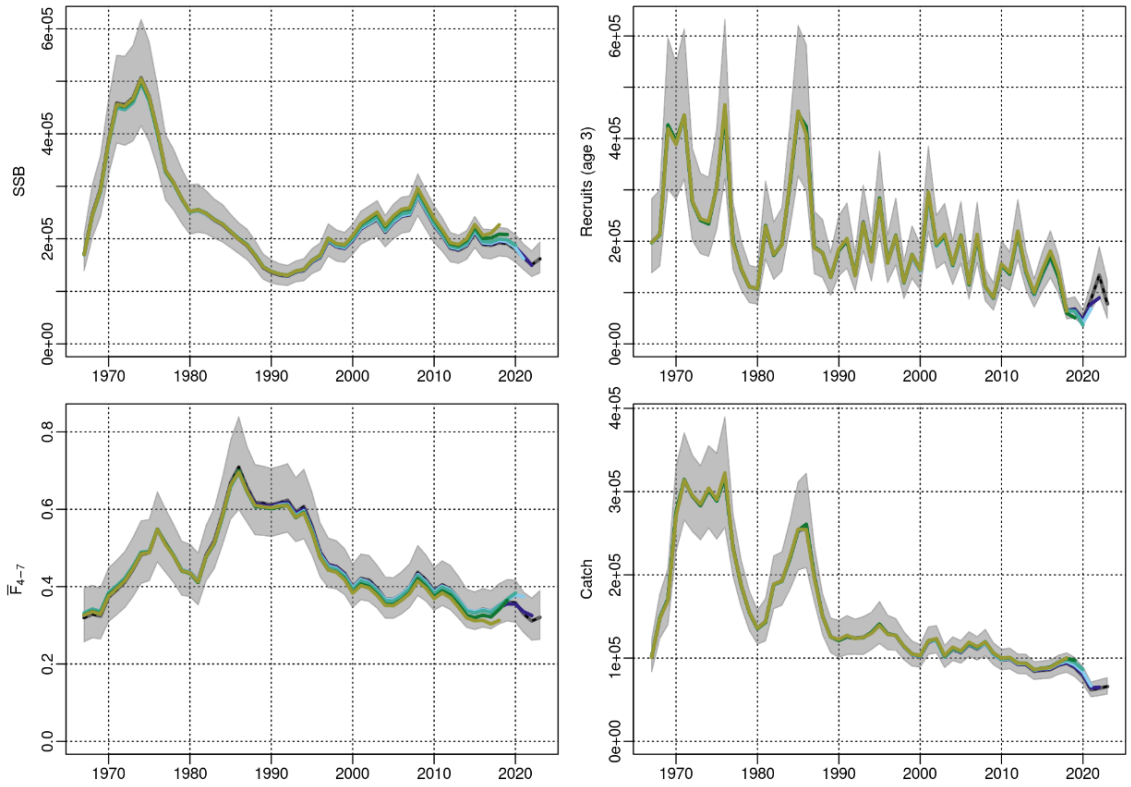


Figure 16.4.9. Saithe in subareas 4 and 6 and in Division 3.a. Five-year retrospective pattern in SSB, F_{4-7}, recruitment, and catches for the final assessment.

