8 Icelandic saithe

8.1 Summary

- The 2013 reference biomass (B_{4+}) is estimated as 321 kt, above the average in the assessment period (1980 to the present). The spawning biomass is estimated as 158 kt, around the highest level in the assessment period and well above $B_{trigger}$ = 65 kt and B_{lim} = 61 kt.
- According to the assessment model, the reference biomass increased by a third between 2009 and 2013, while harvest rate decreased from 25% to 16% (fishing mortality 0.28 to 0.18). Year classes 1998-2000 and 2002 were large, but recruitment since then has been around average.
- Weights of ages 6-8 have increased since 2007-2013 towards the average, but other ages are below average weight. Maturity at ages 4-9 has decreased since 2004, but is still 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.
- There is considerable discrepancy between the default separable model and a TSA model (Gudmundsson 2013), estimating the current biomass (ages 4-14) as 321 kt and 269 kt, respectively. This difference is mainly due to a different fit to the rapidly increasing survey indices in 2009-2013. The spring survey data have been an unreliable indicator of the saithe stock size in the past. The default separable model follows the increase in the survey data, while TSA indicates no biomass increase in 2009-2013.
- In spring 2013, the Icelandic government adopted a harvest control rule for managing the Icelandic saithe fishery, evaluated by ICES (Hjorleifsson and Bjornsson 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 57 kt in the next fishing year.

8.2 Stock description and management units

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

8.3 Fisheries-dependent data

8.3.1 Landings, advice and TAC

Landings of saithe in Icelandic waters in 2012 are estimated to have been 51 783 t (Table 8.1 and Figure 8.1). Of the landings, 39 336 t were caught by trawl, 3 649 t by gillnets, and 8 798 t caught by other fishing gear. The domestic as well as ICES advice for the fishing year 2012/2013 was based on the MSY framework (B-rule) and was 49 000 t. The TAC issued was 50 000 t. 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 (79% in 2008-2012), with gillnet and jiggers taking the majority of the rest. The share taken by the gillnet fleet was larger in the past, 25% in 1982-1996 compared to 9% in 1997-2012 (Figure 8.1).

8.3.2 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, for which monitoring programmes have been in place (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 discard 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 dynamics estimated.

The sampling program and sampling intensity in 2012, as well as the approach used for calculating catch in numbers, is the same as in preceding years. The sampling level in 2012 is indicated in the following text table:

Gear/nation	Landings (t)	No. of otolith samples	No. of otoliths read	No. of length samples	No. of length measurements
Gillnets	3649	8	400	12	1831
Jiggers	3574	10	478	15	1622
Danish seine	1620	4	155	5	563
Bottom trawl	39336	113	4762	372	35013
Other gear	2664	2	7	213	1622
Foreign landings	940	-	-	-	-
Total	51783	137	5802	617	40651

Gillnet catches are split according to a gear-specific age-length key, the rest of the catches are split according to a key based on all samples from commercial gear except those from gillnets. The length-weight relationship used (W = 0.02498 * L^2.75674) is applied to length distributions from both fleets.

8.3.3 Mean weight and maturity at age

Weight at age has declined rather steadily in 1980-2012, but weights of 5 to 8 year-olds has increased rapidly in recent years and are close to the long-term average (Table 8.3 and Figure 8.3). Weight at age in the landings is also used as weight at age in the stock. Weights for 2013 are estimated by applying a linear model using survey weights and the weight of a year class in the previous year as predictors (see stock annex).

A model using maturity-at-age data from the Icelandic groundfish spring survey (Table 8.4 and Figure 8.4) is used to derive smoothed trends in maturity by age and year (see stock annex).

8.3.4 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.

8.4 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, 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 were high in the beginning of the period, low in the period 1995-2001, high in the period around 2005, declining to a relatively low level in 2007-2011, but the 2012 and 2013 survey biomass indices are 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 those saithe caught in the survey is very low.

8.5 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, years 1980-2012) and survey catch at age (ages 3-10, years 1985-2013). Natural mortality is set at 0.2 for all ages.

(Figure 8.6). The selectivity pattern is constant within each period.

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 a given year. The survey residuals are modelled as multivariate normal distribution with the correlation estimated (one coefficient).

8.6 Reference points and HCR

In April 2013, the Icelandic government adopted a management plan for managing the Icelandic saithe fishery. 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 (Hjorleifsson and Bjornsson 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 t equals the average of 0.20 times the current biomass and last year's TAC:

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

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

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

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).

8.7 State of the stock

8) show that the reference biomass declined by a quarter from 2004 to 2009, but appears to be increasing since then, and is now above the long-term average. The harvest rate peaked around 30% in the mid 1990s, but has fluctuated around 22% in 1998-2012 (fishing mortalities 0.42 and 0.28). 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 1998-2000 and 2002 were large, but recruitment since then has been around the long-term average. The details of the fishing mortality and stock in numbers are presented in Tables 8.9 and 8.10.

8.8 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.

A "TAC-constraint" of 55 kt landings is applied in the assessment year, based on best estimates of catches in 2013. This results in a predicted harvest rate similar to last year (u_{2012}=17% and u_{2013}=17%). This is somewhat lower than the target 20%, due to a sudden upward fluctuation in the stock assessment two years in a row.

F = 0.21 is applied in 2014, corresponding to the HCR, the landings in 2014 will be 57 kt and the SSB in 2015 will be 181 kt.

8.9 Uncertainties in assessment and forecast

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 (Hjorleifsson and Bjornsson 2013).

An issue in thisThis year's assessment is substantially more optimistic about recent biomass levels than last year's assessment, which in turn was substantially more optimistic than previous assessments. The spring survey data indicate rapidly increasing biomass in the most recent years, but the commercial catch-at-age data do not suggest increasing biomass.

There is considerable discrepancy between the default separable model and a TSA model (Gudmundsson 2013), estimating the current biomass (ages 4-14) as 321 kt and 269 kt, respectively. This difference is mainly due to a different fit to the rapidly increasing survey indices in 2009-2013. The default model follows the increase in the survey data, while TSA indicates no biomass increase in 2009-2013.

