8 Icelandic saithe

8.1 Stock description and management units

Description of the stock and management units is provided in the stock annex.

The stock was benchmarked and the management plan evaluated in March 2019 (ICES 2019a). The result was no change in assessment setup. A minor change in the management plan was introduced as MGMT $B_{trigger}$ was decreased from 65 to 61 thousand tonnes to be in line with ICES MSY $B_{trigger}$. Other reference points were unchanged except HR_{lim} and $HR_{pa.}$ were introduced to replace F_{lim} and F_{pa}.

According to the management plan, catches in the fishing year 2019/20 should be no more than 80 588 tonnes.

8.2 Fisheries-dependent data

8.2.1 Landings, advice and TAC

Landings of saithe in Icelandic waters in 2018 are estimated to have been 65 547 t (Table 8.1 and Figure 8.1). Of the landings, 60 242 t were caught by trawl, 1259 t by gillnets, and the rest caught by other fishing gear. The domestic as well as ICES advice for the fishing year 2017/2018 was based on the 20% harvest control rule and was 60 237 t. The TAC issued was also 60 237 t but the landings are now estimated to be 59 000 tonnes. The set TAC was therefore nearly caught but not all the TAC transferred from earlier fishing years (Figure 8.2) The trajectory of the landings in the current fishing year and calendar year is shown in Figure 8.2 indicating that the TAC of 79 092 kt will not be reached.

Most of the catch is taken by bottom trawl (83% in 2010–2017, 92% in 2018), with gillnet and jiggers taking the majority of the rest, 5% each fleet. The share taken by the gillnet fleet was larger in the past, 26% in 1982–1996 compared to 9% in 1997–2016 (Figure 8.1). Saithe does not appear much in the longline fishery that has been increasing in last 20 years. The share of longlines has though gradually been increasing from 0.8% before 2000 to 2.2% in 2013–2016 reducing to 1.2% in 2018.

8.2.2 Landings by age

Catch in numbers by age based on landings are listed in Table 8.2. Discarding is not considered to be a problem in the Icelandic saithe fisheries, with an estimated discard proportion of 0.1% (annual reports by Palsson *et al.*, 2003 and later). Since the amount of discards is likely to be small, not taking discards into account in the total catches and catch in numbers is not considered to have major effect on the stock assessment.

In 2018 sea samples constitute about 77% of the length measured fish that is used in the calculation of the catch in number and 67% of the length samples. 90% of the length samples are taken from trawl that accounts for 92% of the catches. On the other hand only 27% of the aged otoliths come from sea samples. The sampling program has been revised in last decades, the number of age samples reduced and the number of fish per sample has also reduced (Figure 8.3).

The sampling of otholits in 2018 increased from 2017 but was considerably less than in 2016. The main reason is reduced number of otoliths sampled at sea by employees of the Fisheries Directorate.

The age and length sampling in 2018 is indicated in the following table:

Fleet	Landings (t)	No. of otolith samples	No. of otoliths read	No. of length samples	No. of length measurements
Long lines	787	0	0	0	0
Gillnets	1690	3	75	3	375
Jiggers	1260	1	25	5	598
Danish seine	993	3	75	5	461
Bottom trawl	60243	62	1604	141	24949
Other gear	602	0	0	0	0
Total	65575	69	1779	154	26383

Foreign landings that are 232 tonnes are included in the landings above. They are mostly caught by longlines (79 tonnes) and handlines (152 tonnes).

Two age-length keys are used to calculate catch at age, one key for the gillnet catch and another key for other gears combined. The same length-weight relationship ($W = 0.02498 * L$^2.75674) is applied to length distributions from both fleets.

In recent years increased proportion of saithe catches has been caught north-west of Iceland (Figure 8.5). This situation could lead to potential problem, if the sampling effort does not follow distribution in the catches. To look at this problem catch in numbers were recompiled using 12 cells, 3 gear (bottom trawl, gillnets and handlines), 2 areas (north and south) and 2 time periods (Jan–May and June–Dec). The resulting catch in numbers are nearly identical (Figure 8.8) and using it in assessment leads to less than 1% difference of reference biomass. Catch in number 2018 is somewhat different from last year's prediction (Figure 8.7). Less is caught of ages 5 and 8–10 but more of other age groups.

8.2.3 Mean weight and maturity at age

Weights of ages 3–6 have been low in recent years, but older ages are close to average weight (Table 8.3 and Figures 8.9 and 8.10). The large 2012 year class has the lowest mean weight of all year classes, both in catches and in the survey. This is in line with density dependent growth that has been observed in this stock and can for example be seen for year classes 1984 and 2000 that are both large. Year classes 2013 and 2014 that seem to be above average have higher mean weight at age than the 2012 year class. The long-term trend since 1980 has been a gradual decline in the weight of all ages.

Weighs at age in the landings are used to compile the reference biomass (B4+) that is the basis for the catch advice. Catch weights are also used to compile the spawning stock. Catch weights for the assessment year are predicted by applying a linear model using survey weights in the assessment year and the weight of the same year class in catches in the previous year as predictors (Magnusson, 2012 and stock annex).

Maturity at ages 4–9 has decreased in recent years and is currently around average since 1985 (Table 8.4 and Figure 8.11). A model using maturity at age from the Icelandic groundfish spring survey is used to derive smoothed trends in maturity by age and year (see stock annex).

8.2.4 Logbook data

Commercial CPUE indices are not used for tuning in this assessment. Although these indices have been explored for inclusion in the past, they were not considered for inclusion in the benchmark (ICES, 2010; ICES, 2019), as the trends in CPUE are considered unreliable as an indicator of changes in abundance.

8.3 Scientific surveys

In the benchmarked assessments from 2010 and 2019, only spring survey data are used to calibrate the assessment. Compared to the autumn survey the spring survey has larger number of stations (lower CV) and longer time series. Saithe is among the most difficult demersal fishes to get reliable information from bottom trawl surveys. In the spring survey, which has 500–600 stations, a large proportion of the saithe is caught in relatively few hauls and there seems to be considerable inter-annual variability in the number of these hauls.

The biomass indices from the spring survey (Figure 8.12) fluctuated greatly in 1985–1995, but were consistently low from 1995–2001. Since 1995 the indices have been variable but compared to the period 1985–1995 the variability seems “real” rather than noise. This difference is also seen by the estimated confidence intervals of the indices that are smaller after 1995. In 2018 the indices were the highest in the series and had tripled since 2014. (Table 8.5 and Figure 8.12). Most of the increase was caused by the 2012 year class that was strong in the surveys 2015–2018 (Figure 8.14). The biomass index from the March survey show lower index in 2019 than recent years (Figure 8.12). The reduction since 2018 that was the highest value in the series (the 1986 value is considered an outlier) is around 50%. Similar reduction in survey biomass has been seen before.

The autumn survey shows similar trend as the spring survey and the index is at high level in 2017 (2004 and 2018 are outliers due to large CV). The values before 2000 might be underestimate due to stations added in 2000 (Figure 8.6) where large schools of saithe are sometimes found. Excluding these stations leads to lower but more stable index.

Indices from the gillnet survey conducted south and west of Iceland since 1996 were high from 2015–2019 and the 2019 value is the highest in the series. (Figure 8.13). The gillnet survey is mostly targeting large saithe (mean weight in 2016 was 6.7 kg).

To summarize, the most recent survey indices give a mixed indication of the state of the stock, but the average of last few years indicate large stock.

The high index in March 1986 (Figure 8.12) is mostly the result of one large haul that is scaled down to the second largest haul when compiling indices for tuning. The scaling is from 16 tonnes to 1 tonne.

Internal consistency in the March survey measured by the correlation of the indices for the same year class in 2 adjacent surveys is relatively poor, with R^2 close to 0.35 where it is highest.

Young saithe tend to live very close to shore, so it is not surprising that survey indices for ages 1 and 2 are poor measures of recruitment, and the number of young saithe caught in the surveys is very low.

8.4 Assessment method

In accordance with the recommendation from the benchmark (ICES, 2019a), a separable forward-projecting statistical catch-age model Muppet (Björnsson, 2019) , developed in AD Model Builder, is used to fit commercial catch at age (ages 3–14 from 1980 onwards) and survey indices at age (ages 2–10 from 1985 onwards). The selectivity pattern is constant within each of 3 periods (Figure 8.15). Natural mortality is set at 0.2 for all ages.

The commercial catch-at-age residuals (Figure 8.20) are relatively small from 2016-2018. The survey residuals (Figure 8.17) show large positive values in 2018 for ages 4–6, the age groups accounting for most of the biomass. The 2019 residuals are relatively small with both positive and negative values. The survey catch-at-age residuals (Figure 8.19) have year blocks with most residuals being negative or most positive in some years. The survey residuals are modelled as multivariate normal distribution with the correlation estimated (one coefficient).

The assessment model is also used for short term forecast.

The input for the short-term forecast is shown in tables 8.3, 8.4 and 8.7. Future weights, maturity, and selectivity are assumed to be the same as in the assessment year, as described in the stock annex. Recruitment predictions are based on the segmented stock-recruitment function estimated in the assessment model which is essentially geometric mean when the stock is above estimated break point that is near B_{loss}.

8.5 Reference points and HCR

In April 2013, the Icelandic government adopted a management plan for managing the Icelandic saithe fishery (Ministry of Industries and Innovation 2013). ICES evaluated this management plan and concluded that it was precautionary and in conformity with ICES MSY framework.

The management plan for the Icelandic saithe fishery, adopted for the first time in 2013 was re-evaluated by ICES in March 2019 and found to be precautionary and in conformity with ICES MSY approach (ICES, 2019a).

The TAC set in year *t* is for the upcoming fishing year, from 1 September in year *t*, to 31 August in year *t*+1. The TAC according to the management plan is calculated as follows.

When SSB ≥ MGMT $B_{trigger}$, the TAC set in year *y* equals the average of 0.20 times the current biomass and last year’s TAC:

$$TAC_{y+1/y} = 0.5 \times 0.20\, B_{y,4+} + 0.5\, TAC_{y/y-1}$$

(Eq. 1)

When SSB is below MGMT $B_{trigger}$, the harvest rate is reduced below 0.20:

$$TAC_{y+1/y} = SSB_y/\text{MGMT } B_{trigger}\ [\ (1 - 0.5\, SSB_y/\text{MGMT } B_{trigger})\ 0.20\, B_{t,4+}) + 0.5\, TAC7_{y/y-1}\ ]$$

(Eq. 2)

Equation 1 is a plain average of two numbers. Equation 2 is continuous over $SSB_y/B_{trigger}$, so the rule does not lead to very different TAC when SSB_y is slightly below or above $B_{trigger}$.

Reference points were also re-evaluated at WKICEMSE 2019 (see table below and ICES 2019a). B_{lim}, B_{pa}, $MSYB_{trigger}$, HR_{MSY} and HR_{Mgt} were unchanged, MGMT $B_{trigger}$ changed from 65 to 61 thousand tonnes and HR_{lim} and HR_{pa} were defined but earlier F_{lim} and F_{pa} had been defined.

Item	B_{lim}	B_{pa}	$MSYB_{trigger}$	$MGTB_{trigger}$	HR_{MSY}	HR_{Mgt}	HR_{lim}	HR_{pa}
Value	44	61	61	61	0.2	0.2	0.36	0.26
Basis	B_{loss}/1.4	B_{loss}	B_{pa}	B_{pa}			Stochastic simulations.	

8.6 State of the stock

The results of the principal stock quantities (Table 8.6 and Figure 8.16) show that the reference biomass (B4+) has historically ranged from 130 to 410 kt (in 1999 and 1988), but this range has been narrower since 2003, between 220 and 410 kt. The current estimated stock size of $B4+_{2019}$ = 410 kt is with the 1988 value the highest in the time series (1980 to the present). Spawning biomass is estimated as 224 kt, the highest in the time series.

The harvest rate peaked around 28% in the mid-1990s, but has since 2013 been below HR_{Mgt} target of 20%. The explanations for lower than intended harvest rate since 2013 are that the allocated TAC has not been fished and the stabilizer has been reducing the tac and. Fishing mortality has been low since 2004 compared to before that. Part of the difference is caused by change in selection pattern (Figure 8.15) that leads to F before and after 2004 not being comparable measures of fishing pressure. SSB has been at a relatively high level during the last ten years.

Recruitment has been relatively stable since year class 2006, above average. Year class 2012 is estimated to be strong and year classes 2013 and 2014 above average. The details of the fishing mortality and stock in numbers are presented in tables 8.7 and 8.8.

The predicted landings in 2019 are 83 kt, what is left of the TAC 2018/19 in the beginning of the year 2019 plus 1/3rd of the TAC 2019/20 (81 kt). Looking at last fishing years where the TAC was not caught (figure 8.4) the value obtained is likely to be an overestimate and trends in landings (Figure 8.2) indicate that the TAC will not be caught. Assumptions about catches in 2019 have no effect on the TAC 2019/20 that is based on the biomass in the beginning of the year 2019.

8.7 Uncertainties in assessment and forecast

The assessment of Icelandic saithe is relatively uncertain due to fluctuations in the survey data, poor recruitment estimates and irregular changes in the fleet selectivity. The internal consistency in the spring bottom trawl surveys is low for saithe. This is not surprising, considering the nature of the species that is partly pelagic, schooling, and relatively widely migrating. There are also indications of time-varying selectivity, so changes in the commercial catch at age may not reflect changes in the age distribution of the population. The retrospective pattern (Figure 8.21) reveals some of the assessment uncertainty. The harvest control rule evaluations incorporated uncertainties in assessment as well as other sources of uncertainty (ICES, 2019).

