5 Northeast Arctic saithe

pok.27.1-2 – *Pollachius virens* in subareas 1 and 2

5.1 The fishery (Table 5.1 and Table 5.2, Figure 5.1)

Currently, the main fleets targeting saithe are trawl, purse-seine, gillnet, handline, and Danish seine. Landings of saithe were highest in 1970–1976 with an average of 239 000 t and a maximum of 265 000 t in 1970. This period was followed by a sharp decline to a level of about 160 000 t in the years 1978–1984, while in 1985 to 1991 the landings ranged from 67 000–123 000 t. After 1991 landings increased, ranging between 136 000 t (in 2000) and 212 000 t (in 2006), followed by a decline to 132 000 t in 2015. In 2021 landings were 188 176 t and assumed to be 205 672 t in 2022. Official Russian landings were not available at the time of the working group meeting, and the landing figure of 11 506 t for 2022, available from Norwegian parliamentary announcement 11 (Mel. St. 11) was used in the assessment. Russian landings of 70 t in the Svalbard Fisheries Protection Zone were not included.

Discarding, although illegal, occurs in the saithe fishery, but is not considered a major problem in the assessment. Due to its nearshore distribution saithe is virtually inaccessible for commercial gears during the first couple of years of life and there are no reports indicating overall high discard rates in the Norwegian fisheries. There are reported incidents of slipping in the purse-seine fishery, mainly related to minimum landing size. Observations from non-Norwegian commercial trawlers indicate that discarding may occur when vessels targeting other species catch saithe, for which they may not have a quota or have filled it. However, there are no quantitative estimates of the level of discarding available.

5.1.1 ICES advice applicable to 2022 and 2023

- The advice from ICES for 2022 was as follows: ICES advised that catches in 2022 should be no more than 197 212 t.
- The advice from ICES for 2023 was as follows: ICES advised that catches in 2023 should be no more than 226 794 t.

5.1.2 Management applicable in 2022 and 2023

Management of saithe in subareas 1 and 2 is by TAC and technical measures. For 2022, The Norwegian Ministry of Trade, Industry and Fisheries set the TAC according to the advice from ICES, i.e. 197 212 t.

For 2023, The Norwegian Ministry of Trade, Industry and Fisheries set the TAC according to the advice from ICES, i.e. 226 794 t.

5.1.3 The fishery in 2022 and expected landings in 2023

Provisional figures show that the landings in 2022 were assumed to be 205 672 t, which is 8460 t higher than the TAC of 197 212 t.

Since the WG does not have any prognosis of total landings in 2023 available, the TAC of 226 794 t is used in the projections.

5.2 Commercial catch-effort data and research vessel surveys

5.2.1 Catch-per-unit-effort

The NEA saithe interbenchmark protocol (IBP; ICES CM 2014/ACOM: 53) recommended leaving out the CPUE time-series in the model tuning (see section 5.3.5). A detailed description of the Norwegian trawl CPUE and its previous use is given in the Stock Annex.

5.2.2 Survey results (Figure 5.1–5.2)

An *ad hoc* subgroup of the AFWG was held to review proposed changes to several survey series using the new "StoX" survey computation methodology on 16 and 17 April 2017 at the JRC, Italy. The survey series reviewed included the coastal survey for saithe for the period 2003 to 2017. StoX is a new program developed at IMR Norway, to produce a more robust, transparent, and automated method of computing survey series. The method is currently used in ICES assessments (for example for NSS herring). For the saithe survey series, a WD was presented to the group (Mehl *et al*., 2018a), examining the differences between the previous survey series and those resulting from StoX in survey indices by age, as well as mean weight and mean length. During the meeting consistency plots were produced for each survey and showed to have a better fit with the StoX series compared to the old series. The meeting concluded that the new StoX survey series should be used to replace the previous survey series in AFWG stock assessment, but that once the assessment model is run the residuals and fits to the data should be examined to check for unexpected detrimental effects on model performance. The resulting SAM model fits using the old and the StoX survey series (using data for both survey series up to 2016, but excluding the 2003 StoX estimate, as this was considered abnormally high) were practically the same, without any detrimental effects on model performance.

The echo abundance observed in 2022 (Staby *et al*., in press) decreased by 18% compared to 2021 and was similar to the average for 2003–2021. The abundance estimated with StoX de-creased with 8% compared to 2021, which is the result of a decrease in estimates of 3 and 5-year-old saithe (respectively 29% and 53% lower than in 2021). Estimates 4-, 6- and 10+year old saithe were higher than the 2021 estimates. The proportion of saithe in the south-ern part of the survey area (south of the Lofoten islands between 620—67°N) increased from about 20% in 1997 to above 60% in 2008, decreased in later years and to approximately 20% until 2021, but increased sharply to above 40% in 2022 due to high abundances of 3 and 4 year old saithe in the most southern survey strata.

5.2.3 Recruitment indices

Owing to the nearshore distribution of juvenile saithe, obtaining early estimates of recruitment for ages 0–2 has not been possible so far. The survey recruitment indices are strongly dependent on the extent to which 2–4 year old saithe have migrated from the coastal areas and become available to the acoustic saithe survey on the banks, and this varies between years. Also, observations from an observer programme, established in 2000 to start a 0-group index series (Borge and Mehl, WD 21 2002) did not seem to reflect the dynamics in year-class strength very well. (Mehl, WD 6 2007; Mehl, WD 7 to WKROUND 2010). The programme was consequently terminated in 2010.

5.3 Data used in the assessment

5.3.1 Catch numbers-at-age (Table 5.3)

Total Norwegian landings by gear and landings data for all other countries from 2022 were updated based on the official total catch (preliminary) reported to ICES or to Norwegian authorities.

Age composition data for 2022 were available for Norwegian and German landings. Despite lacking coverage of catches by the purse-seine fishery in some areas, the biological sampling of all remaining gear groups, areas, and quarters was sufficient to produce a reliable catch-at-age matrix for 2022. Unlike in previous years age data from the Danish seine was not combined with biological samples from the bottom-trawl fishery data.

Catch-at-age estimates (numbers and mean weight and length-at-age) for the Norwegian catches were produced with StoX- Reca (version 3.7.0–9001) for the 2022 assessment[1]. Comparative runs with the older ECA program for the 2021 data produced near identical catch-at-age numbers. This is the second year that catch-at-age estimates are produced with StoX-Reca for input in the SAM assessment. In previous years catch-at-age was estimated manually, and until 2020 with ECA. Total catch-at-age and average weight-at-age was calculated separately in excel, using catch-at-age proportions from the Norwegian bottom-trawl fishery to split Russian and non-Norwegian catches by age.

5.3.2 Weight-at-age (Table 5.4)

Constant weights-at-age values for age groups 3–11 are used for the period 1960–1979, whereas estimated values for the 12+ group vary during this period. For subsequent years, annual estimates of weight-at-age in the catches are used. Weight-at-age in the stock is assumed to be the same as weight-at-age in the catch. Compared to 2021, estimated weight-at-age for age groups 3–12+ differed only slightly in 2022, with a slight increase in weights for 3-year-old saithe.

5.3.3 Natural mortality

A fixed natural mortality of 0.2 for all age groups was used both in the assessment and the forecast.

5.3.4 Maturity-at-age (Table 5.5)

A 3-year running average is used for the period from 1985 and onwards (2-year average for the first and last year). Inconsistencies between proportion mature fish and trends in SSB and recruitment since 2008 resulted in the NEA saithe IBP to recommend the use of a constant maturity ogive for the years from 2007 and onwards based on the average 2005–2007 (ICES CM 2014/ACOM: 53). Analysis are currently being done to investigate which method, i.e. macroscopic determination, otolith spawning rings or histological analysis, is the most reliable to determine the maturity stage.

[1] https://github.com/StoXProject/RstoxFDA/

5.3.5 Tuning data (Table 5.6)

Until the 2005 WG, the XSA tuning was based on three dataseries: CPUE from Norwegian purse-seine and Norwegian trawl and indices from a Norwegian acoustic survey. The 2005 WG found rather large and variable log q residuals and large S.E. log q for the purse-seine fleet, as well as strong year effects, and in the combined tuning the fleet got low scaled weights. The WG decided not to include the purse-seine tuning fleet in the analysis. This was confirmed by new analyses at the 2010 benchmark assessment (ICES CM 2010/ACOM:36). The trawl CPUE series on the other hand did not show the trends in stock size abundance of NEA saithe in later years. In the more recent years there were signs of changes in fishing strategy, with fewer and shorter fishing periods and a smaller proportion of directed saithe fishery (Mehl and Fotland, WD 20 2013).

Analyses of the two remaining tuning series done at the 2010 benchmark assessment indicated that there had been a shift in catchability around year 2002. The survey was redesigned in 2003, and the fishery to a larger degree targeted older ages. Permanent breaks were made in both tuning series in 2002. The acoustic survey, compared with the trawl CPUE time-series, seemed to track the stock changes better, both in abundance and distribution.

The sensitivity runs presented to the IBP (Fotland WD 30 2014 IBP NEA saithe) clearly showed that the residual pattern got worse (strong year effects) when using both tuning series in SAM. It became obvious that SAM tries to fit something in between both contradicting data sources. Therefore, it had to be decided whether one data source was more reliable or whether both data sources should be considered leading to a fit in between both extremes. Given that CPUE series should not be used when larger changes in fishing patterns occur (selectivity, spatial distribution of the fleet, change between targeted and bycatch fishery) it was recommended to leave out the CPUE time-series in its current form for now (ICES CM 2014/ACOM: 53). Another reason was that the proportion of catches covered by the index had decreased steadily between 2002 and 2011, further questioning the representativeness of the CPUE index. However, it may be worth trying alternative CPUE indices (e.g. one index for the targeted fishery only and one index for the fishery with saithe bycatches) until the next benchmark.
The following two tuning fleets are thus used in the present assessment (by the time this report was written the new ICES name for this survey was not available)

- NOcoast-Aco-4Q: Indices from the Norwegian acoustic survey 1994–2001, age groups 3 to 7.
- NOcoast-Aco-4Q: Indices from the Norwegian acoustic survey 2002–2022, age groups 3 to 7.

5.4 SAM runs and settings (Table 5.7)

In connection with the NEA saithe IBP a number of exploratory SAM runs were performed. Model settings and results are presented in working documents included in the IBP report (ICES CM 2014/ACOM: 53).

SAM model settings and configuration in 2023 were the same as in previous simulations.

- Tuning data: Acoustic survey series (age 3–7) only, time-series split (1994–2001 and 2002–present);
- Maturity data: Ogives for the years 2007 and later based on the average of the 2005–2007 data;
- Flat exploitation pattern for age groups 8+;
- Correlated Fs between age groups and time;
- Beverton–Holt stock–recruitment relationship used to estimate recent recruitment.

5.5 Final assessment run (Table 5.8 to Table 5.11, Figure 5.3–5.6)

The state–space assessment model (SAM) was used for the final run. SAM catchabilities and negative log likelihood values are given in Table 5.8.