Further comparison with other assessment models was carried out to explore the overall uncertainty in the assessment. The comparison involved five models which differ mainly in the way the F matrix is modelled:

	Model	Family	F matrix
1	ADSEP (default)	separable	multiplicative in 3 periods
2	ADAPT	vpa	no constraints
3	TSA	state-space (kalman filter)	orthogonal polynomials
4	SAM-ind	state-space (random effects)	independent random walk
5	SAM-cor	state-space (random effects)	correlated random walk

The model comparison (Figure 8.10) shows that the default model estimates the current stock larger than the other models, indicating that the estimated biomass of 321 kt is more likely to be an overestimate than an underestimate.

8.10 Comparison with previous assessment and forecast

Compared to the previous assessment from last year's NWWG 2012, the estimated reference biomass B_{4+} in 2012 has increased substantially from 265 to 311 kt, SSB 2012 has increased by the same proportion from 121 to 144 kt, the harvest rate u_{2011} has decreased from 22% to 18% (fishing mortality 0.26 to 0.20), and the stock numbers at ages 5 to 7 have all increased as shown below.

	NWWG2012	NWWG2013
B_{4+}(2012)	265	311
SSB(2012)	121	144
u(2011)	22%	18%
F_{4-9}(2011)	0.26	0.20
N_5(2012)	23	28
N_6(2012)	15	18
N_7(2012)	5	7

8.11 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. in press). The evidence from tagging experiments (ICES 2008) show some migrations along the Faroe-Iceland Ridge, as well as onto the East Greenland shelf. It is possible that due to migratory behavior, larger saithe become partially out of reach from the fishery. A hypothesis of a descending right limb on the selectivity curve for saithe might have some merit, increasing the saithe resilience to fishing if enough saithe 'escape' from the fishery onto the niche where the large pelagic stocks are available.

8.12 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 periods. This can be partly explained by reduced use of gillnets in the saithe fishery.

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Table 8.1. Saithe in division Va. Nominal catch (t) by countries, as officially reported to ICES.

	Belgium	Faroe Islands	France	Germany	Iceland	Norway	UK (E/W/NI)	UK (Scotland)	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
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

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	2.262	4.320	5.973	2.448	1.924	0.282	0.434	0.287	0.195	0.027	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

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	1207	1635	2330	3248	4281	5387	6550	6401	6940	7697	8615	9447
2014	1207	1635	2330	3248	4281	5387	6550	6401	6940	7697	8615	9447
2015	1207	1635	2330	3248	4281	5387	6550	6401	6940	7697	8615	9447
Avg80-12	1368	1944	2626	3452	4415	5492	6621	7579	8509	9348	10307	10985

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
1980	0.000	0.087	0.211	0.425	0.670	0.849	0.941	1.000	1.000	1.000	1.000	1.000
1981	0.000	0.087	0.211	0.425	0.670	0.849	0.941	1.000	1.000	1.000	1.000	1.000
1982	0.000	0.087	0.211	0.425	0.670	0.849	0.941	1.000	1.000	1.000	1.000	1.000
1983	0.000	0.087	0.211	0.425	0.670	0.849	0.941	1.000	1.000	1.000	1.000	1.000
1984	0.000	0.087	0.211	0.425	0.670	0.849	0.941	1.000	1.000	1.000	1.000	1.000
1985	0.000	0.095	0.203	0.384	0.603	0.787	0.900	1.000	1.000	1.000	1.000	1.000
1986	0.000	0.084	0.182	0.351	0.569	0.763	0.887	1.000	1.000	1.000	1.000	1.000
1987	0.000	0.074	0.163	0.322	0.536	0.738	0.873	1.000	1.000	1.000	1.000	1.000
1988	0.000	0.067	0.148	0.298	0.509	0.716	0.860	1.000	1.000	1.000	1.000	1.000
1989	0.000	0.062	0.138	0.281	0.488	0.699	0.850	1.000	1.000	1.000	1.000	1.000
1990	0.000	0.059	0.132	0.271	0.475	0.688	0.843	1.000	1.000	1.000	1.000	1.000
1991	0.000	0.058	0.131	0.269	0.472	0.686	0.842	1.000	1.000	1.000	1.000	1.000
1992	0.000	0.060	0.134	0.273	0.478	0.691	0.845	1.000	1.000	1.000	1.000	1.000
1993	0.000	0.063	0.141	0.285	0.493	0.703	0.852	1.000	1.000	1.000	1.000	1.000
1994	0.000	0.069	0.152	0.304	0.516	0.722	0.863	1.000	1.000	1.000	1.000	1.000
1995	0.000	0.077	0.169	0.331	0.547	0.746	0.877	1.000	1.000	1.000	1.000	1.000
1996	0.000	0.088	0.190	0.364	0.583	0.773	0.892	1.000	1.000	1.000	1.000	1.000
1997	0.000	0.102	0.216	0.402	0.621	0.800	0.907	1.000	1.000	1.000	1.000	1.000
1998	0.000	0.117	0.245	0.441	0.658	0.824	0.919	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.134	0.274	0.479	0.691	0.845	0.930	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.150	0.301	0.512	0.719	0.862	0.938	1.000	1.000	1.000	1.000	1.000
2001	0.000	0.164	0.324	0.539	0.740	0.874	0.944	1.000	1.000	1.000	1.000	1.000
2002	0.000	0.175	0.341	0.558	0.755	0.882	0.948	1.000	1.000	1.000	1.000	1.000
2003	0.000	0.182	0.351	0.569	0.763	0.887	0.950	1.000	1.000	1.000	1.000	1.000
2004	0.000	0.182	0.352	0.570	0.763	0.887	0.950	1.000	1.000	1.000	1.000	1.000
2005	0.000	0.177	0.344	0.561	0.757	0.883	0.949	1.000	1.000	1.000	1.000	1.000
2006	0.000	0.167	0.329	0.544	0.744	0.876	0.945	1.000	1.000	1.000	1.000	1.000
2007	0.000	0.156	0.310	0.523	0.727	0.867	0.941	1.000	1.000	1.000	1.000	1.000
2008	0.000	0.144	0.292	0.501	0.710	0.856	0.935	1.000	1.000	1.000	1.000	1.000
2009	0.000	0.135	0.276	0.481	0.693	0.846	0.931	1.000	1.000	1.000	1.000	1.000
2010	0.000	0.128	0.264	0.466	0.680	0.838	0.927	1.000	1.000	1.000	1.000	1.000
2011	0.000	0.124	0.256	0.456	0.671	0.833	0.924	1.000	1.000	1.000	1.000	1.000
2012	0.000	0.121	0.251	0.449	0.665	0.829	0.922	1.000	1.000	1.000	1.000	1.000
2013	0.000	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000
2014	0.000	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000
2015	0.000	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000

