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8 Icelandic saithe

Summary

The 2017 reference biomass (B_{4+}) is estimated as 327 kt, 25% above the average in the assessment period (1980 to the present). Spawning stock biomass is estimated as 161 kt, the highest in the assessment period and well above $B_{trigger}$ = 65 kt and B_{lim} = 44 kt.

Harvest rate has been below the target of 0.2 in last 3 years and fishing mortality is also predicted to be low. The reason is that the TAC has not been caught, most likely a problem of availability. Smaller than estimated stock can though not be excluded. The current assessment is an upward revision of last year's assessment mostly due to the strong 2012 yearclass.

Weights of ages 3-6 have been low in recent years, but older ages are close to average weight. Maturity at age of ages 4-9 has decreased in recent years and is currently around average since 1985.

Recruitment has been above average since 2009 and relatively stable. Yearclass 2012 is estimated to be strong and the survey in 2017 indicates that yearclass 2013 is above average.

The assessment model is a separable statistical catch-at-age model implemented in AD Model Builder. Selectivity is age-specific and varies between three periods: 1980-1996, 1997-2003, and 2004 onwards. The result of the assessment changes somewhat with settings of the assessment model, with estimated reference biomass in 2017 varying from 297-354 thous tonnes from models with "plausible settings". The lowes and highest values are from SAM models with little different settings of observation variance. The assessment is considered relatively uncertain but this year's assessment is similar to last year's assessment

In 2013, the Icelandic government adopted a harvest control rule for managing the Icelandic saithe fishery, evaluated by ICES (2013). It is similar to the 20% rule used for the Icelandic cod fishery. When the spawning stock is above $B_{trigger}$, the TAC set in year y for the fishing year $y/y+1$ equals the average of 0.2 B_{4+} in year y and last year's TAC.

According to the adopted harvest control rule, the TAC will be 60 kt in the next fishing year compared to 55 kt in current fishing year. The fact that the TAC has not been caught in recent fishing year and substantial effort is required to catch saithe makes this increase questionable. Reducing harvest rate to 16% keeping the current form of HCR would lead to same TAC in next fishing year as the current one and little change few years after that. The reason for reducing harvest rate is only mixed fisheries problems and change in gear technology, the state of the stock today is that the spawning stock is estimated the largest for at least 37 years.

8.1 Stock description and management units

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

8.2 Fisheries-dependent data

8.2.1 Landings, advice and TAC

Landings of saithe in Icelandic waters in 2016 are estimated to have been 49 200 t (Table 8.1 and Figure 8.1). Of the landings, 42 700 t were caught by trawl, 2 500 t by gillnets, and the rest caught by other fishing gear. The domestic as well as ICES advice for the fishing year 2015/2016 was based on the 20% harvest control rule and was 55 kt. The TAC issued was also 55 kt but the landings are now estimated to be 49 300 tons. The trajectory of the landings in the current fishing year and calendar year is shown in Figure 8.2 indicating that the TAC of 55 kt will not be reached.

Most of the catch is caught in bottom trawl (82% in 2010-2016), with gillnet and jiggers taking the majority of the rest, 6% 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 gradually been increasing from 0.8% before 2000 to 2.5% in last 3 years.

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 2016 sea samples constitute about 80% of the length measured fish that is used in the calculation of the catch in number and 70% of the length samples. 87% of the length samples are taken from trawl that is accounting for 87% of the catches. On the other hand only 35% of the aged otholits come from sea samples.

The sampling program was slightly revised in 2013 and 2014, but the approach used for calculating catch in numbers has not changed. In 2013, the sampling frequency was reduced for bottom trawl, while the sampling frequency was increased for gillnets, jiggers, and demersal seine in 2014. Also in 2014, the number of otoliths from each sample was halved from 50 to 25 for all fishing gears. These revisions in the sampling program were based on the analysis of Thordarson (2012) and lead to approximately 50% reduction in the number of age samples. The age and length sampling in 2016 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	870	0	0	1	199
Gillnets	2520	12	298	13	1346
Jiggers	1720	4	100	11	1594
Danish seine	900	2	50	2	250
Bottom trawl	42770	65	1805	189	33312
Other gear	430	0	0	0	0
Total	49200	83	2253	216	36701

Foreign landings that are 291 tonnes are included in the numbers above. They are caught by longlines (105 tonnes) and handlines (185 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 8.3). 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 8.6) and using it in assessment leads to less than 1% difference of reference biomass in 2017 (329 vs 327). Catch in number 2016 is similar to last year's prediction. (Figure 8.5).

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 8.7 and 8.8). The large 2012 yearclass has the lowest mean weight of all yearclasses, both in catches and in the survey. 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 a year class in the previous year as predictors (Magnusson 2012).

Maturity at ages 4-9 has decreased in recent years and is currently around average (Table 8.4 and Figure 8.9). 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), as the trends in CPUE are considered unreliable as an indicator of changes in abundance.

8.3 Scientific surveys

In the benchmark in 2011, spring survey data were considered superior to the autumn survey for calibrating the assessment, both due to more stations and longer time series. Saithe is among the most difficult demersal fishes to get reliable information on 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 survey biomass indices fluctuated greatly in 1985-1995, but were consistently low in 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 2017 the indices are among the highest in the series and have increased by 50% since 2014. (Table 8.5 and Figure 8.10). Most of the increase is caused by the 2012 yearclass that was strong in the surveys 2016 and 2017 (figure 8.12).

The high index in March 1986 (figure 8.10) 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 tons to 1 ton.

When last benchmark was conducted (2010) the survey series for the autumn survey was relatively short and not considered suitable for tuning but "burn in period" of a survey is longer when the indices are noisy. This might change in the next benchmark and the 2004 autumn survey might require "special treatment" like the 1986 survey in March.

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 0.3 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 survey is very low.

The biomass index from the March survey indicates that the stock is above average level and and has been increasing in last 3 years. The autumn survey shows the stock at relatively high level but the vales before 2000 might be underestimate due to stations added in 2000 (figure 8.4) where some saithe is found The upward trend of last 3 years is not as obvious in the autumn survey indices that are more noisy than the indices from the March survey. Indices from the gillnet survey conducted south and west of Iceland since 1996 have been high from 2015-2017. (Figure 8.11). The gillnet survey is mostly targeting large saithe (mean weight in 2016 was 6.7 kg). To summarize all the surveys indicate that the stock is relatively large in 2017.

8.4 Assessment method

In accordance with the recommendation from the benchmark (ICES 2010), a separable forward-projecting statistical catch-age model, 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 period (Figure 8.13). Natural mortality is set at 0.2 for all ages.

The commercial catch-at-age residuals (Figure 8.18) are relatively small in 2017 for younger ages. The survey residuals in 2016 (figure 8.17) show positive values in 2016 for ages 4-6, the agegroups accounting for most of the biomass. The survey catch-at-age residuals (Figure 8.17) have year blocks with all residuals being only negative or only 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}.

The landings for the ongoing calendar year are predicted based on the 20% HCR, with the calendar year landings consisting of remainder the ongoing fishing year's TAC and 1/3 of the next fishing year's TAC. Looking at last two fishing years where the TAC was not caught and trends in landings (figure 8.2) the value obtained is likely to be an overestimate.

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 in accordance with the precautionary approach and the ICES MSY framework. In the harvest control rule (HCR) evaluation (ICES 2013) B_{lim} was defined as 61 kt, based on B_{loss} as estimated in 2010, and $B_{trigger}$ was defined as 65 kt, based on an estimated hockey-stick recruitment function.

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 20% HCR consists of two equations, as follows.

When $SSB \geq B_{trigger}$, the TAC set in year y equals the average of 0.20 times the current biomass and last year's TAC:

$$TAC_{y+1/y} = 0.5 \times 0.20\, B_{y,4+} + 0.5\, TAC_{y/y-1} \qquad \text{(Eq. 1)}$$

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

$$TAC_{y+1/y} = SSB_y/B_{trigger} \left[(1 - 0.5\, SSB_y/B_{trigger})\, 0.20\, B_{t,4+}) + 0.5\, TAC7_{y/y-1} \right] \qquad \text{(Eq. 2)}$$

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 $B_{trigger}$.

At the NWWG meeting 2016 definition of B_{lim} and B_{pa} were revisited. Also F_{pa} and F_{lim} were defined but these points were not considered necessary when the HCR was evaluated in 2013. The new values of B_{lim} and B_{pa} were 44 and 61 thous. tonnes.

8.6 State of the stock

The results of the principal stock quantities (Table 8.6 and Figure 8.14) 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 327 kt. The current stock size of B4+ of 327 kt is among the highest in the time series (1980 to the present). Spawning biomass is estimated as 161 kt, the highest in the timeseries. In recent years B4+ has been below average since 1980 but SSB above. The reason is mostly low mean weight of younger cohorts that have more weight in B4+ than SSB (figure 8.8) but average mean weight at age of older age groups.

The harvest rate peaked around 30% in the mid 1990's, but has been below the HCR target of 20% since in last 3 years. Fishing mortality has been low since 2004 compared to before that. Part of the difference is caused by change in selection pattern that leads to F before and after 2004 not being comparable. SSB has been at a relatively high level during the last ten years.

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

The predicted landings in 2017 are 62 kt, what is left of the TAC 2016/17 in the beginning of the year 2017 plus 1/3rd of the TAC 2017/18 (60 kt). This value is most likely an overestimate as the TAC has not been reached in last fishing years and there are indications that the TAC for the fishing year 2016/17 will not be reached. Assumptions about catches in 2017 have no effect on the TAC 2017/18 that is based on the biomass in the beginning of the year 2017.

