February 2020

Automation of ALK substitution

For many years Age Length Key supplementation was done manually, following the procedure described here http://www.ices.dk/marine-data/Documents/DATRAS/Indices_Calculation_Steps_IBTS.pdf (Annex 2).

This procedure states that for each species and area, if total measured individuals for a certain age are less than 25, this area ALK should be supplemented with the data from another area following a predefined scheme of neighbour areas:

RFA	sub1	sub2	sub3	sub4	sub5
1	2	3	4	7	6
2	1	3	4	6	7
3	1	2	4	5	6
4	2	3	5	6	7
5	4	6	2	3	7
6	2	4	5	7	3
7	2	6	8	3	4
8	9	7	6	-	-
9	8	7	2	-	-
10	5	6	4	2	3

Table 1: Borrowing areas scheme for NS-IBTS Round Fish Areas

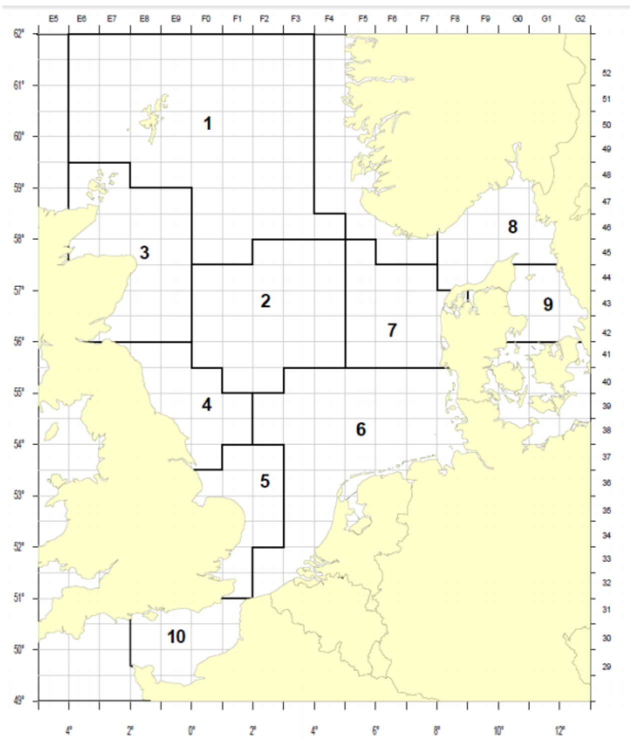


Figure 1: Standard Roundfish Areas used for roundfish since 1980, for all standard species since 1991. Additional RFA 10 added in 2009.

However, this procedure was open to interpretation, if most ages in one area have enough measures, the substitution might not be done. This procedure follows the logic of the person performing the substitution, but it is difficult for the final user to trace back.

The present procedure provides an automated way of substituting ALK and to compare the resulting indices with those calculated with the old manual procedure of substitution.

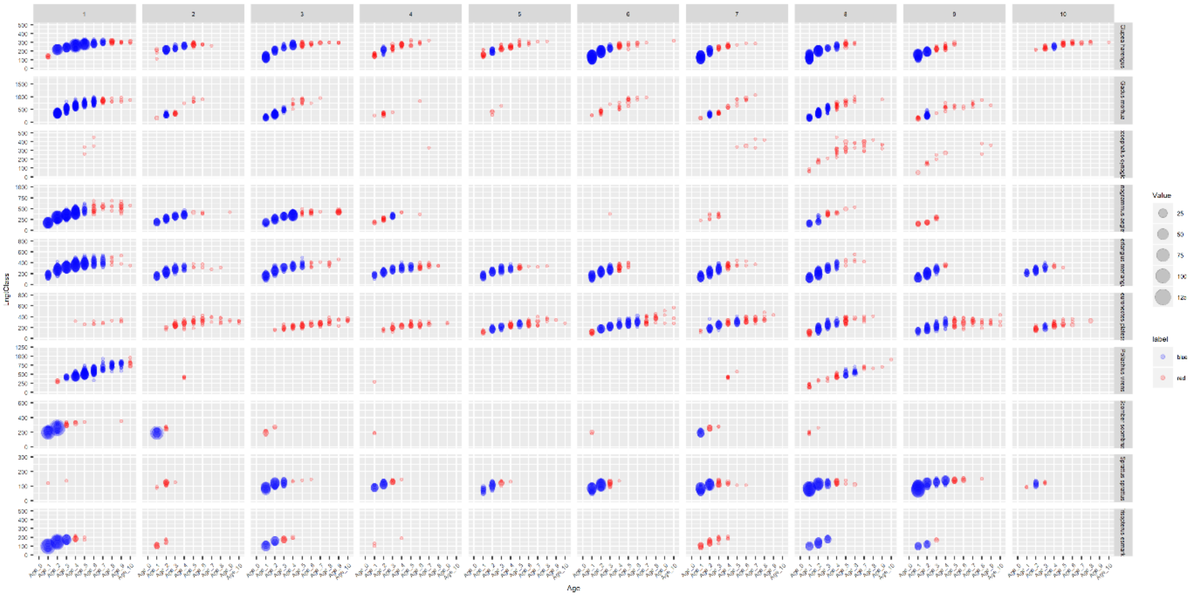


Figure 2: NS-IBTS in 2018 quarter 1 original ALK **as submitted to Datras**. In the horizontal axis are the different Ages, and in the vertical axis the Length. Each row corresponds to one of the 10 target species and each column corresponds to the 10 RFA (Figure 1). In red, age classes that for that area have less than 25 data points, so should be supplemented.

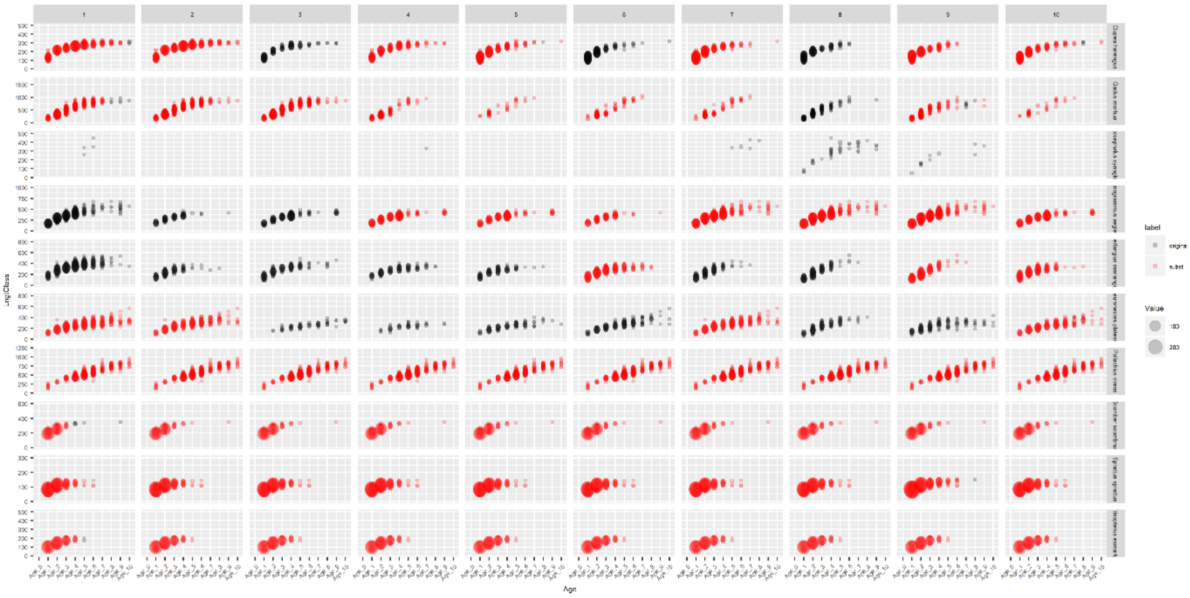


Figure 3: NS-IBTS for 2018 quarter 1 ALK after **manual substitution**. In red are areas that have been supplemented. In this case, all age classes in one area appear supplemented, because the old procedure adds up the whole ALK, not taking into account the different Age classes.

In the automated procedure, for each species, area and age class, it is checked whether there are at least 25 observations. If not, that age class (not all of them as before) will be supplemented with the data from the nearest area (following order in Table 1) and so on until all age classes in all areas have at least 25 data points (or until all possible supplementations have been performed as indicated in Table 1).

