

8 **Sebastes Marinus**

Sebastes marinus in ICES sub-areas V and XIV have been considered as one management unit. Catches in VI have traditionally been included in this report and the group continues to do so.

8.1 **Trends in landings**

Since the early 1980s total landings have decreased by more than 70% from about 130 000 t in 1982 to 37 000 t in 2001 (Table 8.1.1 and Figure 8.1.1). In 2002 the total landings increased to 50 000 t due to increased landings from Division Va, but decreased again in 2003 to 39 000 t and to 33 500 t in 2004. The majority of the *S. marinus* catch is taken in ICES Division Va and contributes between 90-95% of the total landings.

Landings of *S. marinus* in sub-Division Va declined from about 63 000 t in 1990 to 34 000 t in 1996. Since then landings have varied between 32 000 and 49 000 t, with the lowest landings in 2004 and the highest in 2002. The landings decreased in 2003 by about 12 000 t from the previous year and to 36 500 t and continued to decrease in 2004 to 32 000 t. Between 90-95% of the annual *S. marinus* catch in Division Va is taken by bottom trawlers targeting redfish (both fresh fish and factory trawlers; vessel length 48-65 m). The remains are partly caught as by-catch in gillnet and longline fishery. In 2004, as in previous years, most of the catches were taken along the shelf W, SW, and SE of Iceland, mostly between 12°W and 27°W (Figure 8.1.2). Although no direct measurements are available on discards, it is believed that there are no significant discards of *S. marinus* in the redfish fishery due to area closures of important nursery grounds west of Iceland.

In Division Vb, landings dropped gradually from 1985 to 1999 from 9 000 t to 1 500 t and has, since then, remained at that level (Table 8.1.1). The majority of the *S. marinus* caught in sub-Division Vb is taken by pair- and single trawlers (vessels larger than 1000 HP).

Annual landings from sub-area VI increased from 1978 to 1987 followed by a gradual decrease to 1992 (Table 8.1.1). In the 1995-2004 period, annual landings have ranged between 400 and 800 t.

Annual landings from sub-area XIV have been more variable than in the other areas (Table 8.1.1). After the landings reached a record high of 31 000 t in 1982 the *S. marinus* fishery drastically reduced within the next three years (the landings from XIV are about 2 000 t in 1985). During the period 1985-1994 the annual landings from sub-area XIV varied between 600 and 4 200 t but since 1995 there has been little or no directed fishery for *S. marinus*. In recent years, landings have been 200 t or less and is mainly taken as by-catch in the shrimp fishery.

8.1.1 **Biological data form the fishery**

The table below shows the fishery related sampling by gear type and Divisions.

AREA	NATION	GEAR	LANDINGS	SAMPLES	FISH MEASURED
Va	Iceland	Bottom trawl	31,473	219	34,806
Va	Germany/UK	Bottom trawl	6		
Va	Faeroe	Longline	237		
Va	Norway	Longline	22		
Vb	Faeroe	Bottom trawl/gillnets	948	12	106
Vb	Various	Bottom trawl	191		
XIV	Various	Bottom trawl	103		
VI	Various	Bottom trawl	519		

The length distributions from the Icelandic commercial trawler fleet in 1989-2004 show that the majority of the fish caught range between 30 and 45 cm (Figure 8.1.3). From 2000 to 2004 the modes of the length distribution were around 35 cm whereas the modes in 1997-1999 were around 37 cm.

Catch-at-age data from the Icelandic fishery in Division Va shows that the 1985-year class dominated the catches from 1995-2002 (Figure 8.2.4 and Table 8.1.2) and in 2002 this year class contributed 25% of the total catch in weight. The 1990-year class is also strong and this year-class dominated the catch in 2003 and 2004 contributing about 27% of the total catch in weight in both years. The average total mortality (Z), estimated from this 10-year series of catch-at-age data (Figure 8.1.5) is about 0.25 for age groups 15+, and about 0.20 for age groups 20+. This estimation is based on Icelandic age readings, but the ageing can vary between readers. Age reading comparison between four age readers revealed that there were significant difference in between readers and between methods, especially fish older than 20 years (Björnsson and Sigurdsson 2003, Stransky et al 2005a). A fairly good agreement (about 60%) between readers was, however, obtained for ages 11-20 years when allowing for ± 1 year tolerance.

Length distribution from the Faeroes commercial catches for 2001-2004 indicates that the fish caught are on average larger than 40 cm with modes between 40 cm and 45 cm (Figure 8.1.6).

No length data from the catches have been available for several years in Divisions XIV and VI.

8.2 Assessment data

8.2.1 CPUE

CPUE indices for the Icelandic trawl fleet for the period 1985-2004 were estimated from a GLM multiplicative model where data was summarised for each vessel by ICES statistical square, month and year. The model takes, therefore, into account changes in the Icelandic trawl catches due to vessel, area, month, and year effects. All hauls at depths above 500 m with *S. marinus* exceeding 50% of the total catch (assumed to be the directed fishery towards the species), were included in the CPUE estimation (Figure 8.2.1). A considerable increase in the CPUE was observed in 2001 and CPUE continued to increase in 2002-2004. The index in 2004 was 6% higher than the highest value in the series in 1987. Effort towards *S. marinus* has decreased considerable from 1986 to 2004 (Figure 8.2.1).

Un-standardized CPUE of the Faeroes otterboard (OB) trawlers 1991-2004 gradually declined to a record low in 1997 but has since then gradually increased and was 84% of the 1991 value in 2004 (Figure 8.2.2). OB trawlers conduct mixed fishery and direct their fishery to some extent towards *S. marinus*. Un-standardised CPUE from the Faeroes CUBA pair-trawler fleet, where *S. marinus* is mainly caught as bycatch in the saithe fishery, was fairly stable between 1991 to 1998, but gradually decreased from 1999 to a record low in 2002 (Figure 8.2.2). CPUE increased in 2003 and 2004 and the CPUE was in 2004 the second highest recorded. Effort has in recent years increased both for the CUBA and OB trawlers.