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	3.95	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	4.26	7.42	6.78	4.65	2.56	1.11	0.30	0.43	0.36	0.26	0.13	0.01

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

	3	4	5	6	7	8	9	10	11	12	13	14
1980	-0.41	-0.31	0.13	0.08	-0.04	0.11	-0.02	0.12	-0.16	-0.22	-0.36	-0.02
1981	-0.27	-0.13	-0.29	0.19	-0.08	0.03	0.06	0.15	-0.44	0.49	0.62	0.98
1982	0.44	-0.13	0.07	-0.19	0.12	-0.01	0.19	-0.19	-0.62	-0.60	-0.28	-0.05
1983	-1.30	0.49	-0.35	0.06	0.24	0.11	-0.01	-0.42	-1.27	-1.46	-2.70	-2.00
1984	-2.21	-0.85	-0.68	0.12	0.25	0.41	-0.24	0.23	0.50	0.54	1.82	2.56
1985	-0.15	0.65	0.30	0.04	0.14	-0.10	-0.61	-0.39	-0.73	-1.60	0.34	1.29
1986	1.19	-0.38	0.13	-0.17	-0.05	0.05	-0.21	0.49	-0.57	-0.73	-0.96	-0.92
1987	-0.53	0.08	0.16	0.12	0.05	0.04	0.03	-0.09	-0.04	-1.52	-1.00	-0.12
1988	0.48	-0.17	0.03	0.02	-0.07	0.10	0.42	-0.34	0.25	-0.88	-1.71	-3.59
1989	-0.44	0.32	0.00	0.12	-0.31	0.02	0.14	-0.09	0.37	0.20	-0.59	-1.94
1990	-0.93	-0.28	0.04	0.00	0.18	0.03	0.06	-0.20	0.04	-0.40	0.09	-0.84
1991	-1.02	-0.58	0.03	0.17	0.01	-0.04	0.00	0.38	0.12	-0.72	-2.05	-2.06
1992	-0.11	0.30	0.55	0.22	0.03	-0.43	-0.13	-0.22	-0.15	-0.61	0.25	-0.46
1993	0.51	-0.08	-0.18	-0.07	-0.11	-0.04	0.21	0.02	0.17	0.39	0.34	-0.67
1994	0.57	0.51	-0.06	-0.36	-0.23	-0.24	0.11	0.21	0.27	0.41	0.98	0.94
1995	0.83	0.14	0.05	-0.01	0.02	-0.04	-0.11	-0.10	-0.13	-0.45	-0.36	-0.95
1996	0.76	0.08	-0.07	-0.27	-0.18	0.10	0.14	0.02	0.21	-0.07	0.70	1.26
1997	0.14	0.18	-0.16	0.04	-0.02	0.15	-0.06	-0.22	-0.18	0.18	-0.60	0.09
1998	-0.18	-0.03	-0.24	-0.40	0.09	0.00	0.44	0.36	0.64	0.60	0.82	0.44
1999	0.21	0.02	0.00	0.03	-0.01	-0.10	-0.18	0.17	-0.34	-0.28	0.18	0.11
2000	-0.03	-0.10	0.06	0.04	-0.09	0.25	-0.26	-0.14	-0.11	-0.46	-0.01	-0.55
2001	-0.05	0.12	-0.14	-0.07	-0.02	-0.10	0.20	0.03	0.07	0.05	0.24	0.58
2002	-0.33	-0.05	0.09	0.18	-0.09	0.06	-0.14	-0.18	-0.04	-0.60	0.00	-0.12
2003	0.20	-0.15	0.21	-0.02	-0.01	-0.32	0.03	-0.10	0.03	-0.64	0.19	0.72
2004	-0.13	-0.21	0.00	0.15	-0.08	0.10	0.28	0.19	-0.12	-0.32	0.34	-0.16
2005	-0.26	-0.17	-0.11	0.23	0.16	-0.15	-0.09	-0.01	0.10	-0.02	-0.13	-0.17
2006	-0.40	-0.09	-0.12	-0.02	0.26	0.01	-0.17	-0.03	0.36	0.54	0.67	0.20
2007	0.37	0.12	0.13	0.13	-0.10	-0.06	-0.21	-0.22	-0.45	0.23	0.28	0.08
2008	-0.04	0.19	0.16	0.12	-0.09	-0.16	-0.13	-0.12	-0.31	0.14	1.59	1.14
2009	0.26	0.22	0.03	-0.12	-0.11	0.13	-0.18	-0.02	0.06	0.33	0.76	1.61
2010	0.14	0.08	0.11	-0.21	0.01	-0.08	0.26	-0.19	0.03	0.06	0.63	0.90
2011	0.04	-0.06	-0.01	-0.16	-0.01	0.15	0.08	0.23	-0.15	0.06	0.42	1.00
2012	0.01	-0.17	-0.11	-0.16	-0.18	0.01	0.35	0.30	0.67	0.07	0.38	0.67