Figure 5.3 presents normalized residuals for the total catches and the two parts of the acoustic tuning series. There are both year- and age effects and the second part of the series seems to perform better than the first part. Figure 5.4 shows plots of the stock numbers from the SAM vs. tuning indices.

5.5.1 SAM F, N, and SSB results (Tables 5.9–5.11, Figures 5.5–5.6)

The estimated fishing mortality ($F_{4–7}$) in 2021 was 0.186 (AFWG 2022), which is lower than 0.193 from this year's assessment and below the F_{pa} of 0.35. The fishing mortality ($F_{4–7}$) in 2022 was estimated at 0.2. From 1997 to 2009 fishing mortality was below F_{pa}, but started to increase in 2005 and was above F_{pa} in 2010–2012.

Fishing mortality and stock size have in the last decade generally been considerably over- and underestimated respectively. Due to the changes made to the assessment following the benchmark assessment workshop in 2010 (ICES CM 2010/ACOM: 36) and later the NEA saithe IBP in 2014 (ICES CM 2014/ACOM: 53), the retrospective patterns have improved considerably, as is illustrated in Figure 5.6. Based on the 2022 assessment the SSB has in recent years been both slightly over and underestimated while $F_{4–7}$ has been generally overestimated.

The SAM-estimate of the 2014 year class was considered to be reliable enough to be used in the projections. In previous assessments the value of the 3-year olds in the last data year has been set to the long-term geometrical mean, and the value of the year class at age 4 were obtained by applying Pope's approximation. Since 2007 the 2007, 2010, 2013, and 2016 year classes have been above the long-term geometric mean, while in the other years, year-class strength has been considered average or below.

The total biomass (ages 3+) was above the long-term (1960–2021) average from 1997 to 2008, reached a local maximum in 2005, and declined below the average level between 2011 and 2015. Since 2016 it has been above the long-term average, and in 2022 was estimated at > 1 163 597 tonnes, the highest estimate in the time-series. The SSB was above the long-term mean from 2000 to 2009, decreased below the average between 2010 to 2013, and has been above the long-term average since 2014. SSB has been above B_{pa} (220 000 t) since 1996 (Figure 5.5).

5.5.2 Recruitment (Table 5.10, Figure 5.5)

The estimated numbers of age group 3 have varied considerably during the period 2004–2022 (Table 5.10). Until the 2005 WG, RCT3-runs were conducted to estimate the corresponding year classes, with 2 and 3 year olds from the acoustic survey as input together with XSA numbers. However, it was stated several times in the ACOM Technical Minutes that it would be more transparent to use the long-term geometric mean (GM) recruitment. GM values were therefore used in the 2005–2014 since the issue was not discussed at the IBP when SAM was adopted as assessment model. During the 2015 AFWG assessment, analyses were performed to investigate if the last year recruitment value from SAM could be used instead of the long-term GM (for method description refer to Stock Annex). Results from this analysis showed that the retrospective runs of SAM gave better estimates of recruitment than the geometric mean and consequently estimates of the recruiting year class (3-year-olds in the last data year) from the SAM were accepted for the last year.

5.6 Reference points (Figure 5.5)

In 2010 the age span was expanded from 11+ to 15+ and important XSA parameter settings were changed (ICES CM 2010/ACOM: 36). LIM reference points were re-estimated at the 2010 WG according to the methodology outlined in ICES CM 2003/ACFM: 15, while the PA reference point estimation was based on the old procedure (ICES CM 1998/ACFM: 10). The results were not very much different from the previous analyses performed in 2005 (ICES CM 2005/ACFM: 20), and it was decided not to change the existing LIM and PA reference points. The shift from XSA to SAM resulted in only minor changes in estimated fishing mortality, spawning-stock-biomass and recruitment and no new reference points were estimated. Reference points were estimated as: B_{lim} = 136 000 t, B_{pa} = 220 000 t, F_{MP} = 0.32 F_{lim} = 0.58, and F_{pa} = 0.35.

5.6.1 Harvest control rule

In 2007 ICES evaluated the harvest control rule for setting the annual fishing quota (TAC) for Northeast Arctic saithe. ICES concluded that the HCR was consistent with the precautionary approach for all simulated data and settings, including a rebuilding situation under the condition that the assessment uncertainty and error are not greater than those calculated from historic data. This also held true when an implementation error (difference between TAC and catch) equal to the historic level was included. The HCR was implemented the same year. It contains the following elements:

- Estimate the average TAC level for the coming 3 years based on F_{mp}. TAC for the next year will be set to this level as a starting value for the 3-year period.
- The year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development. However, the TAC should not be changed by more than 15% compared with the previous year's TAC.
- If the spawning-stock-biomass (SSB) at the beginning of the year for which the quota is set (first year of prediction), is below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{mp} at SSB = B_{pa} to 0 at SSB equal to zero. At SSB levels below B_{pa} in any of the operational years (current year and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC.

In 2011 the evaluation was repeated taking into account the changes made to the assessment after the 2010 benchmark assessment (ICES CM 2010/ACOM: 36). The analyses indicate that the HCR still is in agreement with the precautionary approach (Mehl and Fotland, WD 11 2011).

The fishing mortality used in the harvest control rule (F_{mp}) was in 2007 set to F_{pa} = 0.35. In June 2013, after the ICES advice for 2014 for this stock had been given, F_{mp} was reduced to 0.32.

5.7 Predictions

5.7.1 Input data (Table 5.12)

The input data to the predictions based on results from the final model run are given in Table 5.12. The estimates for stock number-at-age in 2022 were taken from the final SAM run for ages 4+. The geometric mean (GM) for recruitment (age 3) of 161 475 thousand was used in 2023 and subsequent year classes. The natural mortality of 0.2 is the same as used in the assessment. For exploitation pattern the average of the 2020–2022 fishing mortalities estimated in the final SAM run for ages 3 to 12 was used, with mortalities for 8+ being constant. For weight-at-age in stock and catch the average of the last three years (2020–2022) from SAM input file was used. For maturity-at-age the average of the 2005–2007 annual ogives was applied.

5.7.2 Catch options for 2023 (short-term predictions; Tables 5.13–14)

The management option table (Table 5.13) shows that the expected landings of 226 794 t in 2023 will result in a fishing an adjusted mortality F_{bar} of 0.242, which is higher compared to 2022 of 0.207, but well below the F_{pa} of 0.35. A catch in 2024 corresponding to the $F_{status\ quo}$ level of 0.242 will be 203 835 t, while a catch in 2024 corresponding to the evaluated and implemented HCR of 223 123 t will result in F of 0.269 (Table 5.14).

For a catch in 2023 corresponding to the TAC of 226 794 t, the SSB is expected to decrease from about 727 666 t at the beginning of 2023 to 686 937 t at the beginning of 2024. At $F_{status\ quo}$ in 2023 SSB is estimated to decrease to 55 327 t at the beginning of 2025 and for a catch corresponding to the HCR it will decrease to about 557 261 t in 2025.

5.7.3 Comparison of the present and last year's assessment

The current assessment estimated the total stock in 2023 to be 5% higher and the SSB 1% lower compared to the previous assessment. The F in 2021 from the current assessment is higher than the F from the previous assessment, and the realized F in 2022 is lower compared to the predicted one in 2022 based on the TAC.

	Total stock (3+) by 1 January 2022 (tonnes)	SSB by 1 January 2022 (tonnes)	F4–7 in 2022	F4–7 in 2021
WG 2022	1103920	748913	0.207	0.186
WG 2023	1163597	741480	0.2	0.193

5.8 Comments to the assessment and the forecast (Fig. 5.6)

A statistical model is less sensitive to +group setting than XSA. In addition, the results from XSA were more dependent on the input data (use or no use of CPUE, split of the tuning survey time-series), the shrinkage parameter and whether the number of iterations is capped or not. XSA only converged at a large number of iterations. In contrast, results from SAM are much more robust and depend to a lesser degree on subjective choice of model settings (such as shrinkage). In addition, SAM as a stochastic model is not treating catches as known without error. The fishing mortality rates could be considered correlated in time, and to reflect that neighbouring age groups have more similar fishing mortalities.

The retrospective pattern has been a major concern in the assessment, but due to the changes done at the benchmark assessment in 2010 (ICES CM 2010/ACOM: 36) and later at the NEA saithe IBP in 2014 (ICES CM 2014/ACOM: 53), the assessment has become stable (Figure 5.6)

The biological sampling from the fishery got critically low after the termination of the original Norwegian port-sampling program in 2009. In 2015 this was in particular the case for samples from trawl in quarter two and three in ICES area 1 and age samples from purse-seine fishery south of Lofoten (ICES area 2.a). In 2022 biological sampling from the saithe purse-seine fishery catches in Norwegian waters was adequate, but lacked sampling in some areas in quarter 2

Lack of reliable recruitment estimates is a major problem. Prediction of catches will still, to a large extent, be dependent on assumptions of average recruitment in the intermediate year and the forecast period, since fish from age four to seven constitute major parts of the catches. Since the saithe HCR is a three-year-rule, the estimation of average F_{mp} catch in the HCR will affect stock numbers up to age five, and thereby affect the total prognosis of the fishable stock and the quotas derived from it. The recruitment-at-age 3 estimated by the SAM has on average been at about the long-term geometric mean level since 2005.

5.9 Tables and figures

Table 5.1. Saithe in subareas 1 and 2 (Northeast Arctic). Nominal catch (t) by countries as officially reported to ICES.