8.2.2 Survey data

Figure 8.3.2 shows total biomass index from the Icelandic spring and autumn groundfish surveys in with ± 1 standard deviation in the estimate (68% confidence interval) indicated. The figure shows a large measurement error in some years most notably in recent years in the March survey. This large measurement error is caused by relatively few tows accounting for a large part of the total amount caught and is also reflected in rapid changes of the indices from one year to another.

To get a more stable index, the index of fishable biomass for area from 0–400 m depth, based on an selection curve (Figure 8.2.4) rising sharply from 34–36 cm ($L_{50} = 35$ cm), was calculated. The survey extends down to 500 m depth and the stations between 400 and 500 m are few and show the largest CV. Figure 8.2.5 shows this index of fishable biomass. The index indicates a decrease in the fishable biomass from 1985–1995, but an increasing trend since then. The lowest index was in 1995, only about 30% of the maximum in 1987, but the values in 2004 and 2005 are about 60% of the highest observed value. The total indices were on the other hand used in the BORMICON model (see below). The difference in indices presented, that is an increase in biomass from 2003 to 2004 shown in Figure 8.2.3 compared to a decrease shown in Figure 8.2.4, is because of a sharp increase in biomass at depth stratum 400–500 m caused by few large hauls (Table 8.2.1). This estimate of the fishable biomass could be used as a proxy for the SSB. Figure 8.2.6 shows the proportion of mature *S. marinus* in the commercial catches 1995–2004 as a function of length. The estimated length at which 50% fish became mature (L_{50}) was estimated 33.2 cm, which is about 2 cm lower than the L_{50} of the catchability curve.

Length distributions from the Icelandic groundfish surveys show that the peak (Figure 8.2.7), which has been followed during the last years (first in 1987), has now reached the fishable stock. The increase in the survey index since 1995, therefore, reflects the recruitment of a relatively strong year classes (1985-year class and the 1990-year class). This has been confirmed by age readings (Figure 8.1.4). There is no indication of recruitment after 1990-year class, that is fish less than 12 cm. However, a large amount of fish between 25 and 30 cm was observed in the 2005 survey, but not observed previously as smaller fish. This could therefore be a recruiting fish coming from East Greenland (Figure 8.2.11).

In Division Vb, CPUE of *S. marinus* were available from the Faeroes spring groundfish survey from 1994 to 2005 (Figure 8.2.8). After an increase in the period 1995–1998, CPUE decreased drastically and has been for the last five years at the lowest level in the time series. The Faeroes summer survey that has been conducted since 1996 (see Section 2) shows similar trend as the CPUE in the Faeroes spring survey. From 1996 to 1999 the index decreased to record low and has, since then, been relatively stable. In 2004, CPUE increased and was about 40% of what it was in 1996 (Figure 8.2.8).

From 1985 to 2004, abundance and biomass indices from the German groundfish survey for *S. marinus* >17 cm are illustrated in Figures 8.2.9 and 8.2.10. From 1986 to 1995, an almost continuous reduction in survey biomass occurred. After a severe depletion of the *S. marinus* stock on the traditional fishing grounds around East Greenland in the early 1990's, the survey estimates showed a significant increase in abundance in 2002. The estimates in 2002 were the highest recorded since 1990 and this increase indicates a possible recovery. The estimates were though considerable lower compared to the years prior 1990. Between 2002 and 2003 there was a considerable decrease in abundance, whereas the biomass was stable. This could indicate an increased number of adults off East Greenland. Between 2003 and 2004 the biomass decreased and abundance increased slightly. The length frequencies from the German groundfish survey are illustrated in Figure 8.2.11. Although adults seem to be severely depleted in East Greenland waters there is a sign of increased number of larger fish.

8.2.3 Assessment by use of BORMICON model

Since 1999 the working group has discussed an alternative model (BORMICON (BOReal MIgration and CONsumption model) that has been applied to the stock in Va. The model, where *S. marinus* is used as an example, was described in details by Björnsson and Sigurdsson (2003). The BORMICON model is an age- and length based cohort model, where all the selection curves depend on the length of the fish and information on age is not a prerequisite but can be utilized if available. The commercial catch is modelled as one fleet with a fixed selec-

tion pattern described by a logistic function and total catch in tonnes specified for each time period.

The BORMICON model was run using the same settings as last year's base case. The simulation period is from 1970 to 2005. Two time steps are used each year. Natural mortality is set to 0.15 for the youngest age, decreasing gradually to 0.05 for age 5 and older. The ages used were 1 to 30 years, where the oldest age is treated as a plus group (fish 30 years and older). Recruitment was set at age 1. Length at recruitment was estimated separately prior to and after 1989.

An alternative configuration was also investigated. There the L_{50} in the selection pattern of the commercial fleet was allowed to vary annually after 1998 and the length at recruitment was estimated separately for the 1990-year class. The former change was to check the effects of the area closures to preserve the 1990-year class and the second change to look at problem that the model has in distinguishing between the 1990- and 1991-year classes.

Estimated parameters are:

- Number of fishes when the simulation starts (8 parameters).
- Recruitment each year (32 parameters).
- Length at recruitment (2 parameters).
- Parameters in the growth equation; (2 parameters).
- Parameter β of the beta-binomial distribution controlling the spread of the length distribution.
- Selection pattern of the commercial fleet (2 parameters).

Results for 2005 run is shown in Figure 8.2.12.

Data used for tuning are:

- Length disaggregated survey indices from the Icelandic ground fish survey in March. The total indices 0-500 m were used in the model.
- Length distribution from the Icelandic commercial catch.
- Age length keys and mean length at age from the Icelandic autumn survey.
- Age length keys and mean length at age from the Icelandic catch.

Estimated model parameters were used in simulations to determine the value of F_{\max} and $F_{0.1}$. A year class was started in 1970 and caught using fixed fishing mortality and the estimated selection pattern. The simulation was done for 40 years. The total yield from the year class was then calculated as function of fishing mortality. The results gave $F_{\max}=0.165$, $F_{0.1}=0.09$ and maximum yield was estimated to be 250 g/recruit. Here, F is not fishing mortality, but close to it when small time steps are used, or mortality is small. It is also the mortality of a fish where the selection is 1. The estimated values of F_{\max} and $F_{0.1}$ are more conservative than corresponding estimate from catch at age model and F_{\max} could be a candidate for F_{target} .