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

	2	3	4	5	6	7	8	9	10
1985	-0.36	-1.31	-0.35	0.51	0.18	0.30	-0.18	0.70	-0.99
1986	0.66	-0.52	-0.56	-0.64	-0.41	-0.30	-0.42	-0.70	-0.36
1987	-0.53	0.72	0.65	0.65	0.34	0.92	0.60	0.40	0.21
1988	-0.30	-1.85	-1.23	-0.78	-0.24	-0.42	-0.42	-1.22	-0.71
1989	1.65	0.72	-0.02	-0.26	-0.50	0.43	0.31	0.31	-4.80
1990	-0.10	0.30	0.41	0.30	0.77	0.40	0.73	0.48	-0.51
1991	0.13	-0.24	-0.21	-0.29	-1.00	-0.55	-1.25	-2.59	-2.24
1992	-0.55	0.02	0.65	1.08	0.41	0.57	0.01	-0.62	-1.09
1993	1.70	2.22	0.30	0.96	0.72	0.89	0.43	1.47	0.89
1994	0.74	-0.37	-0.04	0.30	0.18	-0.09	0.75	1.16	2.03
1995	0.37	0.10	-0.47	-1.22	-1.01	-0.81	-0.92	-0.20	0.00
1996	-0.52	-1.10	0.23	-0.30	-0.03	0.46	1.13	-0.69	0.08
1997	1.05	-0.11	0.62	0.42	-0.01	-0.26	-0.04	-0.35	-0.04
1998	-1.26	1.16	0.34	0.14	-0.31	0.29	0.19	0.01	-0.06
1999	0.62	0.72	0.09	-0.16	0.12	-0.52	-0.48	-1.84	-0.79
2000	-0.60	0.08	-0.16	-0.21	-0.13	-0.44	-0.06	-0.67	-0.87
2001	0.09	-0.52	-0.15	-0.49	-0.89	-0.88	-0.05	-0.64	-0.08
2002	0.11	-0.52	-0.58	0.12	0.21	0.38	0.52	0.33	0.42
2003	-1.89	0.80	-0.21	-0.47	-0.29	-0.27	0.36	-1.07	-0.22
2004	-0.06	-0.11	0.25	0.08	0.31	0.34	0.45	0.76	0.63
2005	-0.76	-0.03	-0.05	0.20	0.22	0.23	0.41	0.29	0.84
2006	-5.55	-0.16	-0.06	-0.01	0.89	0.59	0.23	-0.21	0.21
2007	-2.06	-1.33	-0.87	-0.59	-0.48	-0.26	-0.43	-0.74	-0.37
2008	-2.08	0.21	-0.04	-0.17	0.07	-0.19	-0.38	-0.68	-0.94
2009	-1.14	-0.20	-0.47	-0.81	-0.86	-0.92	-1.15	-0.92	-1.00
2010	-2.42	-0.90	0.05	0.06	-0.40	-0.64	-0.82	-1.15	-1.30
2011	-1.25	0.05	-0.15	-0.27	-0.31	-0.34	-0.54	-0.49	0.05
2012	-3.30	-0.33	0.70	0.49	0.01	-0.43	-0.64	-0.18	0.00
2013	-1.24	0.49	0.63	0.27	0.47	0.43	0.69	0.29	0.30

Table 8.8. Saithe in division Va. Main population estimates from the fitted model: Y = landings and u = harvest rate.

	B4+	SSB	Y	u	F4-9	N3	Cohort
1980	312	122	58	19%	0.30	28	32
1981	304	130	59	19%	0.26	20	42
1982	294	148	69	23%	0.30	22	36
1983	269	147	58	22%	0.24	32	67
1984	287	149	63	22%	0.23	42	92
1985	299	139	57	19%	0.25	36	50
1986	318	137	65	20%	0.28	67	32
1987	335	127	81	24%	0.35	92	21
1988	416	123	77	19%	0.32	50	29
1989	398	126	82	21%	0.31	32	15
1990	378	133	98	26%	0.35	21	20
1991	336	143	102	30%	0.38	29	18
1992	288	135	80	28%	0.37	15	30
1993	230	113	72	31%	0.40	20	25
1994	186	94	64	35%	0.46	18	17
1995	152	70	49	32%	0.47	30	9
1996	147	61	40	27%	0.41	25	30
1997	154	62	37	24%	0.37	17	31
1998	151	66	32	21%	0.30	9	53
1999	130	70	31	24%	0.32	30	62
2000	139	71	33	24%	0.34	31	72
2001	158	77	32	20%	0.29	53	26
2002	213	94	42	20%	0.31	62	74
2003	271	119	52	19%	0.31	72	43
2004	312	140	65	21%	0.27	26	20
2005	279	149	69	25%	0.30	74	30
2006	307	157	76	25%	0.31	43	49
2007	279	151	64	23%	0.28	20	50
2008	251	148	70	28%	0.32	30	61
2009	234	137	61	26%	0.28	49	40
2010	251	132	54	22%	0.24	50	43
2011	280	135	51	18%	0.20	61	32
2012	311	144	52	17%	0.19	40	34
2013	321	158	55	17%	0.21	43	34
Average	264	121	60	23%	0.31	38	39

Table 8.9. Saithe in division Va. Stock in numbers from the fitted model.