Year	Faroe Islands	France	Germany (Dem Rep)	Germany (Fed Rep)	Iceland	Norway	Poland	Portugal	Russia[3]	Spain	UK	Others[5]	Total: all countries
1960	23	1700		25 948		96050					9780	14	133515
1961	61	3625		19757		77875					4615	18	105951
1962	2	544		12651		101895			912		4699	4	120707
1963		1110		8108		135297					4112		148627
1964		1525		4420		184700			84		6511	186	197426
1965		1618		11387		165531			137		6746	181	185600
1966		2987	813	11269		175037			563		13078	41	203788
1967		9472	304	11822		150860			441		8379	48	181326
1968			1248	4753		96641					8782		111424
1969	20	193	6744	4355		115140					13585	23	140060
1970	1097		29200	23466		151759			43550		15690		264924
1971	215	14536	16840	12204		128499	6017		39397	13097	10467		241272
1972	109	14519	7474	24595		143775	1111		1278	9247	8348		210456
1973	7	11320	12015	30338		148789	23		2411	2115	6841		213859
1974	46	7119	29466	33155		152699	2521		28931	7075	3104	5	264121
1975	28	3156	28517	41260		122598	3860	6430	13389	11397	2763	55	233453

Year	Faroe Islands	France	Germany (Dem Rep)	Germany (Fed Rep)	Iceland	Norway	Poland	Portugal	Russia[3]	Spain	UK	Others[5]	Total: all countries
1976	20	5609	10266	49056		131675	3164	7233	9013	21661	4724	65	242486
1977	270	5658	7164	19985		139705	1	783	989	1327	6935		182817
1978	809	4345	6484	19190		121069	35	203	381	121	2827		155464
1979	1117	2601	2435	15323		141346			3	685	1170		164680
1980	532	1016		12511		128878			43	780	794		144554
1981	236	218		8431		166139			121		395		175540
1982	339	82		7224		159643			14		732		168034
1983	539	418		4933		149556			206	33	1251		156936
1984	503	431	6	4532		152818			161		335		158786
1985	490	657	11	1873		103899			51		202		107183
1986	426	308		3470		63090			27		75		67396
1987	712	576		4909		85710			426		57	1	92391
1988	441	411		4574		108244			130		442		114242
1989	388	460[2]		606		119625			506	506	726		122817
1990	1207	340[2]		1143		92397			52		709		95848
1991	963	77[2]	**Greenland**	2003		103283			504 [4]		492	5	107327
1992	165	1980	734	3451		119763			964	6	541		127604
1993	31	566	78	3687	3	140604		1	9509	4 [2]	415	5	154903

Year	Faroe Islands	France	Germany (Dem Rep)	Germany (Fed Rep)	Iceland	Norway	Poland	Portugal	Russia[3]	Spain	UK	Others[5]	Total: all countries
1994	67 [2]	557	15	1863	4 [2]	141589		1 [2]	1640 [2]	655 [2]	557	2	146950
1995	172 [2]	358	53	935		165001		5	1148		688	18	168378
1996	248 [2]	346	165	2615		166045		24	1159	6	707	33	171348
1997	193[2]	560	363[2]	2915		136927		12	1774	41	799	45	143629
1998	366	932	437[2]	2936		144103		47	3836	275	355	40	153327
1999	181	638 [2]	655[2]	2473	146	141941		17	3929	24	339	32	150375
2000	224[2]	1438	651[2]	2573	33	125932		46	4452	117	454	8 [2]	135928
2001	537	1279	701[2]	2690	57	124928		75	4951	119	514	2	135853
2002	788	1048	1393	2642	78	142941		118	5402	37	420	3	154870
2003	2056	1022	929[2]	2763	80 [2]	150400		147	3894	18	265	18 [2]	161592
2004	3071	255	891[2]	2161	319	147975		127	9192	87	544	14	164636
2005	3152	447	817[2]	2048	395	162338		354	8362	25	630		178568
2006	1795	899.7	779[2]	2780	255	195462	88.9	101	9823	0	532	42	212557
2007	2048	965.6	801[2]	3019	219	178644	99.3	412	12168	22	557	11.8	198967
2008	2405	1008.6	513[2]	2264	113	165998	65.8	348	11577	33	506	9.7	184840
2009	1611	378.6	697	2021	69	144570	30.6	184.01	11899	2	379	24	161865
2010	1632	677.2	954	1592	124	175246	278.9	93	14664	8	283	2.5	195554
2011	306	504.2	445	1371	66	143314	0	45.34	10007	2	972	15.14	157048

Year	Faroe Islands	France	Germany (Dem Rep)	Germany (Fed Rep)	Iceland	Norway	Poland	Portugal	Russia[3]	Spain	UK	Others[5]	Total: all countries
2012	146	780.55	658	1371	126	143174	0	7.65	13607	4	1087	0	160960
2013	80	1900.92	972	1212	245	111961	2.21	17.24	14796	5	415	21.93	131629
2014	273	1674	407	259	659	115864	0.86	8.25	12396	12	518	0	132070
2015	766	515	393	424	248	115157	1143	10.42	13181	34	403	0	132275
2016	1148	526	613	952	702	121705	530	52	15203	26	301	10	141768
2017 [1]	639	680	407	865	589	126947	504	86	14551	88	439	24	145819
2018	626	937	448	1642		162460	404	51	14171	60	464	17	181280
2019	618	1472	424	1371		144076	46	131	13990	199	419	434	163180
2020		530	410	1544		151697	1.2	132	14082	0	517	118	169405
2021	573	684	449	600	148	171836	0.3	21	13836	3	2	23	188176
2022	570	764	425	485	318	191 305		104	11 506	25	32	138	205673

1 Provisional figures.

2 As reported to Norwegian authorities.

3 USSR prior to 1991.

4 Includes Estonia.

5 Includes Denmark. Netherlands. Ireland. and Sweden.

6 As reported by Working Group member.

Table 5.2 Saithe in subareas 1 and 2 (Northeast Arctic). Catch (´000) by fishing gear.

Year	Purse-seine	Trawl	Gillnet	Others	Total
1977	75.2	69.5	19.3	12.7	176.7
1978	62.9	57.6	21.1	13.9	155.5
1979	74.7	52.5	21.6	15.9	164.7
1980	61.3	46.8	21.1	15.4	144.6
1981	64.3	72.4	24.0	14.8	175.5
1982	76.4	59.4	16.7	15.5	168.0
1983	54.1	68.2	19.6	15.0	156.9
1984	36.4	85.6	23.7	13.1	158.8
1985	31.1	49.9	14.6	11.6	107.2
1986	7.9	36.2	12.3	8.2	64.6
1987	34.9	27.7	19.0	10.8	92.4
1988	43.5	45.4	15.3	10.0	114.2
1989	49.5	45.0	16.9	11.4	122.8
1990	24.6	44.0	19.3	7.9	95.8
1991	38.9	40.1	18.9	9.4	107.3
1992	27.1	67.0	22.3	11.2	127.6
1993	33.1	84.9	21.2	15.7	154.9
1994	30.2	82.2	21.1	13.5	147.0
1995	21.8	103.5	26.9	16.1	168.4
1996	46.9	72.5	31.6	20.3	171.3
1997	44.4	55.9	24.4	19.0	143.6
1998	44.4	57.7	27.6	23.6	153.3
1999	39.2	57.9	29.7	23.6	150.4
2000	28.3	54.5	29.6	23.5	135.9
2001	28.1	58.1	28.2	21.5	135.9
2002	27.4	75.5	30.4	21.5	154.8
2003	43.3	73.8	25.2	19.3	161.6
2004	41.8	74.6	26.9	21.3	164.6

Year	Purse-seine	Trawl	Gillnet	Others	Total
2005	42.1	91.8	25.6	19.1	178.6
2006	73.5	87.1	29.7	22.5	212.8
2007	41.8	100.7	33.3	23.2	199.0
2008	39.4	91.2	37.0	17.1	184.7
2009	35.5	81.1	33.2	12.1	161.9
2010	54.9	89.8	36.9	13.2	194.8
2011	45.3	67.1	32.1	12.2	156.7
2012	44.2	73.9	28.3	14.5	160.9
2013	34.7	65.2	19.2	12.7	131.8
2014	29.3	54.8	26.7	21.2	132.0
2015	30.4	55.4	23.5	22.5	131.8
2016	28.9	64.1	21.4	26.9	141.3
2017[1]	32.4	65.0	21.4	27.3	146.1
2018	36.0	83.6	28.8	33.2	181.5
2019	28.7	68.6	29.4	36.6	163.1
2020	26.8	74	30.3	38.3	169.4
2021	30.9	81.6	29.5	46	188
2022	41.8	88.5	31.5	43.9	205.7

[1] **Provisional figures.**

[2] **Unresolved discrepancies between Norwegian catch by gear figures and the total reported to ICES for these years.**

[3] **Includes 4300 tonnes not categorized by gear. proportionally adjusted.**

[4] **Reduced by 1200 tonnes not categorized by gear. proportionally adjusted.**

Table 5.3 Catch numbers-at-age ('000) of northeast Arctic saithe.

	Age groups									
Year	3	4	5	6	7	8	9	10	11	12+
1960	13517	16828	17422	6514	6281	3088	1691	956	481	1481
1961	25237	12929	17707	5379	1886	1371	736	573	538	1202
1962	45932	13720	5449	10218	2991	1262	1156	556	611	1518
1963	51171	35199	7165	5659	4699	1337	1308	848	550	1612
1964	10925	72344	15966	3299	4214	3223	1518	1482	1282	3038

	Age groups									
Year	3	4	5	6	7	8	9	10	11	12+
1965	42578	5737	30171	11635	3282	2421	3135	802	1136	2986
1966	25127	61199	14727	14475	5220	1542	1047	1083	530	2724
1967	28457	23826	34493	3957	5388	2797	1356	1340	814	2536
1968	29955	21856	6065	9846	936	2274	1070	686	465	922
1969	76011	11745	16650	4666	4716	1107	1682	663	199	303
1970	43834	63270	14081	16298	5157	8004	2521	3722	1103	1714
1971	61743	47522	21614	7661	7690	2326	3489	1760	2514	1888
1972	55351	44490	24752	8650	4769	3012	1584	1817	1044	1631
1973	62938	20793	22199	13224	5868	3246	2368	2153	1291	1947
1974	36884	44149	15714	20476	12182	4815	3267	2512	1440	2392
1975	70255	13502	18901	5123	9018	7841	3365	2714	2237	2544
1976	135592	33159	8618	9448	3725	3483	2905	1870	1183	1940
1977	105935	36703	10845	2205	4633	1557	1718	1030	495	718
1978	56505	31946	14396	5232	1694	2132	1082	1126	756	1726
1979	75819	28545	17280	5384	3550	1178	1659	536	373	1086
1980	40303	36202	9100	6302	3161	1322	145	721	406	1204
1981	85966	22345	22044	3706	2611	2056	378	286	258	385
1982	35853	67150	13481	8477	1088	1291	476	271	124	338
1983	18216	25108	34543	3408	3178	1243	803	261	215	587
1984	43579	34927	12679	11775	1193	1862	589	585	407	537
1985	48989	11992	7200	5287	3746	776	879	134	274	427
1986	21322	12433	5845	4363	2704	1349	338	438	123	152
1987	18555	51742	4506	3238	3624	784	644	267	263	565
1988	8144	35928	32901	4570	2333	1222	968	321	73	30
1989	12607	19400	33343	18578	1762	352	177	189	1	205
1990	23792	16930	9054	10238	7341	1076	160	112	150	118
1991	68682	13630	5752	4883	3877	2381	383	61	90	89
1992	44627	33294	5987	5412	4751	3176	1462	286	93	350