Using retrospective pattern based on the assessment years 2015–2019 Mohn's rho is -0.01 for the reference biomass, -0.07 for the F, 0.08 for SSB and -0.46 for recruitment. Those values are based on comparing estimated values in the beginning of the assessment year to values estimated in 2019. What matters most here is of course retrospective pattern of the reference biomass that is the basis for advice.

The results from the default separable assessment model (Muppet) are compared to alternative model configuration, both in terms of how fishing mortality are modelled, treatment of survey indices and additional survey.

nr	Type of model and settings	B4+ 2018	TAC
1	Separable 3 period	410	80.5
2	Survey outliers removed	459	85.3
3	Separable spring survey and autumn survey since 2000	476	87.2
4	Separable 3 periods 2018	477	84.8
5	SAM Spring survey	323	71.9
6	SAM Spring survey and autumn survey since 2000.	384	71.9

Main metrics based on alternative models and settings. All models except model 7–9 are based on more or less same code. Model 2 uses different data, i.e. survey indices are compiled by Winchorizing. SAM can lead to quite different runs based on the settings, for example number of observation variances.

The results of the different setups can be somewhat different (Figure 8.23 and the table above) with B4+ in 2019 (the number that matters for the advice) ranging from 323 thousand tonnes to 534 thousand tonnes. The lowest number is from a SAM model only tuned with the spring survey but the highest value from a separable model tuned with both the spring and autumn survey.

The difference between models and settings is on the higher side taking into account precision of the stock estimates in the HCR evaluations CV(B4+) = 0.22 . The assessment indicates smaller stock than last year's assessment (figures 8.17, 8.21). The retrospective pattern shows that the results do often change much when including one more year of data.

A problem in the current advisory process is the fact that the TAC has not been fished in some recent years (Figure 8.4). The assessment models indicate substantial reduction of fishing mortality and harvest rate in last 3 years, partly because the TAC has not been fished. The selection pattern observed since 2004 (Figure 8.15) indicates that the fisheries are targeting younger fish than before, something that could be interpreted as lack of large fish. This trend is even greater than observed in the figure as mean weight at age of ages 4–5 have been low in recent years (Figure 8.10) Other measures of stock size, not used directly in the assessment model like the autumn survey and gillnet survey (figures 8.12 and 8.13) do indicate that the stock is large.

The problem seen in recent years is not new and the fact that fishing mortality of saithe was never really high indicates that it might be difficult to catch. One reason is that most of the gear is demersal while saithe is partly pelagic. Change of fleet and fishing practice in recent 10–20 years might also have effects. (see Section 8.9) and the conclusions of that section is really that there is nothing wrong with the saithe assessment, change in fishing patterns and gear composition of the fleet is increasing the problem of catching the saithe quota.

8.8 Ecosystem considerations

Changes in the distribution of large pelagic stocks (blue whiting, mackerel, Norwegian spring-spawning herring, Icelandic summer-spawning herring) may affect the tendency of saithe to migrate off shelf and between management units. Saithe is a migrating species and makes both vertical and long-distance feeding and spawning migrations (Armannsson *et al.*, 2007, Armannsson and Jonsson, 2012, i Homrum *et al.*, 2013). The evidence from tagging experiments (ICES, 2008) show some migrations along the Faroe-Iceland Ridge, as well as onto the East Greenland shelf.

8.9 Changes in fishing technology and fishing patterns

Before 2000 the 15–40% of the saithe was caught in gillnets but only around 5% in recent years. This change is caused by substantial reduction of gillnet boats, especially since 2007. From 1998 to 2015 increased part of the catch of cod (main target species of the Icelandic demersal fleet) was caught by longliners. The fleet has changed so the number of longliners is increasing but the number of gillnets boats, boats operating Danish seine and trawlers is decreasing. Longliners do hardly catch saithe but the other 3 gear types are all catching saithe.

Reduced harvest rate of cod that seems to be a more easily caught fish leads to saithe fishing being difficult without catching too much cod. Large part of the cod is exported fresh and the captains of many trawlers are asked to avoid cod except in the last 2 days of each fishing trip (5–6 days). Recent distribution of saithe in the North-west area could make this a difficult strategy and having to avoid cod is an extra constraint on saithe fisheries.

Many captains complain that finding saithe is difficult and the changes in selection seen in last decade (Figure 8.15) indicates that the fleet is targeting much smaller saithe than before (mean weight at age of ages 3–5 is also very low in recent years). The observed change in selection pattern indicates that the larger saithe is less available to the trawl fisheries than before. The selection pattern observed since 2004 leads to 10% less yield per recruit compared to average selection of the time period.

Looking at the catches of trawlers divided into those that freeze the catch and those that land it fresh, 50% of the catch of saithe by trawlers is taken by the freezing vessels, 50% of redfish but only 20% of the cod catch (Figure 8.22). Freezing vessels are not required to catch the cod just before landing so some bycatch of cod is therefore not considered a problem there. The difference shown here could be an indication of the problem that the captains of the "fresh fish trawlers" are facing but "fresh fish trawlers" are majority of the trawlers.

Redfish is a species that has some effect on saithe fisheries. In recent years, catching redfish has been relatively easy as it can be found in very dense schools west of Iceland. Also, the distribution has changed so it is now abundant in the regions north-west of Iceland where cod and saithe is caught. Redfish is not a wanted bycatch in cod fisheries as it scratches the skin of the cod making it less valuable (less of a problem for freezing trawlers where the fish is unskinned). Therefore, the directed cod-fisheries are conducted with relatively large mesh size to get rid of most of redfish. A consequence is that bycatch of saithe is small as saithe in the area is relatively small. . Relatively low price of saithe in recent years makes the fisheries not profitable unless catch rates are reasonable

If the conclusions above are correct, lowering the target harvest rate to get better balance in mixed fisheries might be an option. The premises behind the HCR evaluations in 2013 were confirmed by ICES (2019a). The problem described is a mixed fisheries problem and does in the current system lead to as much as possible transfer of saithe quota to other species (haddock and redfish in recent years).

8.10 References

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Table 8.1. Saithe in Division 5.a. Nominal catch (t) by countries, as officially reported to ICES.

	Belgium	Faroes	France	Germany	Iceland	Norway	UK (E/W/NI)	UK (Scot)	UK	Total
1980	980	4930			52 436	1				58 347
1981	532	3545			54 921	3				59 001
1982	201	3582	23		65 124	1				68 931
1983	224	2138			55 904					58 266
1984	269	2044			60 406					62 719
1985	158	1778			55 135	1	29			57 101
1986	218	2291			63 867					66 376
1987	217	2139			78 175					80 531
1988	268	2596			74 383					77 247
1989	369	2246			79 796					82 411
1990	190	2905			95 032					98 127
1991	236	2690			99 811					102 737
1992	195	1570			77 832					79 597
1993	104	1562			69 982					71 648
1994	30	975		1	63 333					64 339
1995		1161		1	47 466	1				48 629
1996		803		1	39 297					40 101
1997		716			36 548					37 264
1998		997		3	30 531					31 531
1999		700		2	30 583	6	1	1		31 293
2000		228		1	32 914	1	2			33 146
2001		128		14	31 854	44	23			32 063
2002		366		6	41 687	3	7	2		42 071
2003		143		56	51 857	164			35	52 255
2004		214		157	62 614	1	105			63 091
2005		322		224	67 283	2			312	68 143
2006		415		33	75 197	2			16	75 663
2007		392			64 008	3			30	64 433

	Belgium	Faroes	France	Germany	Iceland	Norway	UK (E/W/NI)	UK (Scot)	UK	Total
2008		196			69 992	2				70 190
2009		269			61 391	3				61 663
2010		499			53 772	1				54 272
2011		735			50 386	2				51 123
2012		940			50 843					51 783
2013		925			57 077					58 002
2014		746			45 733	4				46 483
2015		499			47 973	3				48 473
2016		287			48 920	5				49 212
2017		261			48 786	4			4	49 057
2018		270			65 090					65 360

Table 8.2. Saithe in Division 5.a. Commercial catch at age (thousands).

Year	3	4	5	6	7	8	9	10	11	12+
1980	275	2540	5214	2596	2169	1341	387	262	155	209
1981	203	1325	3503	5404	1457	1415	578	242	61	417
1982	508	1092	2804	4845	4293	1215	975	306	59	129
1983	107	1750	1065	2455	4454	2311	501	251	38	18
1984	53	657	800	1825	2184	3610	844	376	291	546
1985	376	4014	3366	1958	1536	1172	747	479	74	166
1986	3108	1400	4170	2665	1550	1116	628	1549	216	95
1987	956	5135	4428	5409	2915	1348	661	496	498	133
1988	1318	5067	6619	3678	2859	1775	845	226	270	132
1989	315	4313	8471	7309	1794	1928	848	270	191	221
1990	143	1692	5471	10112	6174	1816	1087	380	151	168
1991	198	874	3613	6844	10772	3223	858	838	228	51
1992	242	2928	3844	4355	3884	4046	1290	350	196	125
1993	657	1083	2841	2252	2247	2314	3671	830	223	281
1994	702	2955	1770	2603	1377	1243	1263	2009	454	428

Year	3	4	5	6	7	8	9	10	11	12+
1995	1573	1853	2661	1807	2370	905	574	482	521	154
1996	1102	2608	1868	1649	835	1233	385	267	210	447
1997	603	2960	2766	1651	1178	599	454	125	95	234
1998	183	1289	1767	1545	1114	658	351	265	120	251
1999	989	732	1564	2176	1934	669	324	140	72	75
2000	850	2383	896	1511	1612	1806	335	173	57	57
2001	1223	2619	2184	591	977	943	819	186	94	69
2002	1187	4190	3147	2970	519	820	570	309	101	53
2003	2284	4363	6031	2472	1942	285	438	289	196	72
2004	952	7841	7195	5363	1563	1057	211	224	157	124
2005	2607	3089	7333	6876	3592	978	642	119	149	147
2006	1380	10051	2616	5840	4514	1989	667	485	118	229
2007	1244	6552	8751	2124	2935	1817	964	395	190	99
2008	1432	3602	5874	6706	1155	1894	1248	803	262	307
2009	2820	5166	2084	2734	2883	777	1101	847	555	373
2010	2146	6284	3058	997	1644	1571	514	656	522	409
2011	2004	4850	4006	1502	677	1065	1145	323	433	469
2012	1183	4816	3514	2417	903	432	883	1015	354	549
2013	1163	5538	6366	2963	1610	664	375	537	460	320
2014	668	3499	4867	2805	1276	725	347	241	312	401
2015	781	2712	6461	2917	1509	694	589	249	133	347
2016	1588	6230	2653	2838	1648	1059	526	337	148	131
2017	750	3333	7542	1806	1449	813	648	229	127	237
2018	689	6681	4267	7908	1446	962	455	258	192	175

Table 8.3. Saithe in Division 5.a. Mean weight at age (g) in the catches and in the spawning stock, with predictions in grey.

Year	3	4	5	6	7	8	9	10	11	12+
1980	1428	1983	2667	3689	5409	6321	7213	8565	9147	9979
1981	1585	2037	2696	3525	4541	6247	6991	8202	9537	9523
1982	1547	2194	3015	3183	5114	6202	7256	7922	8924	10021
1983	1530	2221	3171	4270	4107	5984	7565	8673	8801	9445
1984	1653	2432	3330	4681	5466	4973	7407	8179	8770	10520
1985	1609	2172	3169	3922	4697	6411	6492	8346	9401	10767
1986	1450	2190	2959	4402	5488	6406	7570	6487	9616	11080
1987	1516	1715	2670	3839	5081	6185	7330	8025	7974	10886
1988	1261	2017	2513	3476	4719	5932	7523	8439	8748	9823
1989	1403	2021	2194	3047	4505	5889	7172	8852	10170	11194
1990	1647	1983	2566	3021	4077	5744	7038	7564	8854	11284
1991	1224	1939	2432	3160	3634	4967	6629	7704	9061	9547
1992	1269	1909	2578	3288	4150	4865	6168	7926	8349	10181
1993	1381	2143	2742	3636	4398	5421	5319	7006	8070	9842
1994	1444	1836	2649	3512	4906	5539	6818	6374	8341	10388
1995	1370	1977	2769	3722	4621	5854	6416	7356	6815	8799
1996	1229	1755	2670	3802	4902	5681	7182	7734	9256	9601
1997	1325	1936	2409	3906	5032	6171	7202	7883	8856	9865
1998	1347	1972	2943	3419	4850	5962	6933	7781	8695	10043
1999	1279	2106	2752	3497	3831	5819	7072	8078	8865	10872
2000	1367	1929	2751	3274	4171	4447	6790	8216	9369	10443
2001	1280	1882	2599	3697	4420	5538	5639	7985	9059	10419
2002	1308	1946	2569	3266	4872	5365	6830	7067	9240	10190
2003	1310	1908	2545	3336	4069	5792	7156	8131	8051	10825
2004	1467	1847	2181	2918	4017	5135	7125	7732	8420	9547
2005	1287	1888	2307	2619	3516	5080	6060	8052	8292	8569
2006	1164	1722	2369	2808	3235	4361	6007	7166	8459	9583
2007	1140	1578	2122	2719	3495	4114	5402	6995	7792	9848

Year	3	4	5	6	7	8	9	10	11	12+
2008	1306	1805	2295	2749	3515	4530	5132	6394	7694	9589
2009	1412	1862	2561	3023	3676	4596	5651	6074	7356	9237
2010	1287	1787	2579	3469	4135	4850	5558	6289	6750	8785
2011	1175	1801	2526	3680	4613	5367	5685	6466	6851	7739
2012	1160	1668	2369	3347	4430	5486	6161	6448	7220	8236
2013	1056	1675	2219	3244	4529	5628	6397	7055	7378	8342
2014	1211	1575	2229	2983	4378	5598	6773	8023	7875	9020
2015	1072	1639	2141	3122	4262	5555	6633	7697	8269	8773
2016	1105	1468	2260	3071	4127	5272	6379	7247	8566	8969
2017	1282	1674	2199	3255	4314	5718	6361	7630	8590	9238
2018	1346	1724	2335	3005	4178	5319	6544	7773	8530	9324
2019	1244	1851	2381	3167	3978	5260	6507	7550	8562	9172
2020	1244	1851	2381	3167	3978	5260	6507	7550	8562	9172

Table 8.4. Saithe in Division 5.a. Maturity at age, with predictions in grey.

