8 Icelandic saithe

Summary

The 2015 reference biomass (B_{4+}) is estimated as 255 kt, around the average in the assessment period (1980 to the present). Spawning biomass is estimated as 139 kt, above the average in the assessment period and well above $B_{trigger}$ = 65 kt and B_{lim} = 61 kt.

Harvest rate has been around the HCR target of 20% since 2011, with fishing mortality rate between 0.19 and 0.25. Year classes 2008 and 2009 are above average, but recruitment has declined below average since then.

Weights of ages 3-6 have been low in recent years, but older ages are close to average weight. Maturity at ages 4-9 has decreased in recent years and is currently around 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 default separable model (ADSEP) estimates a slightly larger stock size than alternative diagnostic models (ADAPT, TSA, SAM). The estimates of this year's B_{4+} range from 209 (TSA) to 255 kt (ADSEP).

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 population is above $B_{trigger}$, the TAC set in year t equals the average of 0.2 B_{4+} in year t and last year's TAC.

According to the adopted harvest control rule, the TAC will be 55 kt in the next fishing year.

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 2014 are estimated to have been 46 500 t (Table 8.1 and Figure 8.1). Of the landings, 38 600 t were caught by trawl, 2 400 t by gillnets, and the rest caught by other fishing gear. The domestic as well as ICES advice for the fishing year 2014/2015 was based on the 20% harvest control rule and was 58 kt. The TAC issued was also 58 kt. The trajectory of the landings in the current fishing year and calendar year is shown in Figure 8.2.

Most of the catch is caught in bottom trawl (80% in 2010-2014), with gillnet and jiggers taking the majority of the rest. The share taken by the gillnet fleet was larger in the past, 26% in 1982-1996 compared to 9% in 1997-2014 (Figure 8.1).

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). Comparison of sea

and harbour samples indicate that discards have been small in most years since 2000. The sea samples constitute about 60-70% of the length samples used in the calculation of the catch in number. 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.

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). The age and length sampling in 2014 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
Gillnets	2355	9	250	10	1036
Jiggers	2115	14	370	15	1601
Demersal seine	1005	4	150	4	471
Bottom trawl	38634	52	1625	224	32251
Other gear	1624	-	-	189	2354
Foreign landings	750	-	-	-	-
Total	46483	79	2395	442	37713

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.

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 Figure 8.3). The long-term trend since 1980 has been a gradual decline in the weight of all ages. Weight at age in the landings is also used as weight at age in the stock. Weights for the current calendar year are predicted by applying a linear model using survey weights 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 8.4). 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, spring survey data were considered superior to the autumn survey for calibrating the assessment. 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, high in the period around 2005, declining to a relatively low level in 2007-2011. The 2012 and 2013 survey biomass indices were relatively high (Table 8.5 and Figure 8.5).

Internal consistency in the surveys measured by the correlation of the indices for the same year class in 2 adjacent surveys is poor, with R^2 close to 0.3 for the best-defined age groups, and much lower for some other.

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.

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 catch at age (ages 2-10 from 1985 onwards). The selectivity pattern is constant within each period (Figure 8.6). Natural mortality is set at 0.2 for all ages.

The commercial catch-at-age residuals (Table 8.6 and Figure 8.7) are relatively small in recent years, owing to the model flexibility provided by the two recent selectivity periods 1997-2003 and 2004 onwards. The survey catch-at-age residuals (Table 8.7 and Figure 8.7) 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).

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 $SSB \geq B_{\text{trigger}}$, the TAC set in year t equals the average of 0.20 times the current biomass and last year's TAC:

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

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

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

Equation 1 is a plain average of two numbers. Equation 2 is continuous over SSB_t/B_{trigger}, so the rule does not lead to very different TAC when SSB_t is slightly below or above B_{trigger} (Magnusson 2013).

8.6 State of the stock

The results of the principal stock quantities (Table 8.8 and Figure 8.8) show that the reference biomass has historically ranged from 410 to 130 kt (in 1988 and 1999), but this range has been narrower since 2003, between 220 and 320 kt. The current stock size of 255 kt is around the average in the assessment period (1980 to the present). Spawning biomass is estimated as 139 kt, above the average in the assessment period and well above $B_{trigger}$ and B_{lim}.

The harvest rate peaked around 30% in the mid 1990s, but has fluctuated around the HCR target of 20% since 2011, with fishing mortality rate between 0.19 and 0.25. SSB has been stable at a relatively high level during the last ten years, having declined to its historical minimum in the mid 1990s.

Year classes 2008 and 2009 are above average, but recruitment has declined below average since then. The details of the fishing mortality and stock in numbers are presented in Tables 8.9 and 8.10.

8.7 Short-term forecast

The input for the short-term forecast is shown in Table 8.11. 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.

The landings for the ongoing calendar year are predicted based on the 20% HCR, with the calendar year landings consisting of 2/3 of the ongoing fishing year's TAC and 1/3 of the next fishing year's TAC.

Following the HCR, the predicted landings in 2016 are 54 kt and the resulting SSB in 2017 is predicted to be 130 kt.

8.8 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 dstribution of the population. The retrospective pattern (Figure 8.9) 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 diagnostic model runs, involving ADAPT, TSA, and SAM, in order to explore the overall uncertainty in the assessment. The comparison involved four models which differ mainly in the way the commercial catch-at-age variability and F-matrix is modelled:

	Model	Family	CA variability	F matrix
1	ADSEP (default)	separable	observation error	multiplicative in 3 periods
2	ADAPT	vpa	process error	no constraints
3	TSA	state-space (kalman filter)	observation & process error	orthogonal polynomials

4	SAM	state-space (random effects)	observation & process error	correlated random walk

The results from the model comparison (Figure 8.10) show that the default model estimates a slightly larger stock size than the other models, which has also been the case for saithe assessments in recent years. The estimates of this year's B_{4+} range from 209 (TSA) to 255 kt (ADSEP).

8.9 Comparison with previous assessment and forecast

Compared to last year's assessment the estimated reference biomass B_{4+} in 2014 has decreased from 296 to 265 kt, SSB 2014 has decreased from 150 to 132 kt, and the harvest rate u_{2013} has increased from 19% to 22% (fishing mortality 0.22 to 0.25). Stock numbers at age 5 have increased slightly, while stock numbers at ages 6 and 7 have decreased as shown below.

	NWWG 2014	NWWG 2015
B4+(2014)	296	265
SSB(2014)	150	132
u(2013)	19%	22%
F4-9(2013)	0.22	0.25
N5(2014)	24	26
N6(2014)	21	17
N7(2014)	11	9

8.10 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.

8.11 Changes in fishing technology and fishing patterns

According to the stock assessment model fit to the commercial catch-at-age data, the fleet is targeting younger fish since around 2004, compared to earlier years. This can be partly explained by reduced use of gillnets in the saithe fishery.

8.12 References

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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

	Belgium	Faroes	France	Germany	Iceland	Norway	UK (E/W/NI)	UK (Scot)	UK	Total
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
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

Table 8.2. Saithe in division Va. Commercial catch at age (millions).