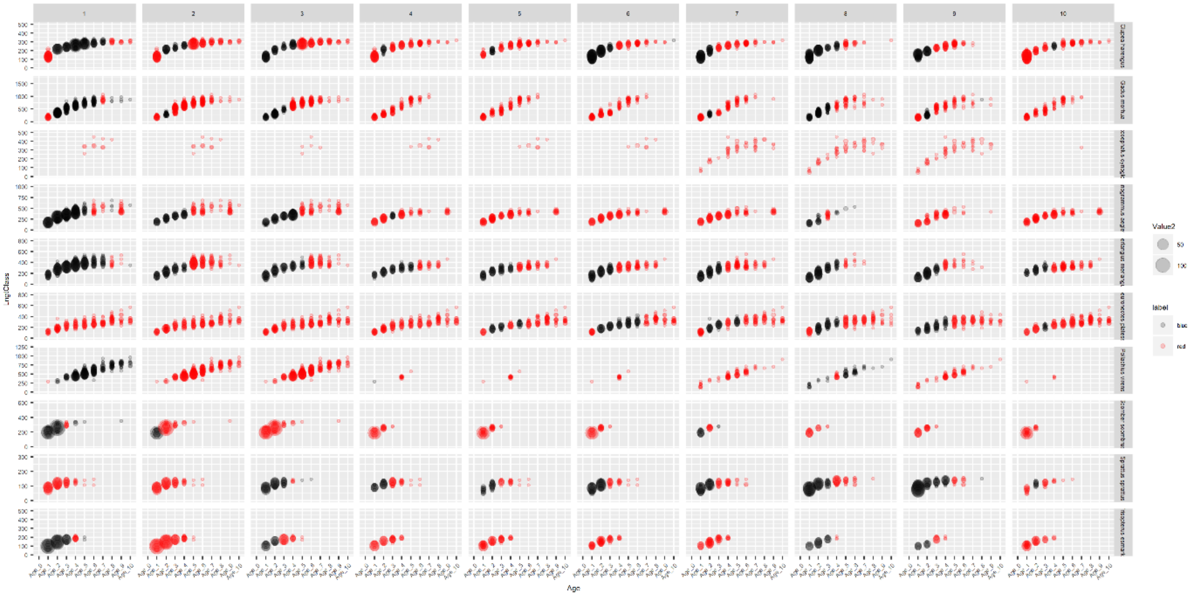


Figure 4: NS-IBTS 2018 quarter 1 after **automated substitution**. Please note that for each area, only age classes with less than 25 observations (those in red here and also in the figure 2, original ALK), have been supplemented.

The effect in the indexes has to be further investigated but preliminary work indicates that trends are kept and differences are rather small:

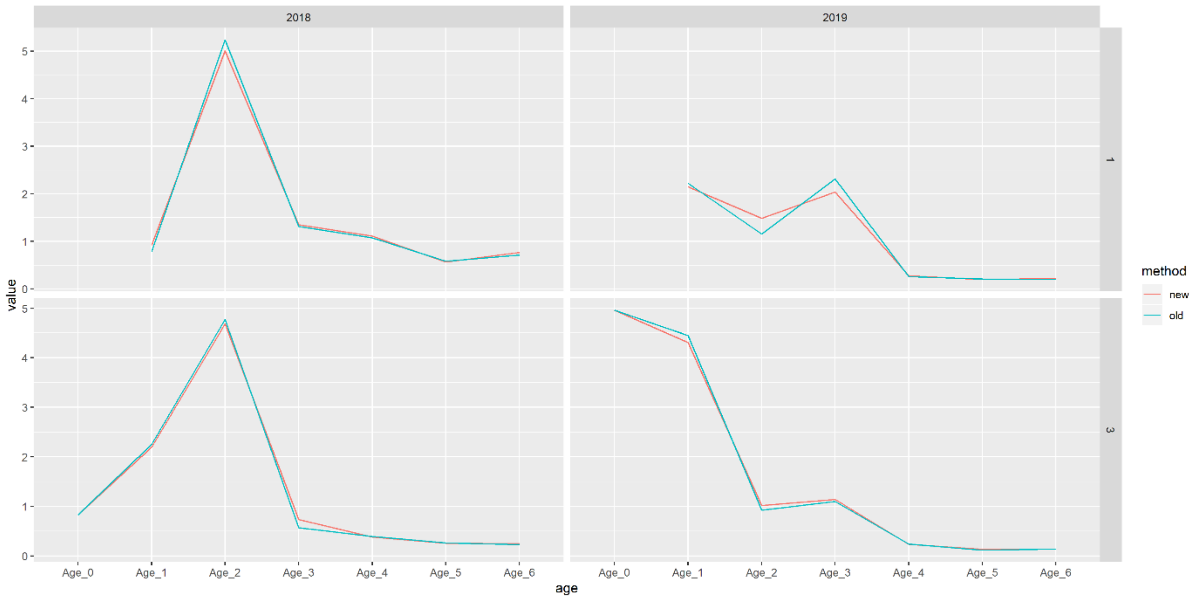


Figure 5: NS-IBTS 2018 and 2019 quarters 1 and 3 **Cod** indexes comparison.

Some instances of larger differences are detected.

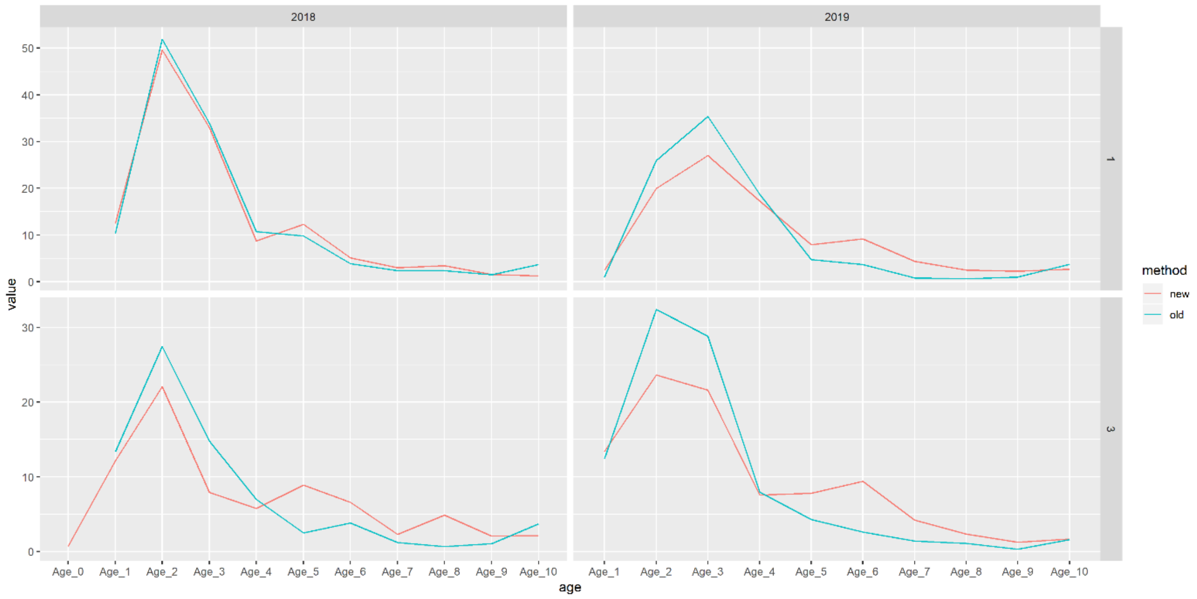


Figure 5: NS-IBTS 2018 and 2019 quarters 1 and 3 **Plaice in 3a** indexes comparison.

The manual procedure seems to provide quite similar indices results to those resulting from the automated substitution.

The advantages of the automated procedure mostly refer to transparency and traceability. The substitution procedure can be stored in TAF, so users can replicate it if needed.

The full procedure to produce these figures is in github (ALK_Automated_substitution.R):

https://github.com/ices-tools-prod/DATRAS/tree/master/ALK_substitution

This automated procedure has been applied for the Indices calculation and age based CPUE data products available in DATRAS since 2020 q1.

In early 2020 DATRAS team met with several stock coordinators affected by the change in the ALK supplementation and following the analysis on the effect on indices is detailed.

General comments

The IBTS-Q1 and IBTS-Q3 are constructed by species and area. In case the number of samples available to construct the ALK is made of less than 25 individuals, the ALK is complemented by ALK from nearby areas. Historically, this supplementation process has been carried out manually following predefined procedures. Though, in some cases, subjective judgment was involved when substituting ALKs.

In order to streamline the supplementation process, an automated procedure has been devised and is reviewed in the herby document for the North Sea Autumn Spawning Herring (NSAS) IBTS-Q1 and IBTS-Q3 indices. It is important to note that for NSAS, the IBTS indices are not used directly in the assessment. Instead, a normalized index is constructed using the data submitted to DATRAS. The code used to generate these normalized indices is available at:

https://github.com/ices-eg/wg_HAWG/tree/master/NSAS/data/IBTS%20index

The results for both indices are shown in the sections below. This consists of the comparison of the time series by year and by year class and the internal consistency of the indices.

For the IBTS-Q1 index, the effect of the change in supplementation methodology is marginal. This is exemplified in index time series (Figure Q1-1 for the index at age, Figure Q1-2 for the index per yearclass). For all ages, there is only minor deviations. The internal consistency of both indices are very similar, though somewhat consistently lower correlation is observable for the newly derived index.