8.7 Uncertainties in assessment and forecast

The assessment of Icelandic saithe is relatively uncertain due to fluctuations in the survey data, as well as irregular changes in the fleet selectivity. The internal consistency in the spring bottom trawl survey is very 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 8.19) reveals some of the assessment uncertainty. The harvest control rule evaluation incorporated uncertainties about assessment estimates, among other sources of uncertainty (ICES 2013).

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

NR	TYPE OF MODEL AND SETTINGS	B4+(2016)	TAC(Y+1/Y)
1	Separable 3 perids	327	60.2
2	Separable 1 period	346	62.1
3	Separable 3 periods less weight on survey*	214	48.9
4	Separable 3 periods survey outliers not included	334	60.9
5	Separable 3 periods random walk	303	57.8
6	Adapt	427	70.2
7	Cod model flexible selection pattern, random walk	314	58.9
8	Std SAM	354	62.9
9	Improved SAM	297	57.2

(* CV of survey is estimated automatically but weighted down to 5% here). All models except model 7-9 are based on more or less same code. Model 4 uses different data, i.e survey indices are compiled by Winchorizing. Std SAM are the devault settings while number of observation parameters has been increased in the other SAM run.

The results of the different models can be somewhat different (figure 8.21 and table above) with B4+ in 2017 (the number that matters for the advice) ranging from 200 thous. tonnes to 420 thous. tonnes. The highest number is from an Adapt type model and the lowest numbers from model with very low weight on the survey. Adapt type models have not been considered suitable for this stock as they do not utilize the information included in the catch data, which is a problem when survey data are as noisy as they are here. The extreme models are model not using the survey (#4) and model only using the survey (#6). The general trend is that the survey indicates larger stock than catch data.

Taking the catch at age models tuned with the survey the range of $B4+_{2017}$ is from 297-354. The extreme values are SAM models with different settings of the observation variances. This difference between models is well within what could be expected according to precision of the stock estimate CV(B4+)=0.2. The assessment indicates higher stock than last years assessment (figures 8.15, 8.19). The retrospective pattern shows that the results have often changed more by including one more year of data.

The main uncertainty in the current assessment is the fact that the TAC has not been fished in last 2 fishing years and there are indications that landings in the current fishing year will be below TAC. The assessment models indicate substantial reduction of fishing mortality and harvest rate in last 3 years, partly because the TAC has not been fished Random walk constrain on fishing mortality works against this reduction, therefore models with random walk constraint indicate smaller stock. The selection pattern observed since 2004 (figure 8.13) 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 8.8) Other measures of stock size, not used directly in the assessment model like the autumn survey and gillnet survey (figures 8.10 and 8.11) do indicate good state of stock.

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 propensity 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 sein and trawlers is decreasing. Longliners do hardly catch saith 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 stragety and having to avoid cod is an extra constraint on saithe fisheries.

Many captains complain that finding saithe is difficult and the increased selection seen in last decade (figure 8.13) 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, 45% of the catch of saithe by trawlers is taken by the freezing vessels, 55% of redfish but only 20% of the cod catch (figure 8.21). 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.

If the conclusions above are correct, lowering the target harvest rate to get better balance in mixed fisheries. might be an option. A harvest rate of 16% next year would lead to unchanged TAC and probably little change in the following years. There are still no indications that the premises behind the HCR evaluations in 2013 need to be investigated again, the problem described is a mixed fisheries problem. Harvest rate of 16% is well below the maximum that would be considered in conformity with the ICES MSY approach that, is 20% or higher.

Table 8.1. Saithe in division Va. 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	4 930			52 436	1				58 347
1981	532	3 545			54 921	3				59 001
1982	201	3 582	23		65 124	1				68 931
1983	224	2 138			55 904					58 266
1984	269	2 044			60 406					62 719
1985	158	1 778			55 135	1	29			57 101
1986	218	2 291			63 867					66 376
1987	217	2 139			78 175					80 531
1988	268	2 596			74 383					77 247
1989	369	2 246			79 796					82 411
1990	190	2 905			95 032					98 127
1991	236	2 690			99 811					102 737
1992	195	1 570			77 832					79 597
1993	104	1 562			69 982					71 648
1994	30	975		1	63 333					64 339
1995		1 161		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

	Belgium	Faroes	France	Germany	Iceland	Norway	UK (E/W/NI)	UK (Scot)	UK	Total
2006		415		33	75 197	2			16	75 663
2007		392			64 008	3			30	64 433
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

Table 8.2. Saithe in division Va. 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
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

Table 8.3. Saithe in division Va. Mean weight at age (g) in the catches and in the spawning stock, with predictions in gray.

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
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	1129	1595	2091	3099	4034	5276	6464	7656	8237	8965
2018	1129	1595	2091	3099	4034	5276	6464	7656	8237	8965

Table 8.4. Saithe in division Va. Maturity at age, with predictions in gray.

YEAR	3	4	5	6	7	8	9	10	11	12
1980	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1981	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1982	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1983	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1984	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1985	0	0.084	0.189	0.373	0.602	0.793	0.907	1	1	1
1986	0	0.076	0.173	0.347	0.574	0.774	0.897	1	1	1
1987	0	0.069	0.158	0.323	0.548	0.755	0.887	1	1	1
1988	0	0.063	0.146	0.302	0.524	0.737	0.877	1	1	1
1989	0	0.058	0.136	0.285	0.504	0.721	0.868	1	1	1
1990	0	0.055	0.129	0.273	0.488	0.708	0.86	1	1	1
1991	0	0.053	0.125	0.266	0.48	0.701	0.856	1	1	1
1992	0	0.053	0.124	0.265	0.479	0.7	0.856	1	1	1
1993	0	0.054	0.128	0.271	0.486	0.706	0.859	1	1	1
1994	0	0.058	0.136	0.285	0.503	0.72	0.867	1	1	1
1995	0	0.065	0.149	0.308	0.531	0.742	0.88	1	1	1
1996	0	0.075	0.17	0.343	0.57	0.771	0.896	1	1	1
1997	0	0.09	0.2	0.389	0.618	0.805	0.913	1	1	1
1998	0	0.109	0.237	0.442	0.668	0.836	0.929	1	1	1
1999	0	0.131	0.277	0.494	0.712	0.863	0.941	1	1	1
2000	0	0.152	0.314	0.537	0.747	0.882	0.95	1	1	1
2001	0	0.168	0.34	0.567	0.769	0.894	0.955	1	1	1
2002	0	0.174	0.349	0.577	0.776	0.898	0.957	1	1	1
2003	0	0.172	0.345	0.573	0.773	0.896	0.956	1	1	1
2004	0	0.163	0.331	0.558	0.762	0.891	0.954	1	1	1
2005	0	0.152	0.314	0.537	0.747	0.882	0.95	1	1	1
2006	0	0.142	0.296	0.516	0.731	0.873	0.946	1	1	1
2007	0	0.134	0.283	0.5	0.718	0.866	0.943	1	1	1
2008	0	0.129	0.274	0.489	0.709	0.861	0.94	1	1	1
2009	0	0.126	0.268	0.482	0.703	0.857	0.939	1	1	1
2010	0	0.123	0.264	0.476	0.698	0.855	0.937	1	1	1
2011	0	0.121	0.259	0.47	0.693	0.852	0.936	1	1	1
2012	0	0.117	0.253	0.462	0.686	0.847	0.934	1	1	1
2013	0	0.113	0.244	0.451	0.676	0.841	0.931	1	1	1
2014	0	0.107	0.234	0.437	0.663	0.833	0.927	1	1	1
2015	0	0.101	0.222	0.42	0.648	0.824	0.922	1	1	1
2016	0	0.094	0.209	0.402	0.631	0.813	0.917	1	1	1
2017	0	0.088	0.197	0.384	0.613	0.801	0.911	1	1	1
2018	0	0.088	0.197	0.384	0.613	0.801	0.911	1	1	1

Table 8.5. Saithe in division Va. 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	0.16
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	6.65	2.53	1.81	0.92	0.4	0
1990	0.34	1.71	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	0.03
1992	0.14	0.92	5.88	5.65	2.84	2.72	1.94	0.28	0.06
1993	1.27	11.03	1.89	6.59	2.34	2.19	1.02	3.94	0.66
1994	0.81	0.74	1.93	1.78	2	0.53	0.81	0.94	3.48
1995	0.48	1.98	1.12	0.52	0.29	0.34	0.1	0.15	0.15
1996	0.12	0.51	3.77	1.13	1.03	0.59	0.97	0.06	0.09
1997	0.32	0.91	4.73	3.96	0.96	0.4	0.15	0.1	0.05
1998	0.11	1.65	2.35	2.54	1.28	0.72	0.29	0.08	0.07
1999	0.73	3.75	0.94	1.27	1.71	0.59	0.16	0.02	0.02
2000	0.38	2.02	2.54	0.61	0.87	0.54	0.44	0.08	0.03
2001	0.92	2.07	2.73	1.68	0.21	0.23	0.39	0.15	0.07
2002	1.02	2.24	3.01	3.1	2.2	0.42	0.46	0.32	0.21
2003	0.05	9.78	5.14	2.97	1.39	0.78	0.2	0.05	0.1
2004	0.9	1.39	9.54	6.17	4.43	1.51	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	8.85	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	0.44
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	0.54	0.44	0.29
2017	0.02	1.48	6.67	14.64	3.03	1.68	0.87	0.45	0.32

Table 8.6. Saithe in division Va. Main population estimates.