Year	3	4	5	6	7	8	9	10	11	12
1980	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1981	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1982	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1983	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1984	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1985	0	0.084	0.191	0.377	0.609	0.8	0.912	1	1	1
1986	0	0.075	0.172	0.349	0.58	0.78	0.901	1	1	1
1987	0	0.067	0.156	0.323	0.551	0.759	0.89	1	1	1
1988	0	0.061	0.143	0.301	0.525	0.74	0.88	1	1	1
1989	0	0.057	0.134	0.284	0.505	0.724	0.871	1	1	1
1990	0	0.054	0.128	0.273	0.491	0.713	0.865	1	1	1
1991	0	0.053	0.125	0.269	0.486	0.709	0.862	1	1	1
1992	0	0.053	0.127	0.272	0.489	0.711	0.864	1	1	1

Year	3	4	5	6	7	8	9	10	11	12
1993	0	0.056	0.132	0.281	0.502	0.721	0.869	1	1	1
1994	0	0.061	0.142	0.299	0.523	0.738	0.879	1	1	1
1995	0	0.068	0.158	0.326	0.554	0.762	0.892	1	1	1
1996	0	0.079	0.18	0.362	0.593	0.789	0.906	1	1	1
1997	0	0.093	0.208	0.403	0.634	0.817	0.92	1	1	1
1998	0	0.109	0.238	0.446	0.674	0.842	0.932	1	1	1
1999	0	0.125	0.269	0.486	0.709	0.862	0.942	1	1	1
2000	0	0.14	0.295	0.519	0.735	0.877	0.948	1	1	1
2001	0	0.151	0.315	0.541	0.752	0.886	0.953	1	1	1
2002	0	0.159	0.326	0.555	0.762	0.892	0.955	1	1	1
2003	0	0.162	0.331	0.56	0.766	0.894	0.956	1	1	1
2004	0	0.161	0.33	0.559	0.765	0.893	0.956	1	1	1
2005	0	0.156	0.323	0.551	0.759	0.89	0.954	1	1	1
2006	0	0.15	0.311	0.538	0.749	0.885	0.952	1	1	1
2007	0	0.141	0.298	0.522	0.737	0.878	0.949	1	1	1
2008	0	0.133	0.283	0.504	0.723	0.87	0.945	1	1	1
2009	0	0.125	0.269	0.487	0.709	0.862	0.942	1	1	1
2010	0	0.119	0.257	0.471	0.696	0.855	0.938	1	1	1
2011	0	0.113	0.248	0.458	0.685	0.848	0.935	1	1	1
2012	0	0.109	0.239	0.447	0.675	0.842	0.932	1	1	1
2013	0	0.105	0.231	0.436	0.666	0.837	0.929	1	1	1
2014	0	0.101	0.224	0.426	0.657	0.831	0.927	1	1	1
2015	0	0.097	0.217	0.416	0.647	0.825	0.924	1	1	1
2016	0	0.094	0.21	0.406	0.637	0.819	0.921	1	1	1
2017	0	0.09	0.203	0.396	0.627	0.812	0.918	1	1	1
2018	0	0.087	0.196	0.385	0.617	0.806	0.914	1	1	1
2019	0	0.083	0.189	0.375	0.607	0.799	0.911	1	1	1
2020	0	0.083	0.189	0.375	0.607	0.799	0.911	1	1	1

Table 8.5. Saithe in Division 5.a. Survey indices at age.

Year	2	3	4	5	6	7	8	9	10
1985	0.59	0.56	3.1	5.31	1.8	1.09	0.51	1.4	0.15
1986	2.3	2.46	2.15	2.2	1.49	0.65	0.3	0.19	0.33
1987	0.38	11.84	13.22	6.61	4.08	3.18	0.82	0.37	0.27
1988	0.31	0.47	2.74	2.85	1.75	0.98	0.41	0.07	0.08
1989	1.42	3.95	5.09	6.68	2.64	1.73	0.89	0.37	0.01
1990	0.73	1.32	4.96	6.42	12.51	3.37	1.23	0.65	0.12
1991	0.22	1.38	1.7	2.18	1.12	2.49	0.31	0.02	0.04
1992	0.14	0.91	5.91	5.67	2.84	2.69	1.93	0.28	0.06
1993	1.27	11.03	1.89	6.6	2.33	2.2	1.02	3.92	0.65
1994	0.83	0.72	1.96	1.79	2.07	0.72	1.13	1.2	2.76
1995	0.49	1.98	1.12	0.52	0.29	0.34	0.1	0.15	0.15
1996	0.13	0.49	3.78	1.16	1.03	0.59	0.98	0.06	0.09
1997	0.32	0.91	4.73	3.98	0.95	0.4	0.16	0.1	0.05
1998	0.13	1.66	2.36	2.55	1.27	0.72	0.3	0.09	0.07
1999	0.73	3.74	0.94	1.27	1.7	0.59	0.16	0.02	0.02
2000	0.38	2.01	2.55	0.61	0.86	0.54	0.45	0.08	0.03
2001	0.92	2.06	2.73	1.68	0.22	0.23	0.4	0.14	0.07
2002	1.02	2.23	3.01	3.11	2.19	0.42	0.47	0.32	0.22
2003	0.05	9.79	5.14	2.98	1.37	0.78	0.21	0.05	0.1
2004	0.9	1.39	9.6	6.27	4.52	1.52	0.84	0.17	0.17
2005	0.25	4.29	2.41	7.5	4.72	2.36	0.88	0.45	0.13
2006	0	2.19	6.76	1.98	8.86	3.5	1.21	0.29	0.25
2007	0.06	0.31	1.75	3.27	0.82	1.64	0.71	0.29	0.16
2008	0.08	2.26	1.81	2.88	4.05	0.62	0.79	0.34	0.15
2009	0.21	2.45	1.85	0.69	0.91	0.84	0.12	0.26	0.15
2010	0.07	1.24	5.07	2.55	0.64	0.61	0.47	0.07	0.12
2011	0.15	3.84	4.24	3.1	1.17	0.41	0.39	0.44	0.17
2012	0.02	1.77	12.01	6.75	2.76	0.63	0.17	0.38	0.5
2013	0.11	4.28	7.57	6.85	4.67	2.58	1.12	0.3	0.43

Year	2	3	4	5	6	7	8	9	10
2014	0.03	0.39	3.89	3.74	2.02	0.87	0.42	0.15	0.11
2015	0.04	1.08	1.93	3.22	1.73	0.82	0.72	0.66	0.43
2016	0.05	3.17	16.21	2.75	2.27	1.08	0.53	0.44	0.28
2017	0.02	1.48	6.67	14.64	3.03	1.68	0.87	0.45	0.3
2018	0.03	0.5	17.92	10.5	15.28	1.51	0.84	0.43	0.32
2019	0.08	4.28	1.32	3.54	2.62	4.07	0.82	0.61	0.14

Table 8.6. Saithe in Division 5.a. Main population estimates.

Year	B4+	SSB	N3	Yield	f4–9	HR
1980	28210	114574	57659	0.29	313263	0.184
1981	20215	121587	57548	0.26	305881	0.211
1982	21622	138852	67865	0.30	295653	0.204
1983	32174	138753	56504	0.24	271130	0.218
1984	41940	141438	60405	0.23	288318	0.194
1985	35338	139662	53728	0.24	300524	0.204
1986	67264	137368	65230	0.28	319527	0.236
1987	91330	128380	80237	0.35	336509	0.233
1988	50688	124868	77244	0.32	416394	0.194
1989	32076	128338	82339	0.31	399025	0.232
1990	20839	135750	97537	0.35	378560	0.266
1991	29486	146130	102201	0.37	337469	0.258
1992	14856	138416	79568	0.37	289030	0.257
1993	19906	115082	71539	0.40	231581	0.286
1994	17760	95670	63559	0.45	188323	0.284
1995	30027	71668	48296	0.46	154144	0.275
1996	25850	62809	39352	0.40	150511	0.25
1997	17052	63579	36671	0.36	157996	0.207
1998	8785	69407	30657	0.29	156077	0.198
1999	30864	73483	30898	0.30	134468	0.239

Year	B4+	SSB	N3	Yield	f4–9	HR
2000	31727	75022	32751	0.32	145679	0.219
2001	54789	81383	31570	0.27	166197	0.232
2002	64134	98699	41969	0.29	224644	0.218
2003	72479	123285	52306	0.28	286223	0.212
2004	25767	145222	64668	0.25	327475	0.206
2005	72717	157128	69054	0.28	293192	0.25
2006	41955	165478	75462	0.30	318755	0.213
2007	18677	160215	64261	0.28	289520	0.234
2008	26428	157105	69426	0.32	258675	0.245
2009	38860	143853	60266	0.30	232621	0.241
2010	37386	132068	53853	0.27	231651	0.224
2011	45428	123631	50769	0.25	236153	0.216
2012	42982	119976	51252	0.25	243010	0.228
2013	45569	121852	57522	0.28	252581	0.196
2014	31669	123148	45538	0.21	255314	0.186
2015	100205	132147	48476	0.198	259558	0.189
2016	50685	147152	49223	0.178	337685	0.145
2017	60378	173493	49054	0.141	386219	0.156
2018	19149	203216	65583	0.170	434032	0.178
2019	65713	224932			410428	
Average	39574	127370	58770	0.29	275349	0.221

Table 8.7. Saithe in Division 5.a. Stock in numbers. Shaded area is input to prediction.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1980	32.3	24.7	28.2	46.9	31	10.3	8.2	3.7	1.3	0.7	0.7	0.5	0.3	0.1
1981	48	26.4	20.2	22.7	35.3	21.3	6.3	4.7	2	0.7	0.4	0.4	0.3	0.2
1982	62.6	39.3	21.6	16.3	17.2	24.7	13.4	3.7	2.6	1.1	0.4	0.2	0.2	0.2
1983	52.7	51.2	32.2	17.4	12.2	11.8	14.9	7.5	2	1.4	0.6	0.2	0.1	0.1
1984	100.3	43.2	41.9	26	13.3	8.7	7.6	9.1	4.3	1.1	0.8	0.4	0.1	0.1
1985	136.2	82.2	35.3	33.9	19.9	9.5	5.6	4.7	5.3	2.6	0.7	0.5	0.2	0.1
1986	75.6	111.6	67.3	28.5	25.9	14.1	6.1	3.4	2.6	3.1	1.5	0.4	0.3	0.1
1987	47.9	61.9	91.3	54.2	21.5	17.8	8.7	3.5	1.8	1.5	1.7	0.9	0.2	0.2
1988	31.1	39.2	50.7	73.3	40.1	14.3	10.3	4.6	1.7	0.9	0.7	0.9	0.5	0.1
1989	44	25.5	32.1	40.8	54.7	27	8.5	5.7	2.3	0.9	0.5	0.4	0.5	0.3
1990	22.2	36	20.8	25.8	30.5	37.2	16.3	4.7	2.9	1.3	0.5	0.3	0.2	0.3
1991	29.7	18.1	29.5	16.7	19.1	20.2	31.4	8.7	2.3	1.5	0.6	0.3	0.1	0.1
1992	26.5	24.3	14.9	23.6	12.3	12.5	11.4	16.2	4.1	1.1	0.7	0.3	0.1	0.1
1993	44.8	21.7	19.9	11.9	17.4	8.1	7.1	5.9	7.7	2	0.5	0.4	0.2	0.1
1994	38.6	36.7	17.8	15.9	8.7	11.2	4.4	3.6	2.7	3.7	0.9	0.3	0.2	0.1
1995	25.4	31.6	30	14.2	11.5	5.4	5.9	2.1	1.5	1.2	1.5	0.4	0.1	0.1
1996	13.1	20.8	25.8	24	10.2	7.1	2.8	2.7	0.9	0.7	0.5	0.7	0.2	0.1

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1997	46	10.7	17.1	20.7	17.5	6.5	3.9	1.4	1.2	0.4	0.3	0.3	0.4	0.1
1998	47.3	37.7	8.8	13.5	14.7	11.4	3.9	2.1	0.7	0.6	0.2	0.1	0.1	0.2
1999	81.7	38.8	30.9	7	9.8	10	7.3	2.3	1.1	0.4	0.3	0.1	0.1	0.1
2000	95.7	66.9	31.7	24.5	5.1	6.6	6.3	4.2	1.2	0.6	0.2	0.2	0.1	0
2001	108.1	78.3	54.8	25.2	17.7	3.4	4.1	3.6	2.2	0.6	0.3	0.1	0.1	0
2002	38.4	88.5	64.1	43.7	18.5	12.2	2.2	2.5	2	1.2	0.3	0.2	0.1	0.1
2003	108.5	31.5	72.5	51	31.8	12.6	7.8	1.3	1.3	1.1	0.6	0.2	0.1	0
2004	62.6	88.8	25.8	57.7	37.3	21.7	8.1	4.6	0.7	0.7	0.6	0.3	0.1	0.1
2005	27.9	51.2	72.7	20.3	39.1	23.4	13.4	5.1	2.9	0.4	0.4	0.3	0.2	0.1
2006	39.4	22.8	42	57.1	13.5	24	14.1	8.2	3.2	1.8	0.3	0.3	0.2	0.1
2007	58	32.3	18.7	32.9	37.4	8.1	14	8.4	5	1.9	1	0.1	0.1	0.1
2008	55.8	47.5	26.4	14.7	21.9	22.9	4.9	8.6	5.3	3.1	1.1	0.6	0.1	0.1
2009	67.8	45.7	38.9	20.6	9.5	12.8	13.1	2.9	5.2	3.1	1.8	0.6	0.3	0
2010	64.1	55.5	37.4	30.4	13.5	5.6	7.5	7.8	1.7	3.1	1.8	1	0.3	0.2
2011	68	52.5	45.4	29.4	20.3	8.3	3.4	4.6	4.9	1.1	1.8	1	0.6	0.2
2012	47.2	55.7	43	35.8	19.9	12.7	5.1	2.1	2.9	3.1	0.7	1.1	0.6	0.3
2013	149.5	38.7	45.6	33.9	24.3	12.5	7.9	3.2	1.4	1.8	1.9	0.4	0.6	0.4
2014	75.6	122.4	31.7	35.8	22.6	14.9	7.5	4.8	2	0.8	1.1	1.1	0.2	0.4