Regarding the IBTS-Q3, the new index yields similar results. This can be observed in Figure Q3-1 where only age 5 exemplifies a discrepancy with a consistent upward revision of the index. This could be driven by the fact that this age is poorly sampled. Though, the indices dynamics for the different ages remain very similar (see Figure Q3-2), even for age 5. The internal consistency is virtually unchanged.

[1] Berg, C. W., Nielsen, A., & Kristensen, K. (2014). Evaluation of alternative age-based methods for estimating relative abundance from survey data in relation to assessment models. Fisheries Research, 151, 91–99. https://doi.org/10.1016/j.fishres.2013.10.005

IBTS-Q1 results figures

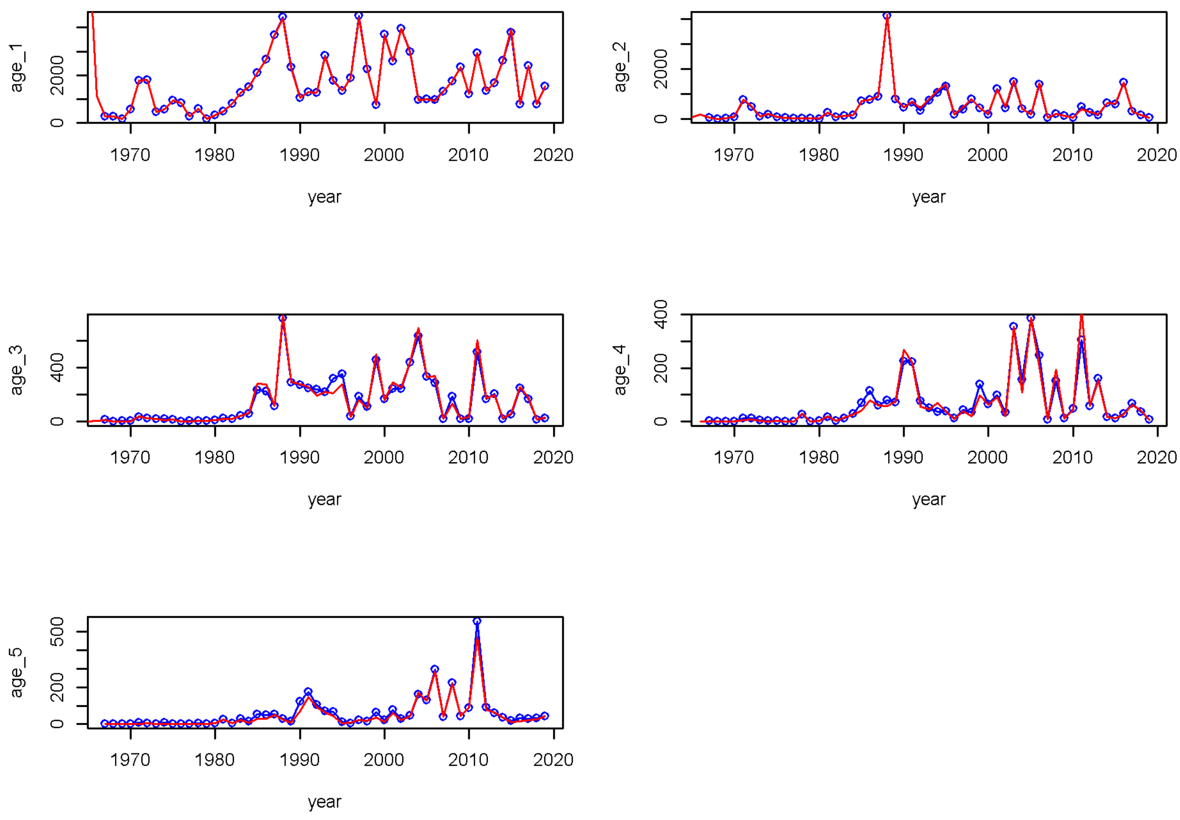


Figure Q1-1: index at age comparison for IBTS-Q1. The blue line with circle markers is the new time series while the red solid line is the old time series.

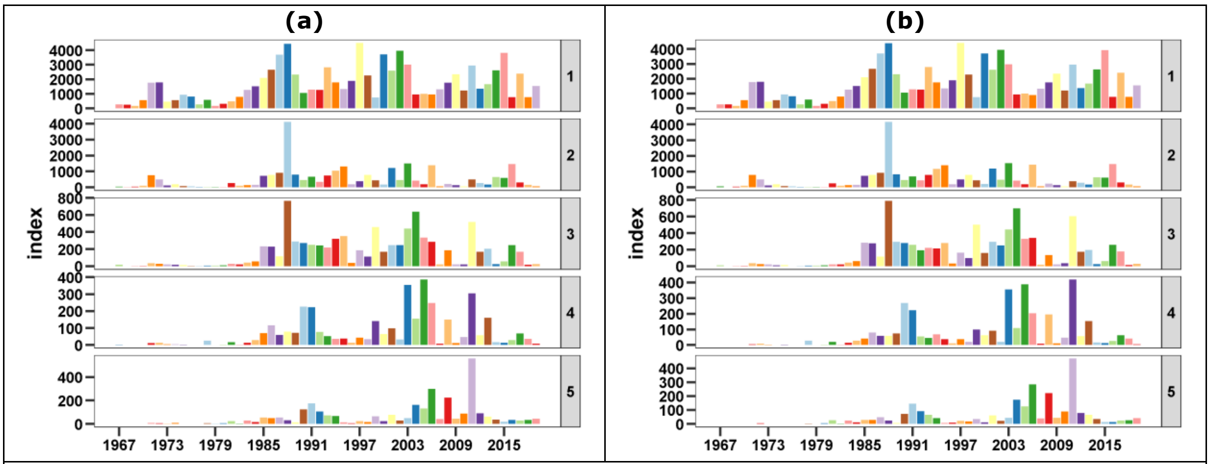


Figure Q1-2: index at age comparison by cohorts for IBTS-Q1. (a) newly derived index. (b) old index.

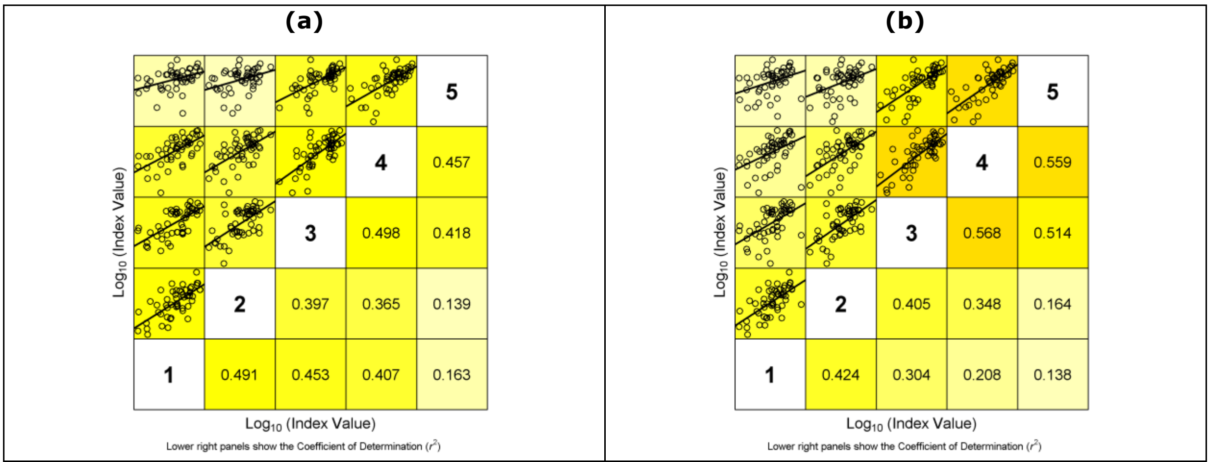


Figure Q1-3: Internal consistency of the IBTS-Q1 index. (a) newly derived index. (b) old index.