YEAR	B4+	SSB	N3	YIELD	F4-9	HR
1980	312	113	28	58	0.29	18.5
1981	305	120	20	58	0.26	18.9
1982	294	137	22	68	0.3	23.1
1983	270	137	32	57	0.24	20.9
1984	287	140	42	60	0.23	21
1985	300	138	35	54	0.25	17.9
1986	319	136	67	65	0.28	20.5
1987	336	128	91	80	0.35	23.9
1988	415	125	51	77	0.32	18.6
1989	398	128	32	82	0.31	20.7
1990	377	135	21	98	0.35	25.9
1991	337	144	29	102	0.37	30.4
1992	288	136	15	80	0.37	27.6
1993	231	112	20	72	0.4	31
1994	187	93	18	64	0.45	34
1995	153	69	30	48	0.46	31.6
1996	149	60	26	39	0.4	26.4
1997	156	61	17	37	0.36	23.5
1998	154	68	9	31	0.3	19.9
1999	133	73	31	31	0.31	23.3
2000	144	75	31	33	0.32	22.8
2001	163	82	54	32	0.27	19.3
2002	221	100	63	42	0.3	19
2003	281	123	72	52	0.29	18.6
2004	322	142	26	65	0.26	20.1
2005	287	151	73	69	0.28	24
2006	313	157	42	75	0.3	24.1
2007	284	153	19	64	0.28	22.6
2008	254	151	27	69	0.32	27.4
2009	228	139	40	60	0.3	26.4
2010	229	129	39	54	0.27	23.5
2011	236	123	47	51	0.25	21.5
2012	246	121	45	51	0.24	20.8
2013	260	126	47	58	0.26	22.1
2014	266	129	28	46	0.2	17.1
2015	267	140	67	48	0.19	18.1
2016	306	150	46	49	0.18	16.1
2017	327	161	28			
Average 1980-2016	264	121	38	59	0.3	22.7

Table 8.7. Saithe in division Va. 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	46.8	30.9	10.3	8.1	3.7	1.3	0.7	0.7	0.5	0.3	0.1
1981	48	26.4	20.2	22.7	35.2	21.2	6.3	4.6	2	0.7	0.4	0.4	0.3	0.2
1982	62.6	39.3	21.6	16.3	17.3	24.6	13.3	3.7	2.6	1.1	0.4	0.2	0.2	0.2
1983	52.8	51.2	32.2	17.4	12.2	11.8	14.8	7.5	1.9	1.4	0.6	0.2	0.1	0.1
1984	99.9	43.2	41.9	26	13.3	8.6	7.6	9	4.3	1.1	0.8	0.4	0.1	0.1
1985	136.1	81.8	35.4	33.9	19.9	9.5	5.6	4.7	5.2	2.5	0.7	0.5	0.2	0.1
1986	75.4	111.4	67	28.6	25.8	14	6.1	3.4	2.6	3.1	1.4	0.4	0.3	0.1
1987	47.5	61.7	91.2	54	21.5	17.8	8.7	3.5	1.8	1.5	1.6	0.8	0.2	0.2
1988	31	38.9	50.5	73.2	39.9	14.3	10.3	4.6	1.7	0.9	0.7	0.9	0.4	0.1
1989	44	25.4	31.8	40.6	54.6	26.9	8.5	5.7	2.3	0.9	0.5	0.4	0.5	0.2
1990	22.1	36	20.8	25.6	30.4	37.2	16.2	4.7	2.9	1.3	0.5	0.3	0.2	0.3
1991	29.6	18.1	29.5	16.7	19	20.2	31.4	8.6	2.3	1.5	0.6	0.2	0.1	0.1
1992	26.4	24.3	14.8	23.6	12.3	12.4	11.4	16.2	4	1.1	0.7	0.3	0.1	0.1
1993	44.5	21.6	19.9	11.9	17.4	8.1	7	5.9	7.7	2	0.5	0.4	0.2	0.1
1994	38.3	36.5	17.7	15.9	8.7	11.2	4.4	3.5	2.7	3.6	0.9	0.3	0.2	0.1
1995	25.2	31.3	29.9	14.1	11.4	5.4	5.8	2.1	1.5	1.2	1.5	0.4	0.1	0.1
1996	13	20.7	25.7	23.8	10.1	7.1	2.8	2.7	0.9	0.6	0.5	0.7	0.2	0.1
1997	45.5	10.6	16.9	20.5	17.4	6.5	3.9	1.4	1.2	0.4	0.3	0.2	0.4	0.1
1998	46.8	37.3	8.7	13.4	14.6	11.3	3.9	2.1	0.7	0.6	0.2	0.1	0.1	0.2
1999	80.6	38.3	30.5	6.9	9.7	9.9	7.2	2.3	1.1	0.4	0.3	0.1	0.1	0.1
2000	94.5	66	31.3	24.3	5	6.6	6.2	4.1	1.2	0.6	0.2	0.2	0.1	0
2001	107.4	77.4	54	24.9	17.5	3.3	4.1	3.5	2.1	0.6	0.3	0.1	0.1	0
2002	38.3	87.9	63.4	43.1	18.3	12	2.2	2.4	1.9	1.1	0.3	0.2	0.1	0
2003	108.2	31.4	72	50.4	31.3	12.4	7.6	1.3	1.3	1	0.6	0.2	0.1	0
2004	62.6	88.6	25.7	57.3	36.8	21.3	7.9	4.5	0.7	0.7	0.5	0.3	0.1	0
2005	28.1	51.3	72.6	20.2	38.5	23	13.2	5	2.8	0.4	0.4	0.3	0.2	0.1
2006	39.7	23	42	56.8	13.3	23.4	13.8	8.1	3.1	1.7	0.2	0.2	0.2	0.1
2007	59.2	32.5	18.8	32.8	36.9	7.9	13.8	8.3	4.9	1.8	1	0.1	0.1	0.1
2008	57.6	48.4	26.6	14.8	21.7	22.5	4.8	8.5	5.2	3	1	0.5	0.1	0.1
2009	70.5	47.2	39.7	20.7	9.4	12.7	13	2.8	5.1	3	1.6	0.5	0.3	0
2010	67.8	57.7	38.6	31	13.5	5.6	7.5	7.8	1.7	3	1.7	0.8	0.3	0.1
2011	69.8	55.5	47.3	30.3	20.6	8.3	3.4	4.6	4.9	1.1	1.7	0.9	0.5	0.2
2012	42.1	57.2	45.5	37.2	20.5	13	5.2	2.2	3	3.1	0.6	1	0.5	0.3
2013	100.3	34.4	46.8	35.8	25.3	13	8.2	3.3	1.4	1.9	1.9	0.4	0.6	0.3
2014	68.5	82.1	28.2	36.8	24	15.8	8	5.1	2.1	0.9	1.1	1	0.2	0.3
2015	41.3	56.1	67.2	22.4	25.9	16	10.4	5.4	3.5	1.4	0.6	0.7	0.6	0.1
2016	48.4	33.8	45.9	53.4	15.8	17.3	10.6	7	3.7	2.3	0.9	0.3	0.4	0.4
2017	50.9	39.7	27.7	36.5	38	10.7	11.6	7.2	4.8	2.5	1.5	0.6	0.2	0.3
2018	51.2	41.7	32.5	21.9	25.2	24.6	6.9	7.6	4.8	3.1	1.5	0.9	0.3	0.1
2019	51.2	41.9	34.1	25.7	15.1	16.4	15.9	4.5	5	3.1	1.9	0.9	0.5	0.2

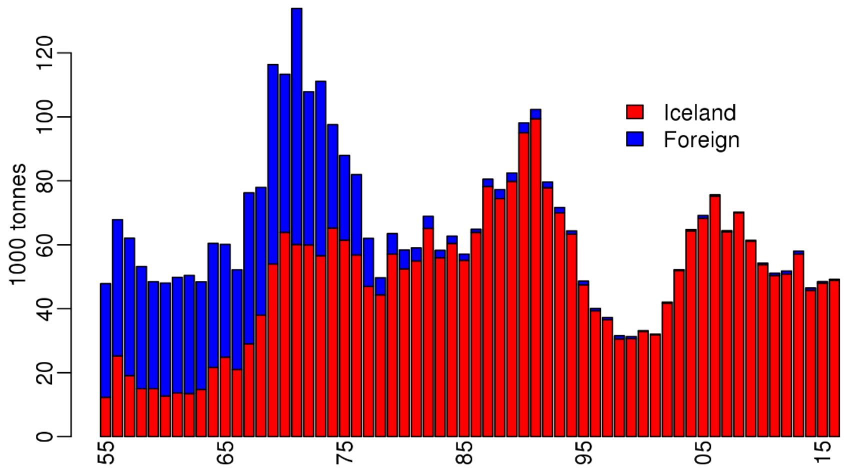
Table 8.8. Saithe in division Va. Fishing mortality rate.