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2015	90.1	61.9	100.2	25.1	25.1	14.9	9.7	5	3.2	1.3	0.5	0.7	0.7	0.1
2016	28.6	73.7	50.7	79.7	17.8	16.7	9.7	6.4	3.3	2.1	0.9	0.3	0.4	0.4
2017	98	23.4	60.4	40.4	57.1	12.1	11.2	6.6	4.4	2.3	1.4	0.6	0.2	0.3
2018	53.4	80.3	19.1	48.4	29.8	40.3	8.4	7.9	4.7	3.1	1.6	1	0.4	0.2
2019	53.2	43.7	65.7	15.3	34.9	20.4	27.2	5.8	5.5	3.2	2.1	1	0.6	0.3
2020	53.2	43.6	35.8	52	10.5	22.5	12.9	17.6	3.8	3.5	2	1.3	0.6	0.4
2021	53.2	43.6	35.7	28.3	35.8	6.8	14.2	8.3	11.5	2.4	2.2	1.2	0.8	0.4

Table 8.8. Saithe in Division 5.a. Fishing mortality rate. Shaded areas show predictions i.e where catches are unknown.

Year	3	4	5	6	7	8	9	10	11	12	13	14
1980	0.016	0.085	0.177	0.293	0.362	0.434	0.403	0.434	0.337	0.356	0.356	0.35
1981	0.015	0.076	0.158	0.262	0.323	0.388	0.36	0.388	0.301	0.318	0.318	0.318
1982	0.017	0.088	0.183	0.303	0.373	0.448	0.415	0.448	0.347	0.367	0.367	0.367
1983	0.014	0.07	0.146	0.243	0.299	0.359	0.333	0.359	0.278	0.294	0.294	0.294
1984	0.013	0.067	0.14	0.231	0.285	0.342	0.318	0.342	0.265	0.28	0.28	0.28
1985	0.014	0.071	0.148	0.245	0.302	0.363	0.337	0.363	0.281	0.297	0.297	0.297
1986	0.016	0.082	0.171	0.283	0.348	0.418	0.388	0.418	0.324	0.342	0.342	0.342
1987	0.02	0.102	0.212	0.352	0.434	0.521	0.483	0.521	0.403	0.426	0.426	0.426
1988	0.018	0.094	0.195	0.323	0.398	0.478	0.443	0.478	0.37	0.391	0.391	0.391
1989	0.017	0.089	0.185	0.307	0.378	0.454	0.421	0.454	0.352	0.372	0.372	0.372
1990	0.019	0.101	0.211	0.35	0.431	0.518	0.48	0.518	0.401	0.424	0.424	0.424
1991	0.021	0.108	0.226	0.374	0.461	0.554	0.514	0.554	0.429	0.454	0.454	0.454
1992	0.02	0.106	0.221	0.366	0.452	0.542	0.503	0.542	0.42	0.444	0.444	0.444
1993	0.022	0.115	0.239	0.397	0.489	0.587	0.545	0.587	0.455	0.481	0.481	0.481
1994	0.025	0.13	0.271	0.45	0.555	0.666	0.617	0.666	0.516	0.545	0.545	0.545
1995	0.026	0.133	0.277	0.459	0.565	0.679	0.629	0.679	0.526	0.556	0.556	0.556
1996	0.022	0.116	0.241	0.4	0.493	0.592	0.549	0.592	0.459	0.485	0.485	0.485
1997	0.035	0.144	0.229	0.309	0.411	0.513	0.548	0.52	0.525	0.476	0.476	0.476

Year	3	4	5	6	7	8	9	10	11	12	13	14
1998	0.029	0.116	0.186	0.25	0.333	0.415	0.444	0.421	0.425	0.385	0.385	0.385
1999	0.03	0.121	0.193	0.26	0.346	0.432	0.462	0.438	0.443	0.401	0.401	0.401
2000	0.031	0.127	0.203	0.274	0.364	0.455	0.486	0.461	0.466	0.422	0.422	0.422
2001	0.026	0.107	0.17	0.23	0.305	0.381	0.407	0.386	0.39	0.354	0.354	0.354
2002	0.029	0.116	0.186	0.25	0.332	0.415	0.443	0.421	0.425	0.385	0.385	0.385
2003	0.028	0.114	0.182	0.245	0.325	0.406	0.434	0.412	0.416	0.377	0.377	0.377
2004	0.038	0.189	0.265	0.283	0.263	0.246	0.265	0.289	0.319	0.33	0.33	0.33
2005	0.041	0.207	0.29	0.311	0.288	0.27	0.291	0.316	0.35	0.361	0.361	0.361
2006	0.044	0.223	0.313	0.336	0.312	0.292	0.314	0.342	0.378	0.391	0.391	0.391
2007	0.041	0.206	0.289	0.31	0.288	0.269	0.29	0.315	0.349	0.36	0.36	0.36
2008	0.048	0.239	0.335	0.359	0.333	0.312	0.336	0.365	0.404	0.417	0.417	0.417
2009	0.045	0.226	0.317	0.34	0.315	0.295	0.318	0.346	0.382	0.395	0.395	0.395
2010	0.041	0.205	0.287	0.308	0.286	0.267	0.288	0.313	0.346	0.358	0.358	0.358
2011	0.038	0.19	0.267	0.286	0.266	0.249	0.268	0.292	0.322	0.333	0.333	0.333
2012	0.037	0.187	0.262	0.281	0.261	0.244	0.263	0.286	0.316	0.327	0.327	0.327
2013	0.041	0.206	0.289	0.31	0.288	0.269	0.29	0.316	0.349	0.361	0.361	0.361
2014	0.031	0.155	0.218	0.233	0.217	0.203	0.218	0.238	0.263	0.271	0.271	0.271
2015	0.029	0.148	0.208	0.223	0.207	0.194	0.208	0.227	0.251	0.259	0.259	0.259

Year	3	4	5	6	7	8	9	10	11	12	13	14
2016	0.027	0.133	0.187	0.2	0.186	0.174	0.188	0.204	0.226	0.233	0.233	0.233
2017	0.021	0.106	0.148	0.159	0.148	0.138	0.149	0.162	0.179	0.185	0.185	0.185
2018	0.025	0.127	0.179	0.192	0.178	0.167	0.179	0.195	0.216	0.223	0.223	0.223
2019	0.034	0.171	0.24	0.257	0.239	0.224	0.241	0.262	0.289	0.299	0.299	0.299
2020	0.034	0.172	0.242	0.259	0.241	0.225	0.243	0.264	0.292	0.301	0.301	0.301

Table 8.9. Saithe in Division 5.a. Output from short-term projections.

2019						
B4+	SSB	F_{bar}	Landings			
410	225	0.23	83			
2020				**2021**		
B4+	SSB	F_{bar}	Landings	B4+	SSB	Rationale
426	232	0.23	83	393	225	20% HCR

20% HCR = average between 0.2 B4+ (current year) and last year's TAC.

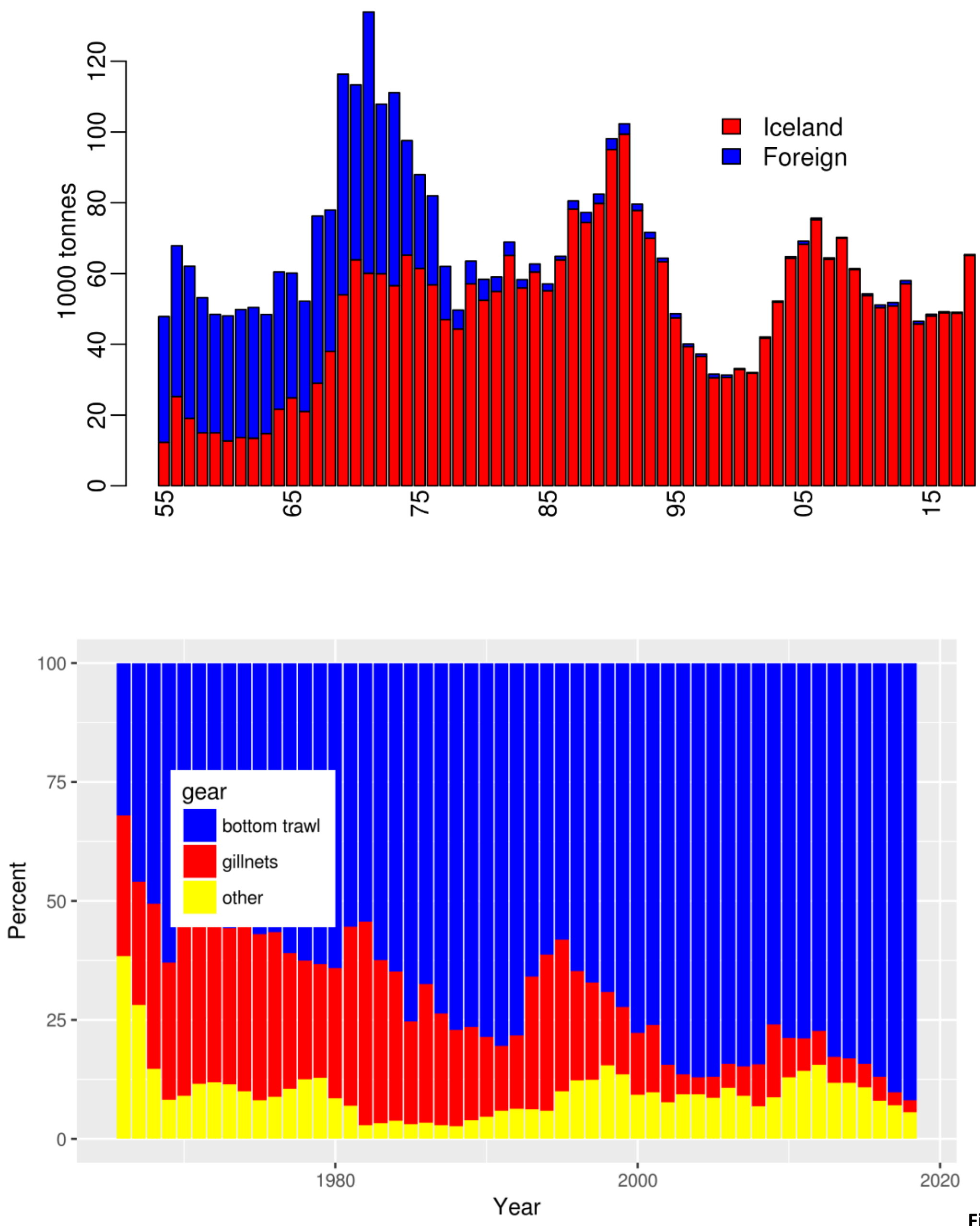

Figure 8.1 Saithe in Division 5.a. Total landings and percent by gear.