IBTS-Q3 figures

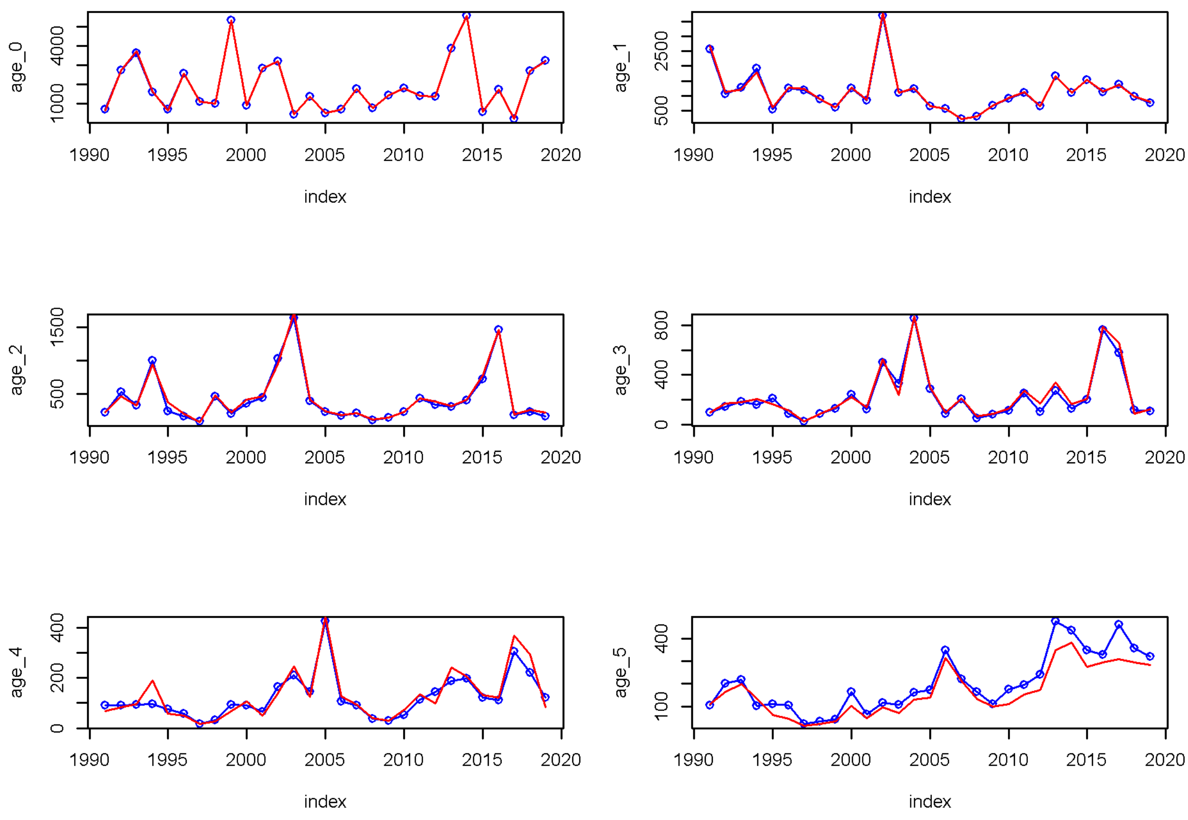


Figure Q3-1: index at age comparison for IBTS-Q3. The blue line with circle markers is the new time series while the red solid line is the old time series.

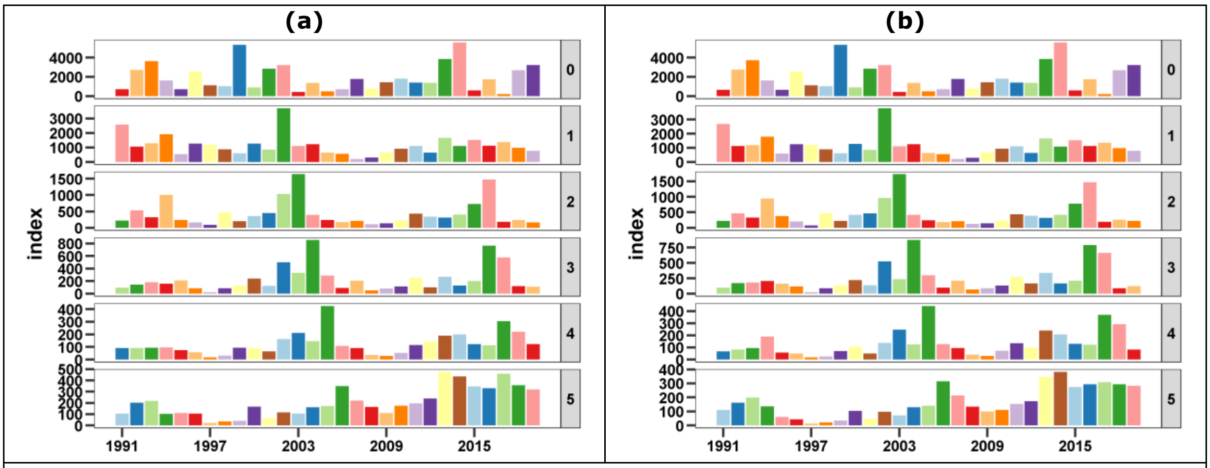


Figure Q3-2: index at age comparison by cohorts for IBTS-Q3. (a) newly derived index. (b) old index.

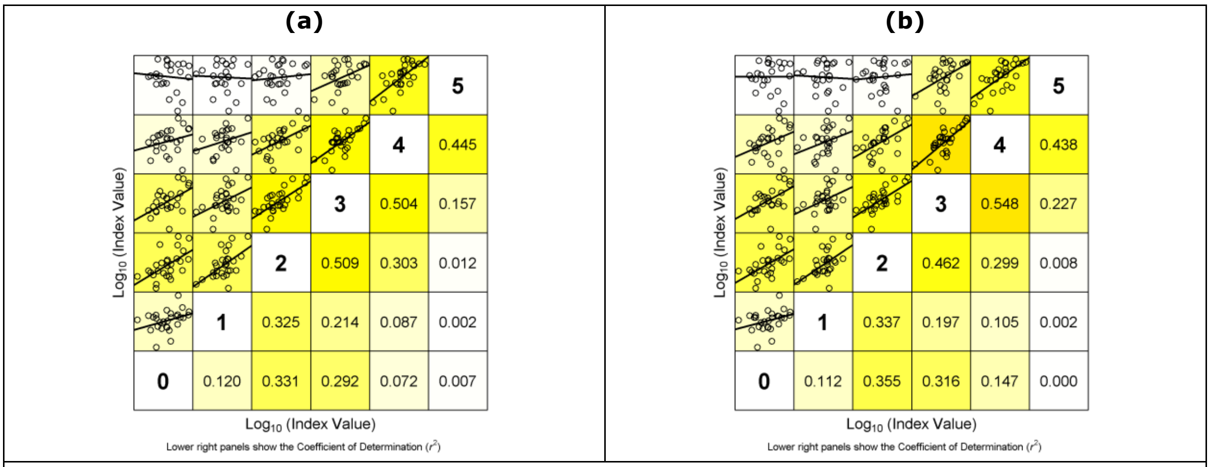


Figure Q3-3: Internal consistency of the IBTS-Q3 index. (a) newly derived index. (b) old index.

Comparison of WGNSSK 2019 stock assessment results with assessment using survey indices calculated with new ALK methodology

ICES have updated the methodology used to calculate the IBTS Q1 and Q3 survey indices. The new method applies automatic fill ins where data is missing rather than relying on subjective decisions made manually each year by an expert. From 2020 index values will only be available as calculated by the new methodology. ICES have provided a full time series of IBTS Q1 and Q3 indices for Northern Shelf haddock to test the effect of the new data on assessment results. The options available will be to either use this complete new time series or use the original time series up to 2019 and then use data from the new methodology from 2020 onwards.

Original versus new indices

The largest differences between the original and new index values are seen at older ages in both Q1 and Q3 (Figures 1 and 2). This is because fill-ins are more likely to be needed at older ages. Ages 4, 5 and to some extent 3 all have higher index values in the new indices. This is more pronounced in Q3.

Figure 1: IBTS Q1 survey indices from the original ("old") and "new" methodologies for Northern Shelf haddock for ages 1 to 5.

Figure 2: IBTS Q3 survey indices from the original ("old") and "new" methodologies for Northern Shelf haddock for ages 1 to 5.

Assessment fit with new indices

The stock assessment model used for Northern Shelf haddock, TSA, allows for ad-hoc adjustments on the CV multipliers of individual data points to allow the user to downweight data points which may be more uncertain. These data points are often found through large prediction errors in the model fit diagnostics which indicate where data points are deviating from the "norm". As the new indices are a new dataset, all ad-hoc adjustments used for survey indices data points were removed for an initial fit. The diagnostic results from the prediction errors for the Q1 survey indices showed that some ad-hoc adjustments might be needed (Figure 3). Two of these data points (IBTS Q1 2011 age 5 and 2014 age 4) were the same as with the original survey indices dataset. A third was added for the new dataset (IBTS Q1 1993 age 4) (Figure 4).

The ad-hoc adjustments improved the model fit based on the -2*loglik value which decreased from 688.3368 with the initial run to 662.2872 with the ad-hoc adjustments. A summary of the model fit results are shown in Figure 5.