YEAR	3	4	5	6	7	8	9	10	11	12	13	14
1980	0.016	0.085	0.178	0.295	0.363	0.437	0.407	0.437	0.358	0.358	0.358	0.358
1981	0.015	0.076	0.159	0.264	0.324	0.391	0.364	0.391	0.32	0.32	0.32	0.32
1982	0.017	0.088	0.183	0.304	0.374	0.451	0.42	0.451	0.369	0.369	0.369	0.369
1983	0.014	0.07	0.147	0.243	0.299	0.361	0.336	0.361	0.296	0.296	0.296	0.296
1984	0.013	0.067	0.139	0.232	0.285	0.343	0.32	0.343	0.281	0.281	0.281	0.281
1985	0.014	0.071	0.148	0.246	0.302	0.364	0.339	0.364	0.298	0.298	0.298	0.298
1986	0.016	0.082	0.17	0.283	0.348	0.419	0.39	0.419	0.343	0.343	0.343	0.343
1987	0.02	0.102	0.212	0.352	0.433	0.522	0.485	0.522	0.427	0.427	0.427	0.427
1988	0.018	0.094	0.195	0.323	0.398	0.479	0.446	0.479	0.393	0.393	0.393	0.393
1989	0.017	0.089	0.185	0.307	0.378	0.456	0.424	0.456	0.373	0.373	0.373	0.373
1990	0.019	0.101	0.211	0.351	0.431	0.52	0.484	0.52	0.426	0.426	0.426	0.426
1991	0.021	0.109	0.226	0.375	0.461	0.556	0.518	0.556	0.455	0.455	0.455	0.455
1992	0.02	0.106	0.221	0.368	0.452	0.545	0.507	0.545	0.446	0.446	0.446	0.446
1993	0.022	0.115	0.24	0.399	0.491	0.592	0.551	0.592	0.484	0.484	0.484	0.484
1994	0.025	0.131	0.272	0.452	0.556	0.671	0.624	0.671	0.549	0.549	0.549	0.549
1995	0.026	0.134	0.278	0.462	0.568	0.685	0.638	0.685	0.561	0.561	0.561	0.561
1996	0.022	0.117	0.243	0.404	0.497	0.599	0.558	0.599	0.491	0.491	0.491	0.491
1997	0.035	0.144	0.23	0.311	0.414	0.52	0.56	0.538	0.542	0.542	0.542	0.542
1998	0.029	0.117	0.187	0.253	0.336	0.422	0.455	0.437	0.44	0.44	0.44	0.44
1999	0.03	0.122	0.195	0.264	0.351	0.44	0.475	0.456	0.459	0.459	0.459	0.459
2000	0.032	0.129	0.206	0.278	0.37	0.464	0.501	0.481	0.484	0.484	0.484	0.484
2001	0.027	0.108	0.173	0.234	0.311	0.39	0.421	0.404	0.407	0.407	0.407	0.407
2002	0.029	0.118	0.189	0.255	0.339	0.426	0.459	0.441	0.445	0.445	0.445	0.445
2003	0.028	0.116	0.185	0.25	0.333	0.418	0.451	0.433	0.436	0.436	0.436	0.436
2004	0.041	0.197	0.27	0.279	0.261	0.252	0.279	0.327	0.382	0.382	0.382	0.382
2005	0.045	0.216	0.296	0.306	0.287	0.276	0.306	0.359	0.419	0.419	0.419	0.419
2006	0.048	0.233	0.318	0.329	0.309	0.297	0.329	0.387	0.451	0.451	0.451	0.451
2007	0.044	0.214	0.293	0.303	0.283	0.273	0.302	0.355	0.414	0.414	0.414	0.414
2008	0.051	0.247	0.337	0.349	0.327	0.315	0.349	0.409	0.478	0.478	0.478	0.478
2009	0.048	0.232	0.317	0.328	0.307	0.296	0.328	0.385	0.449	0.449	0.449	0.449
2010	0.043	0.208	0.284	0.294	0.275	0.265	0.294	0.345	0.402	0.402	0.402	0.402
2011	0.039	0.191	0.261	0.27	0.253	0.244	0.27	0.317	0.37	0.37	0.37	0.37
2012	0.038	0.185	0.253	0.261	0.245	0.236	0.261	0.307	0.358	0.358	0.358	0.358
2013	0.041	0.2	0.274	0.284	0.266	0.256	0.283	0.333	0.388	0.388	0.388	0.388
2014	0.031	0.15	0.205	0.212	0.199	0.192	0.212	0.249	0.291	0.291	0.291	0.291
2015	0.03	0.147	0.202	0.209	0.195	0.188	0.208	0.245	0.286	0.286	0.286	0.286
2016	0.029	0.14	0.192	0.199	0.186	0.179	0.198	0.233	0.272	0.272	0.272	0.272
2017	0.035	0.171	0.233	0.241	0.226	0.218	0.241	0.283	0.331	0.331	0.331	0.331
2018	0.035	0.17	0.232	0.24	0.225	0.217	0.24	0.282	0.329	0.329	0.329	0.329

Table 8.9. Saithe in division Va. Output from short-term projections.

2017						
B4+	SSB	Fbar	Landings			
327	161	0.222	62			
2018				2019		
B4+	SSB	Fbar	Landings	B4+	SSB	Rationale
311	168	0.221	60	297	171	20% HCR

20% HCR = average between 0.2 B4+ (current year) and last year's TAC. Landings in 2016 are most likely an overestimate as the quota remaining will not be caught (figure 8.2).



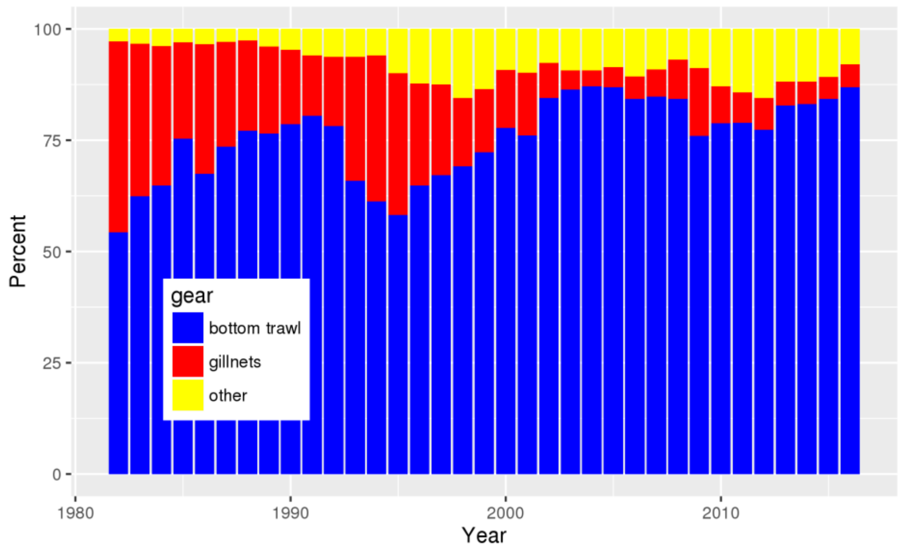


Figure 8.1 Saithe in Division Va. Total landings and percent by gear.

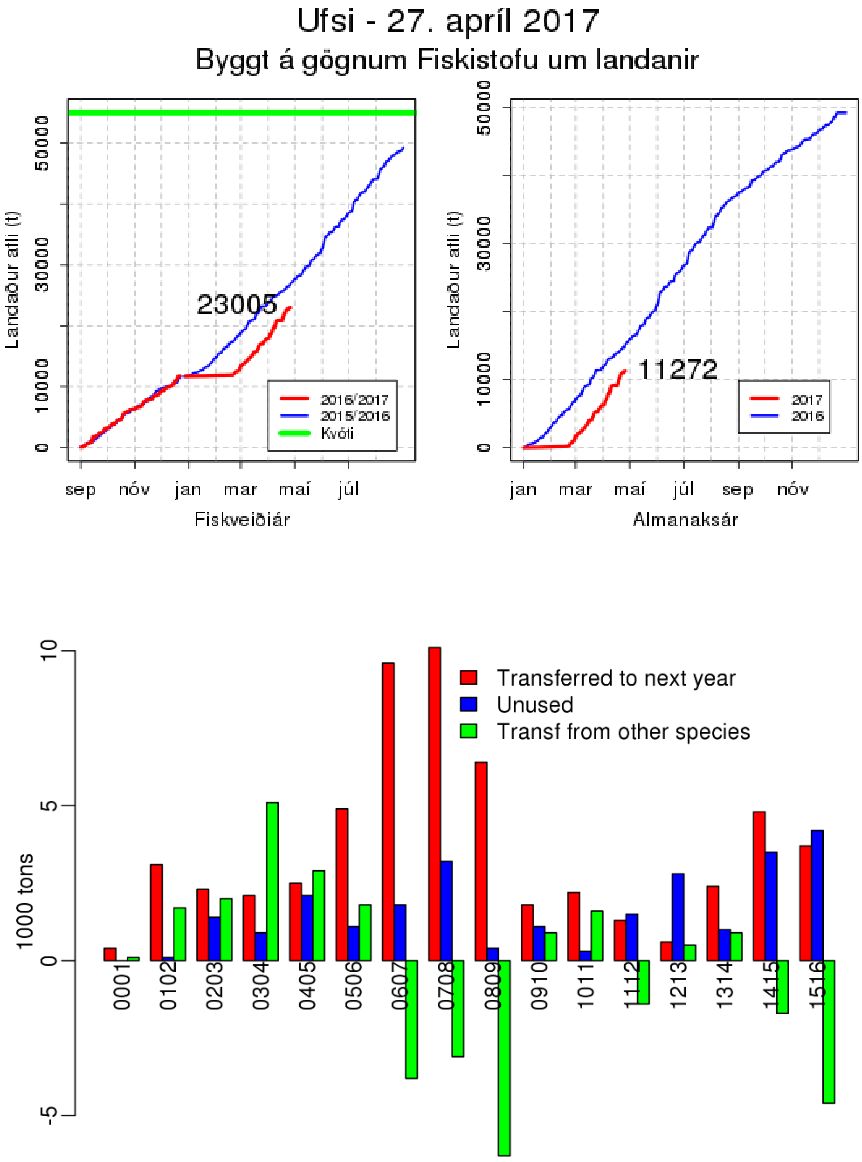


Figure 8.2 Saithe in division Va. Upper figure. Cumulative landings in the current fishing year (left) and calendar year (right). The vertical (green line) in the left figure shows the quota for the current fishing year. Lower figure. Transfer of quota to next fishing year, unused quota and transfer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