	3	4	5	6	7	8	9	10	11	12	13	14
1980	0.275	2.540	5.214	2.596	2.169	1.341	0.387	0.262	0.155	0.112	0.064	0.033
1981	0.203	1.325	3.503	5.404	1.457	1.415	0.578	0.242	0.061	0.154	0.135	0.128
1982	0.508	1.092	2.804	4.845	4.293	1.215	0.975	0.306	0.059	0.035	0.048	0.046
1983	0.107	1.750	1.065	2.455	4.454	2.311	0.501	0.251	0.038	0.012	0.002	0.004
1984	0.053	0.657	0.800	1.825	2.184	3.610	0.844	0.376	0.291	0.135	0.185	0.226
1985	0.376	4.014	3.366	1.958	1.536	1.172	0.747	0.479	0.074	0.023	0.072	0.071
1986	3.108	1.400	4.170	2.665	1.550	1.116	0.628	1.549	0.216	0.051	0.030	0.014
1987	0.956	5.135	4.428	5.409	2.915	1.348	0.661	0.496	0.498	0.058	0.027	0.048
1988	1.318	5.067	6.619	3.678	2.859	1.775	0.845	0.226	0.270	0.107	0.024	0.001
1989	0.315	4.313	8.471	7.309	1.794	1.928	0.848	0.270	0.191	0.135	0.076	0.010
1990	0.143	1.692	5.471	10.112	6.174	1.816	1.087	0.380	0.151	0.055	0.076	0.037
1991	0.198	0.874	3.613	6.844	10.772	3.223	0.858	0.838	0.228	0.040	0.006	0.005
1992	0.242	2.928	3.844	4.355	3.884	4.046	1.290	0.350	0.196	0.056	0.054	0.015
1993	0.657	1.083	2.841	2.252	2.247	2.314	3.671	0.830	0.223	0.188	0.081	0.012
1994	0.702	2.955	1.770	2.603	1.377	1.243	1.263	2.009	0.454	0.158	0.188	0.082
1995	1.573	1.853	2.661	1.807	2.370	0.905	0.574	0.482	0.521	0.106	0.035	0.013
1996	1.102	2.608	1.868	1.649	0.835	1.233	0.385	0.267	0.210	0.232	0.141	0.074
1997	0.603	2.960	2.766	1.651	1.178	0.599	0.454	0.125	0.095	0.114	0.077	0.043
1998	0.183	1.289	1.767	1.545	1.114	0.658	0.351	0.265	0.120	0.081	0.085	0.085
1999	0.989	0.732	1.564	2.176	1.934	0.669	0.324	0.140	0.072	0.025	0.028	0.022
2000	0.850	2.383	0.896	1.511	1.612	1.806	0.335	0.173	0.057	0.033	0.017	0.007
2001	1.223	2.619	2.184	0.591	0.977	0.943	0.819	0.186	0.094	0.028	0.028	0.013
2002	1.187	4.190	3.147	2.970	0.519	0.820	0.570	0.309	0.101	0.027	0.015	0.011
2003	2.284	4.363	4.031	2.472	1.942	0.285	0.438	0.289	0.196	0.028	0.029	0.015

2004	0.952	7.841	7.195	5.363	1.563	1.057	0.211	0.224	0.157	0.074	0.039	0.011
2005	2.607	3.089	7.333	6.876	3.592	0.978	0.642	0.119	0.149	0.089	0.046	0.012
2006	1.380	10.051	2.616	5.840	4.514	1.989	0.667	0.485	0.118	0.112	0.086	0.031
2007	1.244	6.552	8.751	2.124	2.935	1.817	0.964	0.395	0.190	0.043	0.036	0.020
2008	1.432	3.602	5.874	6.706	1.155	1.894	1.248	0.803	0.262	0.176	0.087	0.044
2009	2.820	5.166	2.084	2.734	2.883	0.777	1.101	0.847	0.555	0.203	0.134	0.036
2010	2.146	6.284	3.058	0.997	1.644	1.571	0.514	0.656	0.522	0.231	0.114	0.064
2011	2.004	4.850	4.006	1.502	0.677	1.065	1.145	0.323	0.433	0.244	0.150	0.075
2012	1.183	4.816	3.514	2.417	0.903	0.432	0.883	1.015	0.354	0.277	0.173	0.099
2013	1.163	5.538	6.366	2.963	1.610	0.664	0.375	0.537	0.460	0.124	0.118	0.078
2014	0.668	3.499	4.867	2.805	1.276	0.725	0.347	0.241	0.312	0.199	0.128	0.074

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

	3	4	5	6	7	8	9	10	11	12	13	14
1980	1428	1983	2667	3689	5409	6321	7213	8565	9147	9617	10066	11041
1981	1585	2037	2696	3525	4541	6247	6991	8202	9537	9089	9351	10225
1982	1547	2194	3015	3183	5114	6202	7256	7922	8924	10134	9447	10535
1983	1530	2221	3171	4270	4107	5984	7565	8673	8801	9039	11138	9818
1984	1653	2432	3330	4681	5466	4973	7407	8179	8770	8831	11010	11127
1985	1609	2172	3169	3922	4697	6411	6492	8346	9401	10335	11027	10644
1986	1450	2190	2959	4402	5488	6406	7570	6487	9616	10462	11747	11902
1987	1516	1715	2670	3839	5081	6185	7330	8025	7974	9615	12246	11656
1988	1261	2017	2513	3476	4719	5932	7523	8439	8748	9559	10824	14099
1989	1403	2021	2194	3047	4505	5889	7172	8852	10170	10392	12522	11923
1990	1647	1983	2566	3021	4077	5744	7038	7564	8854	10645	11674	11431
1991	1224	1939	2432	3160	3634	4967	6629	7704	9061	9117	10922	11342
1992	1269	1909	2578	3288	4150	4865	6168	7926	8349	9029	11574	9466
1993	1381	2143	2742	3636	4398	5421	5319	7006	8070	10048	9106	11591
1994	1444	1836	2649	3512	4906	5539	6818	6374	8341	9770	10528	11257
1995	1370	1977	2769	3722	4621	5854	6416	7356	6815	8312	9119	11910
1996	1229	1755	2670	3802	4902	5681	7182	7734	9256	8322	10501	11894
1997	1325	1936	2409	3906	5032	6171	7202	7883	8856	9649	9621	10877
1998	1347	1972	2943	3419	4850	5962	6933	7781	8695	9564	10164	10379
1999	1279	2106	2752	3497	3831	5819	7072	8078	8865	10550	10823	11300
2000	1367	1929	2751	3274	4171	4447	6790	8216	9369	9817	10932	12204
2001	1280	1882	2599	3697	4420	5538	5639	7985	9059	9942	10632	10988
2002	1308	1946	2569	3266	4872	5365	6830	7067	9240	9659	10088	11632
2003	1310	1908	2545	3336	4069	5792	7156	8131	8051	10186	10948	11780
2004	1467	1847	2181	2918	4017	5135	7125	7732	8420	8927	10420	10622
2005	1287	1888	2307	2619	3516	5080	6060	8052	8292	8342	8567	10256
2006	1164	1722	2369	2808	3235	4361	6007	7166	8459	9324	9902	9636
2007	1140	1578	2122	2719	3495	4114	5402	6995	7792	9331	9970	10738
2008	1306	1805	2295	2749	3515	4530	5132	6394	7694	9170	9594	11258
2009	1412	1862	2561	3023	3676	4596	5651	6074	7356	8608	9812	10639
2010	1287	1787	2579	3469	4135	4850	5558	6289	6750	7997	9429	10481
2011	1175	1801	2526	3680	4613	5367	5685	6466	6851	7039	8268	8958
2012	1160	1668	2369	3347	4430	5486	6161	6448	7220	8054	8147	8901
2013	1056	1675	2219	3244	4529	5628	6397	7055	7378	7955	8400	8870
2014	1211	1575	2229	2983	4378	5598	6773	8023	7875	8646	9179	9749
2015	1142	1726	2217	3071	4030	5532	6846	7175	7491	8218	8575	9173
2016	1142	1726	2217	3071	4030	5532	6846	7175	7491	8218	8575	9173
2017	1142	1726	2217	3071	4030	5532	6846	7175	7491	8218	8575	9173

Table 8.4. Saithe in division Va. Maturity at age used for calculating the SSB.