Results from the assessment are shown in Figures 8.2.12-8.2.17 and compared to the results from two previous years in Figure 8.2.18. As may be seen the estimate on catchable biomass for 2005 is similar to the ones estimated in 2002 and 2003, although a little higher, with the difference probably driven by the high survey indices 2004 (Figure 8.2.16). Furthermore, the results for 2005 are similar to the one presented in Björnsson and Sigurdsson (2003), where they used data until 2000.

Figure 8.2.17 shows residuals from the model fit to the survey data, demonstrating large positive residuals in some years, most notably 1993, 1999, and 2003-2005. The large positive residuals for 22-37 cm fish observed in 2003-2005 indicate that survey results exceeded model prediction.

The indices from the groundfish survey are the main indicators of recruitment in the model. As described in section 8.2.2 the groundfish survey has indicated bad recruitment of redfish since the 1991-year class and the model mimics those results. The estimated average year class size in 1992-2001 is now estimated 80 million (at age 0) which is only enough to sustain an annual catch of 20 000 tonnes using estimated maximum yield per recruit of 250 g.

According to the predictions here, the stock is going to be stable for the next few years with an annual catch of 30 000-35 000 t (Figure 8.2.13). This value might though have to be reduced every new year with no sign of good recruitment. From the above-mentioned runs, it is clear that if the groundfish survey is to be accepted as a measure of recruitment, no new large year class will recruit to the fishable stock in the next 10 years.

The estimation of L_{50} in the selection pattern of the commercial fleet was estimated 32.4 cm, which is the lowest value estimated (Table 8.2.2) It is not known whether the changes of selection in the fishery is related to model misspecification or recruitment.

Different catch options were tested in the simulations for a fixed catch. As may be seen in Figures 8.2.13, the catchable biomass will decrease in next 5 years for all catch options exceeding 37 000 t and the total biomass decrease for annual catch above 33 000 t.

8.2.4 State of the stock

S. marinus is mainly caught in ICES Division Va, contributing 90-95% of the total landings from Va, Vb, and XIV. The BORMICON model and available survey information from Division Va show that the *S. marinus* stock decreased considerably from 1985 to the lowest recorded biomass in 1995. An improvement in the fishable biomass has, however, been seen in the most recent years due to improved recruitment. During the last few years, the 1985-year class has contributed significantly to the fishable stock, and the 1990-year class has also contributed significantly to the fishable biomass in the last 5 years. It is expected that those year classes will dominate the catches in the next few years. There is no indication of new, strong year classes since the 1990-year class, that is fish smaller than 12 cm. However, in the 2005 survey, a large number of fish at lengths between 25 and 30 cm was observed. The BORMICON model estimated the exploitation rate to amount to $F=0.16$. In Vb, survey indices do not indicate improved situation in the area, but CPUE indices from the commercial fleet has increased. In sub-Division XIV, the adult fish is severely depleted, but there are signs of improved recruitment (Figure 8.2.11). No information are available on exploitation rate in Divisions Vb and XIV.

In summary, the Icelandic groundfish survey shows a considerable decline in the fishable biomass of *S. marinus* during the period from 1986 to 1994. The stock has since the mid 1990s increased, and is now inside defined safe biological limits (U_{pa}). A large proportion of the catches in Va in recent years are caught from only two year-classes. The fishable stock situation remains bad for Division XIV and Vb.

8.2.5 Catch projections and management considerations

Results from the short term prediction is given in Table 8.2.3. Based on the BORMICON model, a decrease in the fishable biomass is expected for all catch options above about 37 000 t and in total biomass for all options exceeding about 33 000 t. This is due to the poor recruitment after the 1990-year class. The estimated average year class since 1992 is about 80 millions (at age 0) and maximum yield-per-recruit is estimated to about 250 gr. Based on the model results, a TAC below 35 000 t in the next 4 years would provide a fishable stock size above current biomass level at the end of that period and total biomass similar to current level (Table 8.2.3). A large proportion of the catch will be from the 1985- and 1990-year classes. Therefore, after these two strong year classes have passed the fishery, higher yield than about

20 000 t cannot be expected after 2010. The approximate F from the model would decrease from the current level and be close to F_{\max} .

8.3 Biological reference points

The biological reference points are given in Table 8.2.4.

F_{\max} was calculated by following one year class of million fishes for 50 years through the fisheries calculating total yield from the year class as function of fishing mortality of fully recruited fish. From the plot of yield vs. fishing mortality F_{\max} and $F_{0.1}$ were estimated. In the model the selection of the fisheries is length based so only the largest individuals of recruiting year classes are caught, reducing mean weight of the survivors, more as fishing mortality is increased. This is to be contrasted with age based yield per recruit where the same weights at age are assumed in the landings independent of the fishing mortality even when the catch weights are much higher than the mean weight in the stock. Those effects can be seen in Figure 8.2.12 where the model estimates $L_{\text{inf}} = 60\text{cm}$ while the removal of the largest individuals of recruiting year classes let it look like $L_{\text{inf}}=40\text{cm}$. This difference leads to estimates of F_{\max} that are considerably lower than F_{\max} from age based assessment.

Simulations from the BORMICON model give F_{\max} of 0.16, which could be a candidate for F_{target} . The model indicates that catches in the range 30 000 to 35 000 tonnes in the next year will increase the SSB a little and lead to fishing mortality close to F_{\max} .

S. marinus is mainly caught in Division Va, and the relative state of the stock can be assessed through survey index series from that Division. ACFM accepted the proposal of the working group of defining reference points in terms of current state with respect to $U_{\text{lim}} = U_{\max} / 5$ and $U_{\text{pa}} = 60\%$ of U_{\max} . U_{pa} corresponds to the fishable biomass associated with the last strong year class. Based on survey data, the highest recorded biomass was reached in 1987. Based on these definitions, the stock has been close to U_{pa} during the last years (Figure 8.2.5). The survey index series is only available from 1985 (Table 8.2.5).

8.4 Comment on the assessment

The basis for advise and the relative state of the stock is based on projection derived from the analytical BORMICON model and survey index series.