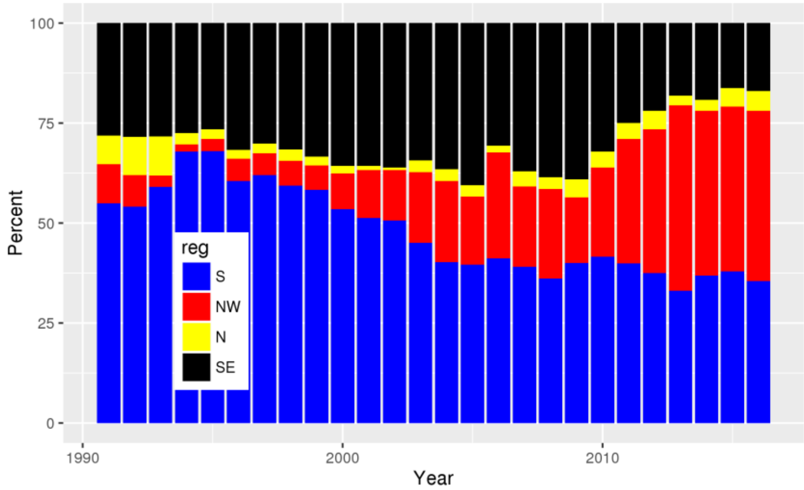


Figure 8.3 Saithe in division Va. Percent of landings by regions defined in figure 8.4.

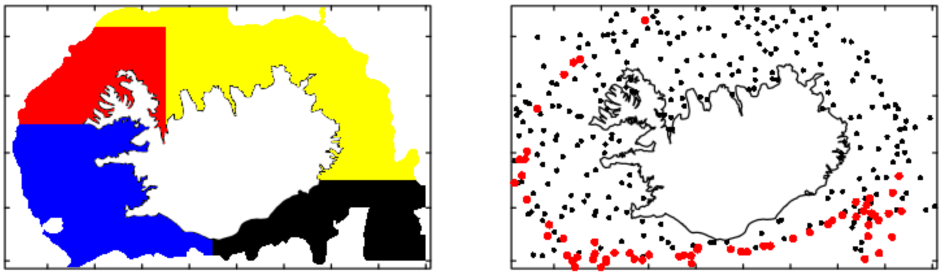


Figure 8.4 Saithe in division Va. Left, definitions of regions used in figures 8.3 and 8.6. Right, stations added in the autumnsurvey in 2000 (red dots).

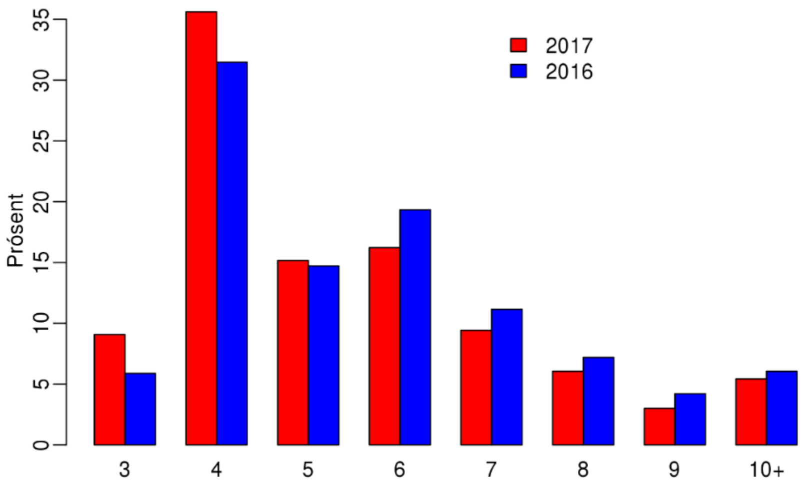


Figure 8.5. Catch in numbers 2015 compared to last years prediction.

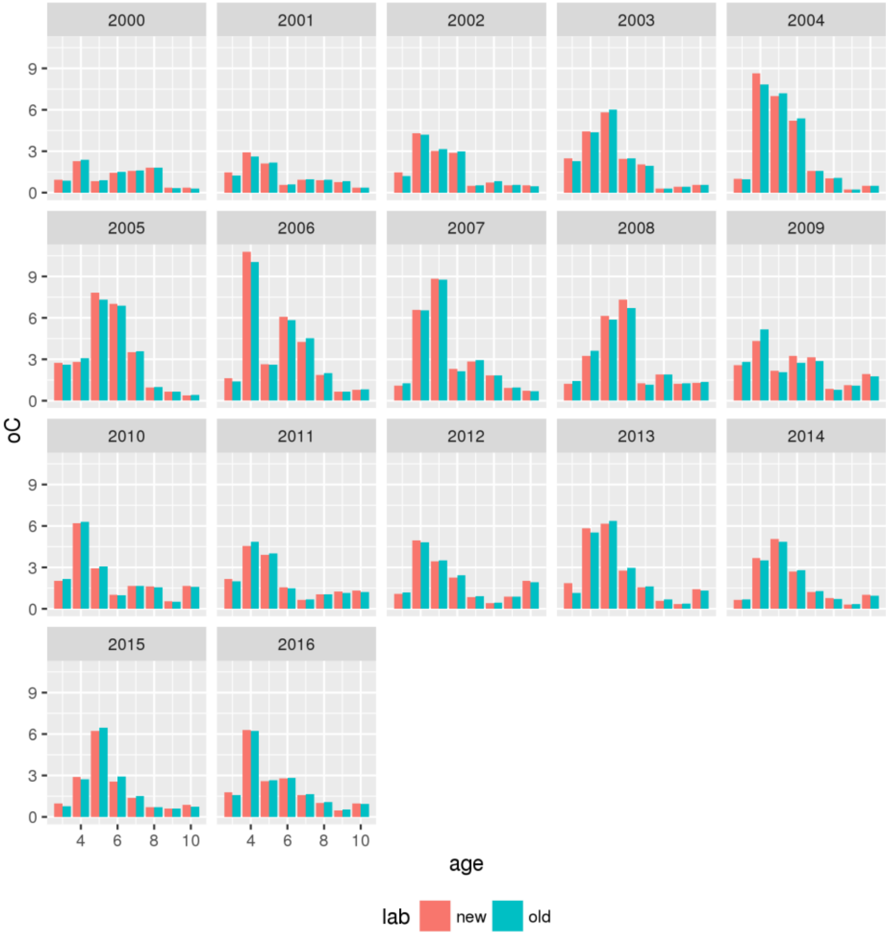


Figure 8.6. Catch in numbers 2000-2015 compiled by 1 region and 1 time interval (old) compared to catch in numbers compiled by 2 regions and 2 time interval (new) . The regions are shown in figure 8.4, north red and yellow and south blue and black.

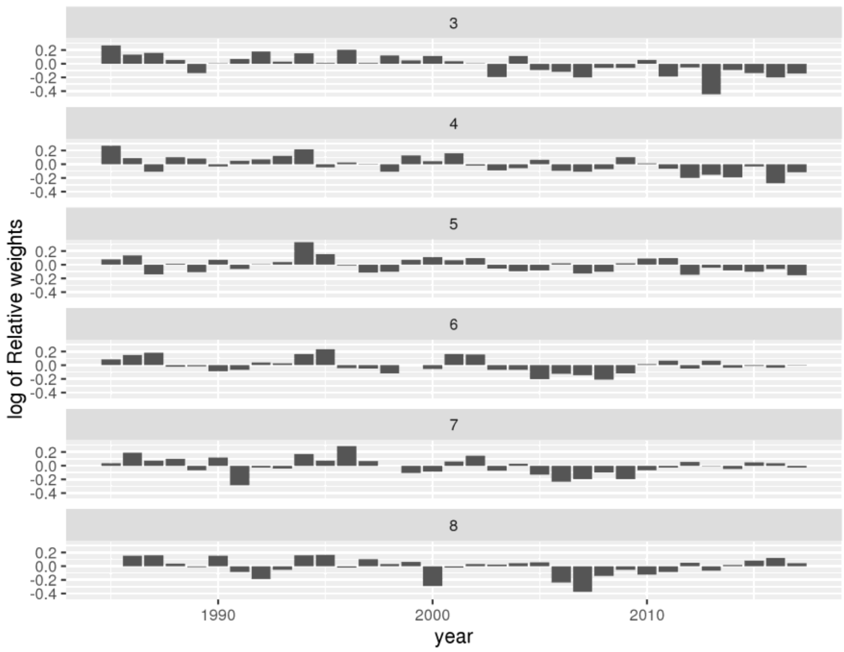


Figure 8.7 Saithe in division Va. Weight at age in the survey, as relative deviations from the mean.

Figure 8.8 Saithe in division Va. Weight at age in the catches, as relative deviations from the mean. Blue bars show prediction.