	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	48.0	26.4	20.1	22.7	35.2	21.2	6.3	4.6	2.0	0.7	0.4	0.4	0.3	0.2
1982	62.3	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	53.0	51.0	32.2	17.4	12.2	11.7	14.8	7.5	1.9	1.4	0.6	0.2	0.1	0.1
1984	99.7	43.4	41.7	26.0	13.3	8.6	7.5	9.0	4.3	1.1	0.8	0.4	0.1	0.1
1985	137.4	81.6	35.5	33.7	19.9	9.4	5.6	4.6	5.2	2.5	0.7	0.5	0.2	0.1
1986	75.1	112.5	66.8	28.7	25.7	14.1	6.0	3.4	2.6	3.0	1.4	0.4	0.3	0.1
1987	47.7	61.5	92.1	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	50.4	74.0	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	32.0	40.5	55.1	26.8	8.5	5.6	2.3	0.9	0.5	0.4	0.5	0.2
1990	22.0	36.0	20.8	25.7	30.3	37.5	16.1	4.8	2.9	1.2	0.5	0.3	0.2	0.3
1991	29.5	18.0	29.5	16.7	19.0	20.1	31.4	8.6	2.3	1.5	0.6	0.2	0.1	0.1
1992	26.2	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	44.2	21.4	19.8	11.8	17.4	8.0	7.0	5.9	7.7	2.0	0.5	0.4	0.2	0.1
1994	37.8	36.2	17.5	15.8	8.6	11.2	4.4	3.5	2.7	3.6	0.9	0.3	0.2	0.1
1995	24.8	30.9	29.6	14.0	11.4	5.4	5.8	2.1	1.5	1.2	1.5	0.4	0.1	0.1
1996	12.7	20.3	25.3	23.6	10.0	7.0	2.8	2.7	0.8	0.6	0.5	0.7	0.2	0.1
1997	44.4	10.4	16.6	20.3	17.2	6.4	3.8	1.4	1.2	0.4	0.3	0.2	0.3	0.1
1998	45.7	36.3	8.5	13.1	14.4	11.2	3.8	2.0	0.7	0.5	0.2	0.1	0.1	0.2
1999	79.0	37.4	29.7	6.8	9.6	9.7	7.1	2.2	1.1	0.3	0.3	0.1	0.1	0.1
2000	92.5	64.7	30.6	23.6	4.9	6.4	6.1	4.0	1.2	0.5	0.2	0.1	0.0	0.0
2001	106.8	75.7	53.0	24.3	17.0	3.2	3.9	3.4	2.0	0.6	0.3	0.1	0.1	0.0
2002	38.2	87.4	62.0	42.2	17.8	11.6	2.1	2.3	1.8	1.1	0.3	0.1	0.0	0.0
2003	110.2	31.3	71.6	49.3	30.6	12.0	7.3	1.2	1.2	0.9	0.5	0.1	0.1	0.0
2004	63.6	90.2	25.6	56.9	35.8	20.7	7.6	4.2	0.6	0.6	0.5	0.3	0.1	0.0
2005	29.1	52.0	73.9	20.0	37.9	22.9	12.8	4.7	2.6	0.4	0.3	0.2	0.1	0.0
2006	45.2	23.9	42.6	57.4	13.1	23.7	13.8	7.7	2.8	1.5	0.2	0.2	0.1	0.1
2007	73.6	37.0	19.5	33.0	37.1	8.1	14.1	8.2	4.5	1.6	0.8	0.1	0.1	0.0
2008	75.0	60.3	30.3	15.2	21.8	23.5	4.9	8.6	5.0	2.7	0.9	0.4	0.0	0.0
2009	90.4	61.4	49.3	23.5	9.8	13.4	13.8	2.9	5.0	2.8	1.4	0.4	0.2	0.0
2010	60.0	74.0	50.3	38.4	15.5	6.2	8.2	8.5	1.8	2.9	1.5	0.6	0.2	0.1
2011	64.3	49.1	60.6	39.5	26.3	10.2	4.0	5.2	5.4	1.1	1.7	0.8	0.3	0.1
2012	47.3	52.6	40.2	47.9	27.7	17.9	6.8	2.6	3.5	3.5	0.7	0.9	0.4	0.2
2013	50.7	38.7	43.1	31.9	34.0	19.1	12.1	4.6	1.8	2.3	2.2	0.4	0.5	0.2

Table 8.10. Saithe in division Va. Fishing mortality from the fitted model.

	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	0.35	0.32	0.35	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	0.60	0.55	0.60	0.49	0.49	0.49	0.49
1994	0.03	0.13	0.27	0.46	0.56	0.68	0.63	0.68	0.55	0.55	0.55	0.55
1995	0.03	0.13	0.28	0.47	0.57	0.69	0.65	0.69	0.57	0.57	0.57	0.57
1996	0.02	0.12	0.25	0.41	0.51	0.61	0.57	0.61	0.50	0.50	0.50	0.50
1997	0.04	0.14	0.23	0.32	0.42	0.53	0.58	0.57	0.59	0.59	0.59	0.59
1998	0.03	0.12	0.19	0.26	0.34	0.43	0.47	0.46	0.48	0.48	0.48	0.48
1999	0.03	0.12	0.20	0.27	0.36	0.46	0.50	0.49	0.50	0.50	0.50	0.50
2000	0.03	0.13	0.21	0.29	0.38	0.48	0.53	0.52	0.53	0.53	0.53	0.53
2001	0.03	0.11	0.18	0.24	0.32	0.41	0.45	0.44	0.45	0.45	0.45	0.45
2002	0.03	0.12	0.20	0.27	0.36	0.45	0.49	0.48	0.50	0.50	0.50	0.50
2003	0.03	0.12	0.19	0.26	0.35	0.44	0.48	0.47	0.48	0.48	0.48	0.48
2004	0.05	0.21	0.25	0.28	0.28	0.29	0.32	0.40	0.52	0.52	0.52	0.52
2005	0.05	0.22	0.27	0.30	0.31	0.31	0.35	0.43	0.57	0.57	0.57	0.57
2006	0.05	0.24	0.28	0.32	0.32	0.33	0.37	0.46	0.60	0.60	0.60	0.60
2007	0.05	0.22	0.26	0.29	0.29	0.30	0.34	0.42	0.55	0.55	0.55	0.55
2008	0.06	0.24	0.29	0.33	0.33	0.33	0.38	0.47	0.61	0.61	0.61	0.61
2009	0.05	0.22	0.26	0.29	0.29	0.30	0.34	0.42	0.55	0.55	0.55	0.55
2010	0.04	0.18	0.22	0.25	0.25	0.25	0.28	0.35	0.46	0.46	0.46	0.46
2011	0.04	0.15	0.19	0.21	0.21	0.21	0.24	0.30	0.39	0.39	0.39	0.39
2012	0.03	0.14	0.17	0.19	0.19	0.20	0.22	0.27	0.36	0.36	0.36	0.36
2013	0.04	0.16	0.19	0.21	0.21	0.22	0.24	0.30	0.40	0.40	0.40	0.40

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

2013	3	4	5	6	7	8	9	10	11	12	13	14
N	43.1	31.9	34.0	19.1	12.1	4.6	1.8	2.3	2.2	0.4	0.5	0.2
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	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000
W	1.207	1.635	2.330	3.248	4.281	5.387	6.550	6.401	6.940	7.697	8.615	9.447
Sel	0.091	0.395	0.474	0.536	0.538	0.548	0.618	0.762	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

2014	3	4	5	6	7	8	9	10	11	12	13	14
N	31.7											
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	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000
W	1.207	1.635	2.330	3.248	4.281	5.387	6.550	6.401	6.940	7.697	8.615	9.447
Sel	0.091	0.395	0.474	0.536	0.538	0.548	0.618	0.762	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

2015	3	4	5	6	7	8	9	10	11	12	13	14
N												
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	0.118	0.246	0.443	0.660	0.825	0.920	1.000	1.000	1.000	1.000	1.000
W	1.207	1.635	2.330	3.248	4.281	5.387	6.550	6.401	6.940	7.697	8.615	9.447
Sel	0.091	0.395	0.474	0.536	0.538	0.548	0.618	0.762	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 the short-term projections.