There are only available data on nursery grounds of *S. marinus* in Icelandic and Greenland waters but no nursery grounds are known in the Faeroe Islands waters. In Icelandic waters, nursery areas are found mostly West and North of Iceland at depths between 50 and approximately 350 m, but also in the South and East (ICES C.M. 1983/G:3; Einarsson, 1960; Magnússon and Magnússon 1975; Pálsson *et al.* 1997). As length (age) increases, migration of young *S. marinus* is anticlockwise from the North coast to the West coast and further to the Southeast fishing areas and to Faeroes fishing grounds in Vb. The largest specimens are found in Subdivision Vb and therefore the year classes from 1985 and 1990 might still not have entered into that area. This might explain the inconsistency between different indicators on the status of the stock.

Table 8.1.1 Official landings (in tonnes) of *S. marinus*, by area, 1978-2004 as officially reported to ICES.

Year	AREA				Total
	Va	Vb	VI	XIV	
1978	31,300	2,039	313	15,477	49,129
1979	56,616	4,805	6	15,787	77,214
1980	62,052	4,920	2	22,203	89,177
1981	75,828	2,538	3	23,608	101,977
1982	97,899	1,810	28	30,692	130,429
1983	87,412	3,394	60	15,636	106,502
1984	84,766	6,228	86	5,040	96,120
1985	67,312	9,194	245	2,117	78,868
1986	67,772	6,300	288	2,988	77,348
1987	69,212	6,143	576	1,196	77,127
1988	80,472	5,020	533	3,964	89,989
1989	51,852	4,140	373	685	57,050
1990	63,156	2,407	382	687	66,632
1991	49,677	2,140	292	4,255	56,364
1992	51,464	3,460	40	746	55,710
1993	45,890	2,621	101	1,738	50,350
1994	38,669	2,274	129	1,443	42,515
1995	41,516	2,581	606	62	44,765
1996	33,558	2,316	664	59	36,597
1997	36,342	2,839	542	37	39,761
1998	36,771	2,565	379	109	39,825
1999	39,824	1,436	773	7	42,040
2000	41,187	1,498	776	89	43,550
2001	35,067	1,631	535	93	37,326
2002	48,570	1,941	392	189	51,092
2003	36,577	1,459	968	215	39,220
2004 ¹⁾	31,738	1,139	519	103	33,498

1) Provisional

Table 8.1.2 *S. marinus*. Landings in Va in weight (tonnes) by age 1995-2004. Highlighted are the 1985- and 1990-yearclasses. It should be noted that the catch-at-age results for 1996 are only based on three samples, which explains that there are no specimen older than 23 years

YEAR/ AGE	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
7	62	0	33	24	7	40	122	130	201	243
8	374	355	230	285	367	64	137	911	211	924
9	1,596	814	481	598	1,643	852	393	767	1,368	522
10	9,436	3,652	1,037	1,214	1,247	4,308	1,615	842	1,122	2,249
11	2,719	9,007	2,698	1,135	1,840	1,894	7,725	3,189	1,198	820
12	1,319	2,074	11,559	3,258	2,643	2,277	1,799	11,069	3,955	956
13	3,534	1,302	2,822	12,552	2,309	1,703	1,973	3,096	9,777	2,066
14	5,671	1,458	1,369	2,086	15,583	2,375	1,246	2,631	2,362	8,705
15	5,971	4,374	3,134	2,039	1,143	14,878	835	1,855	1,979	2,134
16	1,730	5,599	3,662	2,410	1,309	1,777	11,629	3,028	1,218	1,632
17	852	923	3,033	3,408	1,849	1,184	520	12,041	2,267	839
18	368	383	900	2,046	2,699	1,624	783	2,097	6,427	1,361
19	1,134	264	644	1,015	2,272	2,427	1,063	1,173	761	5,060
20	1,144	336	945	726	1,205	2,191	1,792	661	410	1,135
21	503	1,200	450	521	482	544	965	1,409	604	233
22	677	1,022	524	390	222	447	418	1,027	791	482
23	1,427	795	689	425	345	270	435	741	755	537
24	664	0	590	662	223	64	168	362	379	610
25	762	0	752	515	936	393	130	294	303	270
26	365	0	271	399	279	340	125	185	75	129
27	350	0	136	425	650	193	291	83	83	220
28	725	0	204	359	230	528	203	297	27	104
29	0	0	150	54	107	371	153	499	106	116
30	133	0	30	225	231	441	374	174	197	188
Total	41,516	33,558	36,343	36,771	39,821	41,186	34,894	48,561	36,576	31,535

Table 8.2.1 Index on fishable stock of *S. marinus* in the Icelandic groundfish survey 1985-2005 divided by depth intervals.

Year	DEPTH INTERVALS					Total
	< 100m	100-200m	200-400m	400-500m	0 - 400m	
1985	7.0	90.7	139.7	23.6	237.4	261.1
1986	2.0	86.1	179.9	12.1	268.0	280.1
1987	2.0	123.8	150.2	10.0	276.0	286.0
1988	1.1	94.6	110.1	4.0	205.8	209.7
1989	1.1	101.4	117.8	10.9	220.2	231.1
1990	2.3	67.9	81.0	22.2	151.2	173.4
1991	1.7	75.9	52.6	8.3	130.3	138.6
1992	1.2	62.2	58.5	9.4	121.9	131.3
1993	0.7	47.5	50.2	16.6	98.4	115.0
1994	0.5	57.7	51.4	1.3	109.6	110.9
1995	0.3	36.0	44.6	11.2	81.0	92.1
1996	0.8	44.3	76.5	21.1	121.5	142.6
1997	1.0	60.3	71.5	33.6	132.7	166.4
1998	1.6	56.9	71.2	2.7	129.7	132.4
1999	0.7	55.5	107.3	44.4	163.6	207.9
2000	2.0	46.7	68.5	8.1	117.2	125.4
2001	1.6	33.1	66.6	5.8	101.2	107.0
2002	1.8	64.0	74.2	11.4	140.1	151.4
2003	8.7	60.2	107.5	28.8	176.4	205.2
2004	7.9	57.2	91.6	102.3	156.7	259.0
2005	9.4	42.3	112.3	37.6	164.1	201.7

Table 8.2.2 Results of the BORMICON model. BASE CASE, estimated value of L_{50} in the selection pattern of the commercial fleet

YEAR	<1998	1998	1999	2000	2001	2002	2003	2004
L_{50}	33.85	34.49	34.30	33.92	33.65	34.14	32.81	32.40

Table 8.2.3 *S. marinus* in Division Va. Output from short term prediction using results from the BORMICON model, where the annual landings after 2004 is set to 30 000 t. The table gives the SSB (the same as the catchable biomass), total biomass and landings in thousands tons F_{20} is the fishing mortality at age 20.