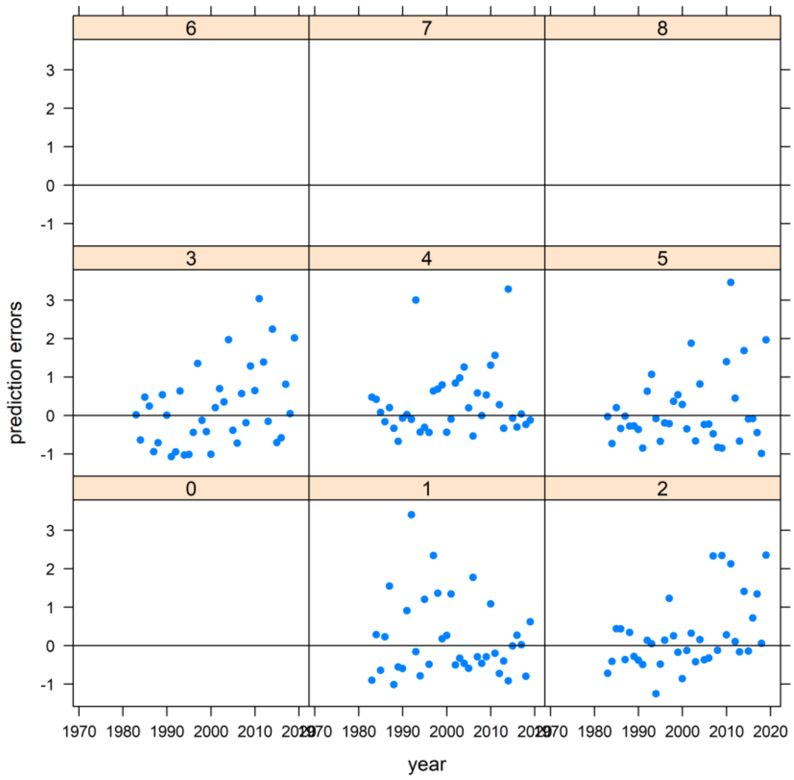
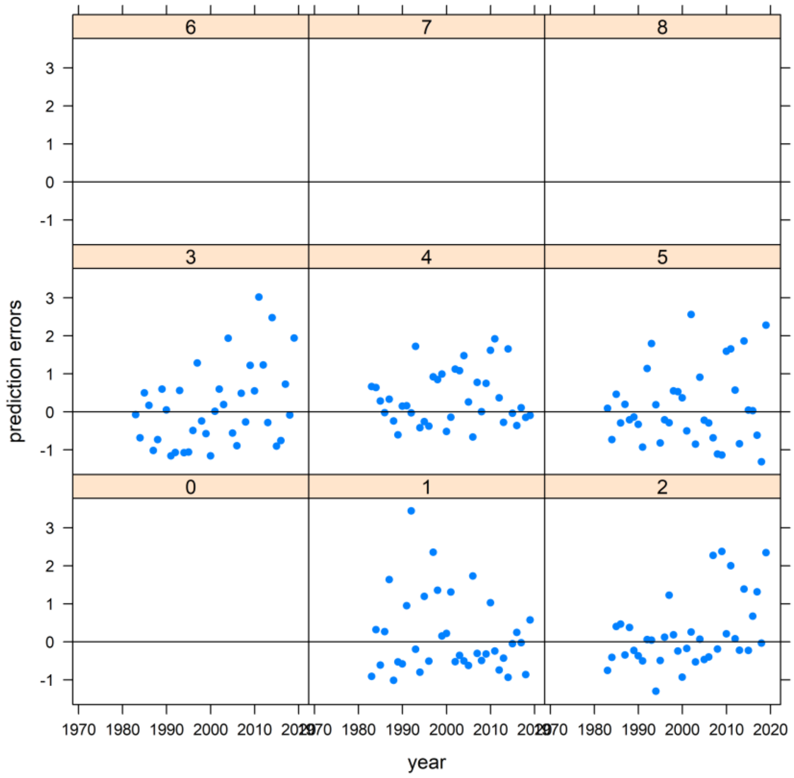


Figure 3: IBTS Q1 prediction errors for the initial model fit (no ad-hoc adjustments) using the new survey



indices dataset.

Figure 4: IBTS Q1 prediction errors for the final model fit (with ad-hoc adjustments) using the new survey indices dataset.

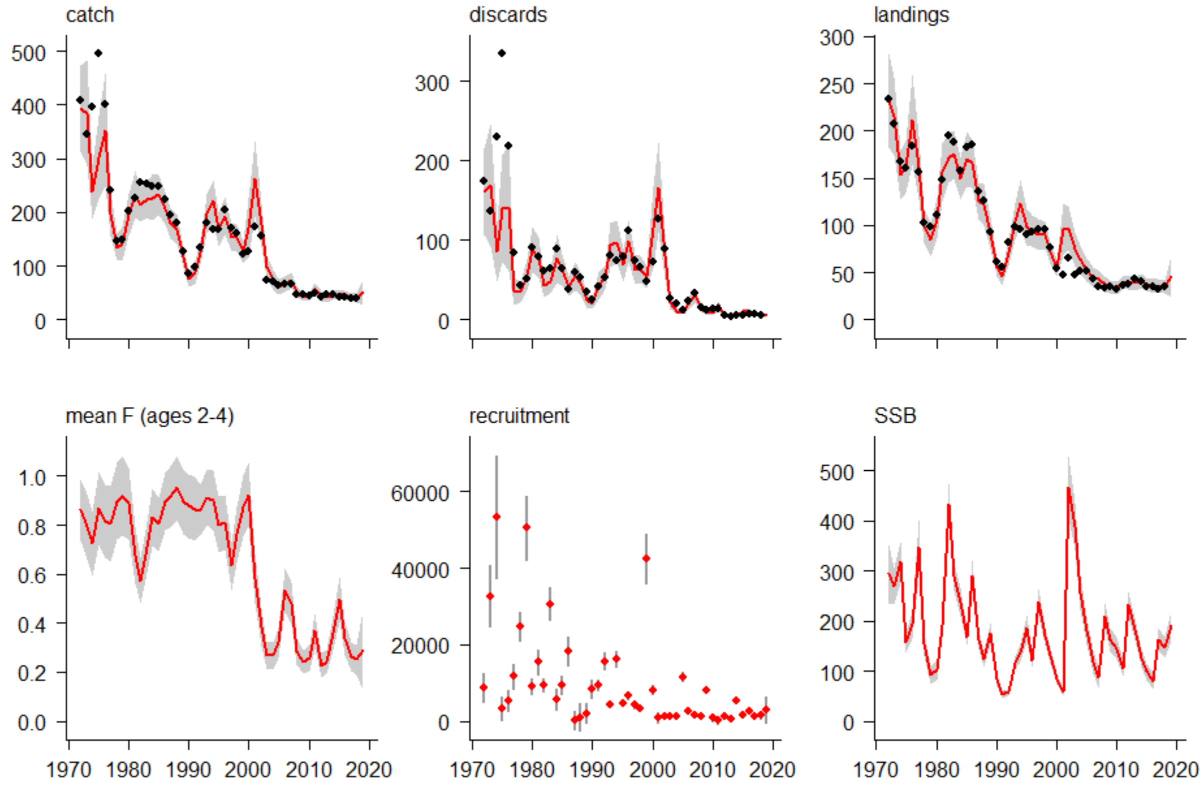


Figure 5: Summary of model fit results using the new IBTS indices dataset. Model estimates are shown in red, observations are showing in black. Grey shading or bars indicate the pointwise 95% confidence intervals.

Comparison with original assessment (WGNSSK 2019)

The new model fit has a larger -2*loglik (662.2872) compared to the WGNSSK 2019 model fit (613.6703) indicating a poorer fit.

A comparison of the model fits showed that the model results for IBTS Q1 and Q3 are very similar though the fit to observations is better for the WGNSSK 2019 fit (Figures 6 and 7). The largest differences in the estimate for Q1 are in the 1999 cohort at ages 1 and 2 where the new model fit estimate is lower than WGNSSK 2019 fit. This is also seen to some extent in the Q3 results. In addition, the new model fit gives a higher estimate in ages 4 and 5 in later years in Q3 compared to the WGNSSK 2019 fit. Only small differences are seen in the estimate of catch at age between the model fits though a substantial difference is seen in the plus group which is estimated to be lower in later years in the new model fit (Figure 8).