	3	4	5	6	7	8	9	10	11	12	13	14
1985	0	0.089	0.197	0.380	0.604	0.792	0.905	1	1	1	1	1
1986	0	0.080	0.178	0.351	0.575	0.772	0.894	1	1	1	1	1
1987	0	0.072	0.162	0.325	0.547	0.751	0.883	1	1	1	1	1
1988	0	0.065	0.148	0.303	0.521	0.731	0.871	1	1	1	1	1
1989	0	0.060	0.138	0.285	0.499	0.714	0.862	1	1	1	1	1
1990	0	0.057	0.131	0.273	0.484	0.701	0.854	1	1	1	1	1
1991	0	0.055	0.127	0.266	0.475	0.694	0.850	1	1	1	1	1
1992	0	0.055	0.127	0.266	0.476	0.694	0.850	1	1	1	1	1
1993	0	0.057	0.131	0.274	0.485	0.702	0.855	1	1	1	1	1
1994	0	0.062	0.141	0.290	0.505	0.718	0.864	1	1	1	1	1
1995	0	0.069	0.157	0.317	0.537	0.743	0.879	1	1	1	1	1
1996	0	0.081	0.181	0.355	0.579	0.775	0.896	1	1	1	1	1
1997	0	0.097	0.212	0.402	0.627	0.807	0.913	1	1	1	1	1
1998	0	0.117	0.248	0.451	0.673	0.837	0.928	1	1	1	1	1
1999	0	0.137	0.284	0.497	0.712	0.860	0.939	1	1	1	1	1
2000	0	0.154	0.313	0.532	0.740	0.877	0.947	1	1	1	1	1
2001	0	0.165	0.331	0.552	0.755	0.885	0.951	1	1	1	1	1
2002	0	0.169	0.337	0.560	0.760	0.888	0.952	1	1	1	1	1
2003	0	0.168	0.335	0.557	0.759	0.887	0.952	1	1	1	1	1
2004	0	0.163	0.328	0.549	0.753	0.884	0.950	1	1	1	1	1
2005	0	0.157	0.318	0.538	0.744	0.879	0.948	1	1	1	1	1
2006	0	0.152	0.309	0.527	0.736	0.874	0.946	1	1	1	1	1
2007	0	0.146	0.300	0.517	0.728	0.870	0.943	1	1	1	1	1
2008	0	0.141	0.291	0.506	0.719	0.865	0.941	1	1	1	1	1
2009	0	0.136	0.282	0.495	0.710	0.859	0.939	1	1	1	1	1
2010	0	0.130	0.272	0.483	0.700	0.853	0.936	1	1	1	1	1
2011	0	0.124	0.261	0.469	0.688	0.847	0.932	1	1	1	1	1
2012	0	0.118	0.250	0.455	0.676	0.839	0.929	1	1	1	1	1
2013	0	0.112	0.239	0.440	0.662	0.830	0.924	1	1	1	1	1
2014	0	0.106	0.228	0.424	0.648	0.821	0.920	1	1	1	1	1
2015	0	0.100	0.217	0.409	0.633	0.812	0.915	1	1	1	1	1
2016	0	0.100	0.217	0.409	0.633	0.812	0.915	1	1	1	1	1
2017	0	0.100	0.217	0.409	0.633	0.812	0.915	1	1	1	1	1

Table 8.5. Saithe in division Va. Survey catch at age.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1985	0.05	0.61	0.58	2.99	5.11	1.74	1.06	0.50	1.37	0.16	0.08	0.08	0.07	0.07
1986	0.02	2.33	2.40	2.06	2.09	1.42	0.62	0.28	0.19	0.32	0.09	0.07	0.03	0.00
1987	0.10	0.39	11.52	12.93	6.42	3.95	3.07	0.79	0.36	0.26	0.33	0.05	0.01	0.03
1988	0.69	0.31	0.49	2.72	2.81	1.71	0.95	0.40	0.07	0.08	0.10	0.05	0.01	0.00
1989	0.20	1.43	3.96	5.05	6.57	2.49	1.77	0.91	0.40	0.00	0.02	0.00	0.03	0.00
1990	0.01	0.35	1.69	4.86	6.37	12.33	3.30	1.21	0.64	0.12	0.06	0.02	0.01	0.03
1991	0.01	0.22	1.40	1.72	2.22	1.13	2.50	0.30	0.02	0.03	0.00	0.01	0.00	0.01
1992	0.01	0.15	0.91	5.73	5.52	2.79	2.68	1.91	0.28	0.06	0.06	0.02	0.00	0.00
1993	0.00	1.27	11.04	2.00	6.80	2.41	2.25	1.02	4.02	0.64	0.05	0.00	0.02	0.00
1994	0.04	0.82	0.73	1.89	1.74	1.95	0.53	0.84	1.00	3.62	0.41	0.18	0.00	0.04
1995	0.06	0.48	1.98	1.12	0.51	0.28	0.34	0.10	0.15	0.15	0.33	0.02	0.00	0.00
1996	0.03	0.13	0.51	3.76	1.12	0.99	0.58	1.00	0.05	0.09	0.10	0.25	0.03	0.00
1997	0.16	0.32	0.90	4.72	3.96	0.94	0.40	0.16	0.10	0.05	0.02	0.02	0.02	0.00
1998	0.01	0.11	1.64	2.33	2.53	1.23	0.71	0.31	0.08	0.07	0.04	0.03	0.05	0.03
1999	0.57	0.75	3.71	0.93	1.25	1.64	0.57	0.17	0.02	0.02	0.02	0.00	0.00	0.02
2000	0.00	0.38	2.02	2.54	0.61	0.84	0.53	0.47	0.07	0.03	0.01	0.00	0.01	0.01
2001	0.00	0.89	1.90	2.64	1.60	0.20	0.23	0.40	0.13	0.07	0.04	0.01	0.00	0.00
2002	0.02	1.05	2.23	2.97	3.08	2.15	0.42	0.49	0.32	0.22	0.02	0.03	0.00	0.00
2003	0.01	0.05	9.62	5.06	2.94	1.34	0.77	0.21	0.05	0.10	0.02	0.03	0.00	0.00
2004	0.01	0.91	1.38	9.39	6.04	4.35	1.48	0.81	0.17	0.16	0.12	0.06	0.02	0.00
2005	0.00	0.26	4.32	2.39	7.42	4.66	2.31	0.86	0.44	0.12	0.05	0.08	0.03	0.00
2006	0.01	0.00	2.18	6.69	1.98	8.91	3.52	1.21	0.29	0.25	0.03	0.04	0.04	0.00
2007	0.00	0.06	0.31	1.73	3.22	0.81	1.62	0.70	0.29	0.16	0.11	0.08	0.02	0.00
2008	0.01	0.08	2.25	1.79	2.85	4.01	0.61	0.78	0.34	0.15	0.09	0.13	0.04	0.02

2009	0.01	0.21	2.43	1.80	0.68	0.91	0.84	0.12	0.26	0.15	0.03	0.04	0.00	0.02
2010	0.00	0.07	1.23	4.99	2.49	0.63	0.60	0.48	0.07	0.13	0.07	0.07	0.07	0.02
2011	0.00	0.15	3.83	4.20	3.06	1.15	0.41	0.39	0.44	0.17	0.10	0.09	0.06	0.05
2012	0.02	0.02	1.75	12.04	6.86	2.75	0.62	0.17	0.38	0.50	0.13	0.12	0.06	0.08
2013	0.01	0.12	4.27	7.43	6.78	4.65	2.57	1.12	0.30	0.44	0.36	0.26	0.13	0.01
2014	0.01	0.03	0.39	3.84	3.78	2.04	0.86	0.42	0.15	0.11	0.18	0.18	0.07	0.09
2015	0.06	0.04	1.07	1.90	3.16	1.72	0.81	0.72	0.68	0.45	0.26	0.23	0.21	0.15

Table 8.6. Saithe in division Va. Commercial catch-at-age residuals log(obs/fit).