F2012=0.186

2013								
B4+	SSB	Fbar	Landings					
321	158	0.205	55					
2014				**2015**				
B4+	SSB	Fbar	Landings	B4+	SSB	SSBchange	TACchange	Rationale
330	173	0.213	58	318	181	8	5	20% HCR

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

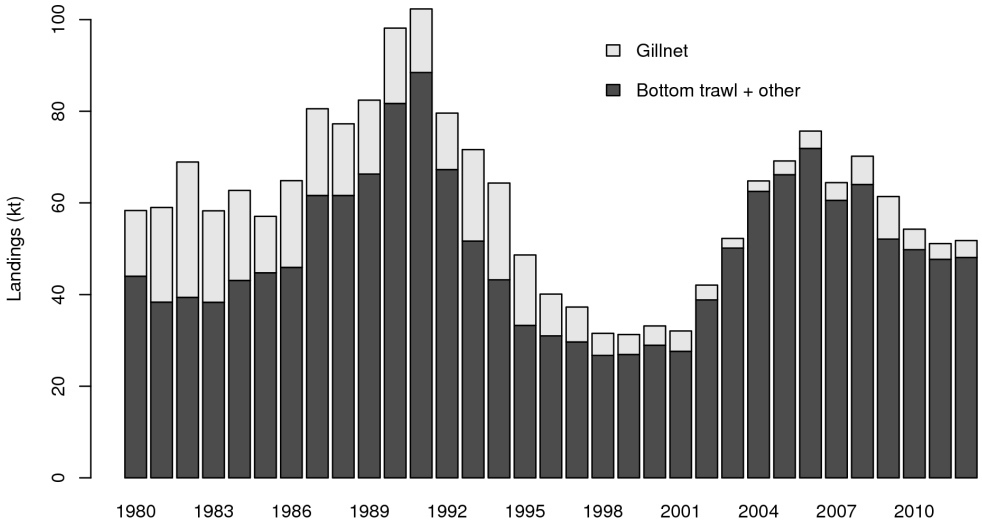

Figure 8.1 Saithe in Division Va. Landings by gear.

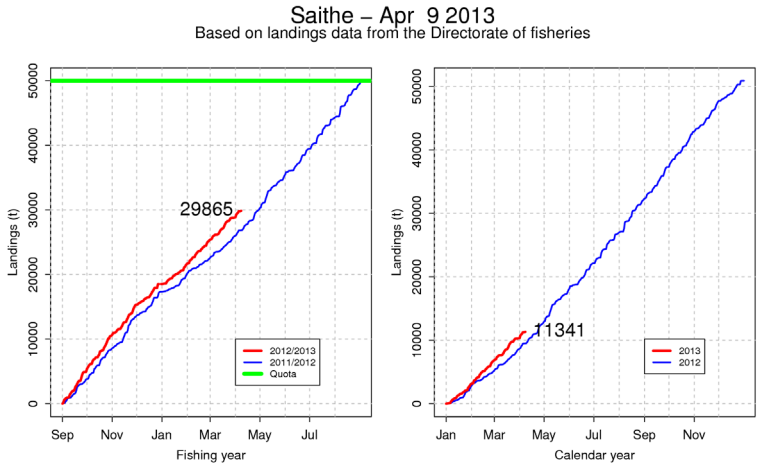

Figure 8.2 Saithe in division Va. Cumulative landings in the current fishing year (left) and calendar year (right). The vertical (green line) in the left figure shows the quota for the current fishing year.

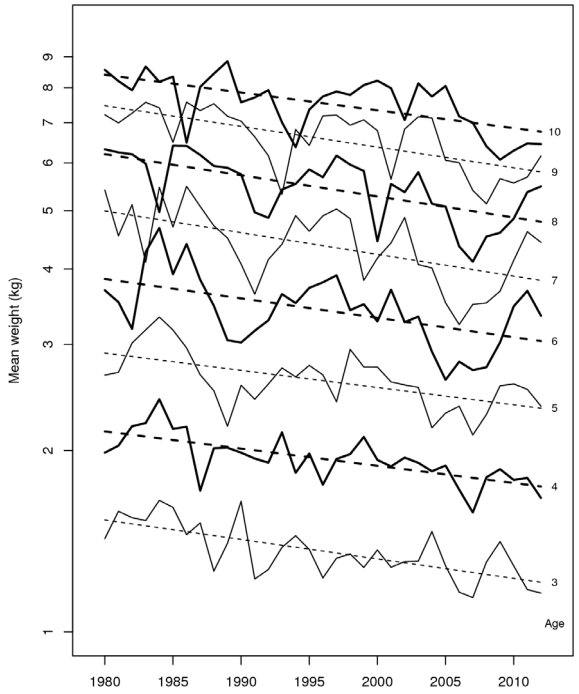

Figure 8.3 Saithe in division Va. Weight at age in the catches. The dotted lines show a linear regression trend on a log-scale.

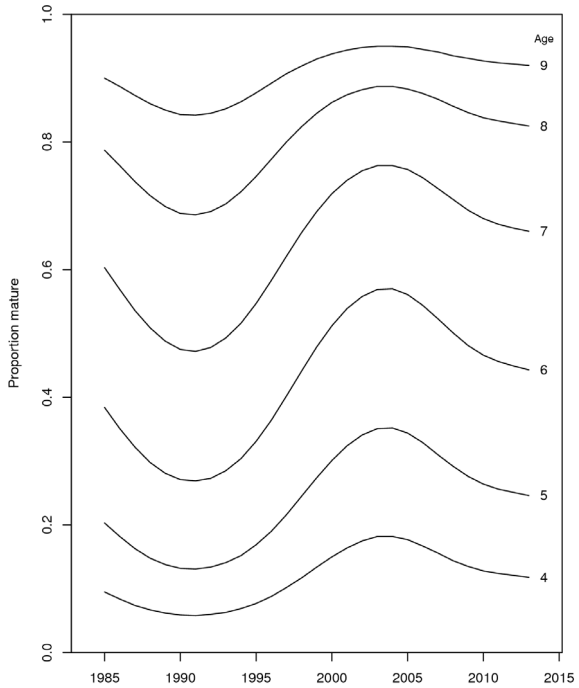

Figure 8.4 Saithe in division Va. Maturity at age used for calculating the SSB.