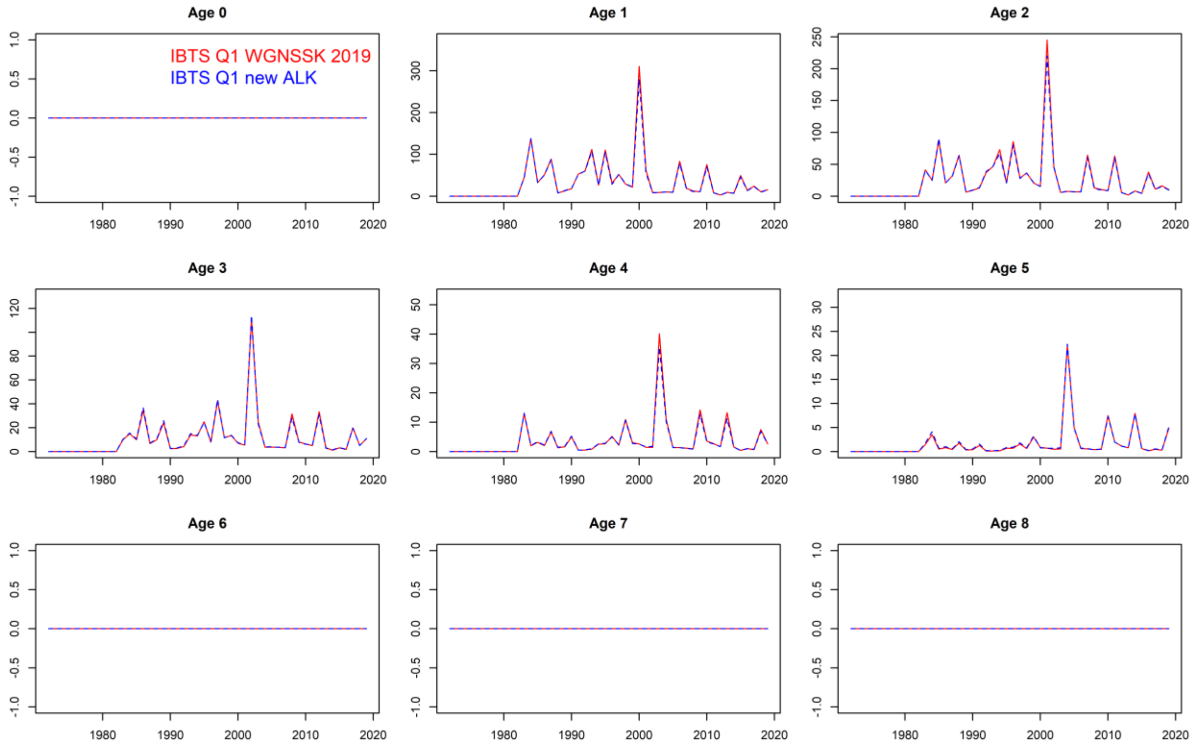


Figure 6: Comparison of IBTS Q1 estimate from the WGNSSK 2019 fit (red) and the new model fit (blue).

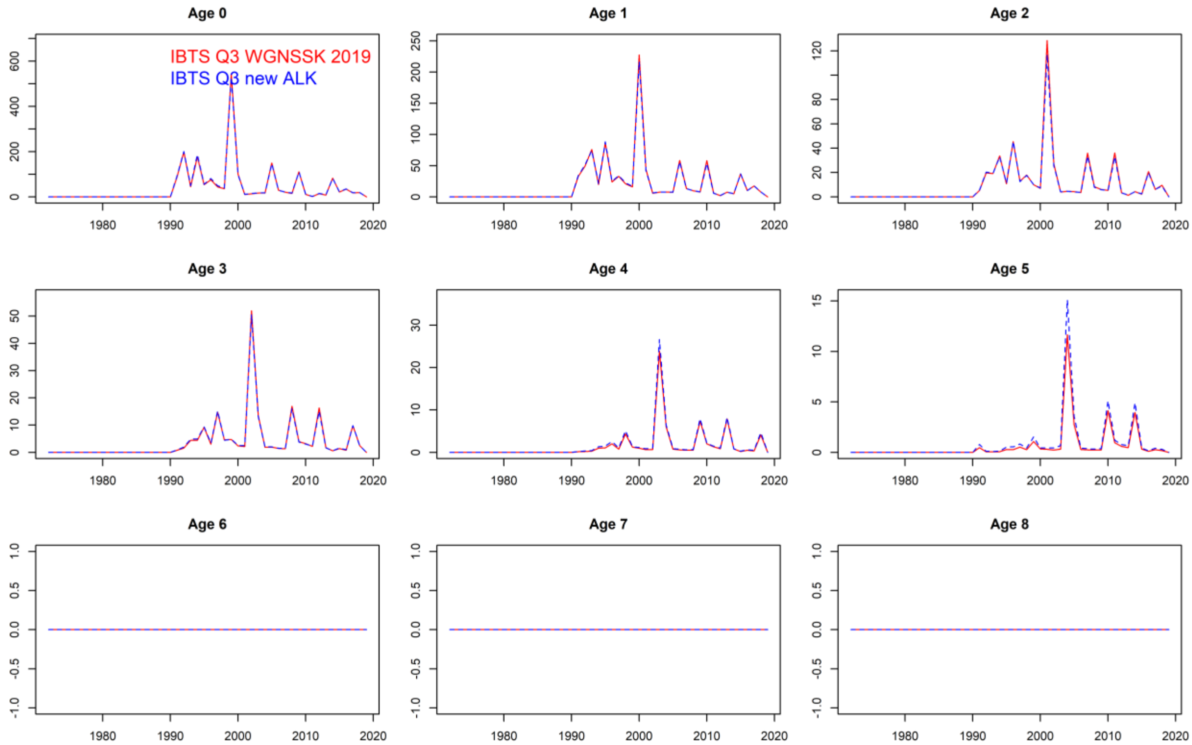


Figure 7: Comparison of IBTS Q3 estimate from the WGNSSK 2019 fit (red) and the new model fit (blue).

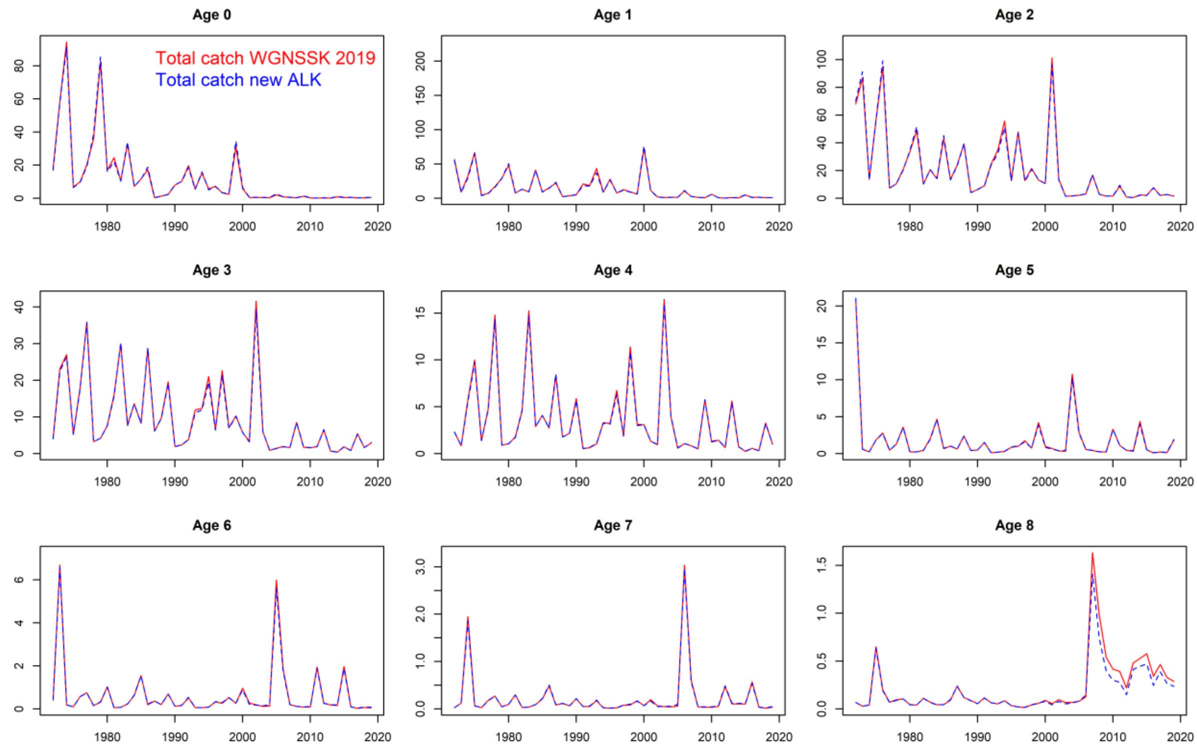


Figure 8: Comparison of catch at age estimate from the WGNSSK 2019 fit (red) and the new model fit (blue).

The estimate of stock n-at-age in the new model fit are lower in all ages except age 0 from the mid 1990s (Figures 9 and 10). The reduction is particularly noticeable in the plus group. Although there is overlap in the confidence intervals of the n-at-age estimates it is the larger year classes which are most likely to be significantly different in the new model fit which is an important finding given that these cohorts are the primary drivers of the stock. This is summarised in the comparison of spawning stock biomass (SSB) where the SSB is lower in the new model fit compared to WGNSSK 2019 fit. SSB is significantly lower after 2000 with little or no overlap in the confidence intervals (Figure 11). The reduction in SSB in the new model fit is approximately 20-30% of the WGNSSK 2019 fit. However, the estimate for mean F, catch and recruitment are very similar with substantial overlap in the confidence intervals though mean F is slightly higher in the new model fit (Figures 12-14).