	Age groups									
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1993	22812	61931	31102	3747	1759	1378	1027	797	76	71
1994	7063	32671	49410	19058	2058	724	421	278	528	129
1995	17178	52109	40145	30451	4177	483	125	259	31	263
1996	10510	54886	18499	18357	17834	2849	485	214	148	325
1997	11789	11698	35011	13567	13452	7058	812	55	48	98
1998	3091	16215	11946	31818	8376	5539	2873	727	111	282
1999	9655	12236	22872	10347	18930	3374	3343	2290	419	170
2000	9175	22768	7747	10676	6123	8303	2530	2652	1022	197
2001	3816	7946	26960	8769	7120	3146	4687	1935	1406	528
2002	6582	17492	11573	25671	5312	4276	2382	3431	965	1420
2003	2345	50653	13600	7123	9594	5494	3545	2519	2327	1813
2004	1002	6129	33840	10613	7494	8307	2792	3088	2377	3072
2005	26093	12543	9841	23141	10799	5659	7852	2674	713	1588
2006	1590	68137	12328	10098	16757	8080	5671	5127	1815	2529
2007	3144	4115	39889	15301	7963	11302	7749	4138	2157	849
2008	25259	18953	5969	24363	9712	5624	7697	4705	1606	1572
2009	9050	34311	9954	6628	15930	4766	3021	4224	2471	1426
2010	26382	43436	28514	7988	3129	12444	2749	1314	1212	1431
2011	6239	45213	13307	15157	6622	2901	5934	1730	647	1115
2012	30742	17841	33911	10496	7058	3522	1570	2586	557	890
2013	17151	15491	15946	21980	5512	3298	1149	729	885	653
2014	7650	24769	13822	9343	12331	3284	2130	904	378	763
2015	13185	15459	30159	9271	7324	7133	1697	723	433	620
2016	8278	20955	13044	15532	6621	4774	4363	1053	718	1382
2017	5421	34736	12901	7324	9032	3885	2562	1924	376	1999
2018	5260	19260	41425	12618	5903	5667	2843	1956	1112	1567
2019	12421	15078	15388	25177	8327	3243	2848	1357	619	1171
2020	6216	27602	13466	14054	17767	5031	2034	1469	564	1236

	Age groups									
Year	3	4	5	6	7	8	9	10	11	12+
2021	5732	7938	26311	12418	11357	12295	3544	1580	954	1939
2022	10717	14040	13340	32216	12655	6452	5394	1289	506	1859

Table 5.4 Catch weight-at-age (kg) northeast Arctic saithe.

	Age groups									
Year	3	4	5	6	7	8	9	10	11	12+
1960	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.55
1961	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.75
1962	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.52
1963	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.33
1964	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.35
1965	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.54
1966	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.43
1967	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.49
1968	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.36
1969	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.16
1970	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.03
1971	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	7.87
1972	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.14
1973	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.01
1974	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	7.69
1975	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	7.73
1976	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	7.86
1977	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.05
1978	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.00
1979	0.71	1.11	1.63	2.33	3.16	4.03	4.87	5.63	6.44	8.28
1980	0.79	1.27	2.03	2.55	3.29	4.34	5.15	5.75	6.11	7.22
1981	0.73	1.40	2.05	2.76	3.30	4.38	5.95	6.39	6.61	7.00
1982	0.77	1.12	2.02	2.61	3.27	3.91	4.69	5.63	7.18	7.69

	Age groups									
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1983	1.05	1.33	1.86	2.80	4.00	4.18	5.33	5.68	7.31	9.16
1984	0.71	1.26	2.02	2.70	3.88	4.47	5.36	6.06	6.28	7.88
1985	0.75	1.33	2.07	2.63	3.28	3.96	4.54	5.55	6.88	8.74
1986	0.59	1.22	1.97	2.30	2.87	3.72	4.30	4.69	5.84	7.21
1987	0.53	0.84	1.66	2.32	2.97	4.00	4.72	5.44	5.79	7.42
1988	0.62	0.87	1.31	2.43	3.87	5.38	5.83	5.36	6.92	8.82
1989	0.74	0.95	1.40	1.78	2.96	3.73	4.62	4.66	8.34	7.69
1990	0.71	1.00	1.45	2.09	2.49	3.75	3.90	6.74	4.94	7.34
1991	0.68	1.05	1.85	2.39	3.08	3.35	4.48	4.66	5.62	7.31
1992	0.67	1.01	1.92	2.28	2.77	3.20	3.73	6.35	6.90	7.83
1993	0.61	0.99	1.65	2.46	2.85	3.03	3.71	4.49	5.56	7.13
1994	0.52	0.76	1.24	2.12	3.22	3.83	4.69	5.31	5.66	7.29
1995	0.56	0.79	1.19	1.71	2.87	3.78	4.06	5.30	6.86	7.65
1996	0.59	0.82	1.33	1.84	2.48	3.73	4.32	5.34	5.98	7.58
1997	0.62	0.95	1.24	1.72	2.35	3.10	4.19	5.79	6.77	7.75
1998	0.68	1.00	1.48	1.87	2.58	3.07	4.13	5.44	6.70	8.59
1999	0.67	1.05	1.45	1.93	2.27	2.97	3.61	4.10	4.93	6.97
2000	0.60	1.03	1.63	2.10	2.67	3.14	3.81	4.41	5.76	8.07
2001	0.75	1.12	1.54	2.04	2.60	3.14	3.63	4.54	5.05	6.17
2002	0.69	1.01	1.50	1.97	2.54	3.25	3.77	4.31	4.91	6.11
2003	0.66	0.91	1.42	1.89	2.54	2.58	3.49	3.75	4.12	5.90
2004	0.70	1.03	1.37	1.90	2.41	2.98	3.44	3.73	4.14	5.47
2005	0.59	0.89	1.49	2.09	2.16	2.99	3.24	3.82	3.92	6.19
2006	0.63	0.83	1.43	1.78	2.27	2.73	3.02	3.90	4.06	5.82
2007	0.73	1.08	1.41	1.86	2.43	2.94	3.35	3.66	4.17	5.54
2008	0.63	0.98	1.38	1.92	2.31	2.83	3.16	3.43	3.82	4.75
2009	0.73	1.03	1.65	2.00	2.37	2.69	3.23	3.38	3.46	4.67
2010	0.70	0.99	1.45	2.14	2.50	3.13	3.34	3.81	3.99	5.17

	Age groups									
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
2011	0.70	0.82	1.42	2.07	2.68	3.25	3.62	3.97	4.52	5.84
2012	0.59	1.07	1.35	2.15	2.82	3.20	3.67	4.16	4.60	5.70
2013	0.57	1.01	1.50	1.83	2.74	3.33	3.91	4.61	4.50	6.13
2014	0.66	0.92	1.58	2.12	2.54	3.49	4.01	4.22	4.71	5.80
2015	0.61	0.85	1.24	1.91	2.45	3.02	3.97	4.74	4.51	6.05
2016	0.84	1.04	1.46	2.02	2.36	3.12	3.53	4.14	4.65	6.03
2017	0.89	1.12	1.68	2.18	2.63	3.13	3.63	4.16	4.5	5.9
2018	0.91	1.21	1.56	2.02	2.51	3.04	3.44	3.89	4.50	5.60
2019	0.83	1.17	1.64	2.06	2.62	3.18	3.71	4.13	4.88	6.14
2020	0.74	1.06	1.57	2.01	2.53	3.13	3.75	4.36	5.05	6.80
2021	0.77	1.16	1.61	2.14	2.68	3.15	3.65	4.14	4.7	6.3
2022	0.92	1.30	1.70	2.05	2.51	3.03	3.42	3.96	4.32	6.00

Table 5.5. 3-year running average maturity ogive 1985–2006. Values for 2007–2020 average of 2005–2007.

Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1985	0	0.02	0.5	0.92	0.99	1	1	1	1	1
1986	0	0.02	0.51	0.94	0.99	1	1	1	1	1
1987	0	0	0.35	0.98	1	1	1	1	1	1
1988	0	0	0.25	0.96	1	1	1	1	1	1
1989	0	0	0.15	0.92	1	1	1	1	1	1
1990	0	0	0.2	0.85	0.99	1	1	1	1	1
1991	0	0.02	0.25	0.84	0.98	1	1	1	1	1
1992	0	0.02	0.3	0.83	0.93	0.92	0.9	0.95	1	1
1993	0	0.02	0.26	0.88	0.92	0.89	0.87	0.89	1	0.99
1994	0	0.02	0.26	0.84	0.9	0.82	0.87	0.89	1	0.99
1995	0	0.02	0.22	0.8	0.92	0.9	0.97	0.94	1	0.99
1996	0	0.03	0.21	0.65	0.91	0.93	1	1	1	1.00
1997	0	0.03	0.14	0.45	0.83	0.94	0.93	0.97	1	1.00
1998	0	0.04	0.07	0.33	0.74	0.93	0.92	0.96	1	1.00

Year	3	4	5	6	7	8	9	10	11	12+
1999	0	0	0.08	0.32	0.74	0.92	0.92	0.96	0.99	0.98
2000	0	0	0.08	0.46	0.82	0.96	0.98	0.99	0.97	0.95
2001	0	0	0.11	0.64	0.93	0.97	0.98	0.99	0.97	0.94
2002	0	0	0.13	0.78	0.95	0.98	0.98	0.99	0.98	0.97
2003	0	0	0.14	0.82	0.96	0.98	0.98	0.99	1	0.99
2004	0	0	0.21	0.8	0.97	0.99	0.99	1	1	0.98
2005	0	0.03	0.3	0.82	0.97	0.99	0.99	1	1	1.00
2006	0	0.04	0.4	0.86	0.98	0.99	1	1	1	1.00
2007	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	0.99
2008	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	0.99
2009	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	0.99
2010	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	0.99
2011	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2012	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2013	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2014	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2015	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2016	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2017	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2018	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2019	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2020	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2021	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00
2022	0	0.05	0.42	0.87	0.97	0.98	0.98	0.97	0.97	1.00

Table 5.6 Northeast Arctic saithe. Tuning datasets applied in final SAM run

```
North-East Arctic saithe (Sub-areas I and II)
102
FLT13: Norway Ac Survey (Catch: Unknown) (Effort: Unknown)
1994 2001
1 1 0.75 0.85
3  7
   1    87.1   108.9    41.4     8.1     0.7
   1   166.1    86.5    46.5    16.5     2.4
   1   122.6   207.4    31.7    15.1     4.0
   1    38.0   184.8    79.8    50.6     9.6
   1    96.7   202.6    69.3    84.3     6.6
   1   233.8    72.9    62.2    21.0    19.2
   1   142.5   176.3    11.6    11.5     8.0
   1   275.9    45.9    53.8     5.6     6.1
FLT14: Norway Ac Survey (Catch: Unknown) (Effort: Unknown)
2002 2022
1 1 0.75 0.85
3  7
1            230.2        92.6         18.9         10.6         2.2
1            87.5         151.7        26.1         6.2          6.4
1            191.2        107.6        44.3         15.2         4.25
1            198.5        51.9         17.6         13.2         7.68
1            40.9         129.9        14.4         4.62         9.49
1            93.5         23.9         58.5         6.51         3.95
1            55.9         15.9         7.84         9.99         3.06
1            96.9         61.4         6.99         4.01         7.62
1            143.0        22.5         17.1         3.95         1.68
1            42.7         59.6         4.61         4.23         1.07
1            69           29.7         18.8         3.48         2.83
1            77.1         16.5         13.3         11.6         2.19
1            40.1         70.8         8.73         5.6          5.44
1            72.4         22.7         30.1         6.08         4.22
1            145.7        32.0         10.5         11.2         4.15
1            91.1         63.9         13.3         2.76         5.35
1            30.6         61.1         45.4         12.3         4.2
1            84.4         50.6         24.2         17.75        3.54
1            48.23        90.45        28.85        12.33        6.52
1            64.9         33.6         59.3         15.3         8.3
1            46.35        48.26        25.73        22.21        7.06
```