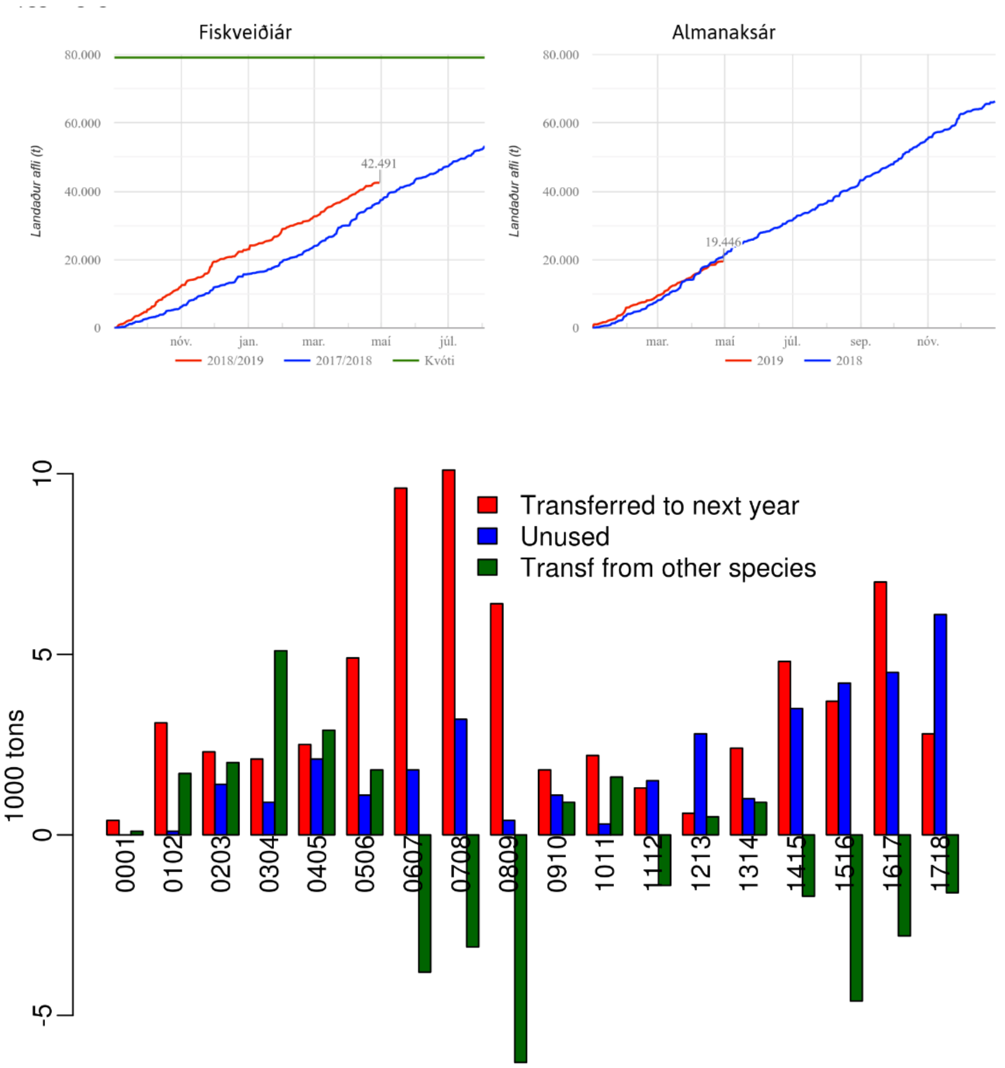

Figure 8.2 Saithe in Division 5.a. Upper figure. Cumulative landings in the current fishing year (left) and calendar year (right). The vertical (green line) in the left figure shows the quota for the current fishing year. Lower figure. Transfer of quota to next fishing year, unused quota and transfer from other species (negative transfer from other species means transfer to other species).

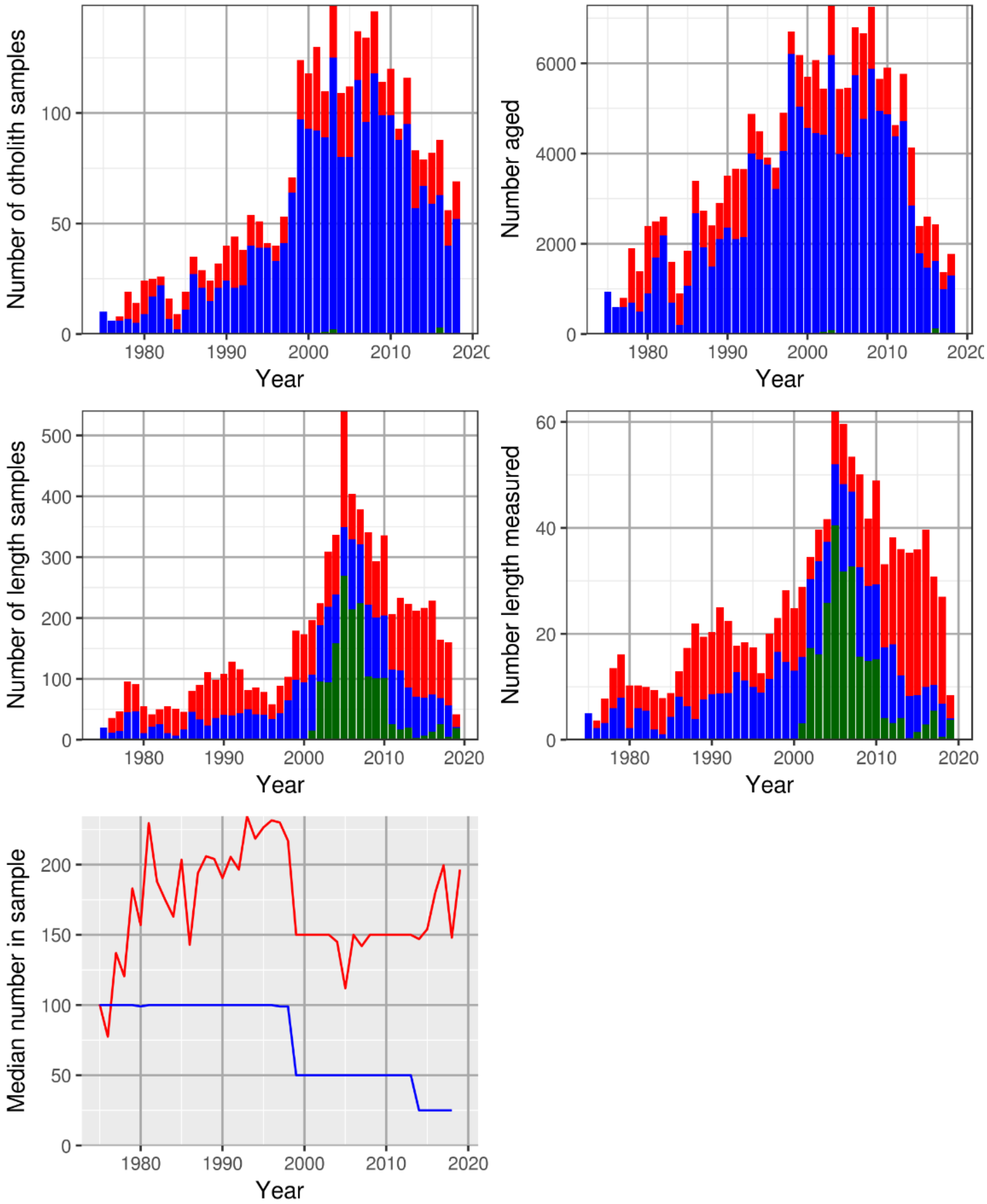

Figure 8.3 Saithe in Division 5.a. Development of sampling intensity from catches.

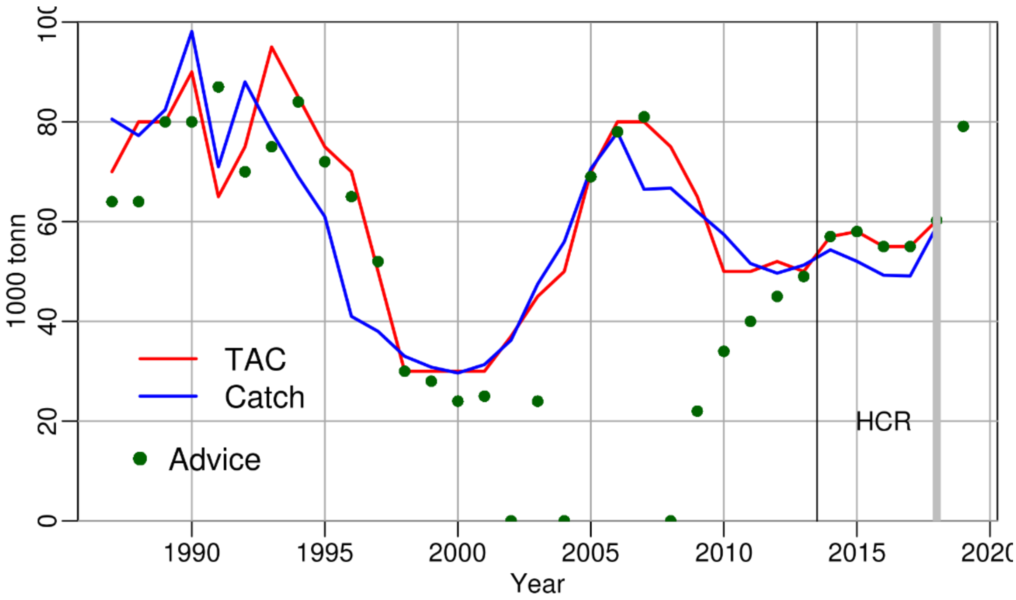

Figure 8.4. Advice, TAC and catch of saithe since 1987.

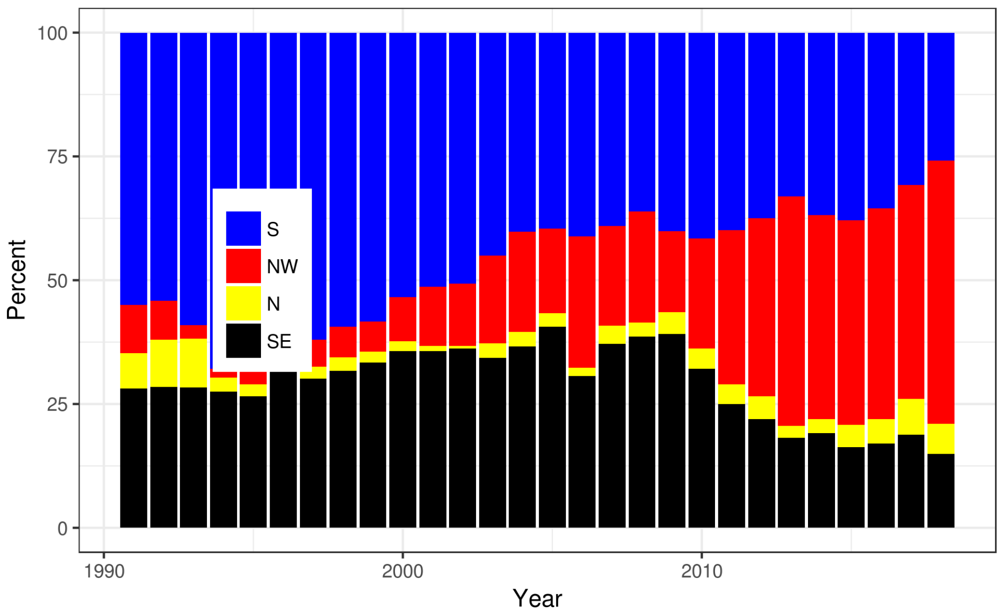

Figure 8.5 Saithe in Division 5.a. Percent of landings by regions defined in Figure 8.4.

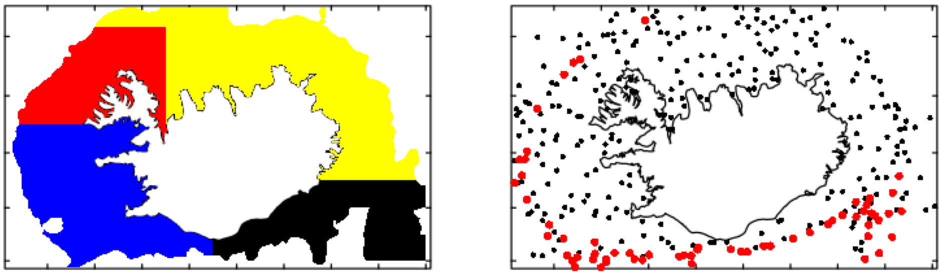

Figure 8.6 Saithe in Division 5.a. Left, definitions of regions used in figures 8.3 and 8.6. Right, stations added in the autumn survey in 2000 (red dots).

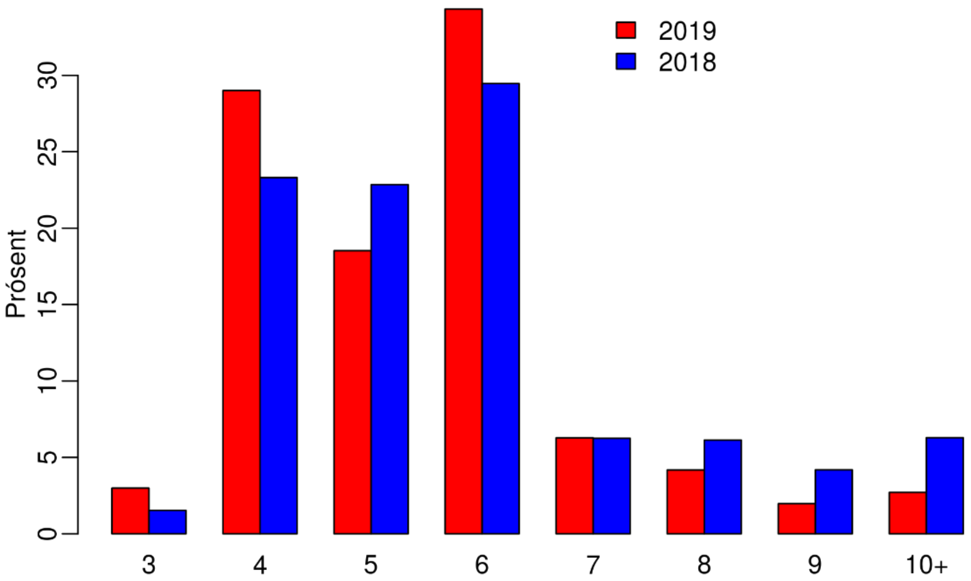

Figure 8.7. Catch in numbers 2018 compared to last year's prediction.