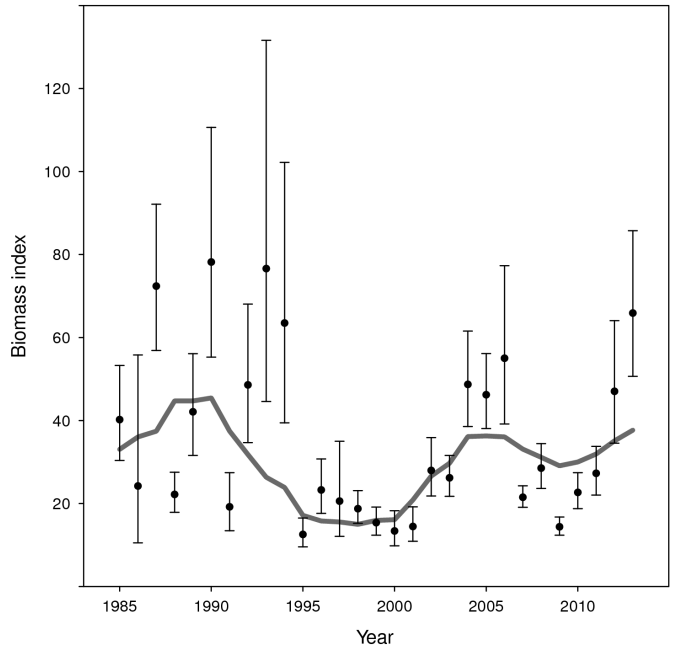

Figure 8.5 Saithe in division Va. Spring survey biomass index and model fit. The vertical lines indicate +/- 1 standard error.

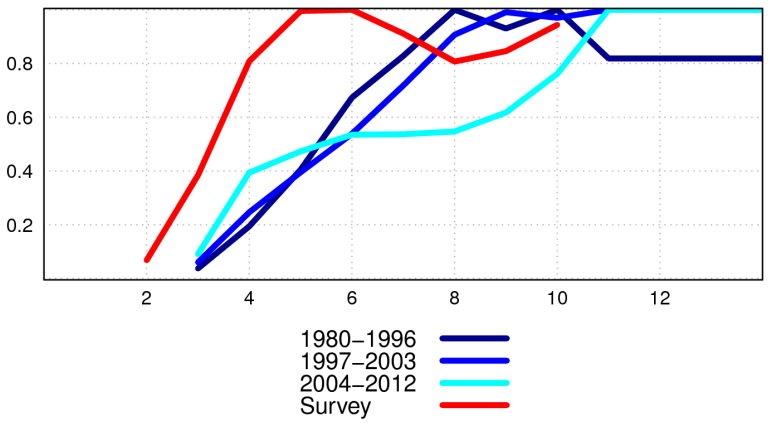

Figure 8.6. Estimated selectivity patterns for the 3 periods.

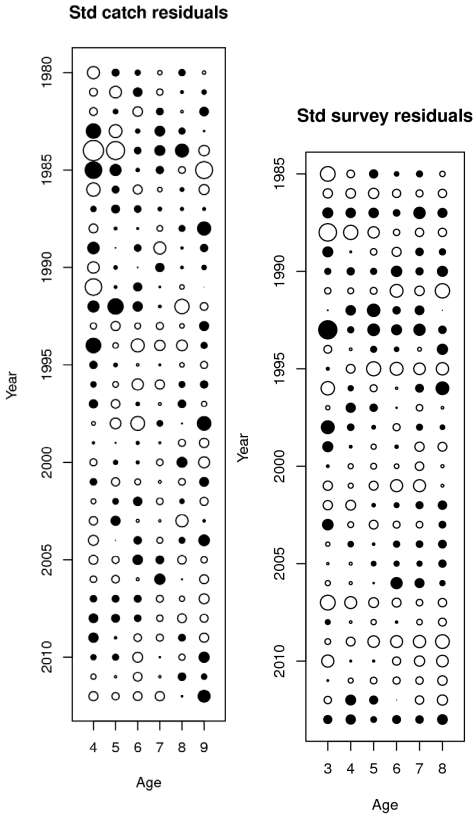

Figure 8.7. Saithe in division Va. Commercial and survey catch-at-age residuals from the fitted model. Filled circles are positive log residuals and hollow circles are negative log residuals.