YEAR	SSB	F_{20}	TOTAL BIOMASS	LANDINGS
2004	183.3	0.175	340.5	31.5
2005	195.9	0.184	349.0	35.0
2006	205.2	0.175	352.2	35.0
2007	215.1	0.167	353.2	35.0
2008	225.1	0.159	352.3	35.0
2009	233.2	0.153	349.5	35.0

Table 8.2.4 Biological reference points for *S. marinus* in Division Va.

PARAMETERS	ESTIMATION
F_{max}	0.16
$F_{0.1}$	0.09
SSB	183 000 t
Yield per recruit	250 g

Table 8.2.5 Index in thousands of total biomass of *S. marinus* from the groundfish survey in March 1985-2005 and CV of the estimates.

YEAR	INDEX	CV
1985	331	0.094
1986	372	0.134
1987	348	0.115
1988	270	0.101
1989	335	0.153
1990	297	0.327
1991	200	0.106
1992	171	0.094
1993	202	0.144
1994	189	0.125
1995	163	0.139
1996	230	0.209
1997	282	0.318
1998	230	0.158
1999	381	0.204
2000	264	0.201
2001	222	0.153
2002	259	0.122
2003	409	0.188
2004	457	0.310
2005	345	0.136

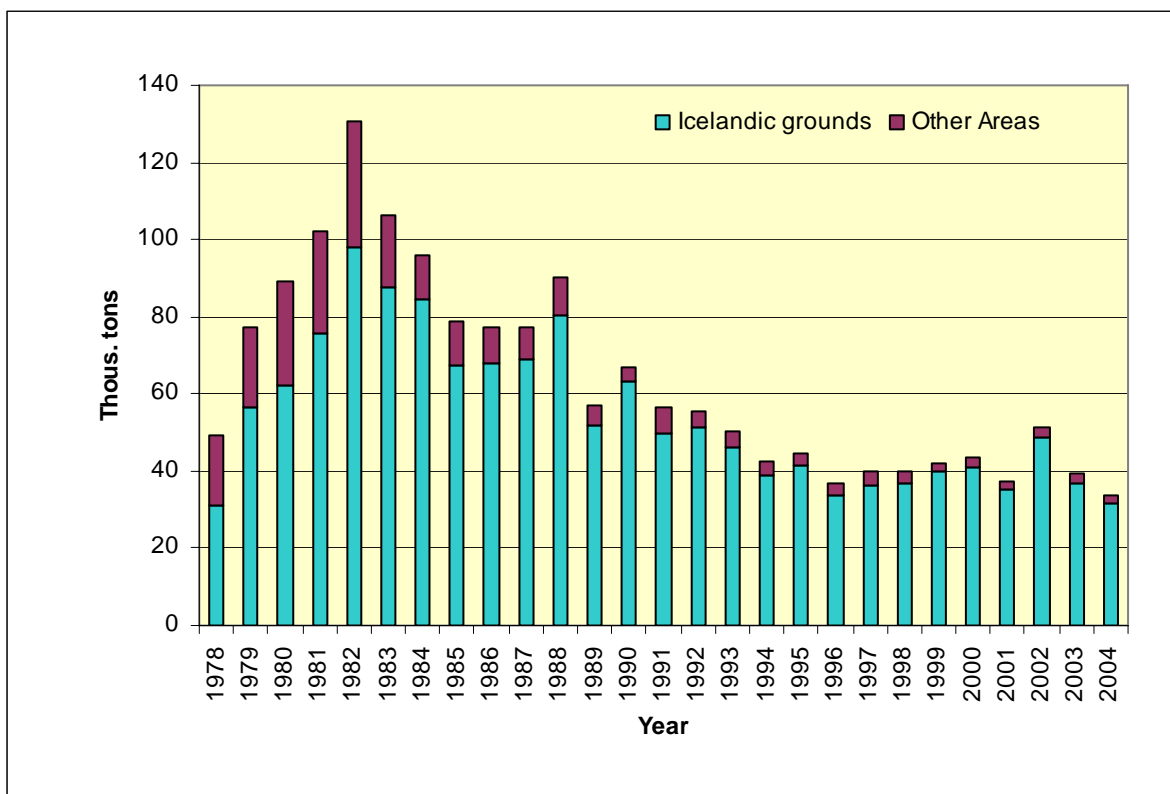


Figure 8.1.1 *Sebastes marinus*. Nominal landings in tonnes in ICES Division Va and in other areas (landing statistics for ICES Divisions Vb, VI and XIV combined) 1978-2004. Landings statistics for 2004 are provisional.