Table 5.7 SAM parameter settings

Model used: State-space assessment model SAM (https://www.stockassessment.org).
Software used: Template Model Builder (TMB) and R.
Visible stock on (https://www.stockassessment.org) "NEAsaithe_2023_v3".
Model Options agreed upon at IBP saithe winter 2014.

```
$minAge
# The minimium age class in the assessment
 3
$maxAge
# The maximum age class in the assessment
 12
$maxAgePlusGroup
# Is last age group considered a plus group (1 yes, or 0 no).
1
$keyLogFsta
# Coupling of the fishing mortality states (nomally only first row is used).
  0  1  2  3  4  5  5  5  5  5
 -1 -1 -1 -1 -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, or 2 AR(1)
 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 -1 -1
  0  1  2  3  3 -1 -1 -1 -1 -1
  4  5  6  7  7 -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 -1 -1 -1 -1 -1 -1
$keyVarF
# Coupling of process variance parameters for log(F)-process (nomally only first row is used)
  0  0  0  0  0  0  0  0  0  0
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$keyVarLogN
# Coupling of process variance parameters for log(N)-process
 0 1 1 1 1 1 1 1 1 1

$keyVarObs
# Coupling of the variance parameters for the observations.
  0  0  0  0  0  0  0  0  0  0
  1  1  1  1  1 -1 -1 -1 -1 -1
```

2 2 2 2 2 -1 -1 -1 -1 -1**Table 5.7 SAM parameter settings continued**

$obsCorStruct
Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for unstructured). | Possible values are: "ID" "AR" "US"
"ID" "ID" "ID"
$keyCorObs
Coupling of correlation parameters can only be specified if the AR(1) structure is chosen above.
NA's indicate where correlation parameters can be specified (-1 where they cannot).
#3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-11 11-12
NA NA NA NA NA NA NA NA NA
NA NA NA NA -1 -1 -1 -1 -1
NA NA NA NA -1 -1 -1 -1 -1
$stockRecruitmentModelCode
Stock recruitment code (0 for plain random walk, 1 for Ricker, and 2 for Beverton–Holt).
2
$noScaledYears
Number of years where catch scaling is applied.
0
$keyScaledYears
A vector of the years where catch scaling is applied.

$keyParScaledYA
A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).
$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, and 2 FSB index).
-1 -1 -1

Table 5.8 SAM catchabilities, negative log likelihood values and number of parameters.

Index	Fleet number	Age	Catchability	Low	High
1	2	3	0.872	0.593	1.281
2	2	4	1.174	0.8	1.721
3	2	5	0.608	0.414	0.892
4	2	6	0.375	0.279	0.505
5	2	7	0.375	0.279	0.505
6	3	3	0.566	0.467	0.687
7	3	4	0.483	0.398	0.585
8	3	5	0.289	0.238	0.351
9	3	6	0.188	0.158	0.223
10	3	7	0.188	0.158	0.223

Model fitting.

Model	log(L)	#par	AIC
Current	-567.30	17	1168.61
base	-560.41	17	1154.81

Table 5.9 Estimated fishing mortalities.

Year Age	3	4	5	6	7	8	9	10	11	12
1960	0.236	0.284	0.321	0.279	0.222	0.163	0.163	0.163	0.163	0.163
1961	0.222	0.260	0.273	0.227	0.174	0.126	0.126	0.126	0.126	0.126
1962	0.222	0.261	0.267	0.226	0.177	0.132	0.132	0.132	0.132	0.132
1963	0.224	0.273	0.281	0.238	0.194	0.153	0.153	0.153	0.153	0.153
1964	0.237	0.297	0.318	0.277	0.240	0.207	0.207	0.207	0.207	0.207
1965	0.233	0.291	0.325	0.288	0.253	0.230	0.230	0.230	0.230	0.230
1966	0.260	0.320	0.344	0.289	0.244	0.223	0.223	0.223	0.223	0.223
1967	0.260	0.310	0.319	0.264	0.224	0.217	0.217	0.217	0.217	0.217
1968	0.222	0.241	0.230	0.185	0.152	0.147	0.147	0.147	0.147	0.147
1969	0.232	0.242	0.222	0.175	0.143	0.131	0.131	0.131	0.131	0.131
1970	0.329	0.362	0.341	0.284	0.251	0.240	0.240	0.240	0.240	0.240

Year Age	3	4	5	6	7	8	9	10	11	12
1971	0.360	0.385	0.357	0.295	0.270	0.259	0.259	0.259	0.259	0.259
1972	0.383	0.391	0.351	0.283	0.259	0.244	0.244	0.244	0.244	0.244
1973	0.422	0.428	0.386	0.317	0.299	0.284	0.284	0.284	0.284	0.284
1974	0.544	0.560	0.513	0.429	0.417	0.395	0.395	0.395	0.395	0.395
1975	0.598	0.619	0.566	0.477	0.489	0.479	0.479	0.479	0.479	0.479
1976	0.653	0.682	0.611	0.498	0.496	0.471	0.471	0.471	0.471	0.471
1977	0.580	0.615	0.541	0.430	0.417	0.378	0.378	0.378	0.378	0.378
1978	0.575	0.651	0.596	0.487	0.476	0.432	0.432	0.432	0.432	0.432
1979	0.555	0.676	0.639	0.528	0.509	0.454	0.454	0.454	0.454	0.454
1980	0.494	0.637	0.620	0.519	0.481	0.422	0.422	0.422	0.422	0.422
1981	0.457	0.629	0.623	0.522	0.460	0.392	0.392	0.392	0.392	0.392
1982	0.422	0.621	0.625	0.527	0.448	0.374	0.374	0.374	0.374	0.374
1983	0.402	0.630	0.656	0.595	0.531	0.453	0.453	0.453	0.453	0.453
1984	0.444	0.715	0.732	0.722	0.681	0.593	0.593	0.593	0.593	0.593
1985	0.351	0.589	0.611	0.648	0.679	0.592	0.592	0.592	0.592	0.592
1986	0.241	0.448	0.495	0.571	0.649	0.595	0.595	0.595	0.595	0.595
1987	0.223	0.453	0.528	0.663	0.809	0.756	0.756	0.756	0.756	0.756
1988	0.213	0.455	0.536	0.660	0.772	0.662	0.662	0.662	0.662	0.662
1989	0.201	0.424	0.472	0.526	0.535	0.401	0.401	0.401	0.401	0.401
1990	0.223	0.478	0.523	0.593	0.602	0.452	0.452	0.452	0.452	0.452
1991	0.192	0.427	0.478	0.552	0.568	0.429	0.429	0.429	0.429	0.429
1992	0.172	0.429	0.540	0.689	0.754	0.604	0.604	0.604	0.604	0.604
1993	0.130	0.354	0.475	0.620	0.680	0.541	0.541	0.541	0.541	0.541
1994	0.100	0.297	0.420	0.569	0.630	0.505	0.505	0.505	0.505	0.505
1995	0.081	0.250	0.340	0.439	0.472	0.372	0.372	0.372	0.372	0.372
1996	0.072	0.227	0.315	0.422	0.488	0.417	0.417	0.417	0.417	0.417
1997	0.053	0.164	0.227	0.298	0.339	0.291	0.291	0.291	0.291	0.291
1998	0.046	0.154	0.221	0.298	0.347	0.322	0.322	0.322	0.322	0.322
1999	0.045	0.157	0.230	0.299	0.339	0.321	0.321	0.321	0.321	0.321

Year Age	3	4	5	6	7	8	9	10	11	12
2000	0.038	0.140	0.206	0.268	0.296	0.290	0.290	0.290	0.290	0.290
2001	0.029	0.115	0.179	0.239	0.266	0.272	0.272	0.272	0.272	0.272
2002	0.026	0.108	0.169	0.231	0.262	0.289	0.289	0.289	0.289	0.289
2003	0.024	0.103	0.159	0.218	0.263	0.324	0.324	0.324	0.324	0.324
2004	0.022	0.095	0.149	0.208	0.263	0.350	0.350	0.350	0.350	0.350
2005	0.031	0.126	0.182	0.243	0.292	0.379	0.379	0.379	0.379	0.379
2006	0.038	0.154	0.216	0.287	0.347	0.456	0.456	0.456	0.456	0.456
2007	0.045	0.171	0.231	0.302	0.358	0.464	0.464	0.464	0.464	0.464
2008	0.070	0.248	0.302	0.368	0.423	0.531	0.531	0.531	0.531	0.531
2009	0.079	0.275	0.325	0.376	0.421	0.521	0.521	0.521	0.521	0.521
2010	0.097	0.328	0.377	0.409	0.434	0.505	0.505	0.505	0.505	0.505
2011	0.096	0.312	0.372	0.413	0.442	0.490	0.490	0.490	0.490	0.490
2012	0.101	0.302	0.356	0.388	0.412	0.437	0.437	0.437	0.437	0.437
2013	0.085	0.248	0.296	0.321	0.342	0.351	0.351	0.351	0.351	0.351
2014	0.074	0.218	0.267	0.292	0.318	0.325	0.325	0.325	0.325	0.325
2015	0.068	0.204	0.254	0.278	0.303	0.305	0.305	0.305	0.305	0.305
2016	0.059	0.183	0.241	0.279	0.318	0.332	0.332	0.332	0.332	0.332
2017	0.051	0.157	0.211	0.256	0.303	0.320	0.320	0.320	0.320	0.320
2018	0.052	0.152	0.207	0.259	0.316	0.336	0.336	0.336	0.336	0.336
2019	0.049	0.135	0.181	0.231	0.285	0.295	0.295	0.295	0.295	0.295
2020	0.047	0.125	0.164	0.213	0.269	0.279	0.279	0.279	0.279	0.279
2021	0.048	0.122	0.161	0.212	0.276	0.293	0.293	0.293	0.293	0.293
2022	0.054	0.134	0.172	0.220	0.275	0.278	0.278	0.278	0.278	0.278

Table 5.10 Estimated stock numbers.