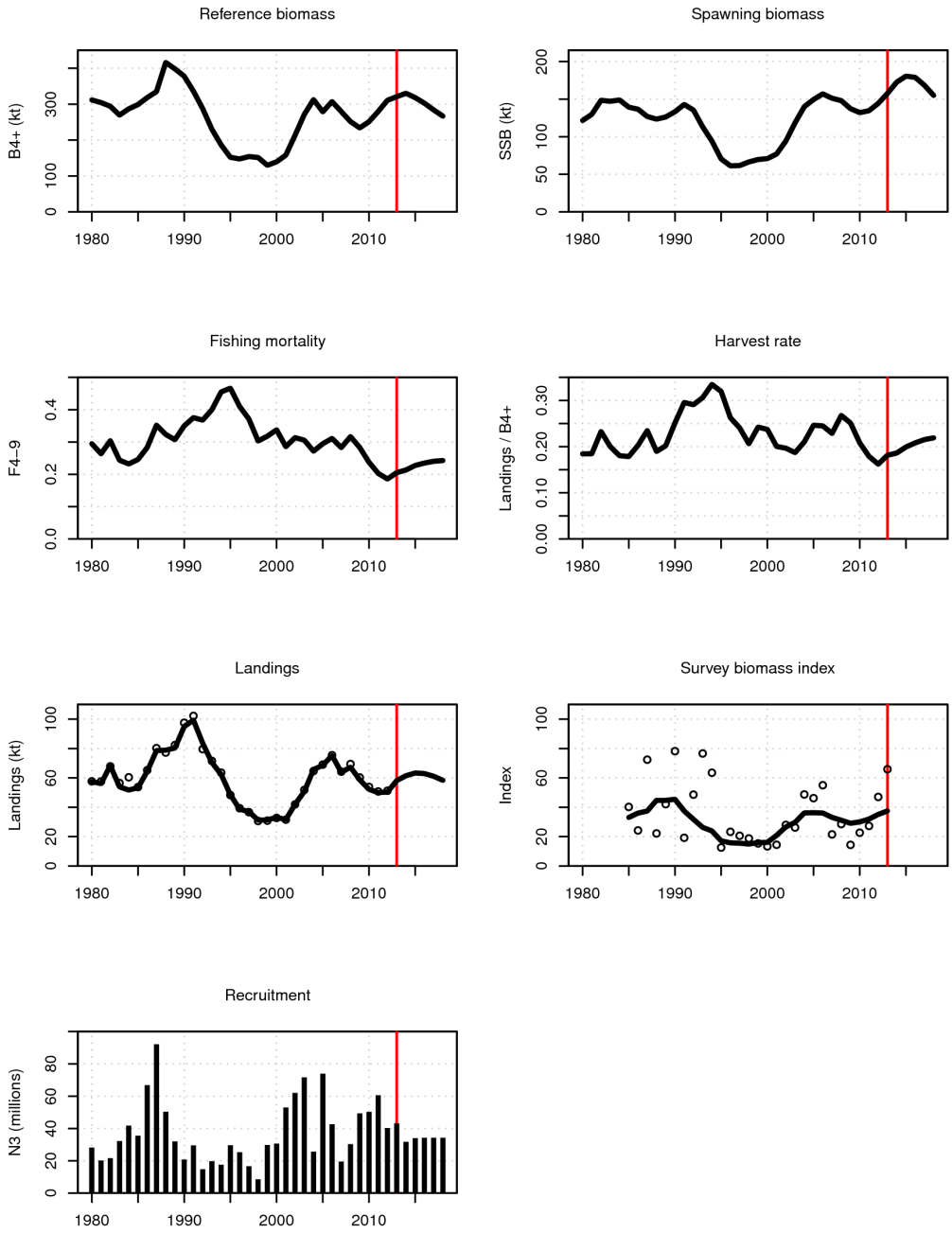

Figure 8.8. Saithe in division Va. Results from the fitted model and short-term forecast. The red line indicates the time of the current assessment.

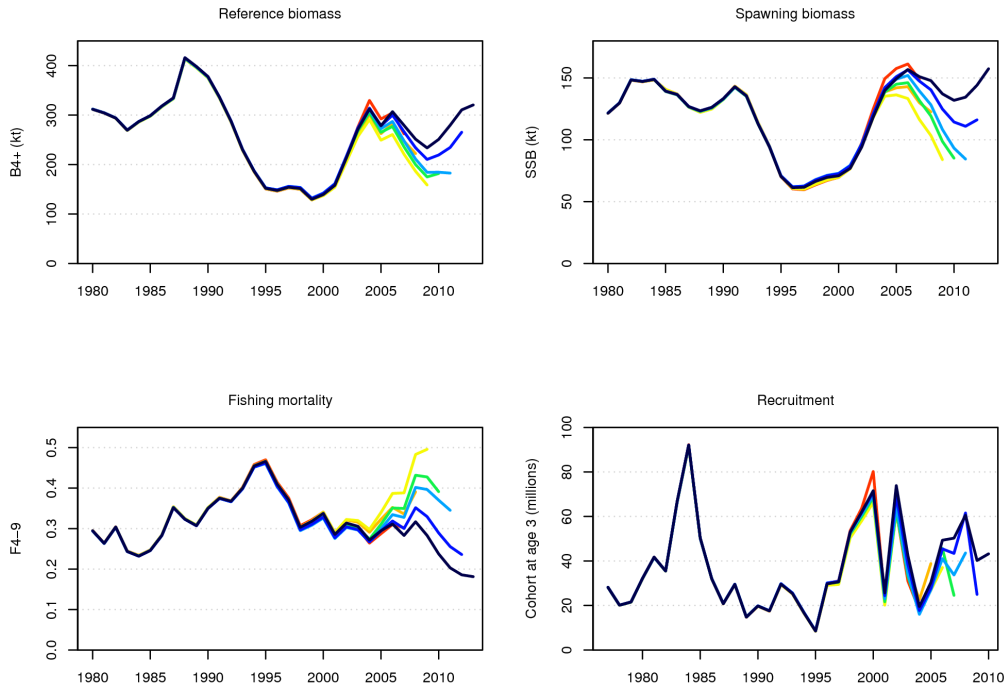

Figure 8.9. Saithe in division Va. Retrospective pattern for the assessment model.

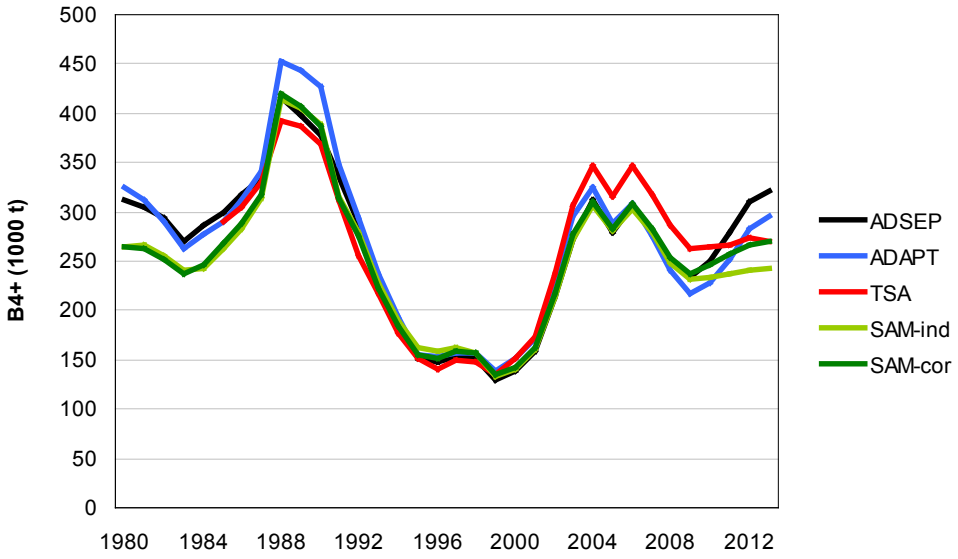

Figure 8.10. Saithe in division Va. Comparison between the default separable model (ADSEP) and alternative assessment models.