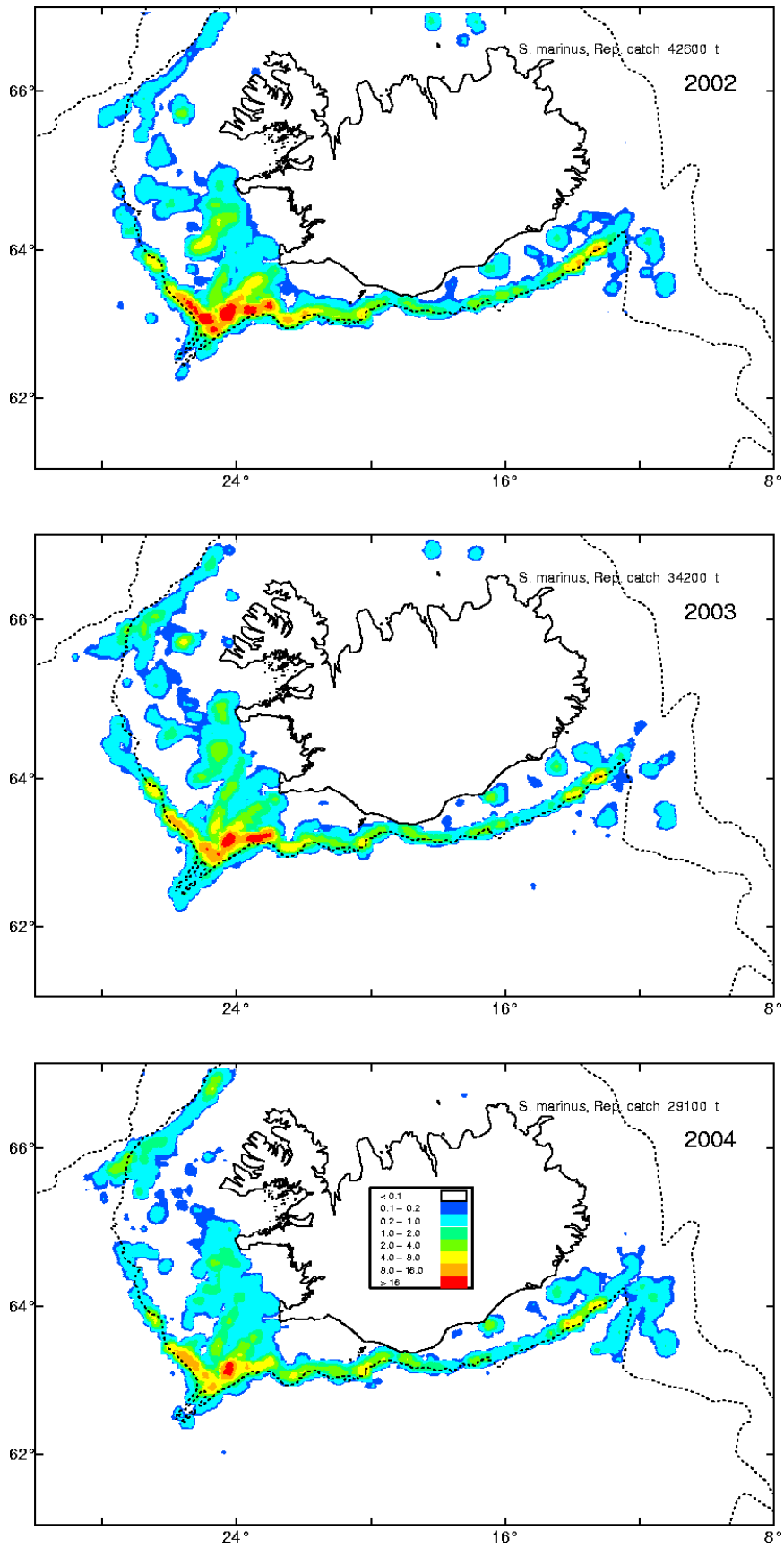


Figure 8.1.2 Geographical distribution of *S. marinus* catches in Division Va 2002-2004.