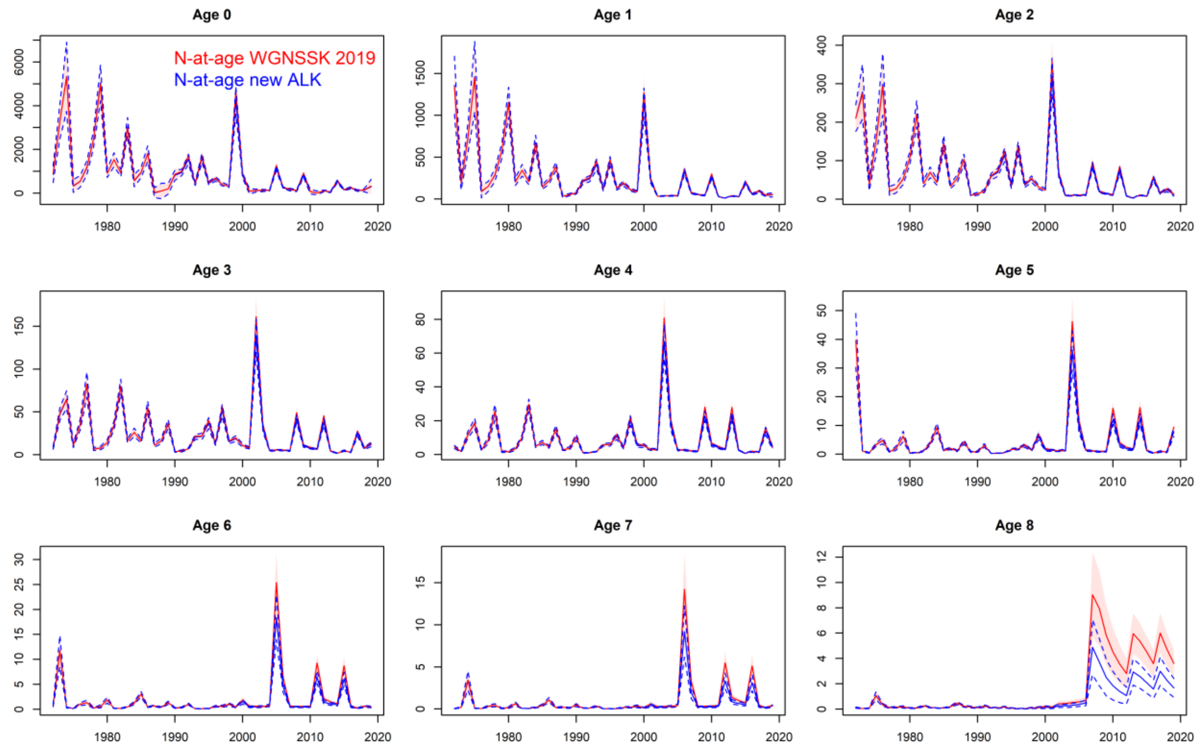


Figure 9: Comparison of stock n-at-age estimate from WGNSSK 2019 fit (red) and the new model fit (blue). Pink shaded areas and blue dashed lines represent the pointwise 95% confidence intervals.

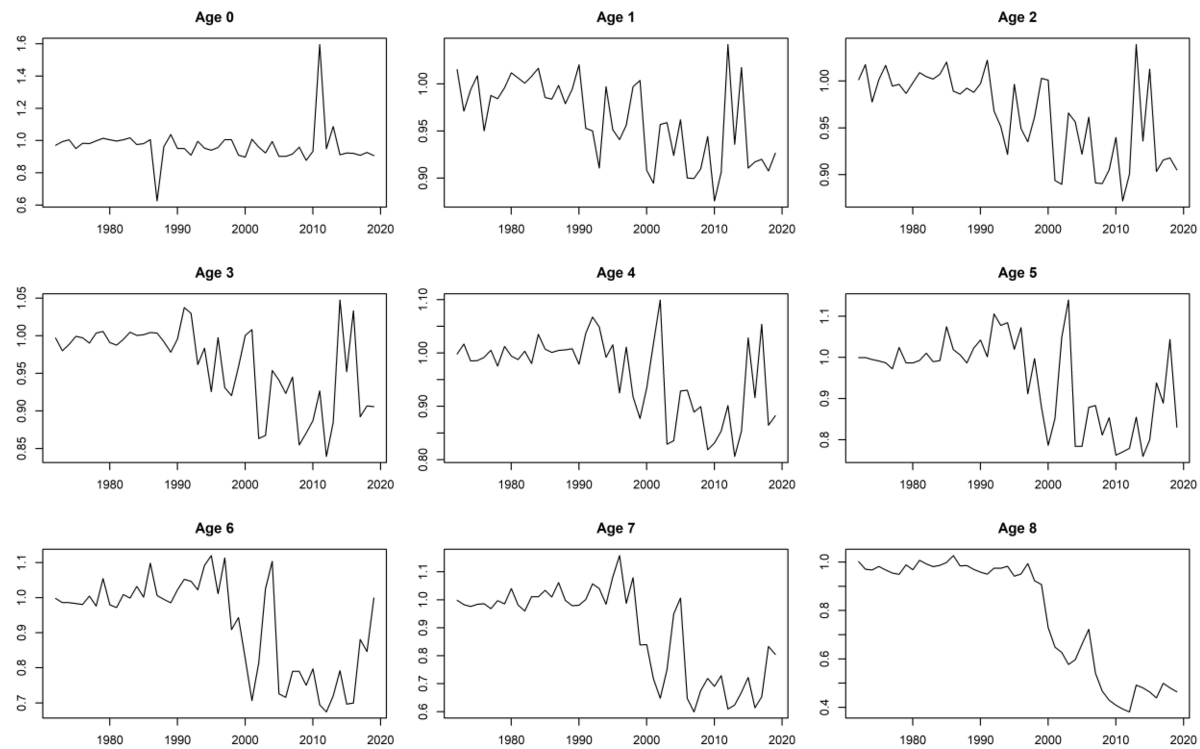


Figure 10: Ratio of stock n-at-age new model fit to WGNSSK 2019 fit.

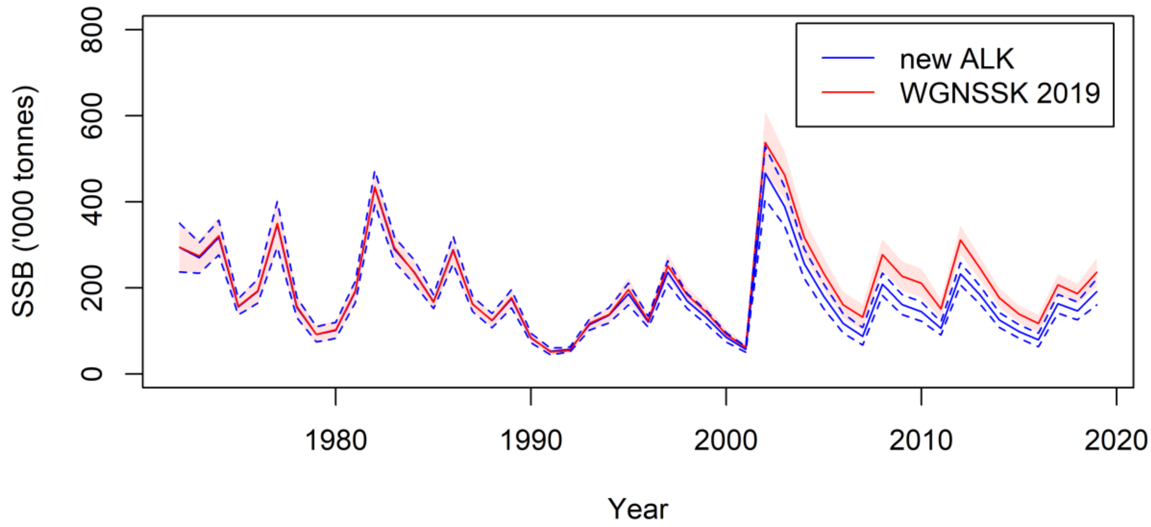


Figure 11: Comparison of SSB estimate from WGNSSK 2019 fit (red) and the new model fit (blue). The pink shaded region and blue dashed lines represent the pointwise 95% confidence intervals for the WGNSSK 2019 and new model fit respectively.