	3	4	5	6	7	8	9	10	11	12	13	14
1980	-0.79	-0.60	0.25	0.16	-0.08	0.22	-0.05	0.22	-0.30	-0.41	-0.70	-0.04
1981	-0.51	-0.26	-0.56	0.36	-0.16	0.06	0.12	0.28	-0.85	0.93	1.19	1.88
1982	0.84	-0.25	0.13	-0.37	0.24	-0.03	0.37	-0.36	-1.20	-1.15	-0.53	-0.10
1983	-2.48	0.94	-0.67	0.11	0.46	0.20	-0.01	-0.80	-2.43	-2.79	-5.17	-3.83
1984	-4.23	-1.61	-1.29	0.22	0.47	0.79	-0.45	0.43	0.96	1.03	3.47	4.90
1985	-0.28	1.23	0.58	0.08	0.27	-0.19	-1.16	-0.75	-1.41	-3.07	0.65	2.46
1986	2.28	-0.72	0.24	-0.32	-0.09	0.10	-0.41	0.93	-1.09	-1.39	-1.83	-1.75
1987	-0.99	0.16	0.32	0.22	0.09	0.07	0.06	-0.18	-0.08	-2.91	-1.91	-0.24
1988	0.92	-0.31	0.06	0.04	-0.14	0.20	0.79	-0.66	0.48	-1.69	-3.27	-6.88
1989	-0.84	0.61	0.01	0.23	-0.58	0.04	0.27	-0.18	0.71	0.37	-1.13	-3.73
1990	-1.78	-0.54	0.07	0.01	0.34	0.06	0.11	-0.37	0.07	-0.78	0.16	-1.61
1991	-1.96	-1.11	0.06	0.33	0.03	-0.08	0.01	0.72	0.23	-1.38	-3.92	-3.95
1992	-0.22	0.58	1.05	0.43	0.06	-0.83	-0.25	-0.40	-0.28	-1.17	0.48	-0.88
1993	0.98	-0.16	-0.33	-0.14	-0.20	-0.08	0.40	0.04	0.33	0.75	0.65	-1.28
1994	1.09	0.98	-0.12	-0.69	-0.43	-0.46	0.20	0.41	0.51	0.80	1.87	1.79
1995	1.59	0.28	0.10	-0.02	0.04	-0.08	-0.20	-0.19	-0.26	-0.87	-0.68	-1.83
1996	1.45	0.17	-0.12	-0.51	-0.34	0.19	0.27	0.03	0.39	-0.15	1.33	2.41
1997	0.25	0.33	-0.30	0.08	-0.03	0.29	-0.10	-0.40	-0.30	0.37	-1.12	0.20
1998	-0.36	-0.07	-0.47	-0.76	0.18	0.00	0.84	0.70	1.24	1.15	1.57	0.84
1999	0.38	0.03	0.00	0.08	0.00	-0.20	-0.35	0.33	-0.65	-0.57	0.31	0.17
2000	-0.07	-0.20	0.11	0.07	-0.16	0.48	-0.49	-0.27	-0.22	-0.93	-0.09	-1.12
2001	-0.09	0.23	-0.27	-0.14	-0.03	-0.18	0.39	0.06	0.13	0.04	0.37	1.00
2002	-0.62	-0.08	0.18	0.36	-0.17	0.12	-0.26	-0.35	-0.09	-1.20	-0.10	-0.36
2003	0.40	-0.28	0.42	-0.02	-0.02	-0.61	0.04	-0.20	0.04	-1.24	0.24	1.21
2004	-0.16	-0.39	-0.11	0.27	-0.10	0.28	0.61	0.41	-0.05	-0.47	0.75	-0.26
2005	-0.39	-0.32	-0.31	0.44	0.34	-0.23	-0.13	-0.01	0.31	-0.07	-0.31	-0.43
2006	-0.69	-0.16	-0.35	-0.03	0.56	0.07	-0.33	-0.10	0.76	0.95	1.05	0.12
2007	0.79	0.22	0.14	0.25	-0.13	-0.04	-0.40	-0.48	-0.82	0.30	0.25	-0.26
2008	0.11	0.36	0.18	0.23	-0.11	-0.23	-0.24	-0.30	-0.60	0.10	2.71	1.70
2009	0.75	0.49	-0.11	-0.27	-0.16	0.29	-0.34	-0.12	0.10	0.42	1.08	2.54
2010	0.46	0.28	0.11	-0.46	0.03	-0.12	0.47	-0.43	0.07	-0.06	0.84	1.18
2011	0.14	-0.06	-0.05	-0.30	-0.04	0.29	0.14	0.36	-0.24	-0.01	0.48	1.41
2012	-0.57	-0.37	-0.27	-0.20	-0.24	0.06	0.66	0.55	1.38	0.12	0.55	0.91
2013	-0.50	-0.04	0.33	-0.02	-0.19	-0.11	0.28	0.12	-0.36	0.35	-0.53	0.01
2014	0.16	-0.20	0.50	-0.04	-0.22	-0.37	-0.24	0.45	0.28	-0.38	1.99	0.16

Table 8.7. Saithe in division Va. Survey catch-at-age residuals log(obs/fit).

	2	3	4	5	6	7	8	9	10
1985	-0.43	-1.53	-0.46	0.55	0.20	0.36	-0.17	0.83	-1.01
1986	0.78	-0.61	-0.69	-0.80	-0.50	-0.35	-0.47	-0.68	-0.39
1987	-0.62	0.87	0.73	0.74	0.44	1.13	0.74	0.53	0.25
1988	-0.35	-2.15	-1.48	-0.96	-0.29	-0.46	-0.39	-1.31	-0.59
1989	1.95	0.86	-0.05	-0.34	-0.60	0.50	0.33	0.35	-5.74
1990	-0.12	0.36	0.45	0.33	0.91	0.48	0.88	0.65	-0.47
1991	0.15	-0.28	-0.27	-0.36	-1.18	-0.62	-1.45	-3.10	-2.26
1992	-0.64	0.03	0.74	1.23	0.46	0.66	-0.02	-0.70	-1.15
1993	2.00	2.63	0.31	1.07	0.80	1.02	0.44	1.69	0.97
1994	0.88	-0.44	-0.09	0.29	0.18	-0.12	0.84	1.31	2.32
1995	0.43	0.12	-0.56	-1.48	-1.24	-0.96	-1.03	-0.21	-0.09
1996	-0.62	-1.29	0.24	-0.41	-0.09	0.52	1.34	-0.87	0.00
1997	1.22	-0.13	0.70	0.44	-0.07	-0.32	-0.04	-0.47	-0.15
1998	-1.50	1.36	0.36	0.11	-0.41	0.34	0.23	-0.06	-0.18
1999	0.72	0.85	0.06	-0.24	0.09	-0.64	-0.57	-2.24	-1.04
2000	-0.72	0.10	-0.23	-0.30	-0.21	-0.55	-0.07	-0.87	-1.14
2001	0.10	-0.62	-0.22	-0.64	-1.11	-1.04	-0.08	-0.84	-0.22
2002	0.13	-0.61	-0.72	0.08	0.18	0.42	0.60	0.34	0.36
2003	-2.22	0.95	-0.28	-0.61	-0.41	-0.34	0.38	-1.36	-0.40
2004	-0.05	-0.12	0.31	0.07	0.34	0.37	0.45	0.80	0.59
2005	-0.87	0.00	-0.06	0.26	0.33	0.29	0.40	0.25	0.83
2006	-6.50	-0.16	-0.07	-0.03	1.07	0.72	0.23	-0.33	0.06
2007	-2.08	-1.51	-1.01	-0.67	-0.48	-0.20	-0.47	-0.90	-0.54
2008	-2.23	0.39	-0.03	-0.17	0.19	-0.09	-0.36	-0.77	-1.19
2009	-1.10	0.00	-0.45	-0.90	-0.89	-0.90	-1.27	-1.08	-1.22
2010	-2.62	-0.81	0.25	0.18	-0.39	-0.66	-0.85	-1.35	-1.41
2011	-1.60	0.30	0.04	-0.10	-0.17	-0.21	-0.50	-0.45	0.12
2012	-3.77	-0.50	1.04	0.82	0.31	-0.24	-0.60	-0.05	0.11
2013	-0.95	0.71	0.60	0.56	0.88	0.87	1.09	0.54	0.52
2014	-2.84	-1.35	-0.03	0.00	-0.32	-0.45	-0.62	-0.80	-0.24
2015	-2.74	-0.45	-0.10	-0.09	-0.43	-0.80	-0.06	0.38	0.85

Table 8.8. Saithe in division Va. Main population estimates. The recruitment column is aligned so that the 2000 cohort is shown in the year 2000, but that cohort size is the estimated N at age 3 in 2003.