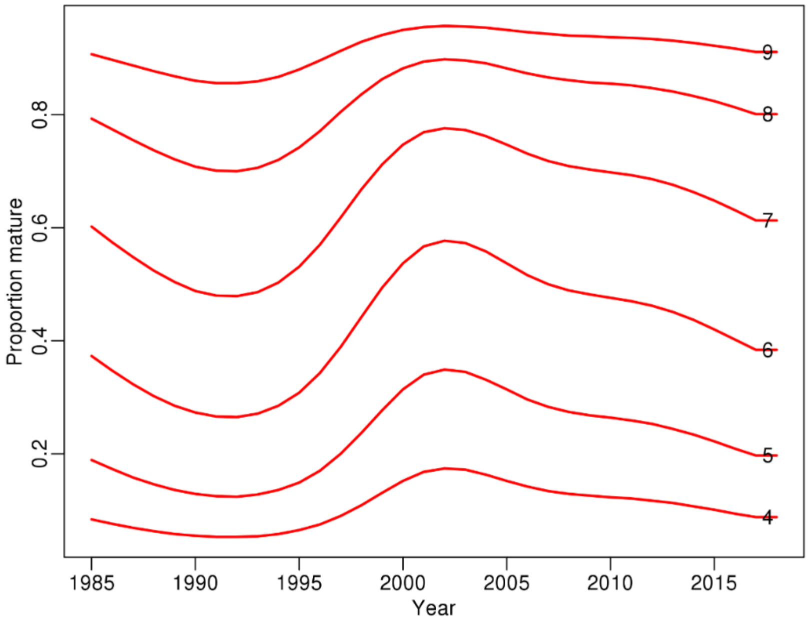


Figure 8.9 Saithe in division Va. Maturity at age used for calculating the SSB.

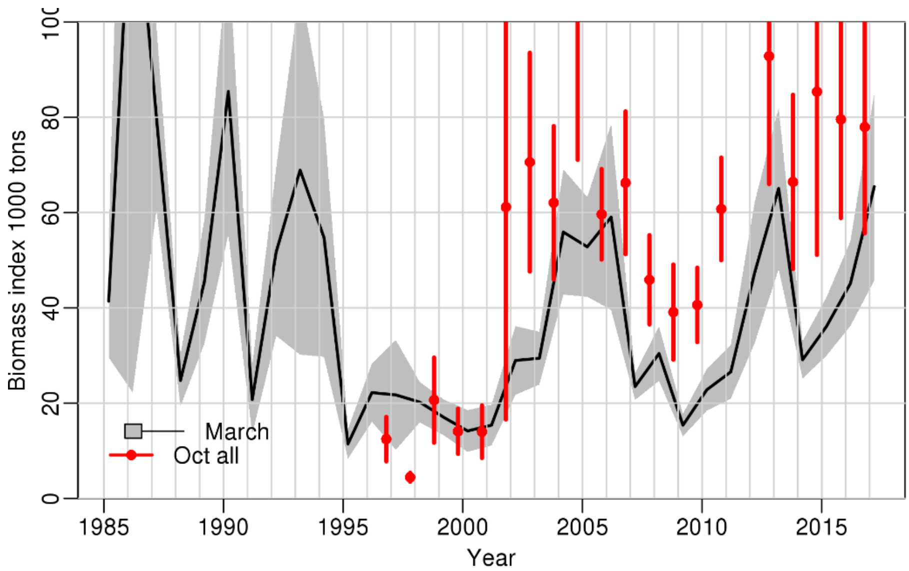


Figure 8.10 Saithe in division Va. Biomass index from the groundfish surveys in March and October.

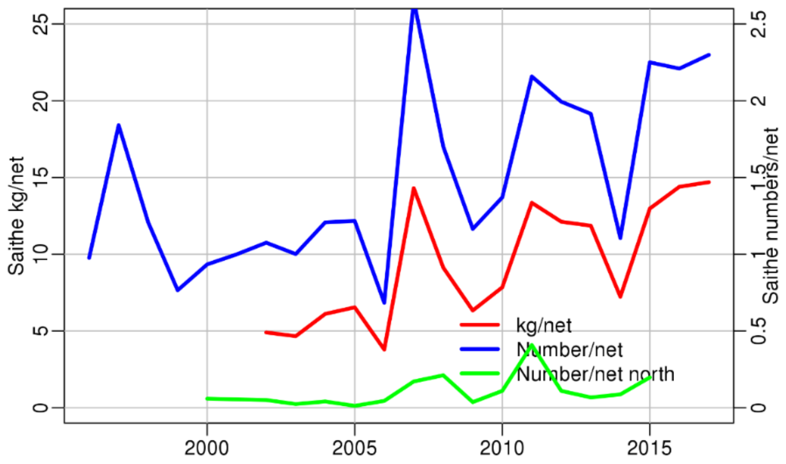


Figure 8.11 Saithe in division Va Indices from the gillnet survey in April 1996-2016. Saithe was not length measured in the survey before 2002 so catch in kg can not be compiled.

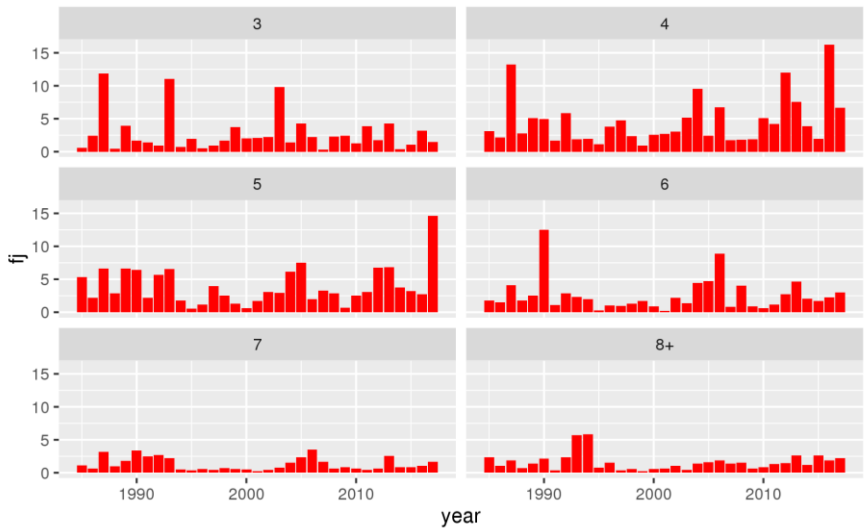


Figure 8.12 Saithe in division Va Survey indices by age from the spring survey.

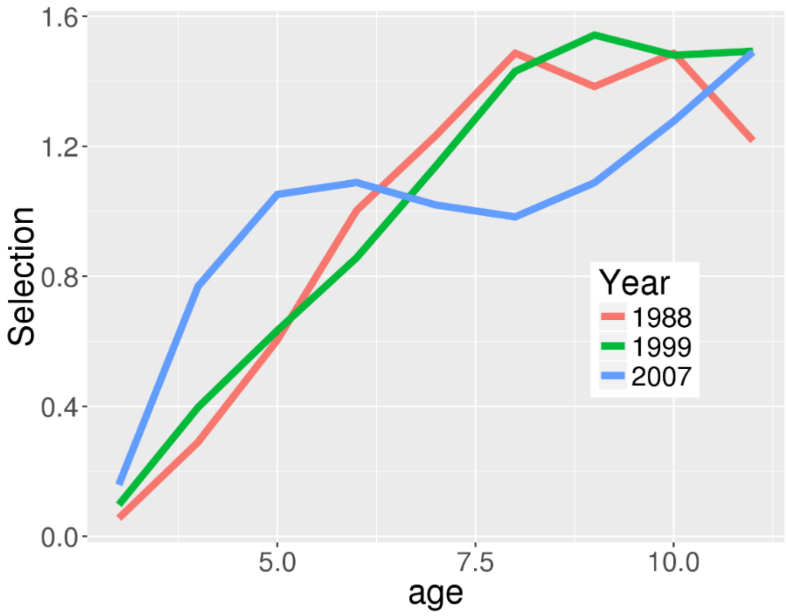


Figure 8.13. Estimated selectivity patterns for the 3 periods, 1980-1996, 1997-2003 and 2014-2016.

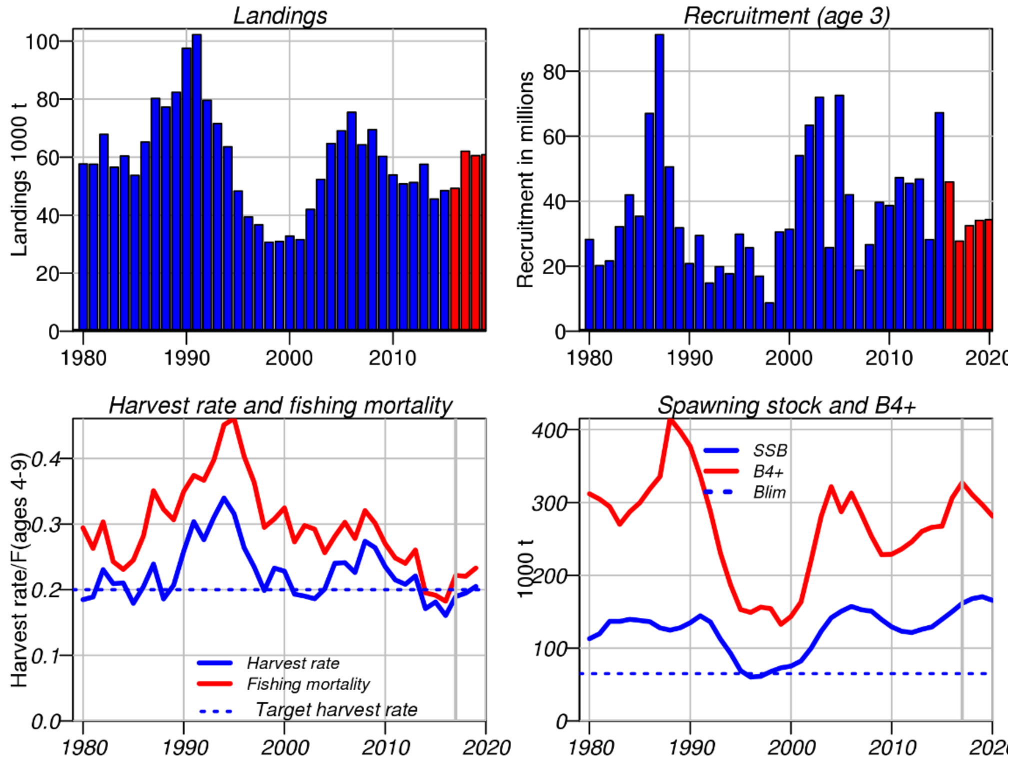


Figure 8.14. Saithe in division Va. Results from the fitted model and short-term forecast. The red line indicates the time of the current assessment.