Year Age	3	4	5	6	7	8	9	10	11	12
1960	84079	103226	53980	28173	26059	14372	10479	7303	3630	12079
1961	116214	56698	68778	30139	17271	15941	8962	7002	5132	11302
1962	206621	67991	36514	44527	18665	12602	11347	6196	5191	12547
1963	273528	132908	38603	25443	28630	11904	9852	8217	4494	13418

Year Age	3	4	5	6	7	8	9	10	11	12
1964	81169	192620	77480	22472	17643	18909	8042	7491	6151	13828
1965	254961	50031	112526	45156	14487	11618	12321	5019	5203	13937
1966	134476	182203	34550	63062	26328	9318	7532	7288	3181	12706
1967	174381	83363	111102	20172	36558	16003	6318	5244	4556	10145
1968	143868	116792	47240	64260	12981	23801	10027	4115	3364	8275
1969	266743	88148	80530	31741	42485	10738	17820	6984	2676	6827
1970	220529	168816	58099	54845	22491	29909	9248	14113	5138	7173
1971	229792	143804	87176	35366	32827	14322	17676	6580	9307	7923
1972	154318	138647	86061	46363	22951	19551	9605	10386	4323	10125
1973	201313	80104	79486	52469	27756	15440	12677	6824	6374	8952
1974	101040	110832	41722	46290	32918	16780	10298	8261	4293	9027
1975	168387	44127	52926	19840	23853	17925	9299	6053	4792	7159
1976	220290	75077	19336	25755	10499	11396	8682	4695	3077	5759
1977	202595	90031	30957	8406	13339	5459	5694	4261	2303	4200
1978	136803	89530	38536	15025	4596	7305	3204	3089	2395	3965
1979	195887	60073	38714	17165	7706	2361	4024	1757	1537	3421
1980	119022	94840	23541	16835	8556	3656	1125	2061	963	2671
1981	231779	57069	43571	9995	8255	4419	1832	687	1063	1822
1982	128129	125161	24415	19534	4696	4370	2240	1033	398	1631
1983	101092	68261	54157	9872	9339	2589	2501	1242	605	1293
1984	94913	58277	30644	20676	4286	4555	1300	1334	711	1061
1985	104326	42188	23148	12852	7066	1921	2089	554	609	830
1986	178816	49304	17688	11018	5986	2437	946	955	268	630
1987	144333	132638	22561	8348	5504	2778	853	480	424	466
1988	80758	101721	76586	11143	3461	2046	1326	229	201	292
1989	78116	55056	56087	39228	4882	1189	817	615	51	289
1990	87239	47799	29605	26555	18855	2442	594	459	369	216
1991	226128	48323	22077	15107	11246	8486	1239	297	264	325
1992	281572	142477	22451	10926	7826	5046	4680	647	168	376

Year Age	3	4	5	6	7	8	9	10	11	12
1993	211195	213251	76279	10125	4267	3120	1967	2310	280	239
1994	150391	162523	132423	37401	4346	1719	1485	757	1244	269
1995	273698	132560	112143	75455	15566	1847	795	778	301	828
1996	158175	243535	88164	68459	40373	7958	1036	484	448	706
1997	164454	119907	178058	57926	40086	21558	4150	503	259	630
1998	104242	135278	83593	127604	32828	24078	12874	2553	332	631
1999	240168	78876	95525	53406	73772	18342	15008	7664	1477	581
2000	158541	192183	51062	55699	31145	40581	11311	9610	4371	1130
2001	211794	106083	139384	35301	33070	18947	24102	7238	6071	3183
2002	359919	177595	77616	93122	23797	20523	12597	14969	4485	5906
2003	152144	316927	122993	51134	56259	17106	12703	8613	9123	6489
2004	155024	121582	208700	85354	35212	36152	10916	7418	5492	9120
2005	438601	119479	78729	124586	56076	23640	22144	6872	3799	7567
2006	74583	345403	79622	48195	73346	34565	14779	12527	3908	6072
2007	114083	54185	215236	52212	29553	39664	19717	8275	6249	4387
2008	201813	76384	37703	114141	29929	16411	19872	10760	4183	5079
2009	147080	154557	45931	24844	62134	15615	7847	9254	5299	4242
2010	271353	99013	90765	28389	14069	32976	7745	3759	4143	4379
2011	114066	199649	50435	46592	15549	8081	15919	3921	1844	3946
2012	154814	92081	123283	30926	24536	8987	4378	7716	1912	2863
2013	210355	92310	63589	77194	18248	13153	4984	2438	3908	2503
2014	109238	170823	60152	42421	45620	10958	7618	3127	1443	3687
2015	165684	80773	120680	41590	28370	26826	6424	4420	1950	3237
2016	253893	119653	54304	73330	27280	17487	15589	3752	2870	3784
2017	179118	220097	81199	33948	41589	16230	10315	8635	2089	4703
2018	131707	150607	177339	58864	23883	23388	9741	6165	4976	4381
2019	263024	124821	110826	118264	34922	14225	12953	5597	3458	5532
2020	132807	242131	104484	80238	72090	21379	8699	7573	3316	5781
2021	151158	104116	203031	80100	54021	45591	12979	5337	4647	6217

Year Age	3	4	5	6	7	8	9	10	11	12
2022	150445	121225	85401	151384	54133	32665	27140	7468	3043	6948
pred		116703	86827	58878	99419	33671	20244	16820	4628	6192

Table 5.11 Estimated recruitment, total-stock biomass (TBS), spawning-stock biomass (SSB), and average fishing mortality for ages 4 to 7 (F4–7).

Year	R (age 3)	Low	High	SSB	Low	High	Fbar (4–7)	Low	High	TSB	Low	High
1960	84079	52714	134104	462719	339250	631125	0.276	0.198	0.386	686938	534636	882626
1961	116214	76781	175898	454759	336232	615070	0.233	0.171	0.319	661651	517853	845379
1962	206621	137234	311091	460750	343996	617130	0.233	0.172	0.315	725691	577504	911903
1963	273528	181849	411426	458092	345758	606923	0.247	0.184	0.330	837367	676279	1036824
1964	81169	53533	123072	483310	370432	630585	0.283	0.213	0.376	818411	659651	1015379
1965	254961	169667	383135	523287	405529	675238	0.289	0.218	0.384	858523	696756	1057848
1966	134476	89721	201557	482287	371181	626650	0.299	0.226	0.397	827034	671120	1019170
1967	174381	116106	261906	493982	383301	636624	0.279	0.210	0.372	800254	650786	984052
1968	143868	95911	215804	469867	363567	607248	0.202	0.151	0.270	758286	617277	931506
1969	266743	177311	401282	509886	402962	645182	0.195	0.147	0.260	868987	718470	1051038
1970	220529	147366	330016	567910	458192	703901	0.309	0.238	0.402	973203	818089	1157727
1971	229792	154257	342316	554559	452428	679746	0.327	0.253	0.422	954117	807044	1127993
1972	154318	103734	229568	535897	440865	651413	0.321	0.250	0.412	878601	746245	1034433
1973	201313	135387	299340	537164	447236	645175	0.358	0.281	0.456	846518	723803	990037
1974	101040	67696	150807	493549	413138	589611	0.480	0.380	0.605	735942	632574	856202
1975	168387	113226	250419	398906	335045	474941	0.538	0.428	0.675	614215	527937	714592
1976	220290	147745	328454	281395	234816	337213	0.572	0.457	0.716	544151	461858	641108
1977	202595	136229	301293	209075	173859	251424	0.500	0.398	0.629	478340	402945	567843
1978	136803	91902	203642	189121	158387	225820	0.552	0.442	0.691	418444	354877	493397
1979	195887	131773	291195	170457	142714	203592	0.588	0.471	0.734	410434	343926	489803
1980	119022	80040	176988	150230	125646	179625	0.564	0.452	0.705	392006	328520	467761
1981	231779	155146	346263	154477	128513	185688	0.558	0.447	0.698	447649	369101	542913
1982	128129	85966	190973	135722	112992	163025	0.556	0.443	0.696	403308	334037	486944
1983	101092	67592	151196	163889	135419	198344	0.603	0.484	0.752	410137	343053	490341

Year	R (age 3)	Low	High	SSB	Low	High	Fbar (4–7)	Low	High	TSB	Low	High
1984	94913	63214	142506	146768	121662	177054	0.713	0.575	0.884	323412	272554	383761
1985	104326	69384	156864	110731	92138	133076	0.632	0.507	0.787	270857	226456	323963
1986	178816	118990	268721	83529	69419	100506	0.541	0.432	0.677	266745	217693	326850
1987	144333	96672	215492	72095	60041	86569	0.613	0.495	0.759	284738	232707	348403
1988	80758	53541	121809	88401	73051	106975	0.606	0.488	0.752	303296	249740	368338
1989	78116	51664	118110	104198	80787	134393	0.489	0.389	0.616	286636	236935	346763
1990	87239	57301	132820	120215	96015	150513	0.549	0.437	0.689	273090	228831	325909
1991	226128	149736	341494	114715	94100	139845	0.506	0.403	0.636	355308	288684	437308
1992	281572	186896	424206	95221	80140	113140	0.603	0.483	0.752	464067	373206	577048
1993	211195	141557	315090	97284	81037	116787	0.532	0.426	0.666	533253	431809	658530
1994	150391	102652	220333	148368	120558	182591	0.479	0.380	0.603	485777	402461	586341
1995	273698	185243	404391	197382	158422	245924	0.375	0.295	0.477	587883	488841	706993
1996	158175	107657	232399	246300	200738	302205	0.363	0.284	0.463	681142	569585	814547
1997	164454	112130	241194	245799	200884	300756	0.257	0.199	0.332	724261	603961	868525
1998	104242	71349	152299	294132	240682	359453	0.255	0.197	0.330	801821	669047	960945
1999	240168	164321	351025	309293	249982	382677	0.256	0.197	0.333	804184	677002	955260
2000	158541	108495	231674	368293	297991	455181	0.228	0.175	0.296	823627	696901	973397
2001	211794	146289	306633	373894	306856	455576	0.200	0.154	0.259	880459	749503	1034297
2002	359919	253865	510277	448064	373993	536805	0.193	0.149	0.248	1024865	879264	1194578
2003	152144	107102	216129	434942	366522	516136	0.185	0.144	0.239	999662	856951	1166140
2004	155024	108055	222411	515190	438685	605036	0.179	0.138	0.232	1012293	868588	1179775
2005	438601	308156	624263	598107	507119	705420	0.211	0.164	0.272	1094304	940312	1273514
2006	74583	52768	105415	531879	453991	623130	0.251	0.196	0.322	938859	807812	1091165
2007	114083	80979	160720	542373	464693	633039	0.266	0.208	0.340	877537	753171	1022437
2008	201813	143821	283187	465652	392823	551983	0.335	0.263	0.426	728565	628921	843996
2009	147080	104996	206031	359677	303496	426259	0.349	0.277	0.441	676066	585281	780934
2010	271353	194251	379057	326093	276090	385153	0.387	0.307	0.489	698092	600492	811556
2011	114066	81072	160488	290881	245996	343956	0.385	0.304	0.488	584113	501946	679730
2012	154814	110305	217283	299618	254058	353348	0.364	0.288	0.461	594030	510699	690958