	B4+	SSB	Cohort	Y	F4–9	HR
1980	312	122	32	58	0.29	19%
1981	304	130	42	59	0.26	19%
1982	294	148	35	69	0.30	23%
1983	270	147	67	58	0.24	22%
1984	287	149	91	63	0.23	22%
1985	299	139	50	57	0.25	19%
1986	318	137	32	65	0.28	20%
1987	335	128	21	81	0.35	24%
1988	415	125	29	77	0.32	19%
1989	397	127	15	82	0.31	21%
1990	377	134	20	98	0.35	26%
1991	336	143	18	102	0.37	30%
1992	288	135	30	80	0.37	28%
1993	230	112	25	72	0.40	31%
1994	187	93	17	64	0.45	34%
1995	152	70	9	49	0.46	32%
1996	148	61	30	40	0.41	27%
1997	155	62	31	37	0.37	24%
1998	153	68	53	32	0.30	21%
1999	131	72	63	31	0.31	24%
2000	141	74	72	33	0.33	23%
2001	161	80	26	32	0.28	20%
2002	217	96	72	42	0.31	19%
2003	276	118	42	52	0.30	19%
2004	316	137	19	65	0.26	20%
2005	282	147	27	69	0.29	25%
2006	307	156	41	76	0.31	25%
2007	278	152	41	64	0.28	23%
2008	248	149	50	70	0.32	28%
2009	224	137	45	61	0.30	27%
2010	227	127	39	54	0.27	24%
2011	239	122	21	51	0.24	21%
2012	253	122	26	52	0.23	20%
2013	268	128	32	58	0.25	22%
2014	265	132	33	46	0.19	18%
2015	255	139	33	57	0.26	22%

Table 8.9. Saithe in division Va. Stock in numbers.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1980	32.2	24.6	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	47.9	26.4	20.2	22.7	35.2	21.2	6.3	4.6	2.0	0.7	0.4	0.4	0.3	0.2
1982	62.4	39.3	21.6	16.3	17.2	24.6	13.3	3.7	2.6	1.1	0.4	0.2	0.2	0.2
1983	52.8	51.1	32.1	17.4	12.2	11.8	14.8	7.5	1.9	1.4	0.6	0.2	0.1	0.1
1984	99.7	43.2	41.8	26.0	13.3	8.6	7.5	9.0	4.3	1.1	0.8	0.4	0.1	0.1
1985	136.4	81.6	35.4	33.8	19.9	9.4	5.6	4.6	5.2	2.5	0.7	0.5	0.2	0.1
1986	75.3	111.7	66.8	28.6	25.8	14.0	6.0	3.4	2.6	3.0	1.4	0.4	0.3	0.1
1987	47.6	61.7	91.4	53.9	21.6	17.8	8.7	3.5	1.8	1.5	1.6	0.8	0.2	0.2
1988	31.0	39.0	50.5	73.4	39.8	14.3	10.2	4.6	1.7	0.9	0.7	0.9	0.4	0.1
1989	44.0	25.4	31.9	40.6	54.7	26.8	8.5	5.6	2.3	0.9	0.5	0.4	0.5	0.2
1990	22.1	36.0	20.8	25.7	30.4	37.2	16.2	4.7	2.9	1.2	0.5	0.3	0.2	0.3
1991	29.5	18.1	29.5	16.7	19.0	20.2	31.4	8.6	2.3	1.5	0.6	0.2	0.1	0.1
1992	26.3	24.2	14.8	23.6	12.3	12.4	11.3	16.2	4.0	1.1	0.7	0.3	0.1	0.1
1993	44.3	21.5	19.8	11.9	17.4	8.0	7.0	5.9	7.7	2.0	0.5	0.4	0.2	0.1
1994	38.0	36.3	17.6	15.9	8.7	11.2	4.4	3.5	2.7	3.6	0.9	0.3	0.2	0.1
1995	25.0	31.1	29.7	14.1	11.4	5.4	5.8	2.1	1.5	1.2	1.5	0.4	0.1	0.1
1996	12.8	20.5	25.5	23.7	10.1	7.0	2.8	2.7	0.8	0.6	0.5	0.7	0.2	0.1
1997	44.9	10.5	16.8	20.4	17.3	6.5	3.8	1.4	1.2	0.4	0.3	0.2	0.4	0.1
1998	46.2	36.8	8.6	13.3	14.5	11.2	3.9	2.1	0.7	0.6	0.2	0.1	0.1	0.2
1999	79.7	37.8	30.1	6.8	9.6	9.8	7.1	2.3	1.1	0.3	0.3	0.1	0.1	0.1
2000	93.4	65.2	31.0	23.9	5.0	6.5	6.1	4.1	1.2	0.6	0.2	0.1	0.0	0.0
2001	106.8	76.5	53.4	24.6	17.2	3.3	4.0	3.5	2.1	0.6	0.3	0.1	0.1	0.0
2002	38.1	87.5	62.6	42.6	18.0	11.8	2.1	2.4	1.9	1.1	0.3	0.1	0.0	0.0
2003	107.7	31.2	71.6	49.8	30.9	12.2	7.4	1.2	1.3	1.0	0.6	0.2	0.1	0.0
2004	62.2	88.2	25.5	57.0	36.2	20.9	7.7	4.3	0.7	0.6	0.5	0.3	0.1	0.0
2005	28.1	50.9	72.2	19.9	38.0	22.8	13.0	4.8	2.7	0.4	0.4	0.3	0.2	0.0
2006	40.4	23.0	41.7	56.2	13.0	23.3	13.8	7.9	3.0	1.6	0.2	0.2	0.1	0.1
2007	61.0	33.1	18.8	32.4	36.2	7.9	13.8	8.2	4.8	1.7	0.9	0.1	0.1	0.1
2008	61.1	50.0	27.1	14.7	21.2	22.3	4.8	8.5	5.1	2.8	0.9	0.4	0.1	0.0
2009	74.2	50.0	40.9	21.0	9.3	12.6	13.0	2.8	5.0	2.9	1.5	0.5	0.2	0.0
2010	66.6	60.8	41.0	31.8	13.6	5.6	7.5	7.8	1.7	2.9	1.6	0.7	0.2	0.1
2011	58.4	54.5	49.7	32.0	21.1	8.5	3.5	4.7	4.9	1.0	1.6	0.8	0.4	0.1
2012	30.6	47.8	44.6	39.0	21.7	13.6	5.4	2.2	3.0	3.0	0.6	0.9	0.5	0.2
2013	39.3	25.1	39.2	35.1	26.7	14.1	8.7	3.5	1.4	1.9	1.8	0.3	0.5	0.3
2014	47.6	32.1	20.5	30.7	23.6	17.0	8.9	5.5	2.2	0.9	1.1	1.0	0.2	0.3
2015	48.8	39.0	26.3	16.2	21.6	16.0	11.4	6.0	3.7	1.5	0.6	0.7	0.6	0.1

Table 8.10. Saithe in division Va. Fishing mortality rate.