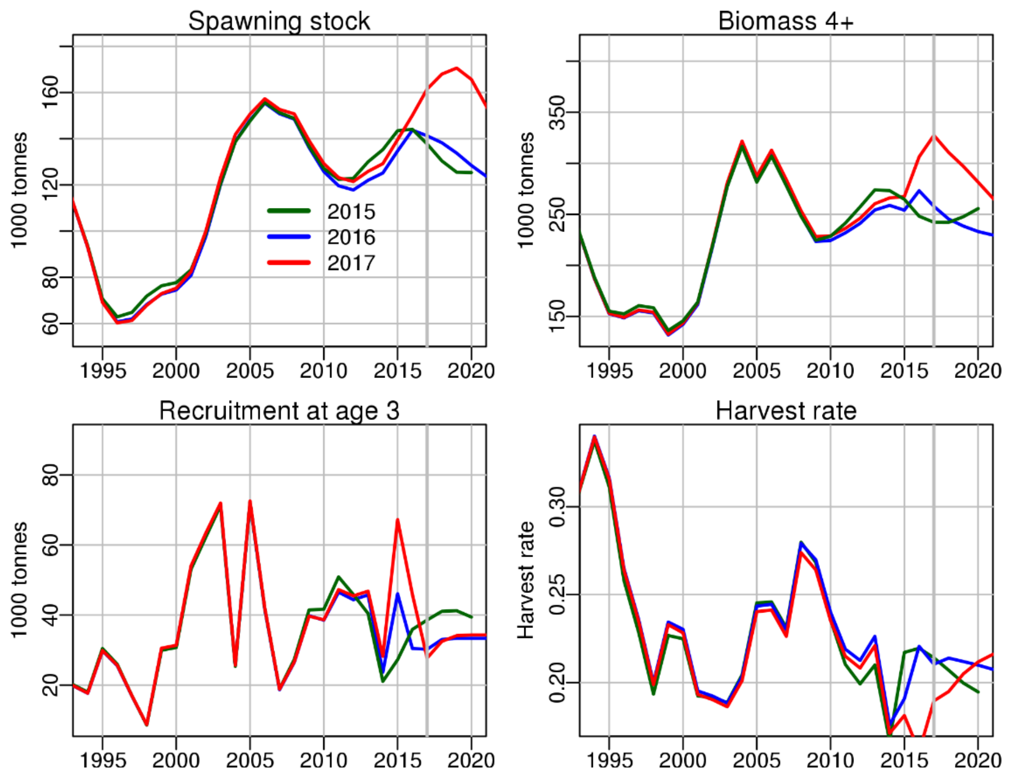


Figure 8.15. Saithe in division Va. Comparison of this year's assessment and short term forecast with results from two previous years.

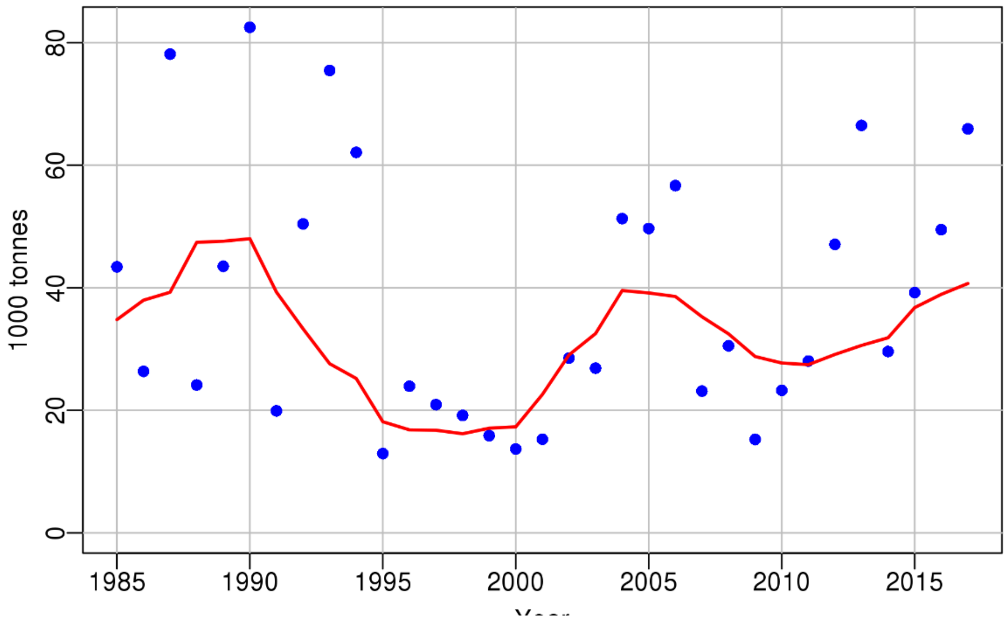


Figure 8.16. Saithe in division Va. Observed and predicted survey biomass from the "SPALY model".

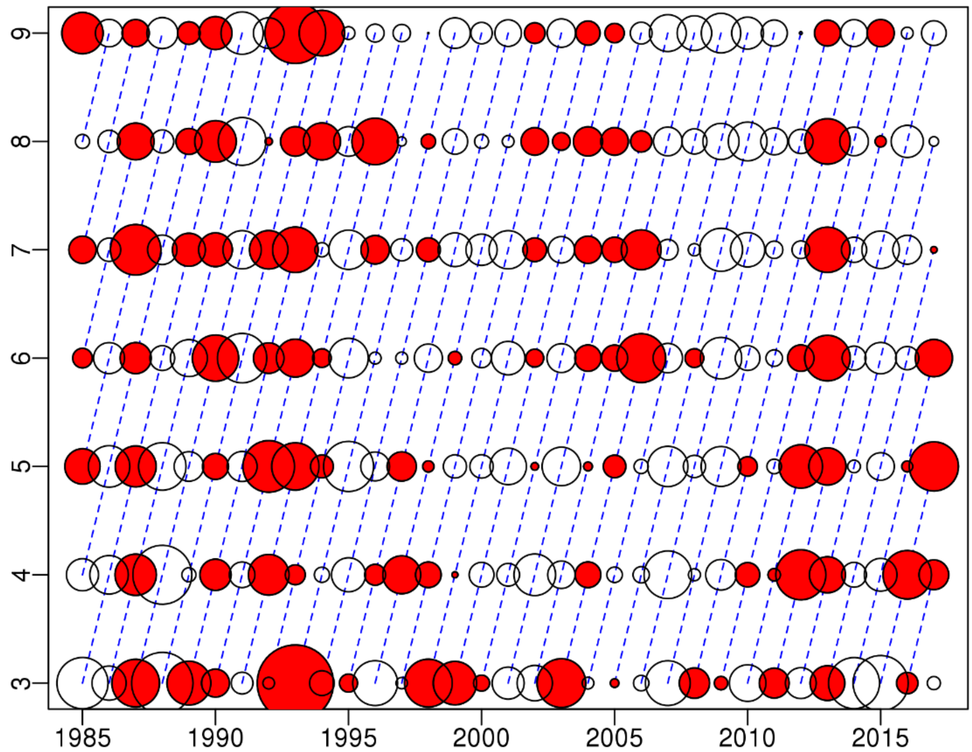


Figure 8.17. Saithe in division Va. Survey residuals from the "SPALY model".