Year	R (age 3)	Low	High	SSB	Low	High	Fbar (4–7)	Low	High	TSB	Low	High
2013	210355	150281	294443	321355	269250	383544	0.302	0.237	0.385	607239	520669	708202
2014	109238	77882	153219	346463	290173	413673	0.274	0.214	0.349	640254	548989	746691
2015	165684	118228	232189	355503	297714	424510	0.260	0.203	0.333	624140	533862	729685
2016	253893	179872	358376	388877	322707	468614	0.255	0.198	0.329	791132	671289	932370
2017	179118	127046	252532	398106	329512	480980	0.232	0.179	0.300	887013	750160	1048832
2018	131707	91953	188647	458189	376478	557634	0.234	0.180	0.304	931515	783488	1107511
2019	263024	184594	374777	547833	440741	680946	0.208	0.158	0.274	1047133	874815	1253395
2020	132807	93258	189130	598474	473223	756875	0.193	0.144	0.257	1065723	880945	1289259
2021	151158	103550	220655	701042	545746	900529	0.193	0.142	0.262	1154001	935950	1422853
2022	150445	93996	240795	741480	556921	987201	0.200	0.141	0.284	1163597	920295	1471222

Table 5.12 Northeast Arctic saithe. Prediction input data

rMFDP version
Run: r
F_{bar} age range: 4–7

2023

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	161475	0.2	0	0	0	0.81	0.05	0.81
4	116703	0.2	0.05	0	0	1.172	0.127	1.172
5	86827	0.2	0.42	0	0	1.626	0.166	1.626
6	58878	0.2	0.87	0	0	2.085	0.215	2.085
7	99419	0.2	0.97	0	0	2.615	0.273	2.615
8	33671	0.2	0.98	0	0	3.141	0.283	3.141
9	20244	0.2	0.98	0	0	3.618	0.283	3.618
10	16820	0.2	0.97	0	0	4.103	0.283	4.103
11	4628	0.2	0.97	0	0	4.648	0.283	4.648
12	6192	0.2	0.994	0	0	6.388	0.283	6.388

2024

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	161475	0.2	0	0	0	0.81	0.05	0.81

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
4	.	0.2	0.05	0	0	1.172	0.127	1.172
5	.	0.2	0.42	0	0	1.626	0.166	1.626
6	.	0.2	0.87	0	0	2.085	0.215	2.085
7	.	0.2	0.97	0	0	2.615	0.273	2.615
8	.	0.2	0.98	0	0	3.141	0.283	3.141
9	.	0.2	0.98	0	0	3.618	0.283	3.618
10	.	0.2	0.97	0	0	4.103	0.283	4.103
11	.	0.2	0.97	0	0	4.648	0.283	4.648
12	.	0.2	0.994	0	0	6.388	0.283	6.388

2025

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	161475	0.2	0	0	0	0.81	0.05	0.81
4	.	0.2	0.05	0	0	1.172	0.127	1.172
5	.	0.2	0.42	0	0	1.626	0.166	1.626
6	.	0.2	0.87	0	0	2.085	0.215	2.085
7	.	0.2	0.97	0	0	2.615	0.273	2.615
8	.	0.2	0.98	0	0	3.141	0.283	3.141
9	.	0.2	0.98	0	0	3.618	0.283	3.618
10	.	0.2	0.97	0	0	4.103	0.283	4.103
11	.	0.2	0.97	0	0	4.648	0.283	4.648
12	.	0.2	0.994	0	0	6.388	0.283	6.388

Input units are thousands and kg - output in tonnes

Table 5.13 Northeast Arctic saithe. Short-term prediction

rMFDP version
Run: r
F_{bar} age range: 4–7

2023

Biomass	SSB	F_{Mult}	F_{Bar}	Landings
1100574	727666	1.240	0.242	226794

2024–2025

2024					2025	
Biomass	SSB	F_{Mult}	F_{Bar}	Landings	Biomass	SSB
1011526	638756	0	0	0	1174065	769181
	638756	0.1	0.0195	18669	1153541	751232
	638756	0.2	0.039	36911	1133494	733727
	638756	0.3	0.0586	54736	1113912	716655
	638756	0.4	0.0781	72156	1094783	700005
	638756	0.5	0.0976	89180	1076096	683766
	638756	0.6	0.1172	105818	1057840	667927
	638756	0.7	0.1367	122080	1040005	652479
	638756	0.8	0.1562	137975	1022579	637410
	638756	0.9	0.1757	153511	1005552	622712
	638756	1	0.1952	168698	988915	608375
	638756	1.1	0.2148	183545	972658	594390
	638756	1.2	0.2343	198059	956771	580748
	638756	1.3	0.2538	212250	941246	567439
	638756	1.4	0.2734	226124	926073	554456
	638756	1.5	0.2929	239690	911243	541790
	638756	1.6	0.3124	252955	896749	529433
	638756	1.7	0.3319	265927	882582	517377
	638756	1.8	0.3515	278612	868733	505615
	638756	1.9	0.371	291018	855195	494139
	638756	2	0.3905	303152	841961	482942

Input units are thousands and kg - output in tonnes

Table 5.14 Northeast arctic saithe. Short-term projection output HCR landings

rMFDP version
Run: r
F_{bar} age range: 4–7

2023

Biomass	SSB	F_{Mult}	F_{Bar}	Landings
1100574	727666	1.240	0.2071	226794

2024

Biomass	SSB	F_{Mult}	F_{Bar}	Landings
1050549	686937	1.378	0.269	223124

2025

Biomass	SSB	F_{Mult}	F_{Bar}	Landings
929354	557261	1.6389	0.32	230315

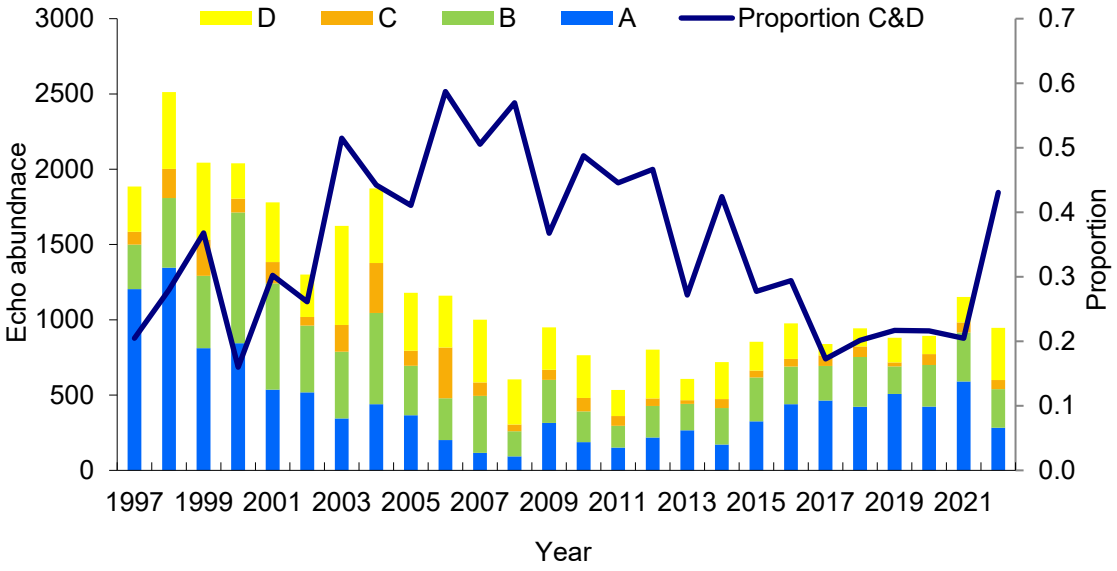

Figure 5.1. Northeast Arctic saithe. Echo abundance and proportion of saithe in the southern half of the survey area (subarea C+D).

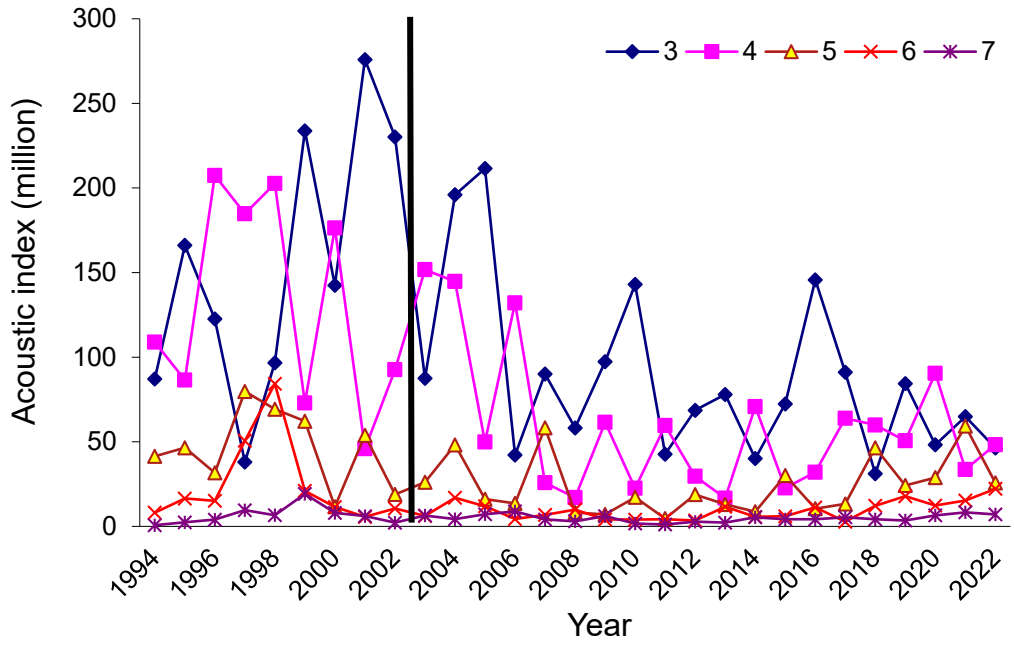

Figure 5.2. Northeast Arctic saithe. acoustic survey tuning indices by age class (3–7). break in 2002 black line.

Figure 5.3. Northeast Arctic saithe. Final run normalized residuals. Blue circles indicate positive residuals (larger than predicted) and filled red circles indicate negative residuals. The top figure shows residuals for the total catch series. the figure in the middle the residuals for the first survey series and the bottom figure the residuals for the survey series from 2002.