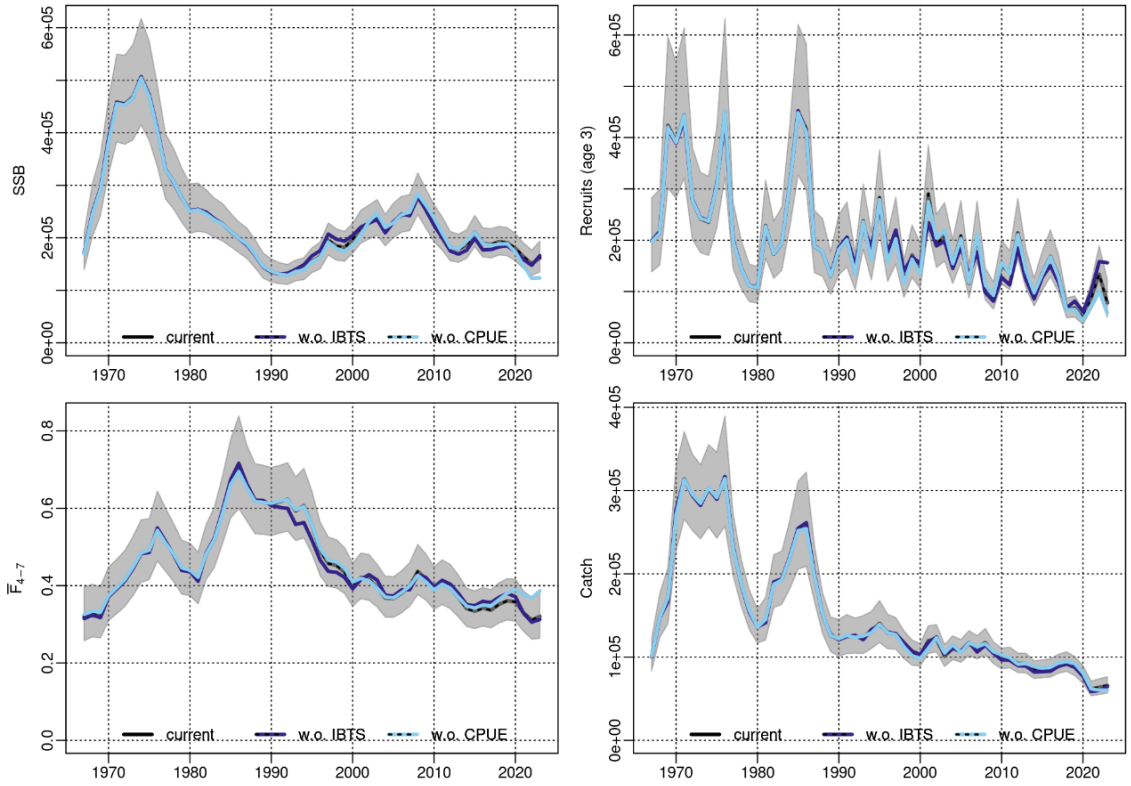
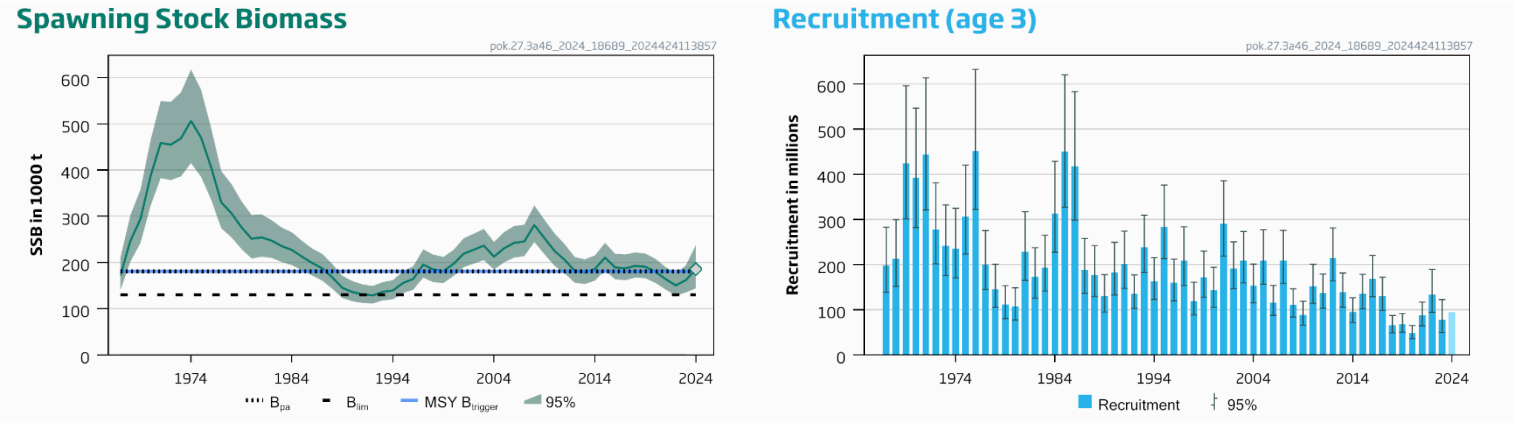


Figure 16.4.10. Saithe in subareas 4 and 6 and in Division 3.a. Stock summary of trends in SSB, F_{4-7}, recruitment, and catches for the final assessment model. Black lines and grey-shaded confidence interval indicate the final assessment model, including the survey Q3–4 indices for ages 3–8 and the CPUE index. The light blue line is the assessment with only the survey Q3–4 tuning series, while the dark blue one is the assessment with only the CPUE index.