	3	4	5	6	7	8	9	10	11	12	13	14
1980	0.02	0.09	0.18	0.30	0.36	0.44	0.41	0.44	0.36	0.36	0.36	0.36
1981	0.01	0.08	0.16	0.26	0.32	0.39	0.36	0.39	0.32	0.32	0.32	0.32
1982	0.02	0.09	0.18	0.30	0.37	0.45	0.42	0.45	0.37	0.37	0.37	0.37
1983	0.01	0.07	0.15	0.24	0.30	0.36	0.34	0.36	0.30	0.30	0.30	0.30
1984	0.01	0.07	0.14	0.23	0.29	0.34	0.32	0.34	0.28	0.28	0.28	0.28
1985	0.01	0.07	0.15	0.25	0.30	0.37	0.34	0.37	0.30	0.30	0.30	0.30
1986	0.02	0.08	0.17	0.28	0.35	0.42	0.39	0.42	0.34	0.34	0.34	0.34
1987	0.02	0.10	0.21	0.35	0.43	0.52	0.49	0.52	0.43	0.43	0.43	0.43
1988	0.02	0.09	0.19	0.32	0.40	0.48	0.45	0.48	0.39	0.39	0.39	0.39
1989	0.02	0.09	0.19	0.31	0.38	0.46	0.43	0.46	0.37	0.37	0.37	0.37
1990	0.02	0.10	0.21	0.35	0.43	0.52	0.48	0.52	0.43	0.43	0.43	0.43
1991	0.02	0.11	0.23	0.38	0.46	0.56	0.52	0.56	0.46	0.46	0.46	0.46
1992	0.02	0.11	0.22	0.37	0.45	0.55	0.51	0.55	0.45	0.45	0.45	0.45
1993	0.02	0.12	0.24	0.40	0.49	0.59	0.55	0.59	0.49	0.49	0.49	0.49
1994	0.03	0.13	0.27	0.45	0.56	0.67	0.63	0.67	0.55	0.55	0.55	0.55
1995	0.03	0.13	0.28	0.46	0.57	0.69	0.64	0.69	0.56	0.56	0.56	0.56
1996	0.02	0.12	0.25	0.41	0.50	0.60	0.56	0.60	0.49	0.49	0.49	0.49
1997	0.04	0.14	0.23	0.31	0.42	0.53	0.57	0.55	0.56	0.56	0.56	0.56
1998	0.03	0.12	0.19	0.26	0.34	0.43	0.46	0.45	0.46	0.46	0.46	0.46
1999	0.03	0.12	0.20	0.27	0.36	0.45	0.49	0.47	0.48	0.48	0.48	0.48
2000	0.03	0.13	0.21	0.28	0.38	0.47	0.51	0.50	0.51	0.51	0.51	0.51
2001	0.03	0.11	0.18	0.24	0.32	0.40	0.43	0.42	0.43	0.43	0.43	0.43
2002	0.03	0.12	0.19	0.26	0.35	0.44	0.47	0.46	0.47	0.47	0.47	0.47
2003	0.03	0.12	0.19	0.26	0.34	0.43	0.47	0.45	0.46	0.46	0.46	0.46
2004	0.05	0.21	0.26	0.28	0.27	0.26	0.30	0.37	0.43	0.43	0.43	0.43
2005	0.05	0.22	0.29	0.31	0.29	0.29	0.32	0.40	0.47	0.47	0.47	0.47
2006	0.05	0.24	0.31	0.33	0.31	0.31	0.35	0.43	0.51	0.51	0.51	0.51
2007	0.05	0.22	0.28	0.30	0.29	0.28	0.32	0.39	0.46	0.46	0.46	0.46
2008	0.06	0.25	0.32	0.34	0.33	0.33	0.37	0.45	0.53	0.53	0.53	0.53
2009	0.05	0.24	0.30	0.32	0.31	0.30	0.34	0.42	0.50	0.50	0.50	0.50
2010	0.05	0.21	0.27	0.28	0.27	0.27	0.30	0.37	0.44	0.44	0.44	0.44
2011	0.04	0.19	0.24	0.26	0.25	0.24	0.27	0.34	0.40	0.40	0.40	0.40
2012	0.04	0.18	0.23	0.25	0.23	0.23	0.26	0.32	0.38	0.38	0.38	0.38
2013	0.04	0.20	0.25	0.27	0.25	0.25	0.28	0.35	0.41	0.41	0.41	0.41
2014	0.03	0.15	0.19	0.20	0.20	0.19	0.22	0.27	0.32	0.32	0.32	0.32
2015	0.05	0.20	0.26	0.28	0.26	0.26	0.29	0.36	0.43	0.43	0.43	0.43

Table 8.11. Saithe in division Va. Input values for short-term projections. Same weights are used for catch weights and stock weights.

2015	3	4	5	6	7	8	9	10	11	12	13	14
N	26.3	16.2	21.6	16.0	11.4	6.0	3.7	1.5	0.6	0.7	0.6	0.1
M	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
mat	0.000	0.100	0.217	0.409	0.633	0.812	0.915	1.000	1.000	1.000	1.000	1.000
w	1.142	1.726	2.217	3.071	4.030	5.532	6.846	7.175	7.491	8.218	8.575	9.173
sel	0.106	0.476	0.608	0.648	0.621	0.611	0.687	0.846	1.000	1.000	1.000	1.000
pF	0	0	0	0	0	0	0	0	0	0	0	0
pM	0	0	0	0	0	0	0	0	0	0	0	0
2016	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
N	31.9											
M	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
mat	0.000	0.100	0.217	0.409	0.633	0.812	0.915	1.000	1.000	1.000	1.000	1.000
w	1.142	1.726	2.217	3.071	4.030	5.532	6.846	7.175	7.491	8.218	8.575	9.173
sel	0.106	0.476	0.608	0.648	0.621	0.611	0.687	0.846	1.000	1.000	1.000	1.000
pF	0	0	0	0	0	0	0	0	0	0	0	0
pM	0	0	0	0	0	0	0	0	0	0	0	0
2017	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
N	32.7											
M	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
mat	0.000	0.100	0.217	0.409	0.633	0.812	0.915	1.000	1.000	1.000	1.000	1.000
w	1.142	1.726	2.217	3.071	4.030	5.532	6.846	7.175	7.491	8.218	8.575	9.173
sel	0.106	0.476	0.608	0.648	0.621	0.611	0.687	0.846	1.000	1.000	1.000	1.000
pF	0	0	0	0	0	0	0	0	0	0	0	0
pM	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.12. Saithe in division Va. Output from short-term projections.

2015			
B4+	SSB	Fbar	Landings
255	139	0.26	57

2016				2017		
B4+	SSB	Fbar	Landings	B4+	SSB	Rationale

238	138	0.26	54	227	130	20% HCR

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

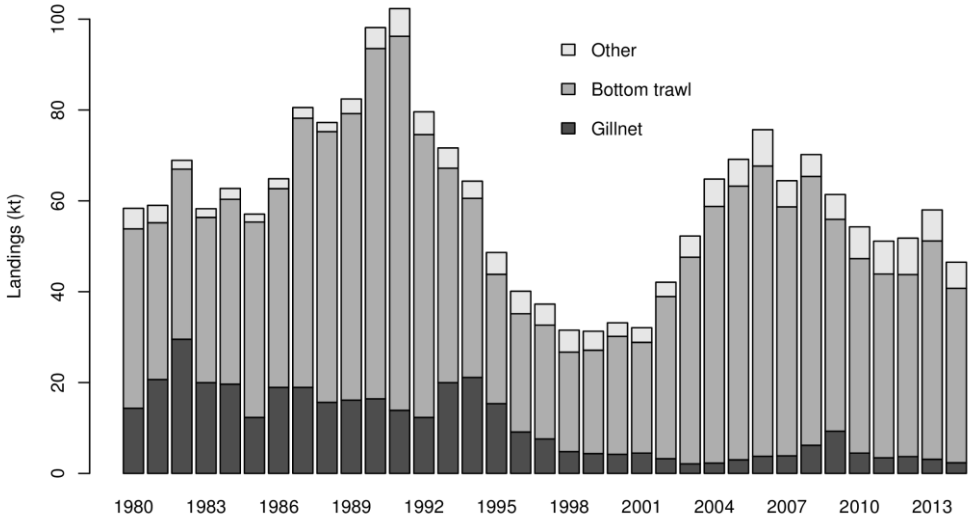

Figure 8.1 Saithe in Division Va. Landings by gear.

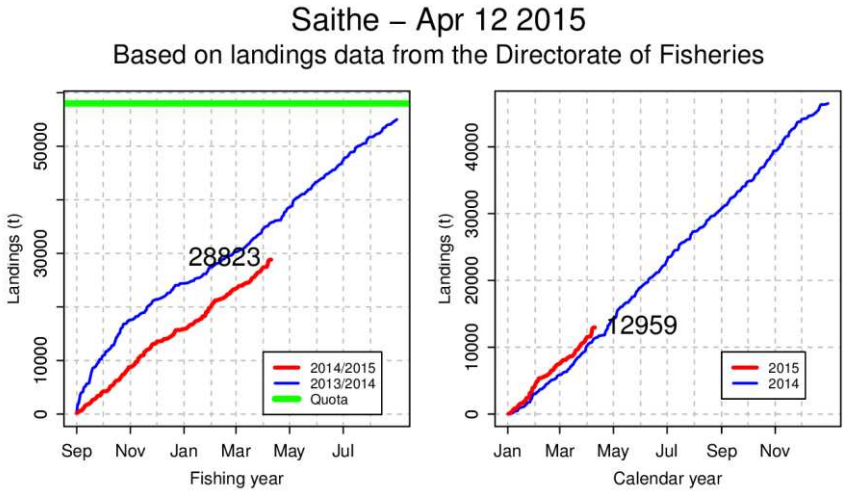

Figure 8.2 Saithe in division Va. Cumulative landings in the current fishing year (left) and calendar year (right). The vertical (green line) in the left figure shows the quota for the current fishing year.