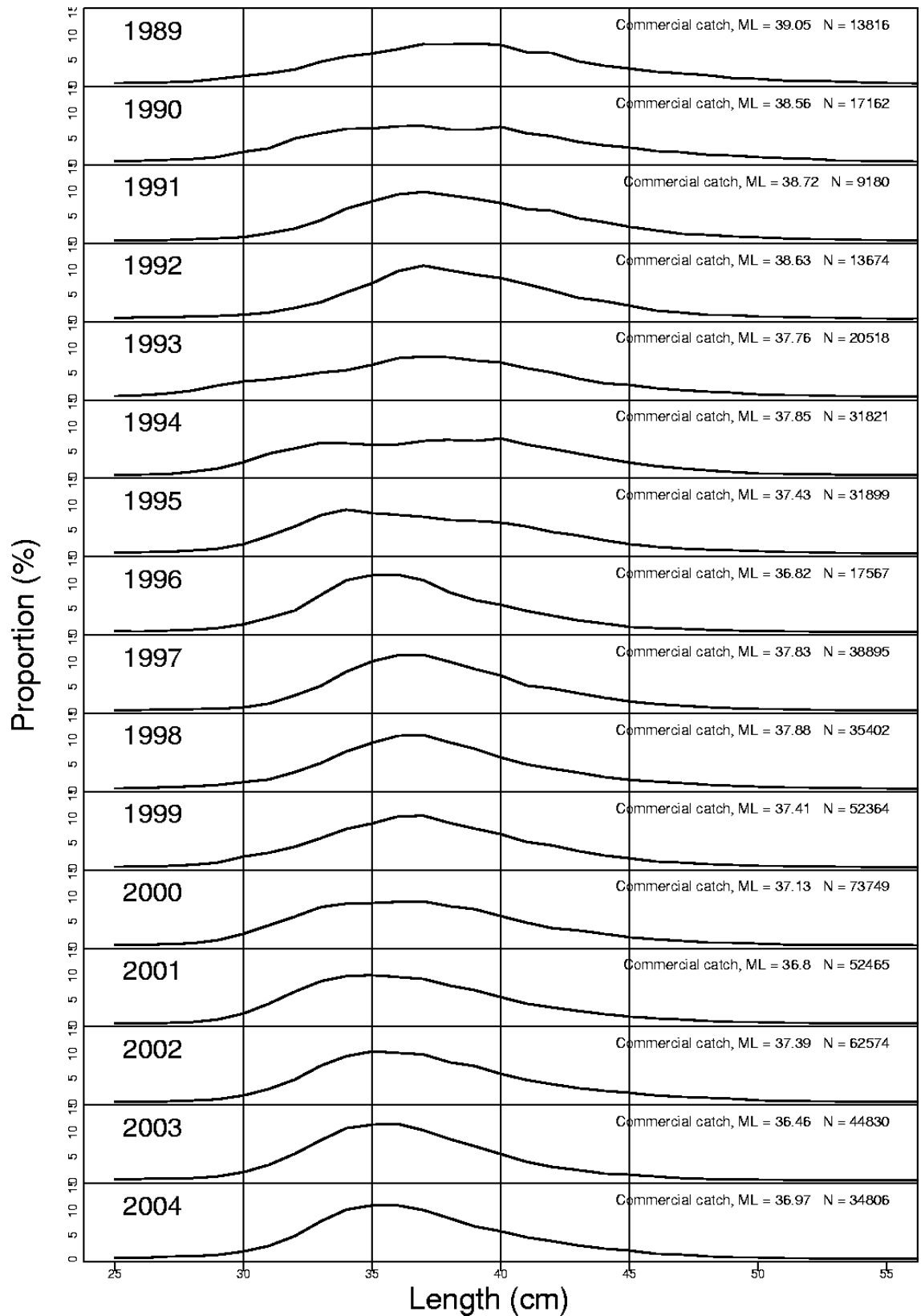


Figure 8.1.3 Length distribution of *S. marinus* in the commercial landings of the Icelandic bottom trawl fleet 1989-2004.