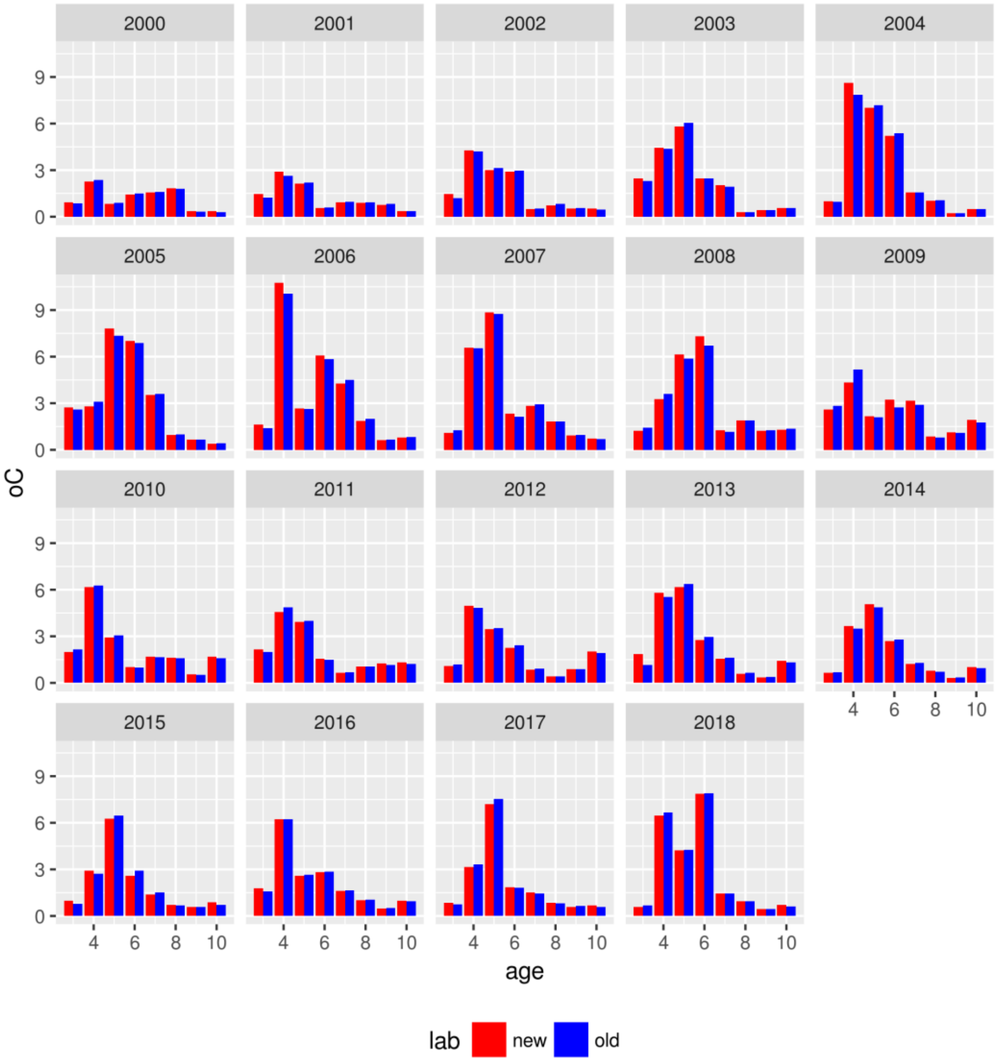

Figure 8.8. Catch in numbers 2000–2018 compiled by 1 region and 1 time interval (old) compared to catch in numbers compiled by 2 regions and 2 time interval (new) . The regions are shown in Figure 8.6, north red and yellow and south blue and black.

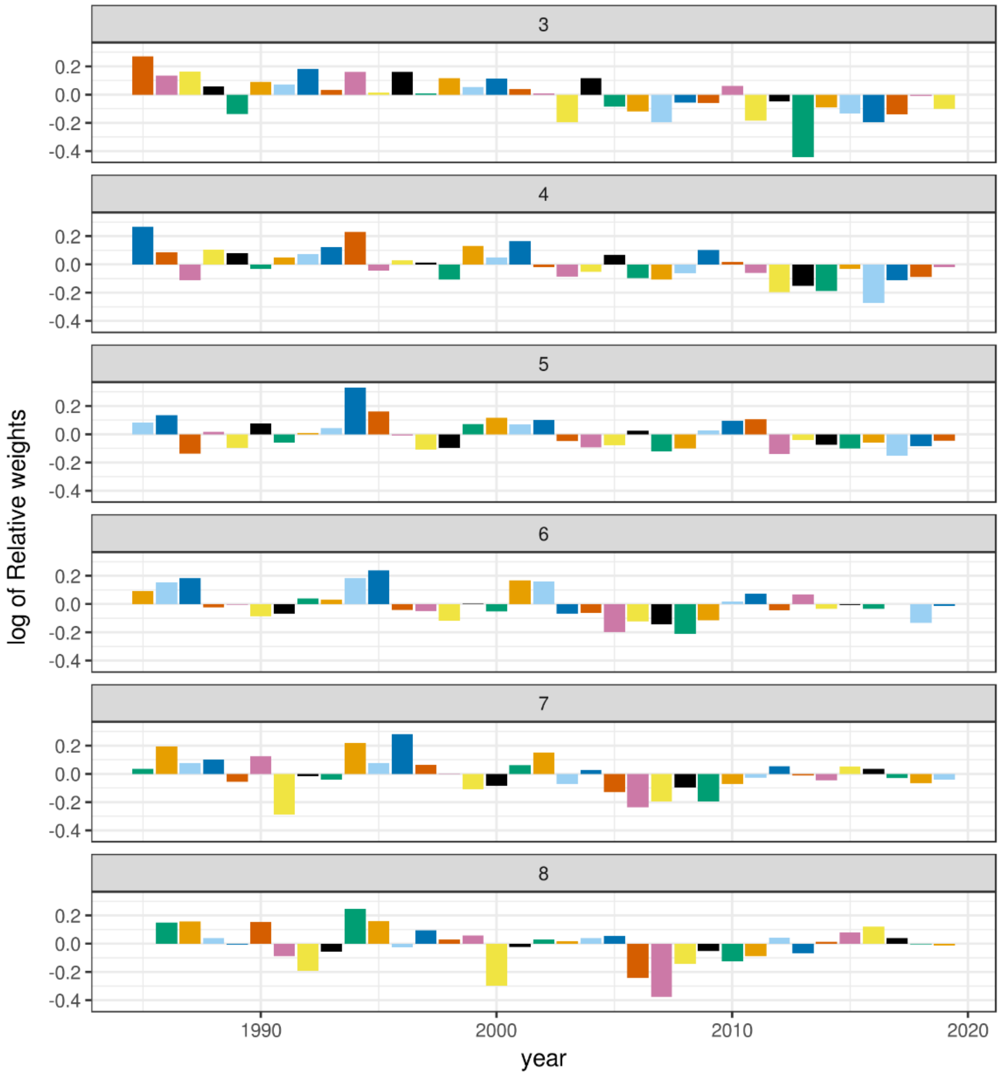

Figure 8.9 Saithe in Division 5.a. Weight at age in the survey, as relative deviations from the mean.

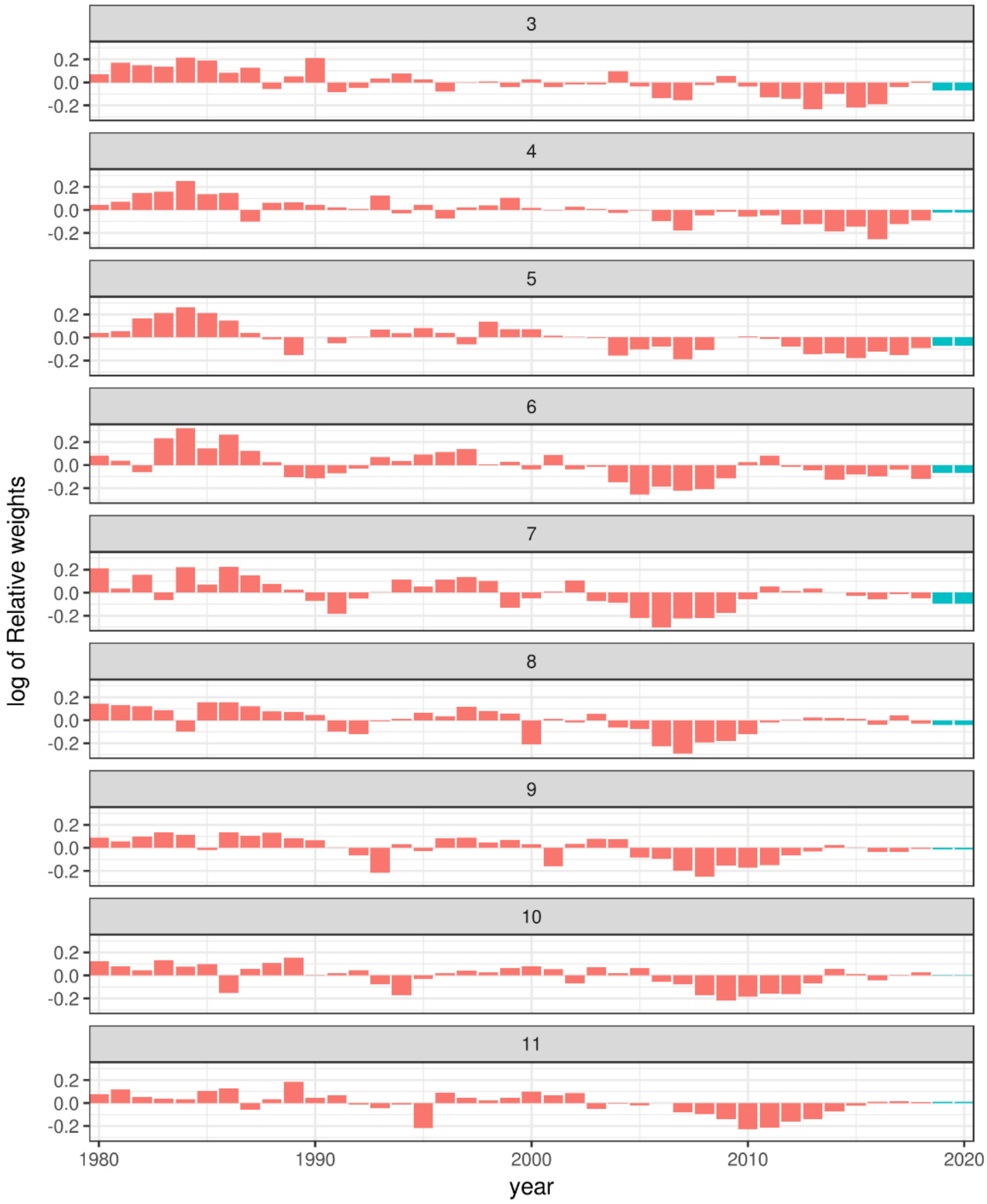

Figure 8.10. Saithe in Division 5.a. Weight at age in the catches, as relative deviations from the mean. Blue bars show prediction.

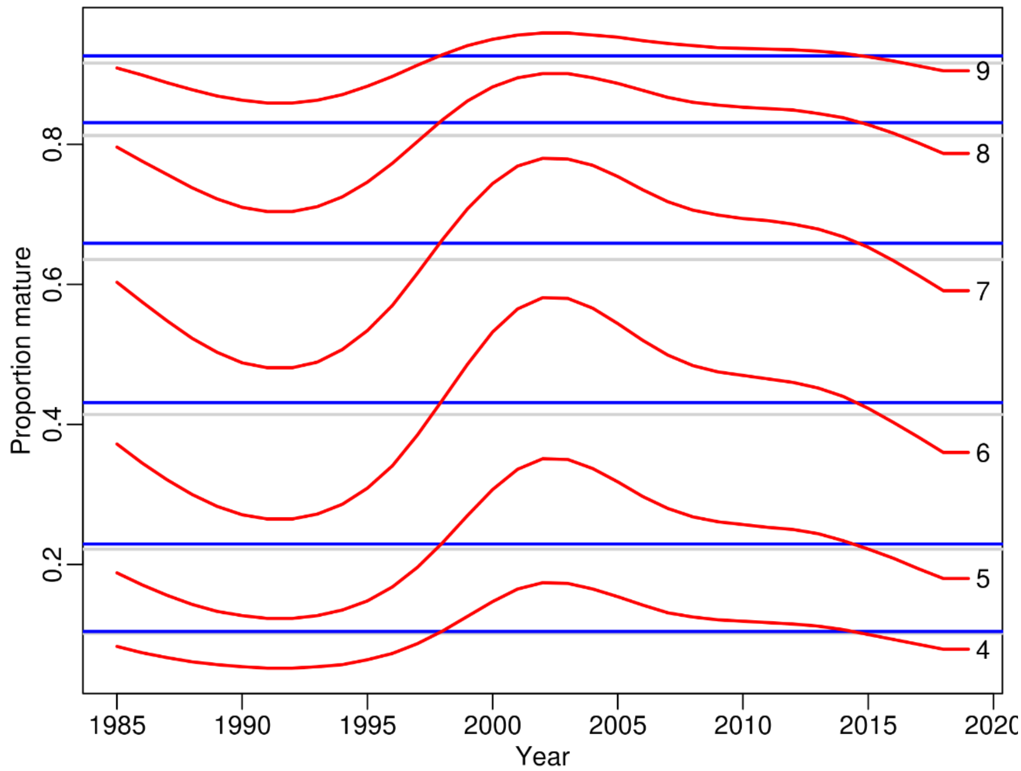

Figure 8.11 Saithe in Division 5.a. Maturity at age used for calculating the SSB. The horizontal lines show the average of last 10 years (blue one) and he average since 1985.