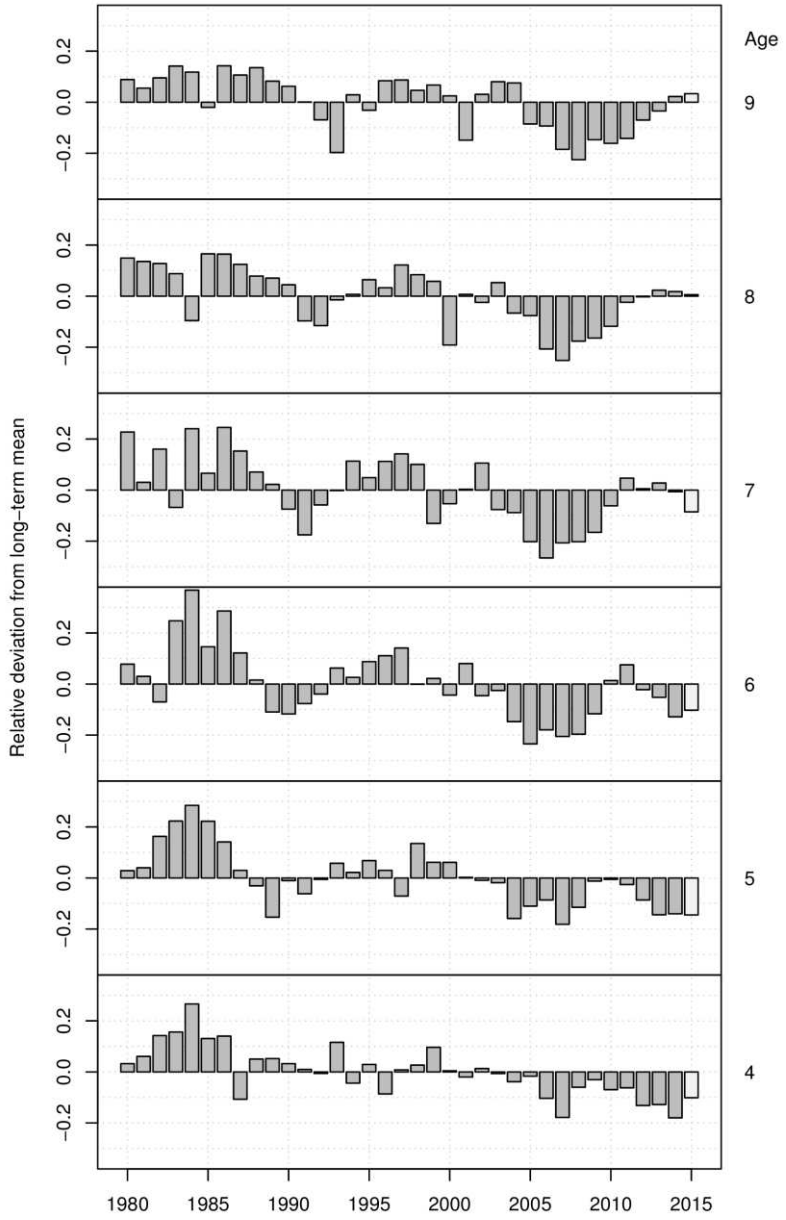

Figure 8.3 Saithe in division Va. Weight at age in the catches, as relative deviations from the mean. The current year's deviation is a preliminary prediction.

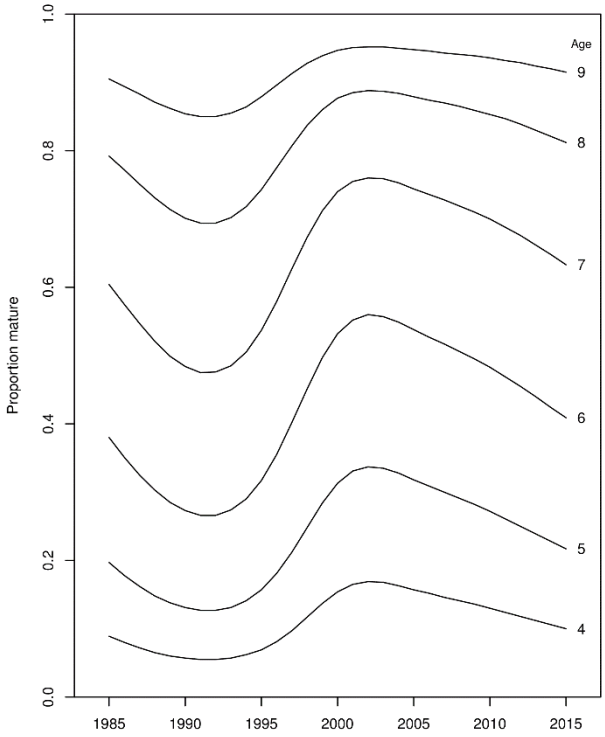

Figure 8.4 Saithe in division Va. Maturity at age used for calculating the SSB.

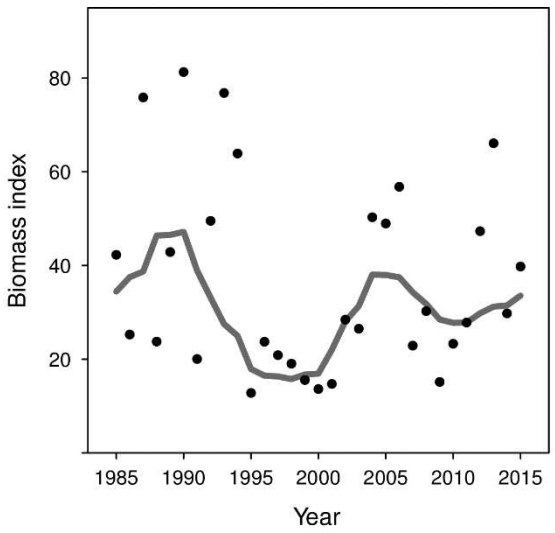

Figure 8.5 Saithe in division Va. Spring survey biomass index and model fit.

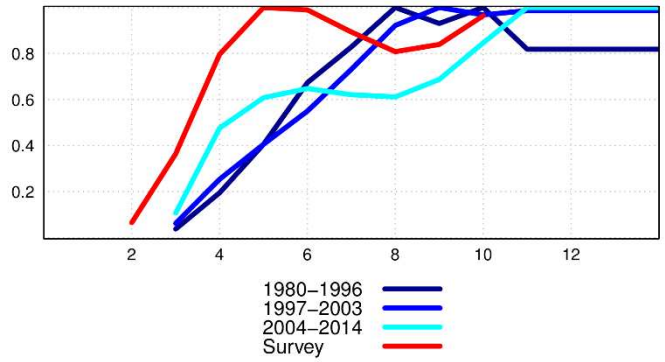

Figure 8.6. Estimated selectivity patterns for the 3 periods.