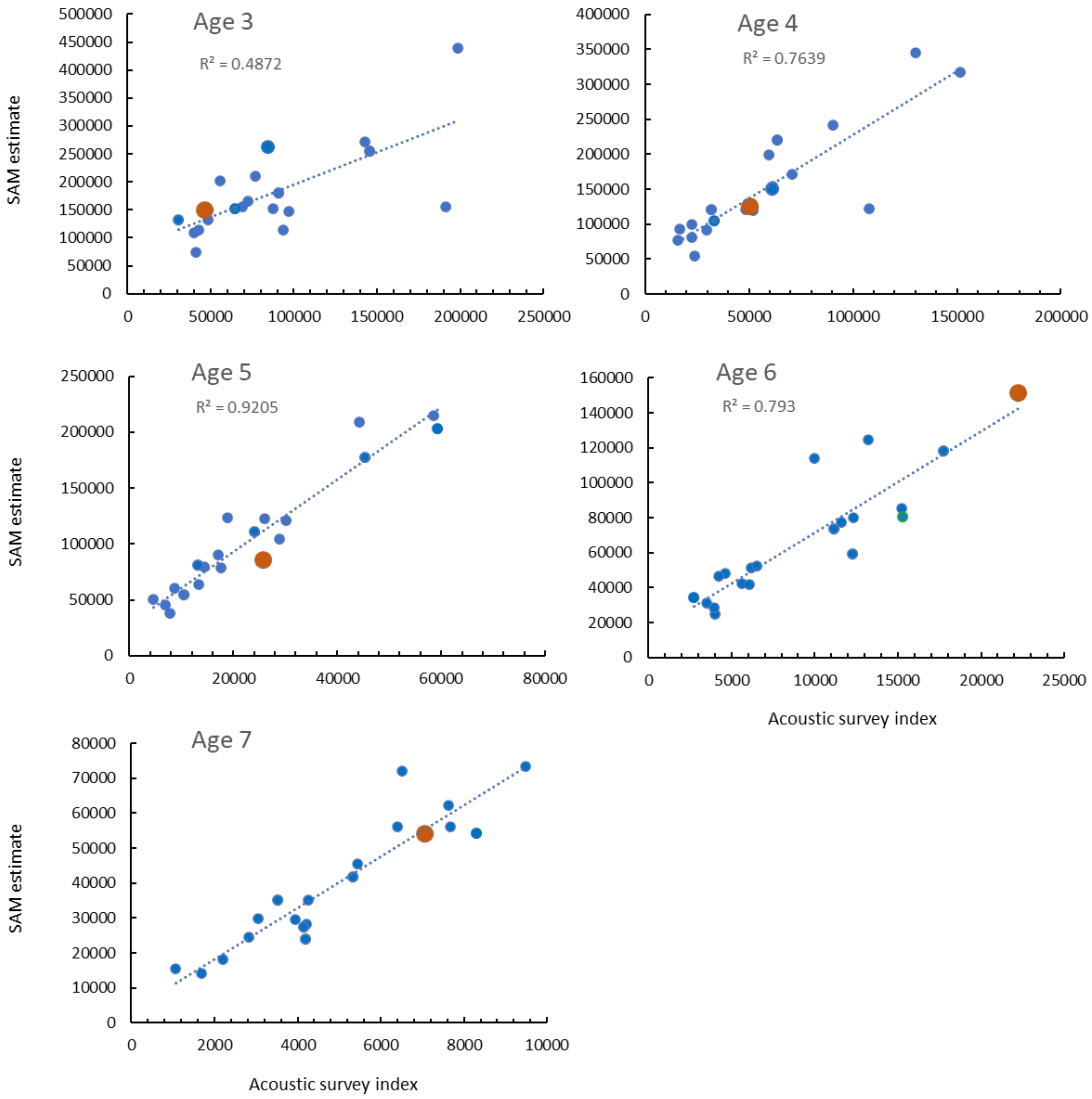

Figure 5.4. NEA saithe - Acoustic survey vs. SAM. Red point 2022 data.

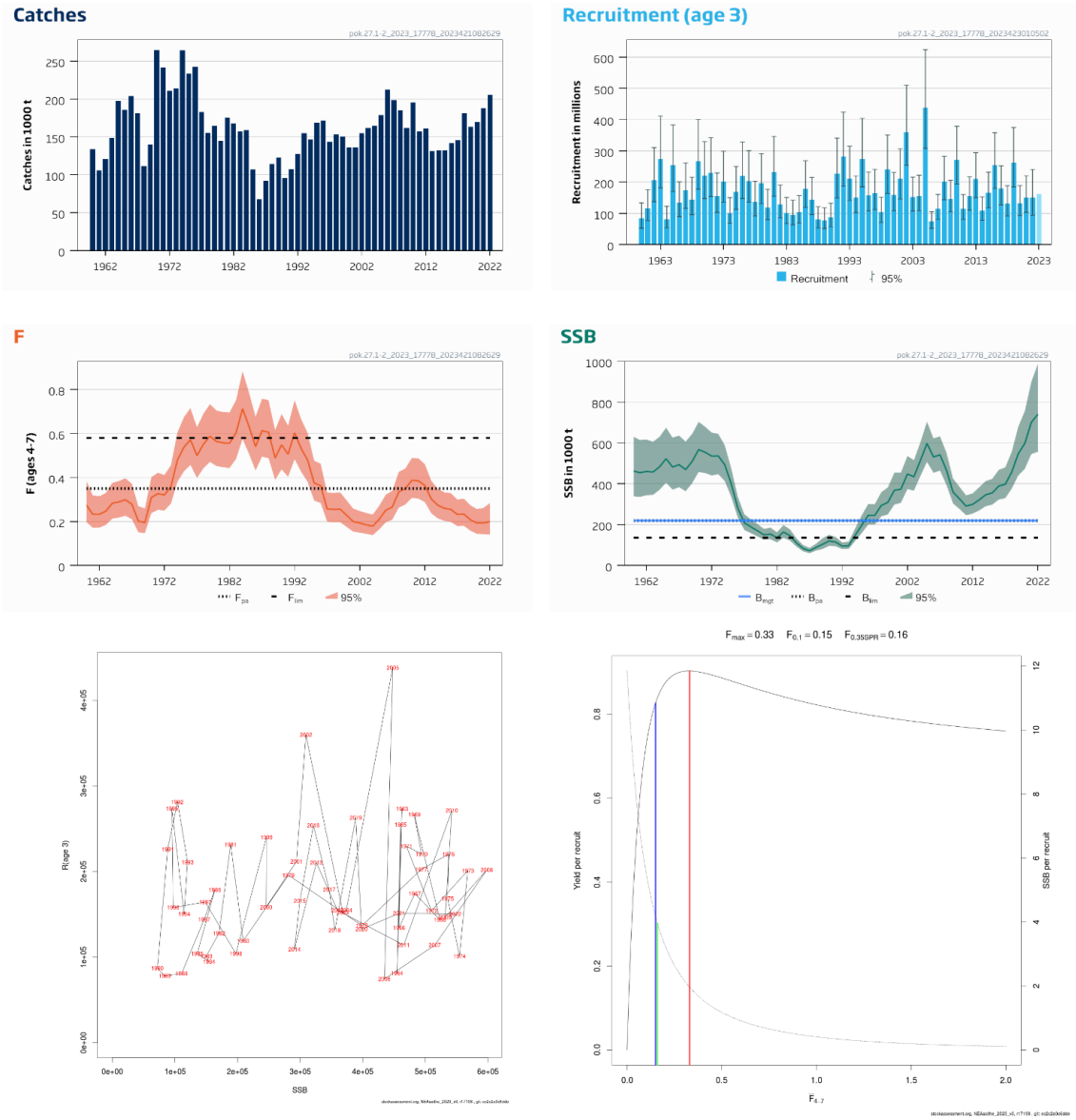

Figure 5.5. Northeast Arctic saithe (subareas 1 and 2).

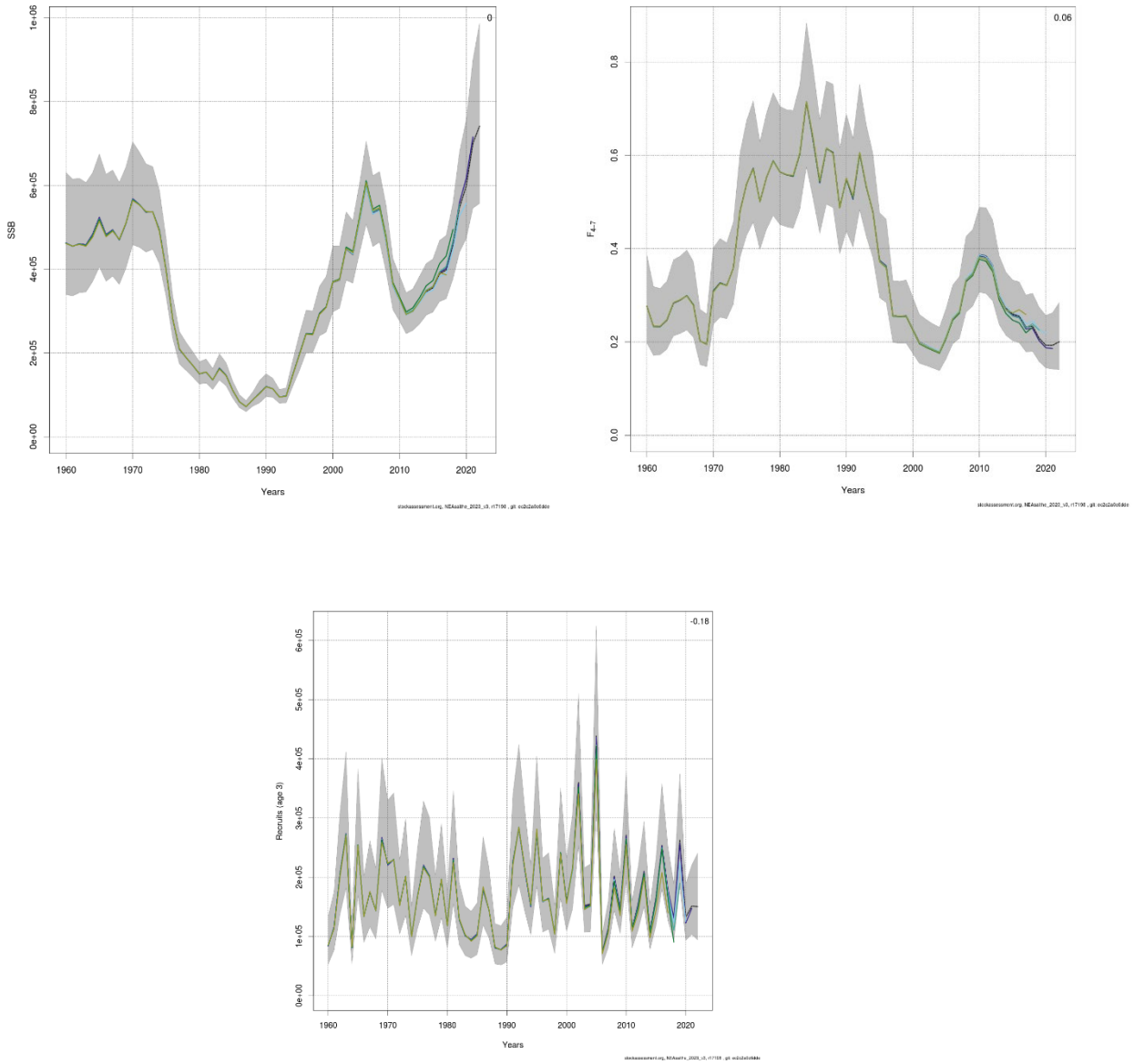

Figure 5.6. Saithe in subareas 1 and 2 (Northeast Arctic) RETROSPECTIVE SAM SSB. F4–7. and recruits.

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