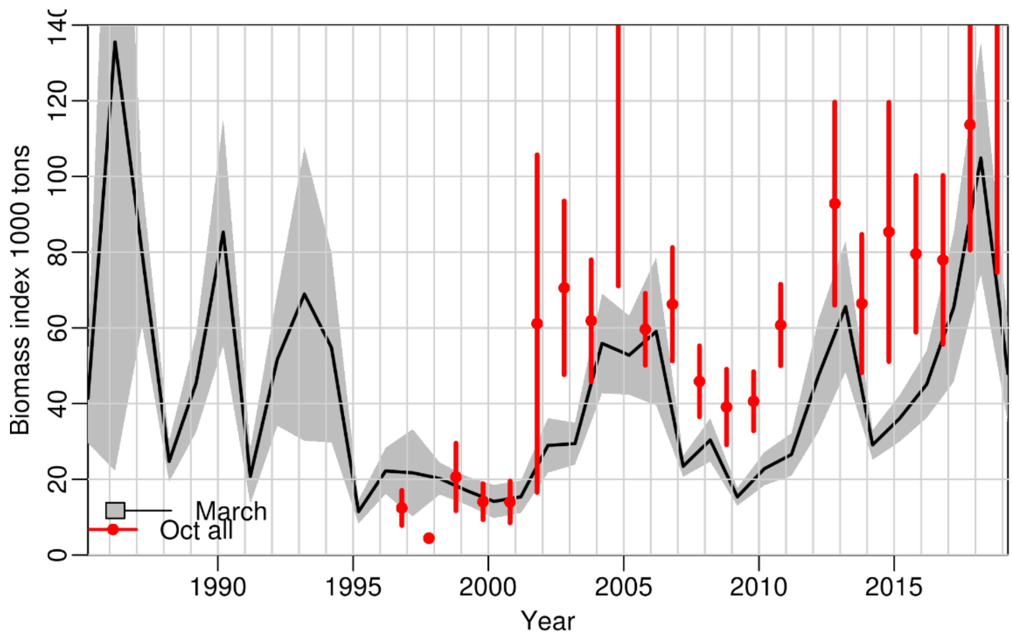

Figure 8.12 Saithe in Division 5.a. Biomass index from the groundfish surveys in March and October.

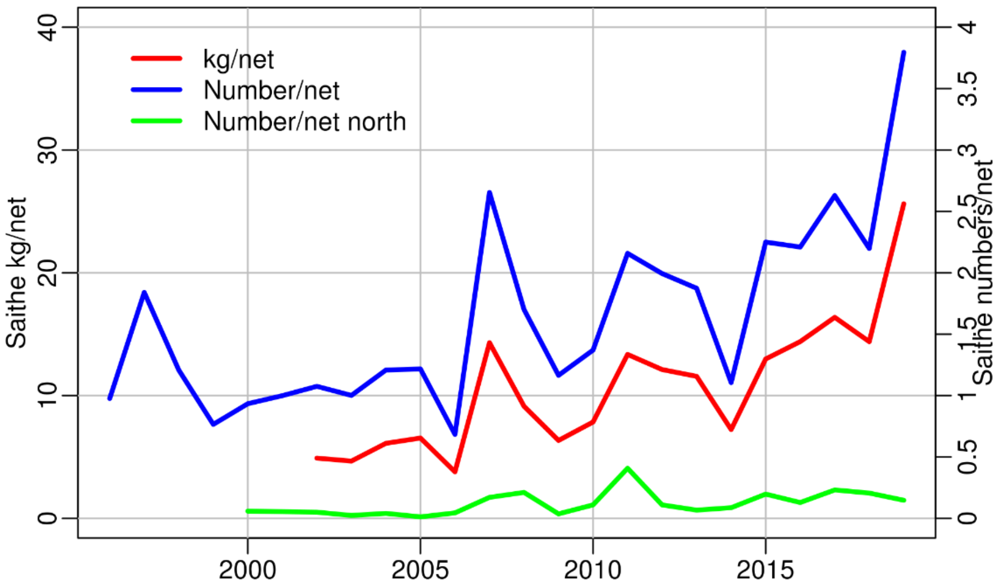

Figure 8.13 Saithe in Division 5.a. Indices from the gillnet survey in April 1996–2018. Saithe was not length measured in the survey before 2002 so catch in kg cannot be compiled. (add 2018)

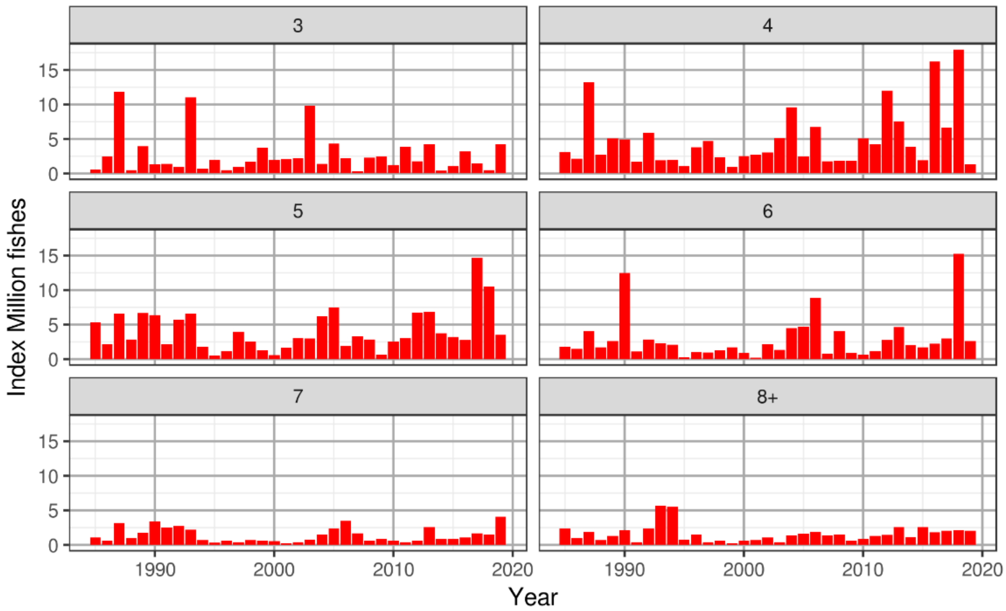

Figure 8.14 Saithe in Division 5.a. Survey indices by age from the spring survey.

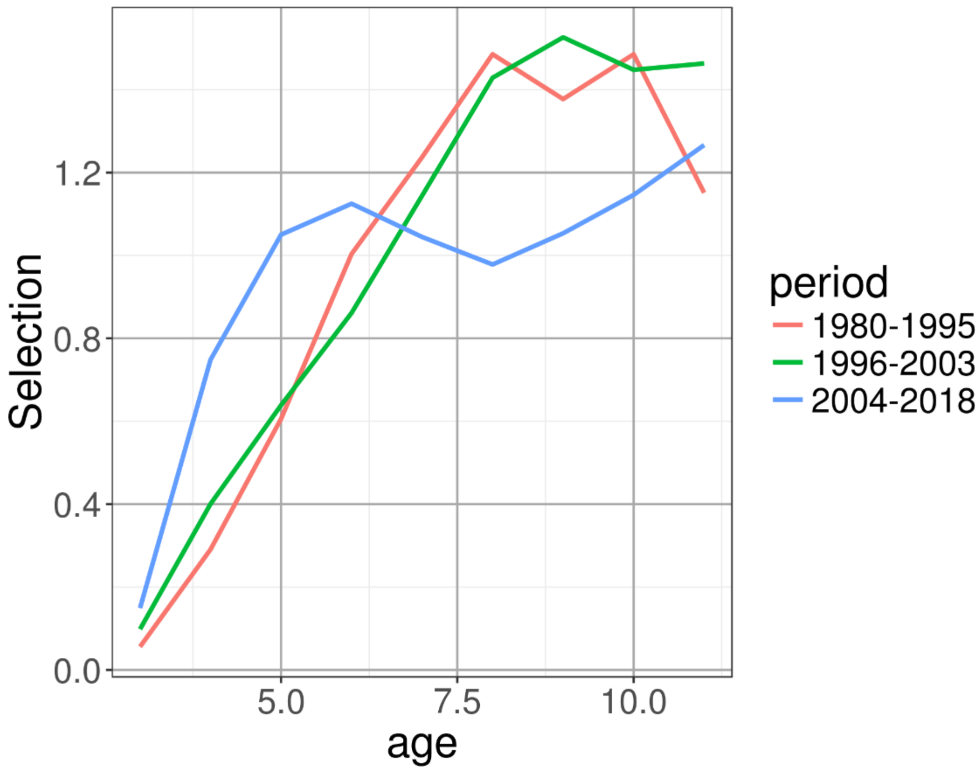

Figure 8.15. Estimated selectivity patterns for the 3 periods, 1980–1996, 1997–2003 and 2014–2016.

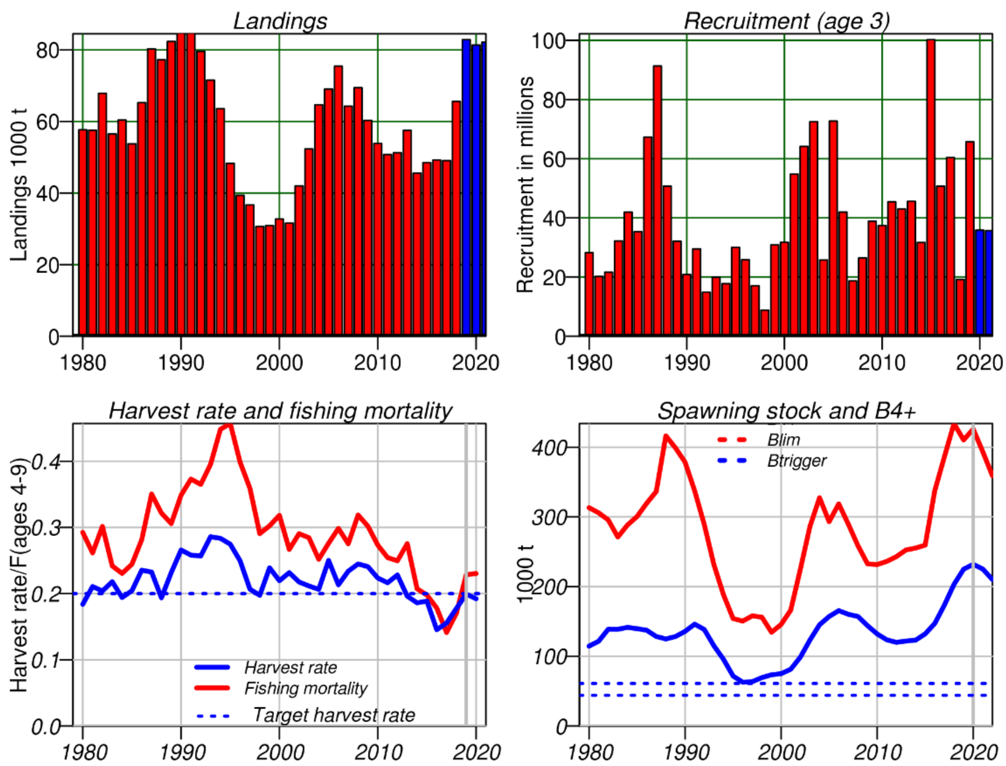

Figure 8.16. Saithe in Division 5.a. Results from the fitted model and short-term forecast. The red line indicates the time of the current assessment.

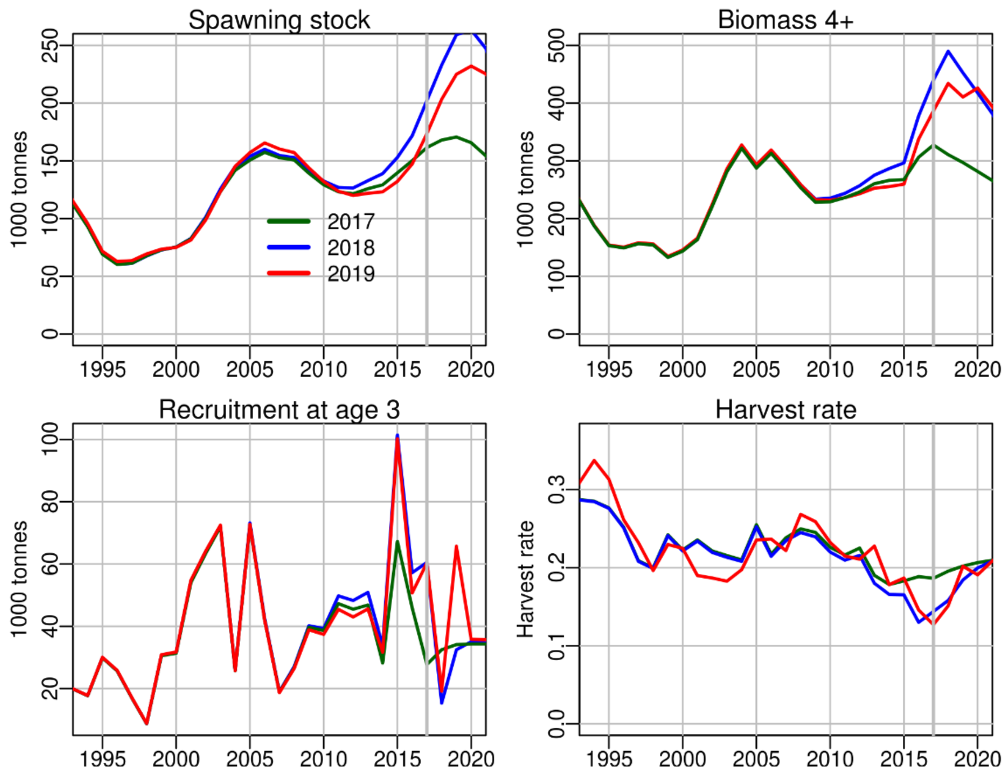

Figure 8.17. Saithe in Division 5.a. Comparison of this year's assessment and short term forecast with results from two earlier years.