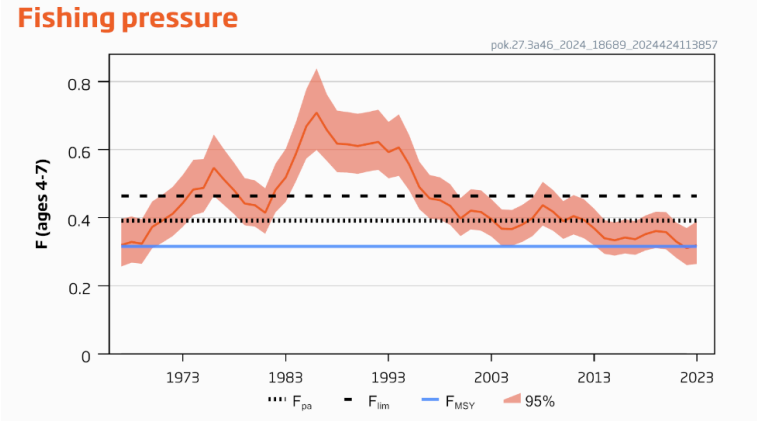


Figure 16.5.1. Saithe in subareas 4 and 6 and in Division 3.a. Summary of stock assessment in relation to reference points for SSB and F. Predicted recruitment values are light shaded. Shaded areas (F, SSB) and error bars (R) indicate pointwise 95% confidence intervals. SSB estimate in 2024 (diamond) relies on the stochastic recruitment STF for age 3 (6% of SSB); ages 4–10+ are 2023 survivors.

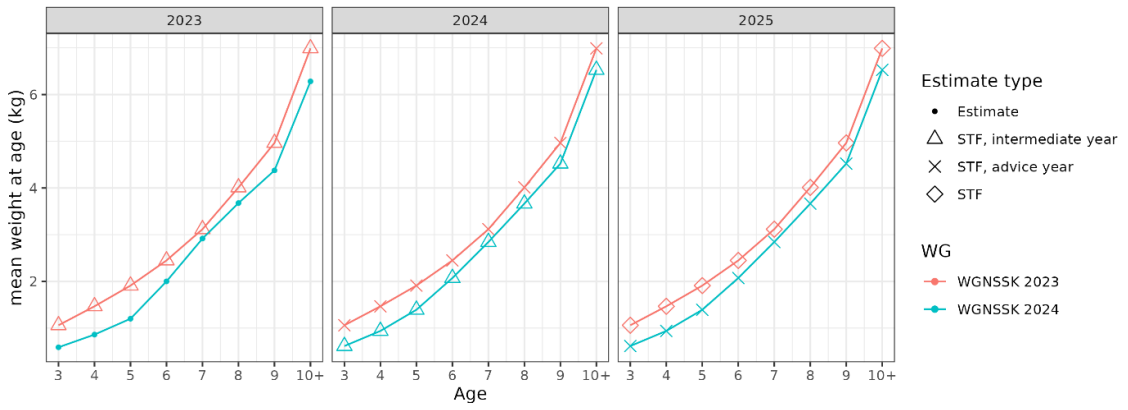


Figure 16.7.1. Saithe in subareas 4 and 6 and in Division 3.a. Comparison of the last three years of mean stock weights-at-age (InterCatch estimates and forecast assumptions) between the current assessment (WGNSSK 2024) and the previous assessment (WGNSSK 2023).