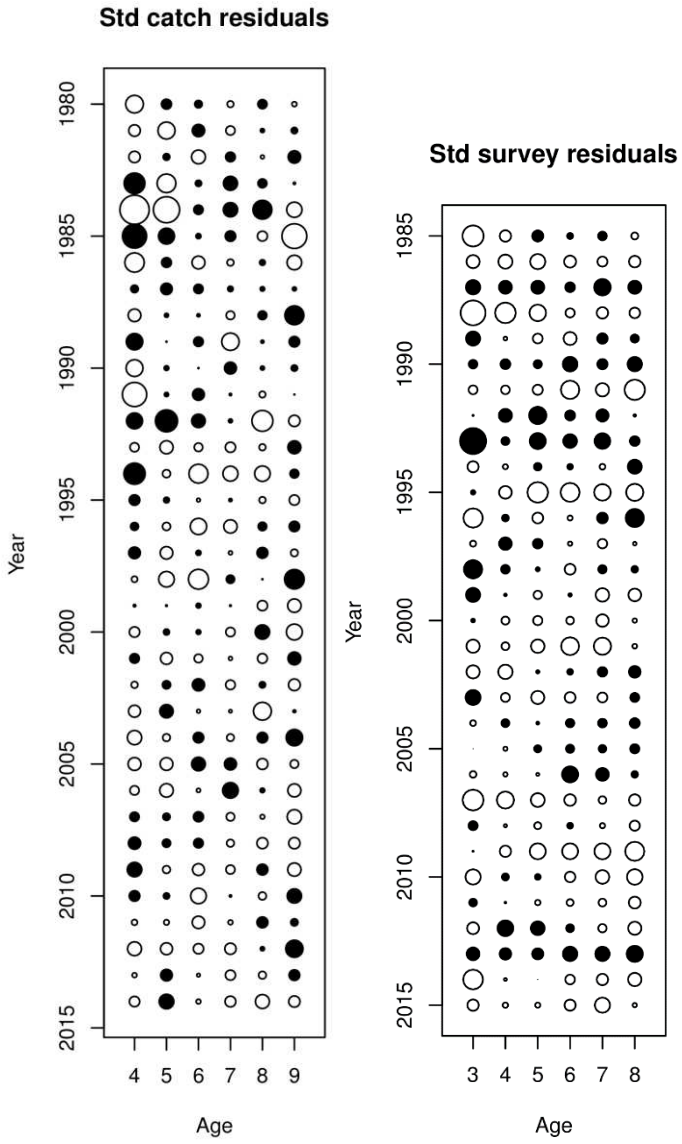

Figure 8.7. Saithe in division Va. Commercial and survey catch-at-age residuals from the fitted model. Filled circles are positive log residuals and hollow circles are negative log residuals.

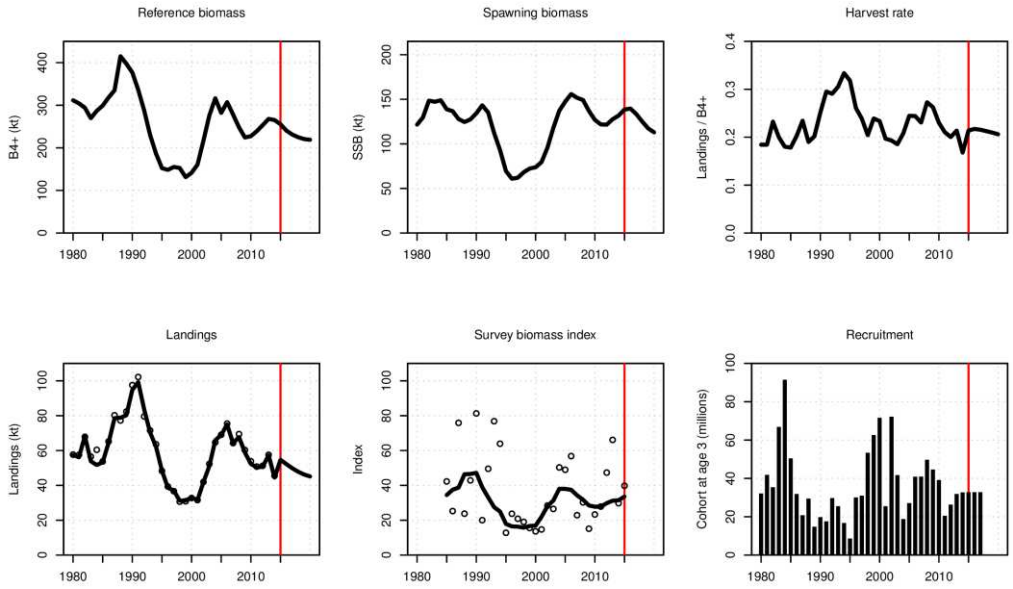

Figure 8.8. Saithe in division Va. Results from the fitted model and short-term forecast. The red line indicates the time of the current assessment.

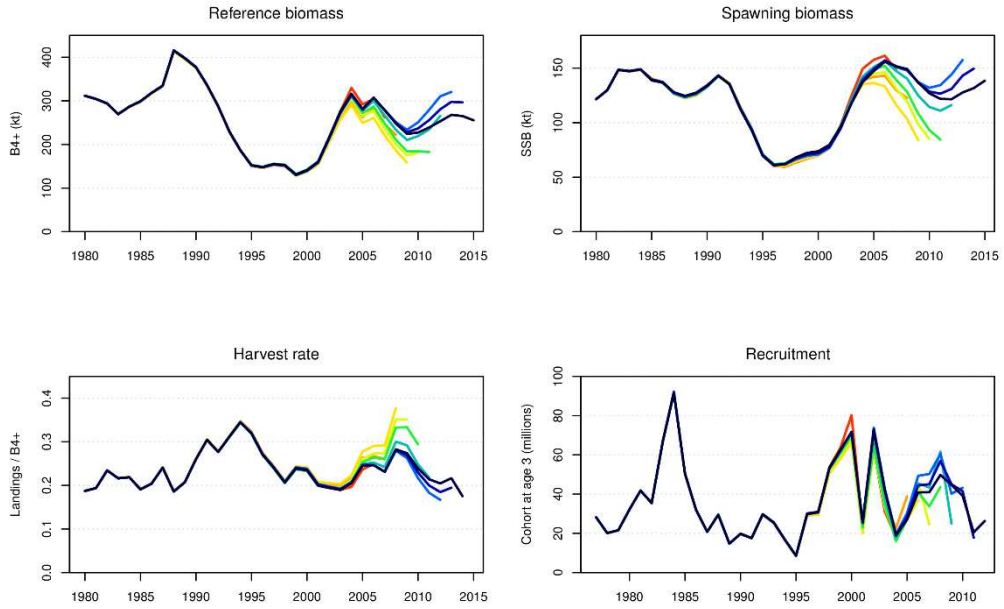

Figure 8.9. Saithe in division Va. Retrospective pattern for the assessment model.

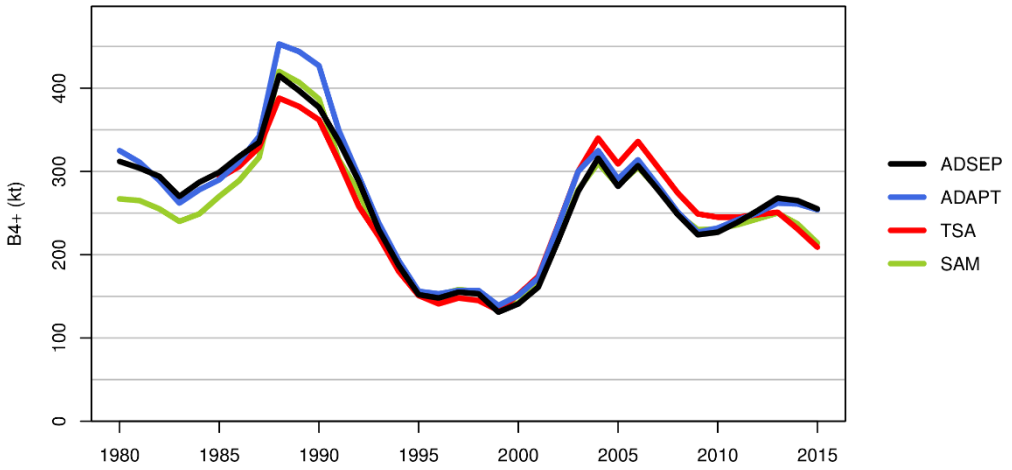

Figure 8.10. Saithe in division Va. Comparison between the default separable model (ADSEP) and alternative assessment models.