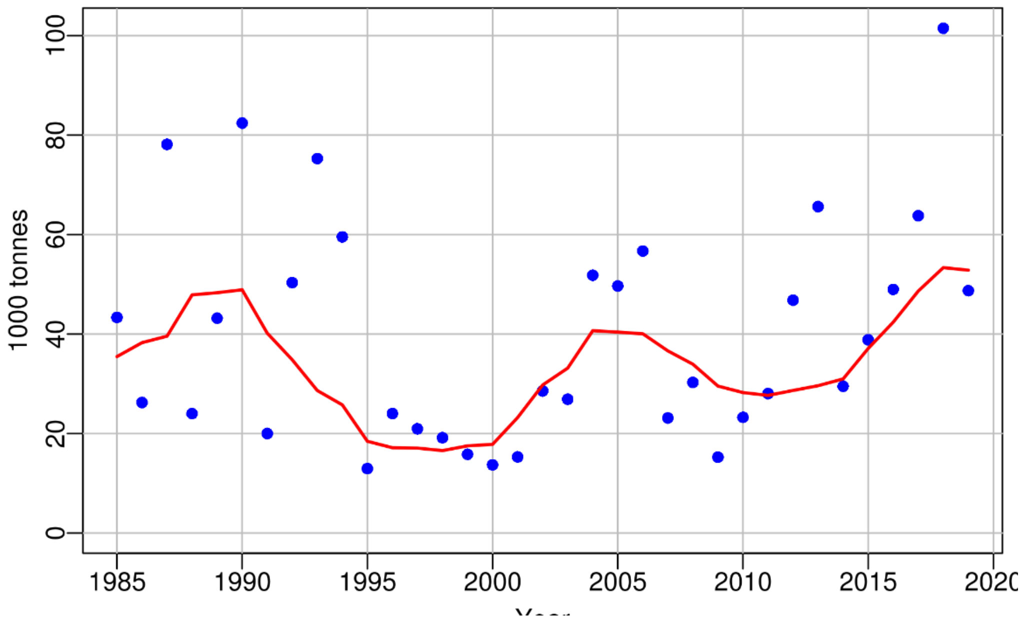

Figure 8.18. Saithe in Division 5.a. Observed and predicted survey biomass from the "SPALY model".

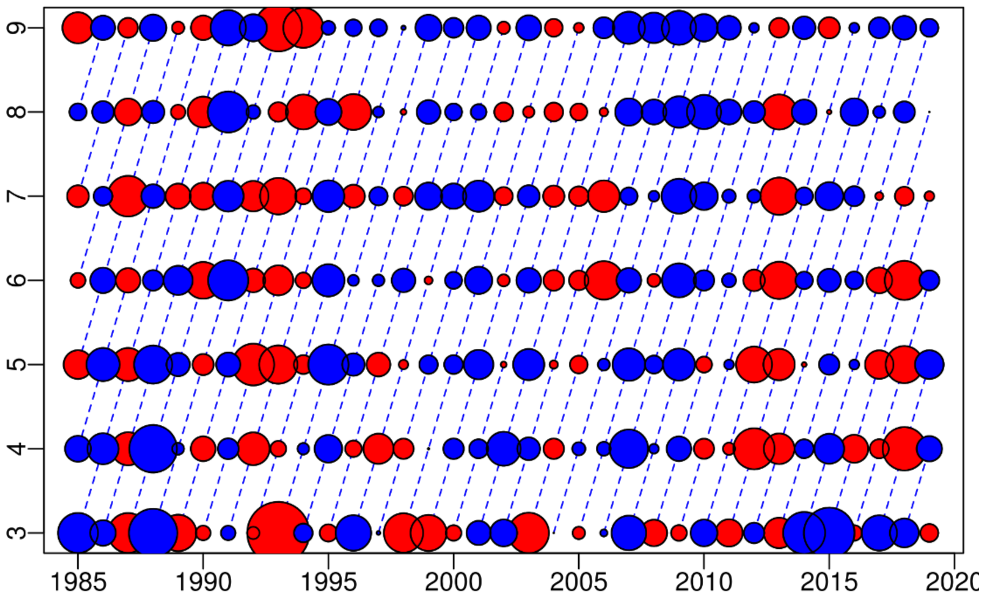

Figure 8.19. Saithe in Division 5.a. Survey residuals from the "SPALY model".

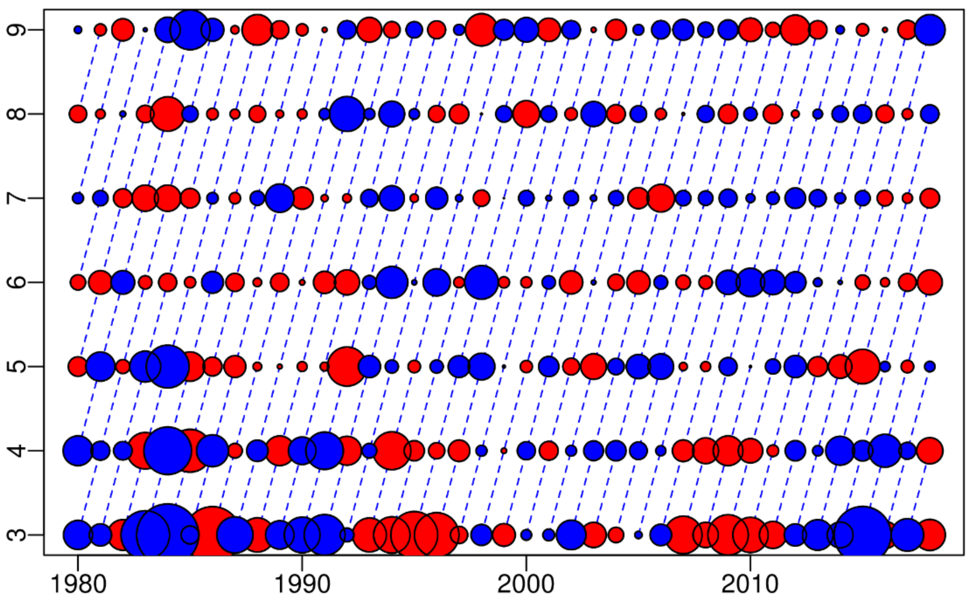

Figure 8.20. Saithe in Division 5.a. Catch residuals from the "SPALY model".

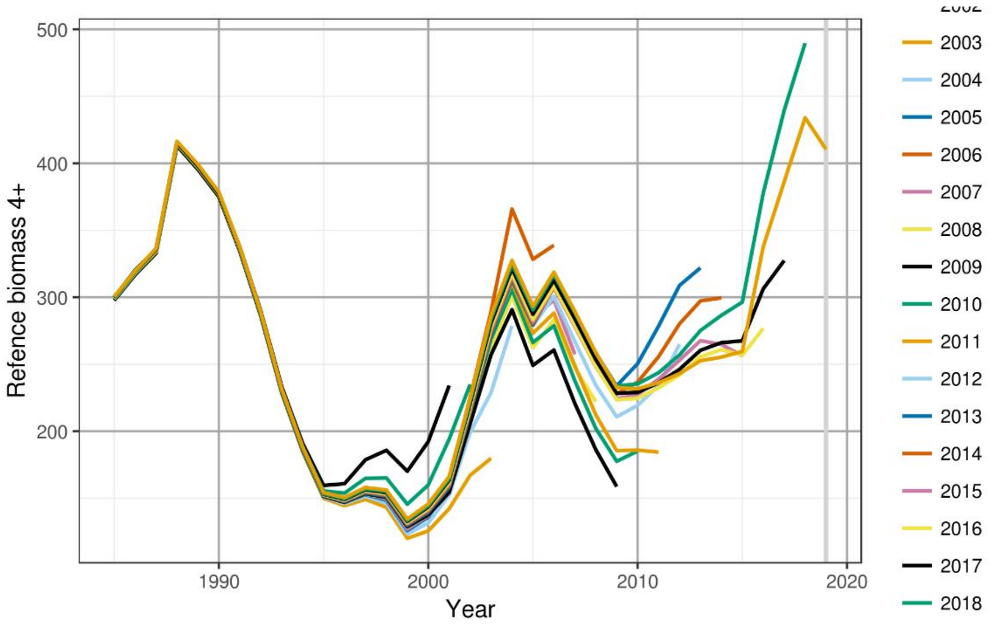

Figure 8.21. Saithe in Division 5.a. Retrospective pattern for the assessment model. The figure shows estimate of B4+. The grey vertical lines shows the year 2018.

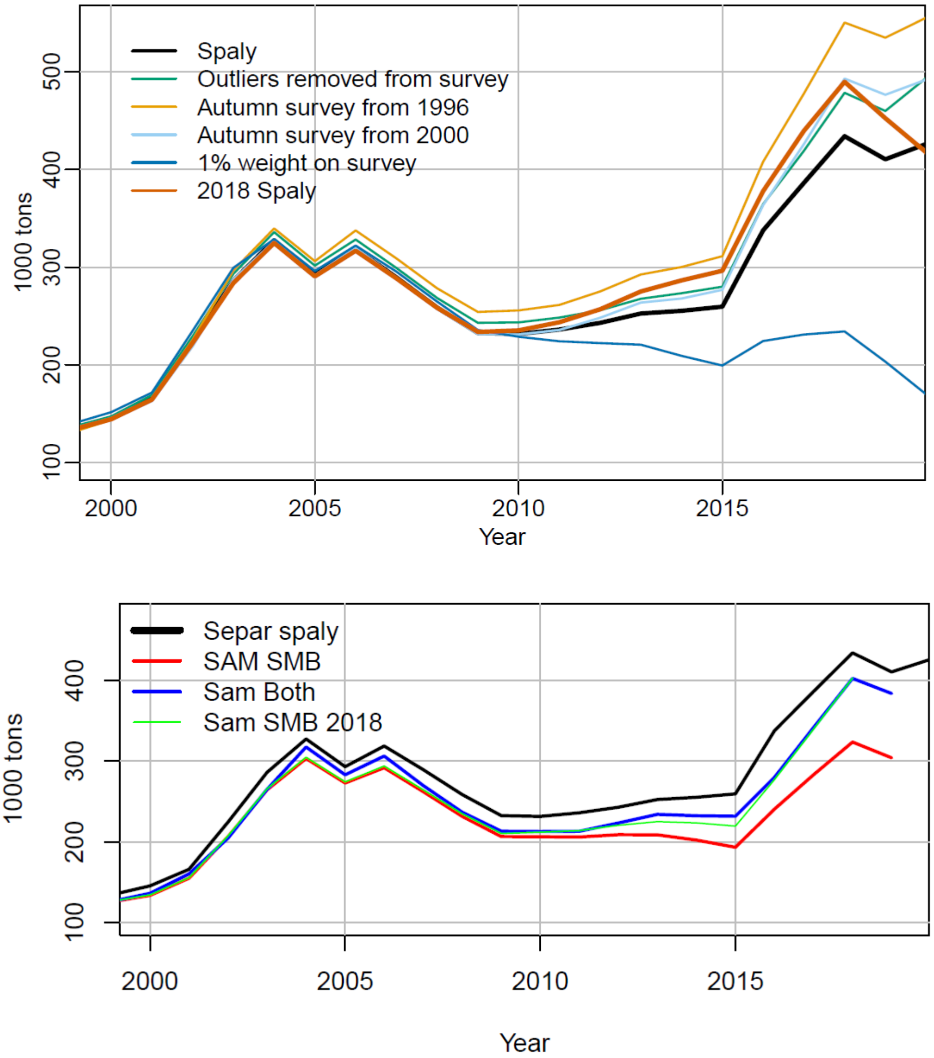

Figure 8.20. Saithe in Division 5.a. Comparison between the default separable model (Muppet) and alternative assessment model settings.

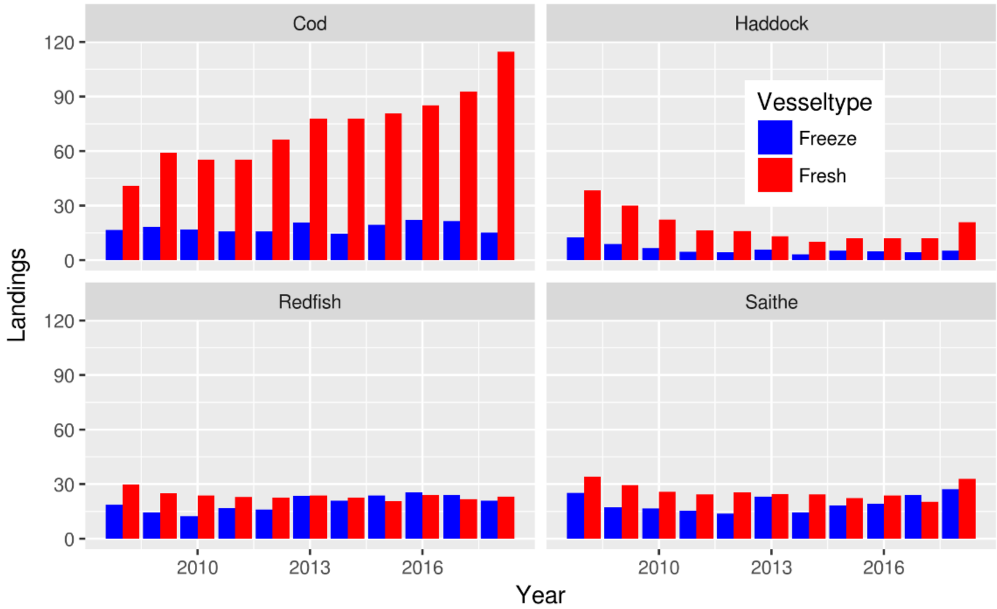

Figure 8.22. Saithe in Division 5.a. Catch by trawlers divided between those that freeze the catch and those that do not. Number of trawlers landing has been reducing gradually from 73 in 2008 to 63 in 2017 (including vessels landing > 500 t each year) but the number of freezing trawlers has been 17–18 all the time. The freezing trawlers have therefore been 20–28% of the total number of trawlers.