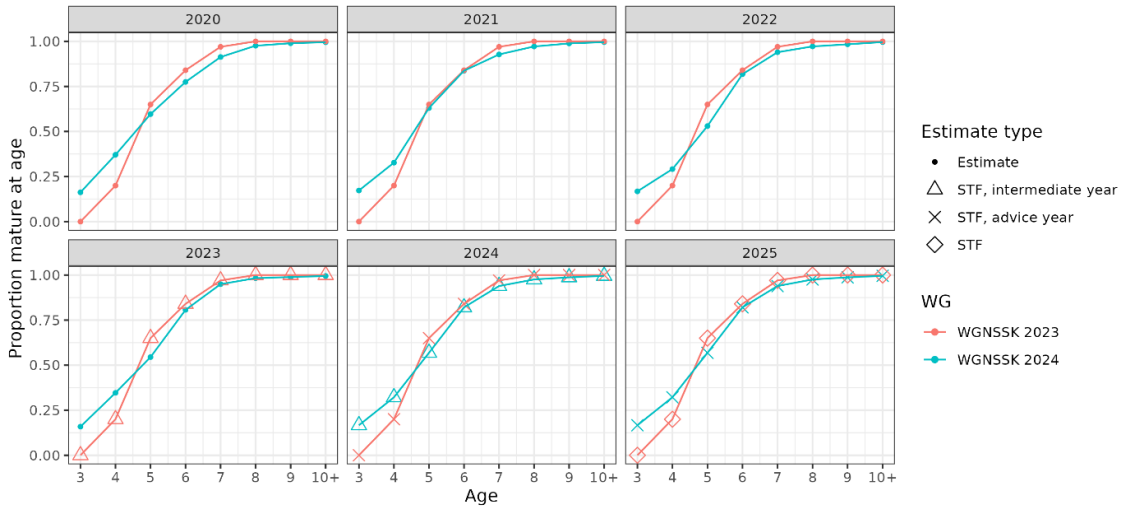


Figure 16.7.2. Saithe in subareas 4 and 6 and in Division 3.a. Comparison of the 2020–2025 proportion mature-at-age (estimates and forecast assumptions) between the current assessment (WGNSSK 2024; model-based maturity ogive) and the previous assessment (WGNSSK 2023; static maturity ogive).

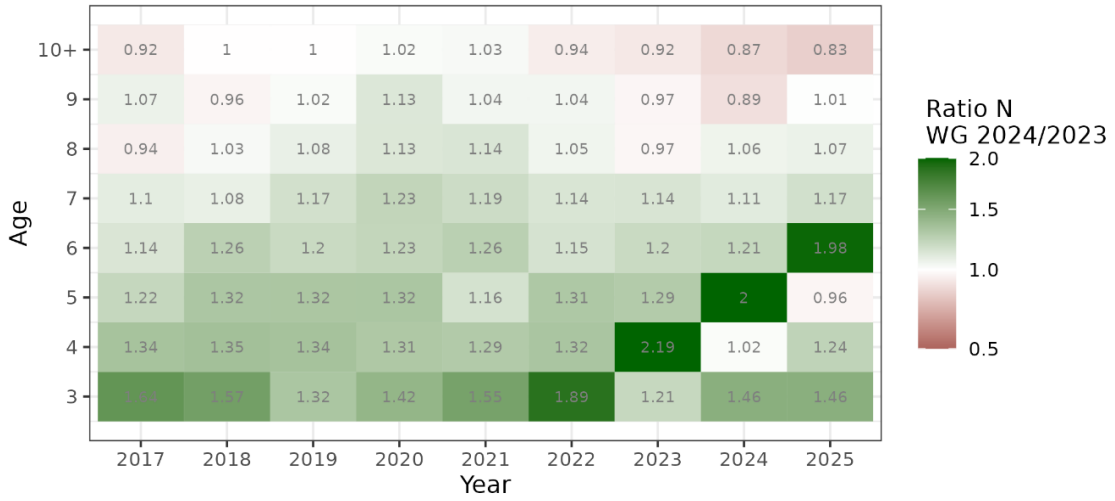


Figure 16.7.3. Saithe in subareas 4 and 6 and in Division 3.a. Ratio of number-at-age estimates (model and forecast) between the current assessment (WGNSSK 2024; intermediate year 2024, STF 2025) and the previous assessment (WGNSSK 2023; intermediate year 2023, STF 2024–2025) for the period 2017–2025. A value over 1 indicates an increased estimate.