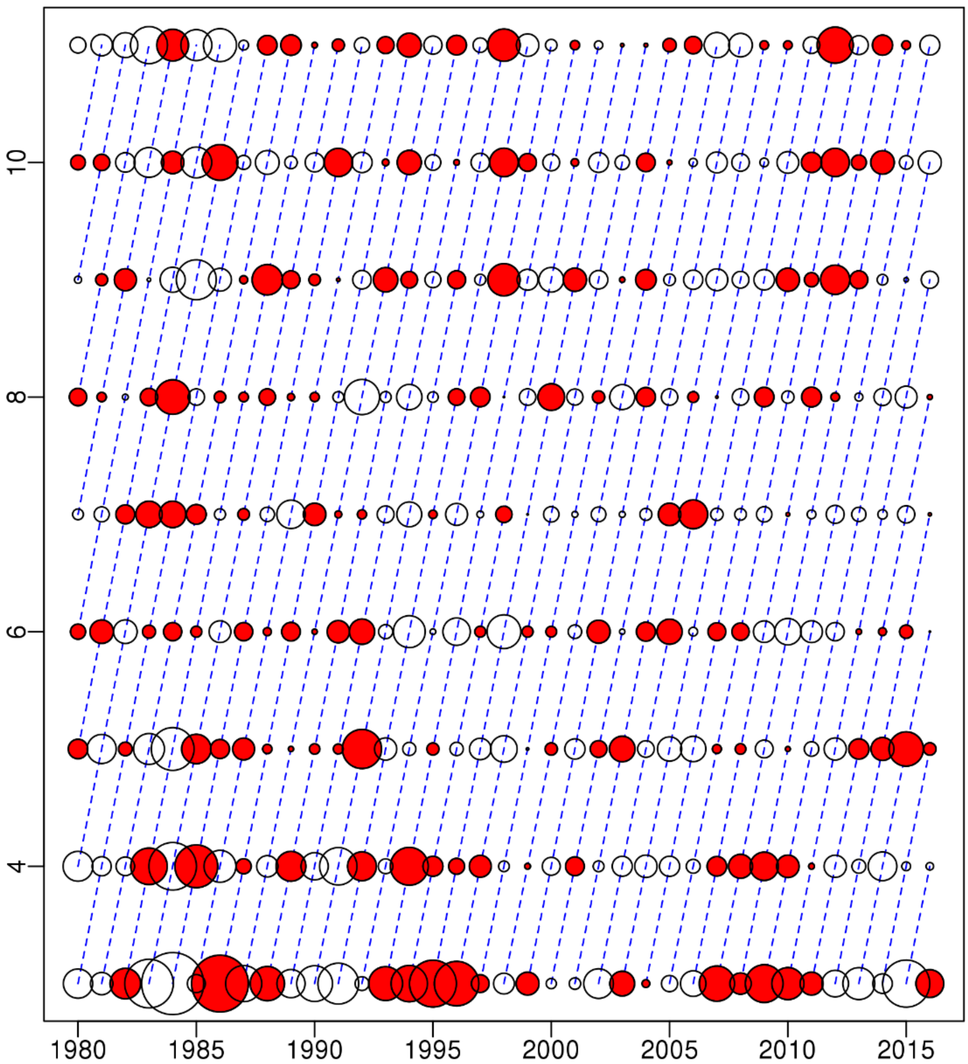


Figure 8.18. Saithe in division Va. Catch residuals from the "SPALY model".

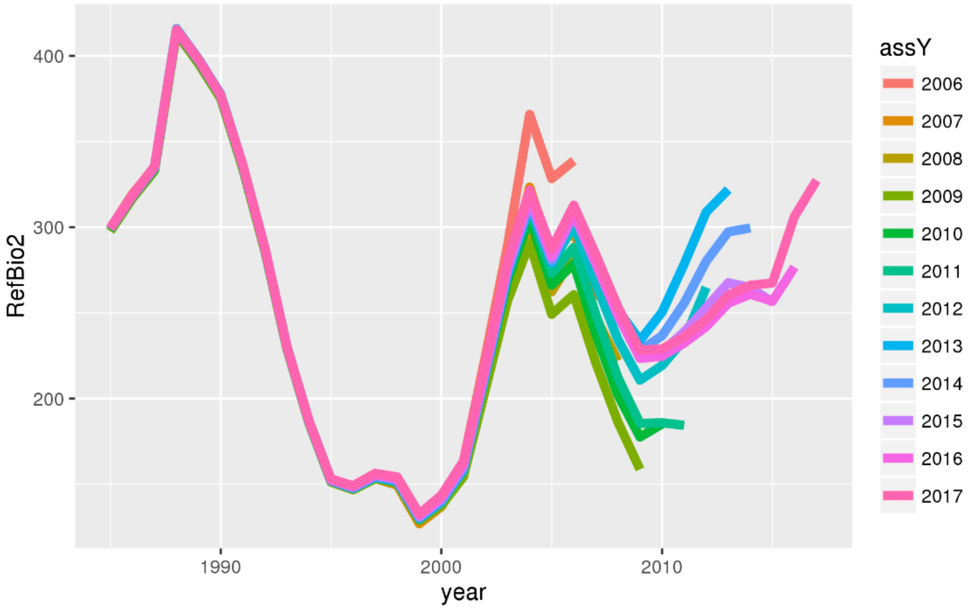
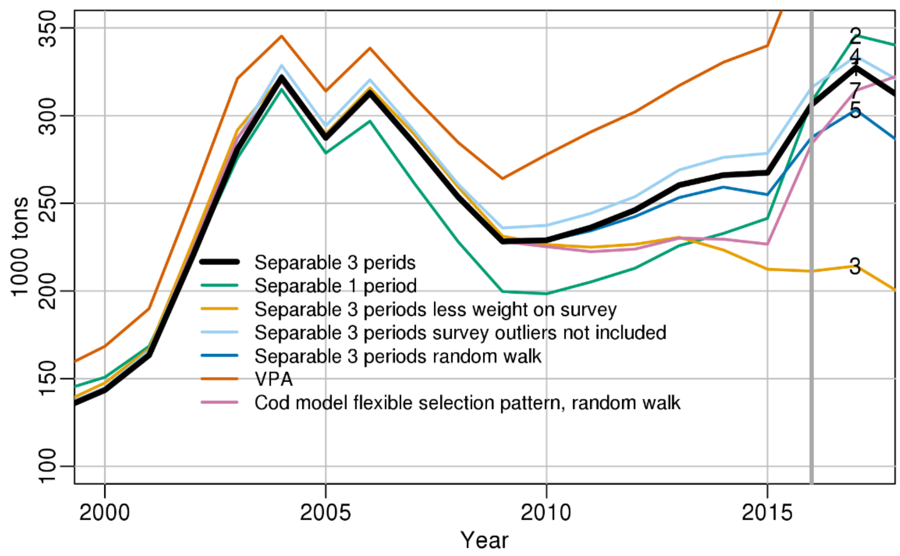


Figure 8.19. Saithe in division Va. Retrospective pattern for the assessment model. The figure shows estimate of B4+. Not finished



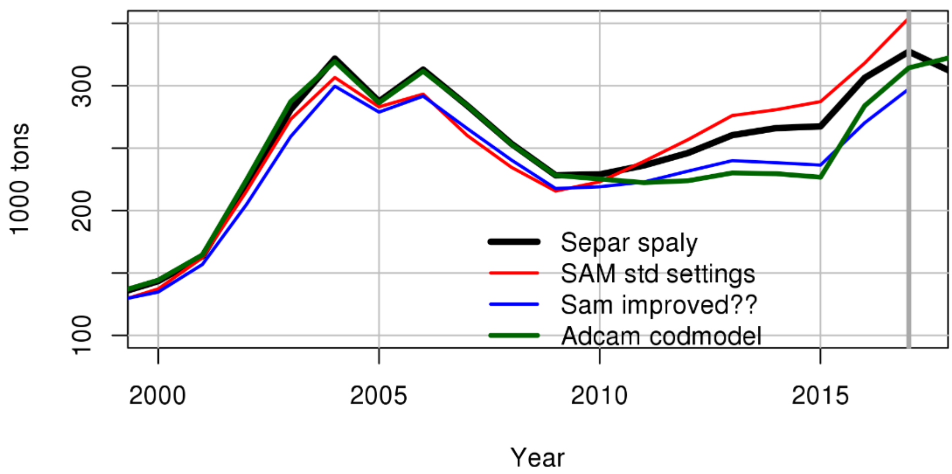


Figure 8.20. Saithe in division Va. Comparison between the default separable model (ADSEP) and alternative assessment model settings.

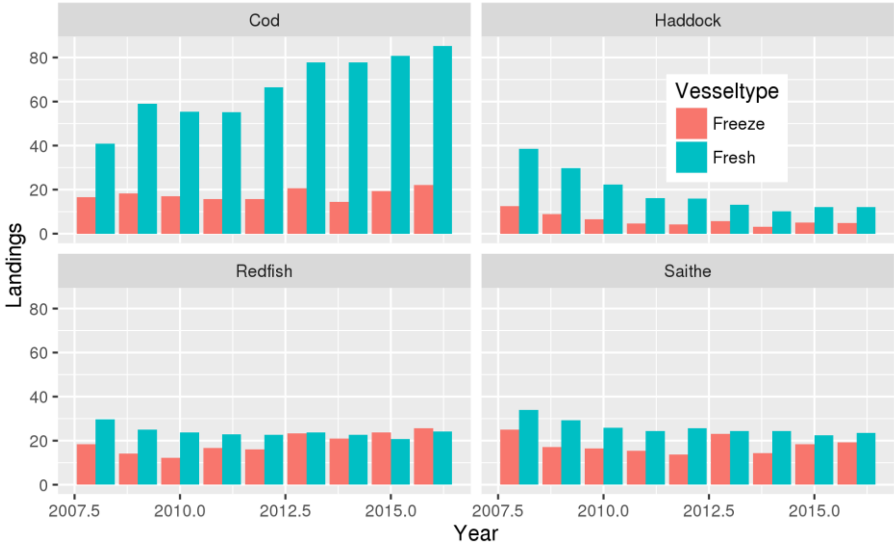


Figure 8.21. Saithe in division Va. Catch by trawlers divided between those that freeze the catch and those that do not. Number of trawler landing has been reducing gradually from 91 in 2008 to 66 in 2016 but the number of freezing trawlers has been 17-18 all the time. The freezing trawlers have therefore been 20-25% of the total number of trawlers.