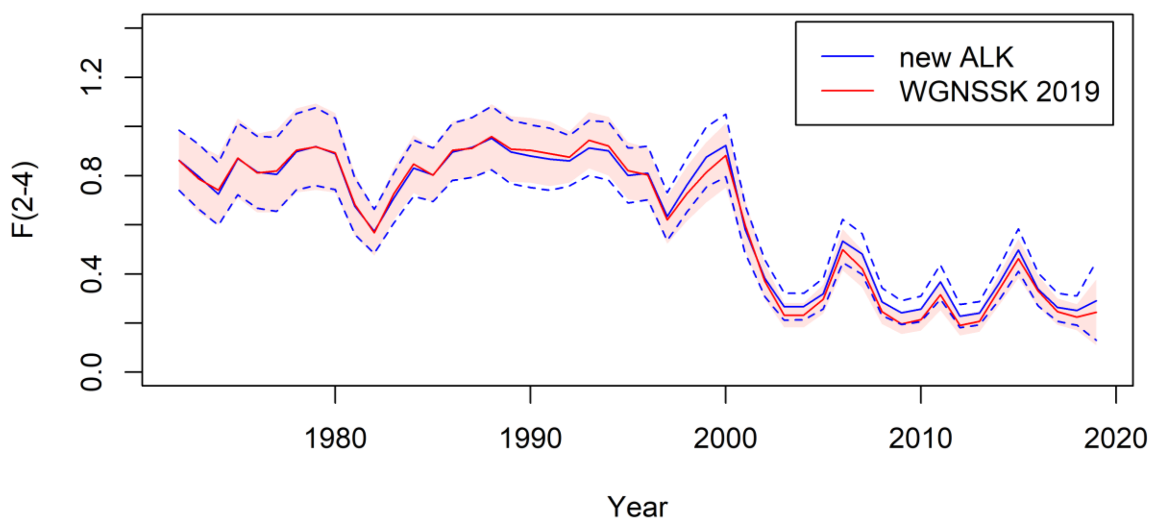


Figure 12: Comparison of mean F(2-4) estimate from WGNSSK 2019 fit (red) and the new model fit (blue). The pink shaded region and blue dashed lines represent the pointwise 95% confidence intervals for the WGNSSK 2019 and new model fit respectively.

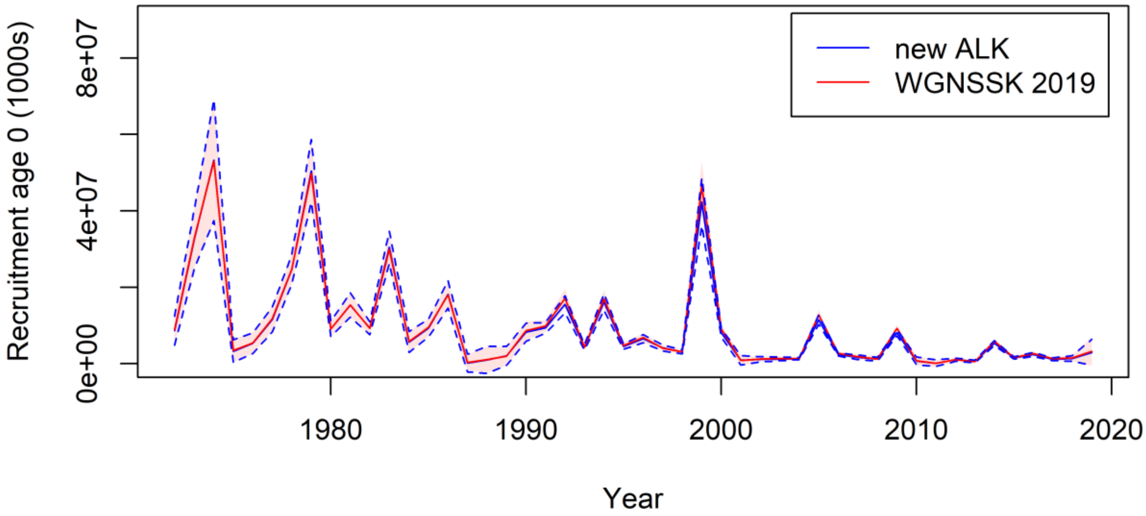


Figure 13: Comparison of recruitment estimate from WGNSSK 2019 fit (red) and the new model fit (blue). The pink shaded region and blue dashed lines represent the pointwise 95% confidence intervals for the WGNSSK 2019 and new model fit respectively.

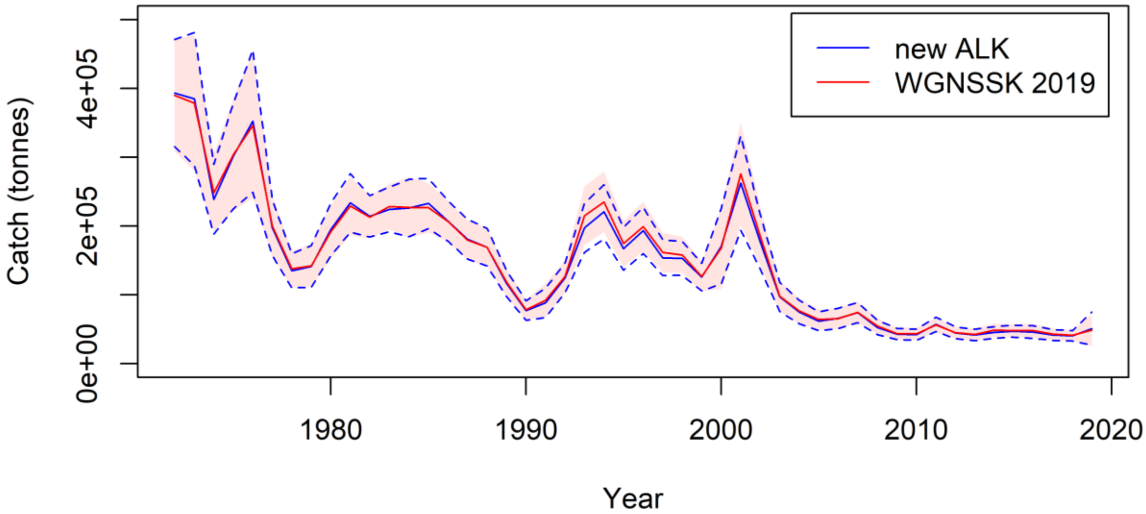


Figure 14: Comparison of total catch estimate from WGNSSK 2019 fit (red) and the new model fit (blue). The pink shaded region and blue dashed lines represent the pointwise 95% confidence intervals for the WGNSSK 2019 and new model fit respectively.

February 2020

Whiting in area 4 and subdivision 7d – 2020 DATRAS survey update

Tanja Miethe

Marine Scotland Science, Marine Laboratory, 375 Victoria Road, Aberdeen AB11 9DB, UK

With the new ALK substitution procedure, the DATRAS survey indices changed little for whiting in area Subarea 4 and Division 7d. In the SAM assessment, DATRAS survey data is included only for ages 1-5 from 1978 (Q1) and 0-5 from 1991 (Q3). Some differences can be found at age 5 (slide 2, 5), which lead to weaker age correlations between age 5 with other age groups in Quarter 1 (slide 7). Quarter 3 is less affected by the substitution procedure.

In comparison to the WGNSSK 2019 assessment (ICES, 2019a), the addition of an extra data year increased recruitment estimates and slightly lowered F estimates for the final years (slide 12). In comparison to the old substitution method, the new method suggests slightly lower recruitment and SSB around the year 2000, with fishing mortality left unaffected.

Overall, diagnostics of the SAM assessment with the new DATRAS survey data are acceptable and showed similar residual patterns as previous assessments (slides 14-15). Leave-one out runs (removing a survey) confirm a stronger effect of quarter 3 IBTS survey on the assessment estimates in comparison to quarter 1 (slide 16), as found in previous assessments. Retrospectives are acceptable (slide 17), and comparable to previous assessments.

Reference points were recalculated and compared to the last benchmark from 2018 (ICES, 2018). The spawning stock recruitment relationship remains a type 5, with B_{lim}= B_{loss}. The value of B_{lim} is similar to the values at the benchmark (slide 18). The survey update had only a minor effect on B_{lim} (125 387 instead of 119 970 tonnes). As in the benchmark F_{msy} is capped by F_{p05}. With addition of extra data years (2018, 2019) and the new substitution procedure, F_{msy} increased from the benchmark value of 0.172 to 0.227. The difference is mainly due to the extra data years rather than the new substitution procedure. The new data years led to higher estimated recruitment in the recent two years, affecting the EqSim results. The substitution procedure itself caused only a minor change in F_{msy} (from 0.219 to 0.227). Furthermore, management strategy evaluations for this stock in 2019 suggest that current MSY reference points and ranges may not be precautionary in the respective simulations under non-equilibrium conditions (ICES, 2019b).

It is therefore not recommended to update the current reference points for whiting (whg.27.47d) at this point. The DATRAS indices calculated using the new substitution method can be used in future assessments of whiting in 27.47d.

ICES 2018. Report of the Benchmark Workshop on North Sea Stocks (WKNSEA 2018), 5–9 February 2018, Copenhagen, Denmark. ICES CM 2018/ACOM:33, 634pp

ICES 2019a. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). ICES Scientific Reports, 1:7, 1271 pp. http://doi.org/10.17895/ices.pub.5402

ICES 2019b. WORKSHOP ON NORTH SEA STOCKS MANAGEMENT STRATEGY EVALUATION (WKNSMSE). ICES Scientific Reports, 1:12, 378 pp.http://doi.org/10.17895/ices.pub.5090