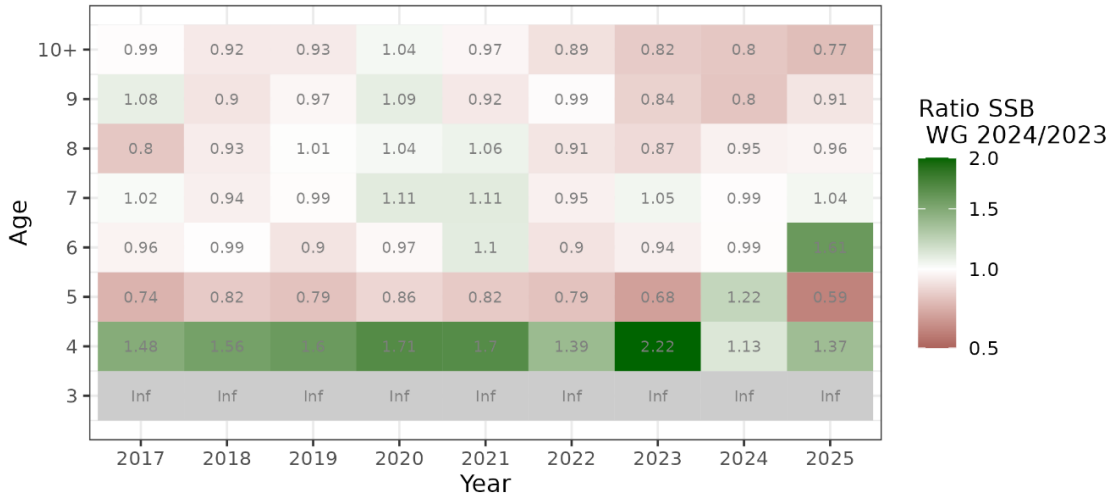


Figure 16.7.4. Saithe in subareas 4 and 6 and in Division 3.a. Ratio of spawning-stock biomass (SSB)-at-age estimates (model and forecast) between the current assessment (WGNSSK 2024; intermediate year 2024, STF 2025) and the previous assessment (WGNSSK 2023; intermediate year 2023, STF 2024–2025) for the period 2017–2025. A value over 1 indicates an increased estimate. The maturity ogive was updated in 2024 (WKBGAD; ICES, 2024), leading to age 3 contributing to the SSB, unlike in the previous assessment (Figure 16.7.2), which is why the ratio is infinite.

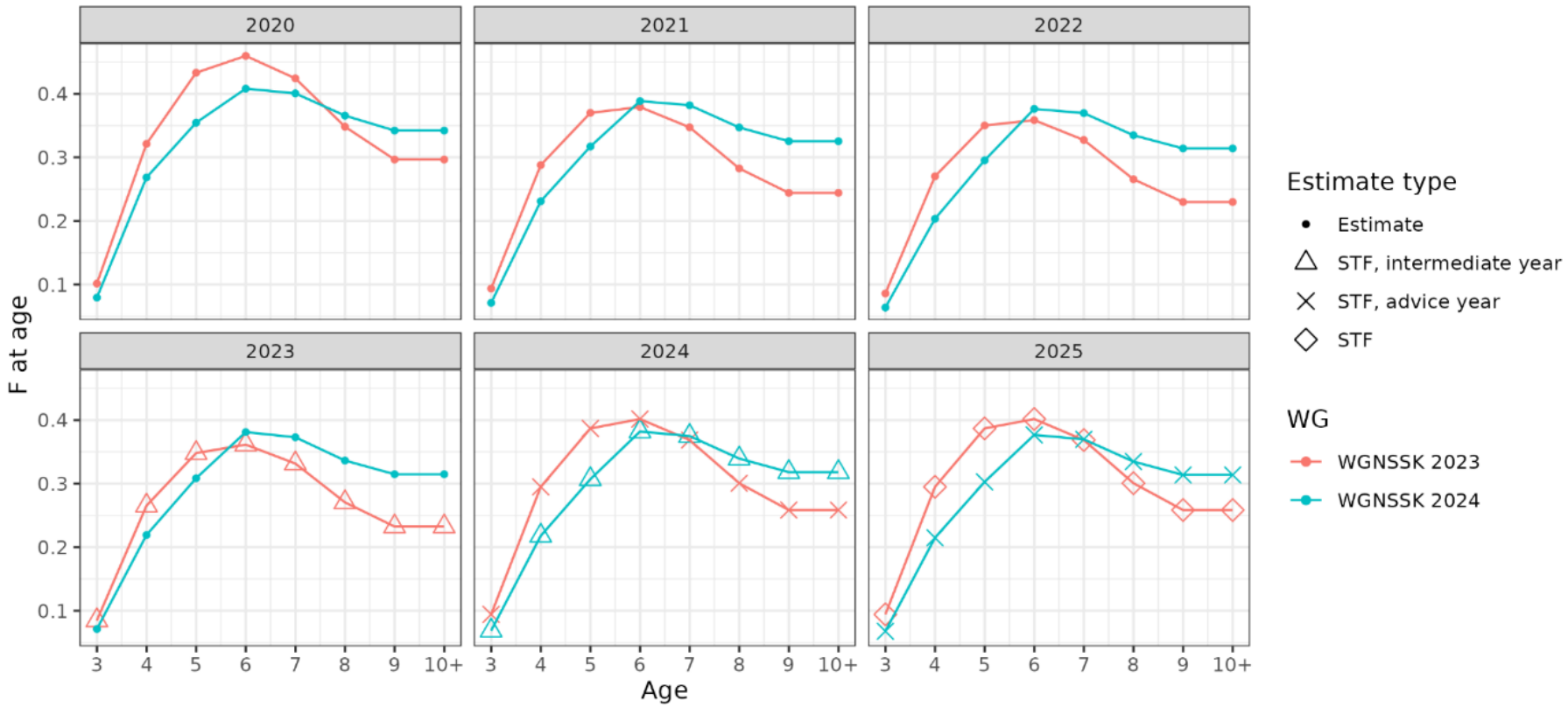


Figure 16.7.5. Saithe in subareas 4 and 6 and in Division 3.a. Comparison of fishing mortality (F)-at-age estimates per year (model and forecast) between the current assessment (WGNSSK 2024) and the previous assessment (WGNSSK 2023).

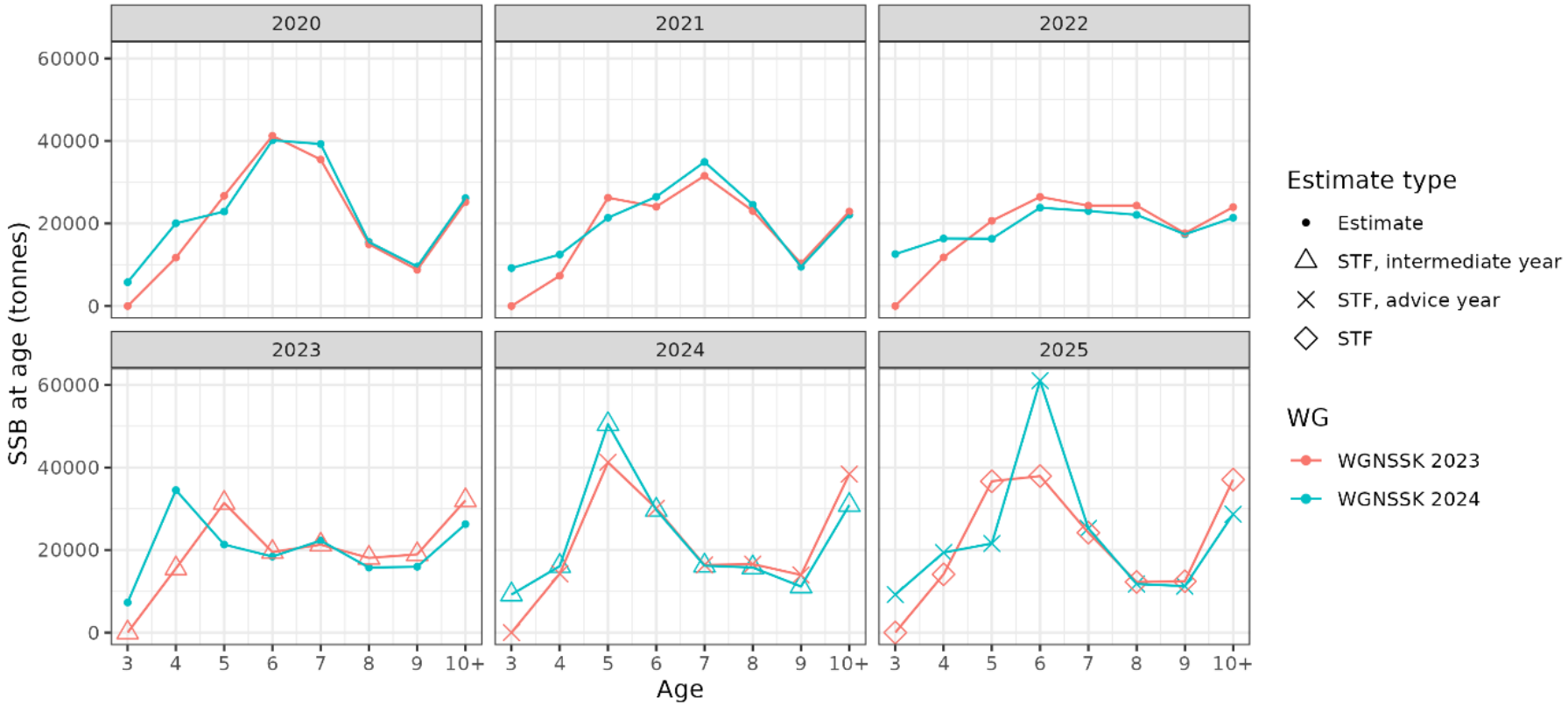


Figure 16.7.6. Saithe in subareas 4 and 6 and in Division 3.a. Comparison of spawning-stock biomass (SSB)-at-age estimates per year (model and forecast) between the current assessment (WGNSSK 2024) and the previous assessment (WGNSSK 2023).

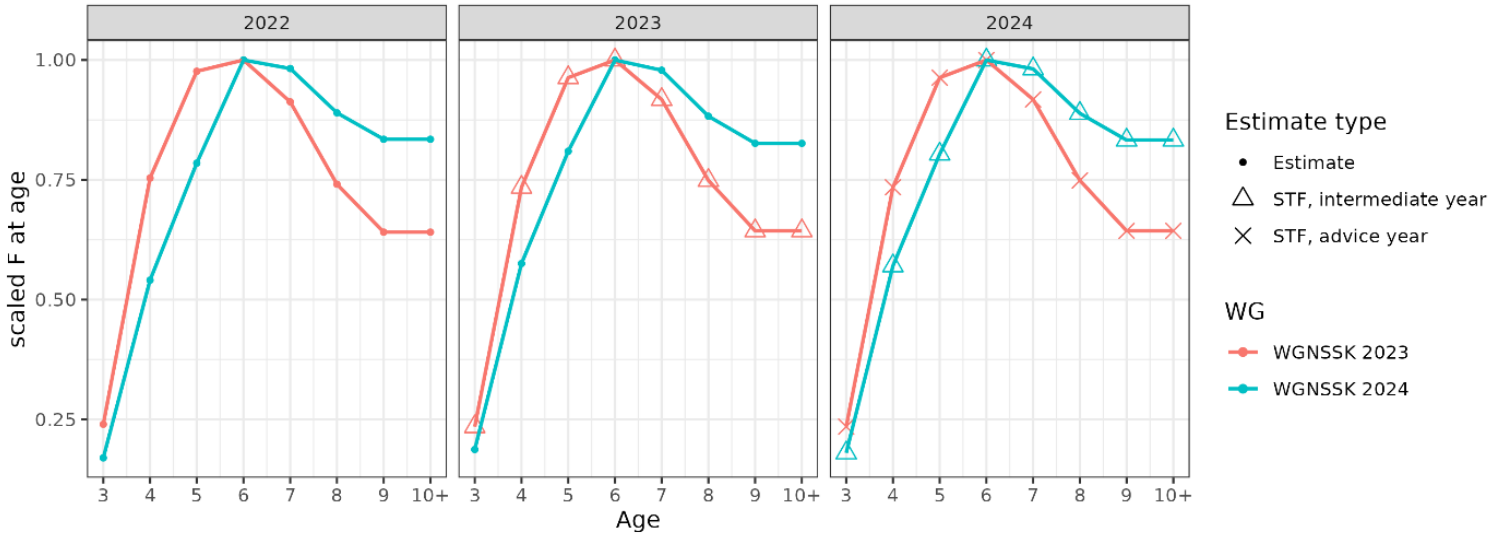


Figure 16.7.7. Saithe in subareas 4 and 6 and in Division 3.a. Comparison of the last three years of scaled fishing mortality (F) ogives (model and forecast) between the current assessment (WGNSSK 2024) and the previous assessment (WGNSSK 2023).

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