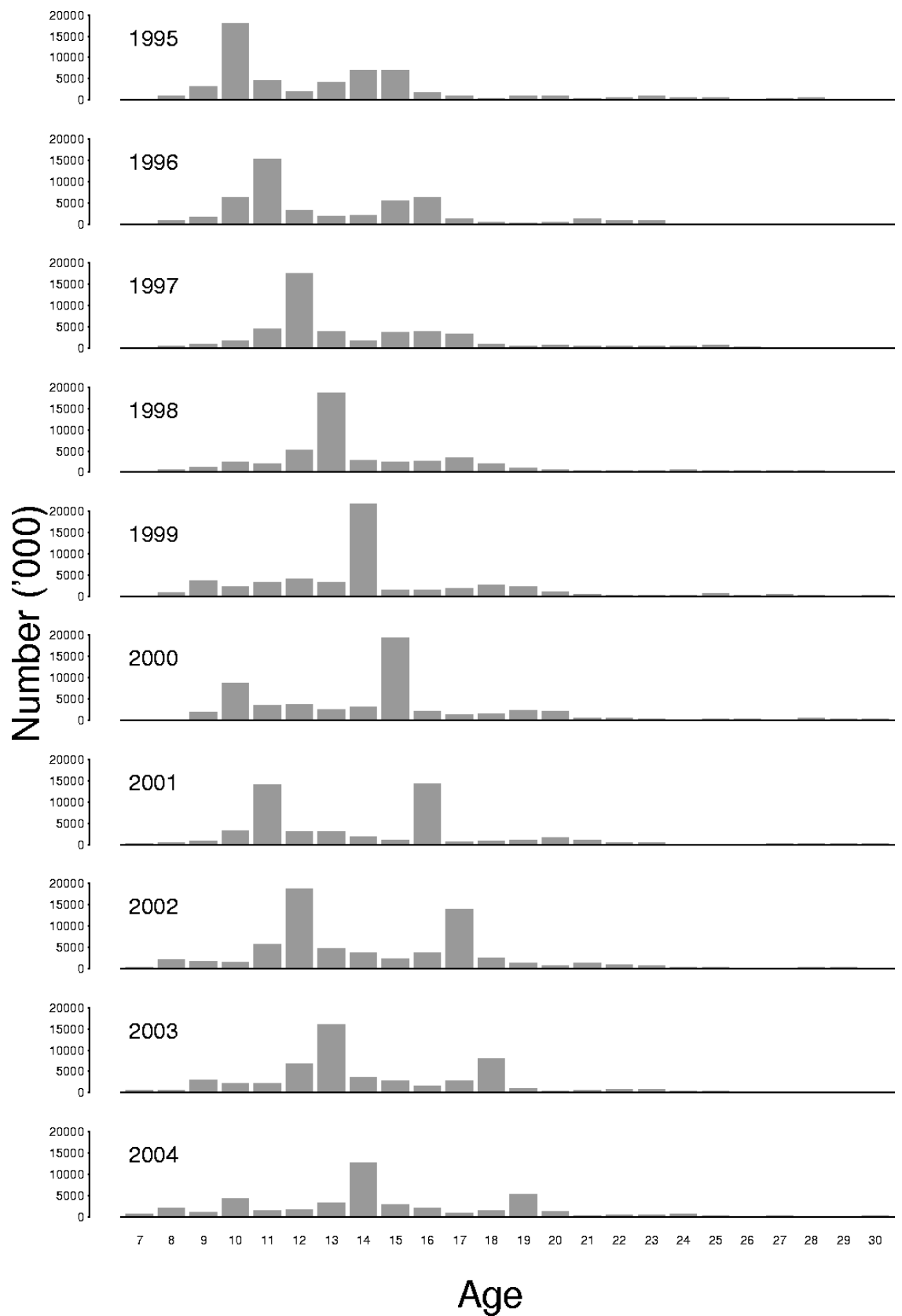


Figure 8.1.4

S. marinus. Catch-at-age in numbers in ICES Subdivision Va 1995-2004.

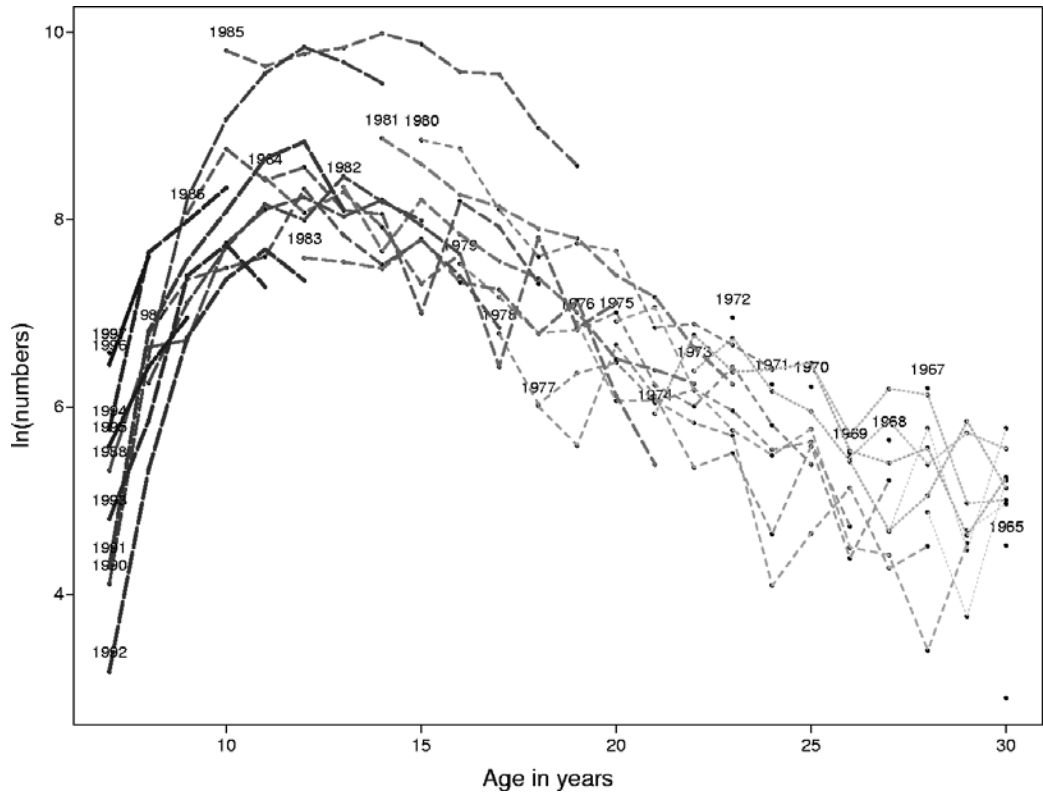


Figure 8.1.5 *S. marinus*. Catch curve based on the catch-at-age data in ICES Division Va 1995-2004.

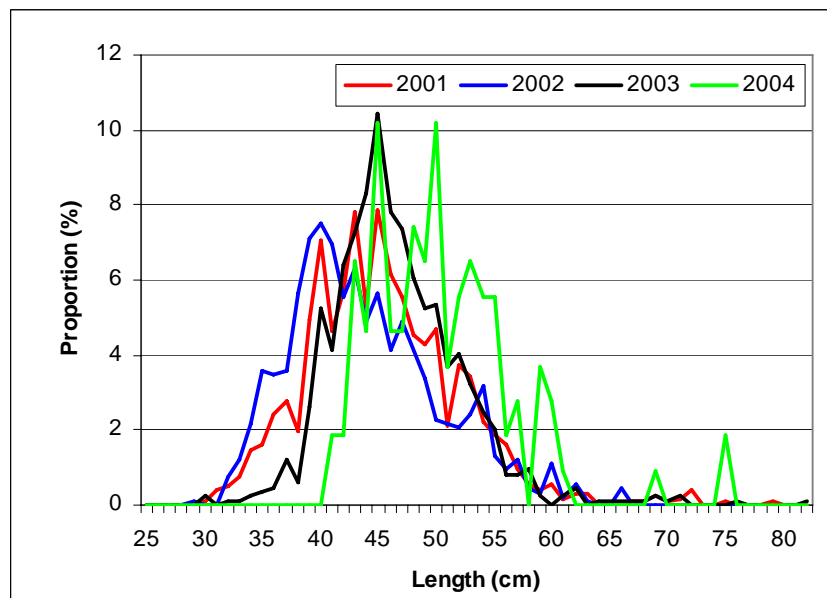


Figure 8.1.6 *S. marinus*. Length distribution from Faroese catches in 2001-2004.

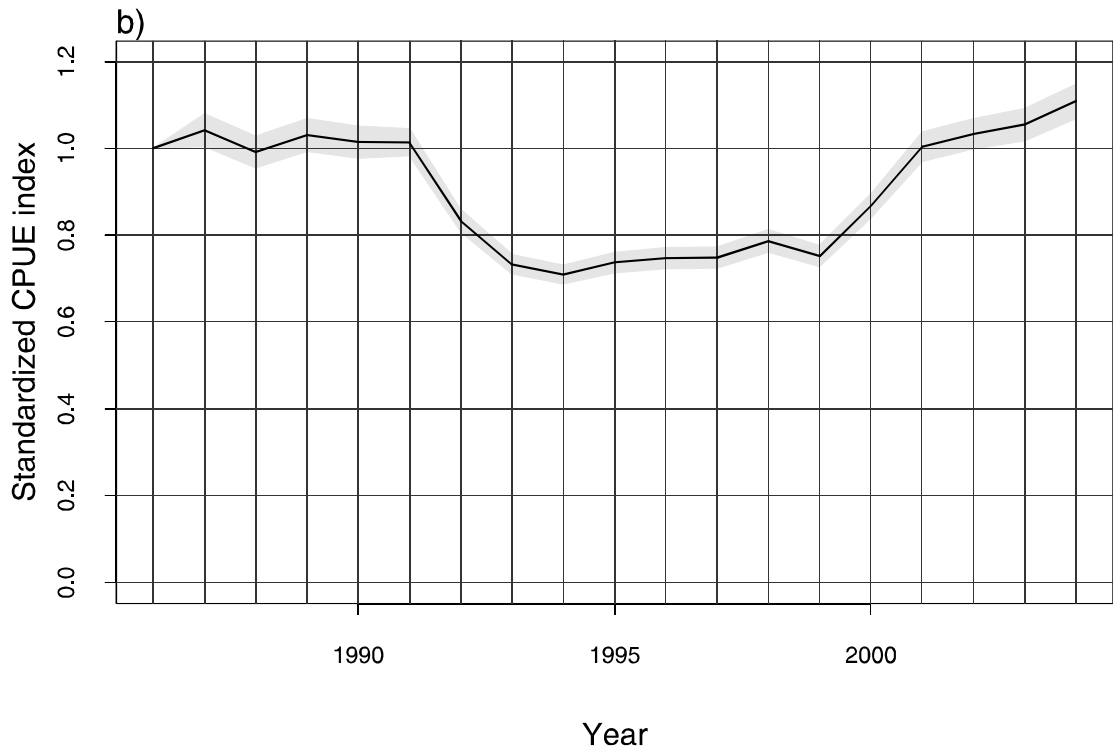
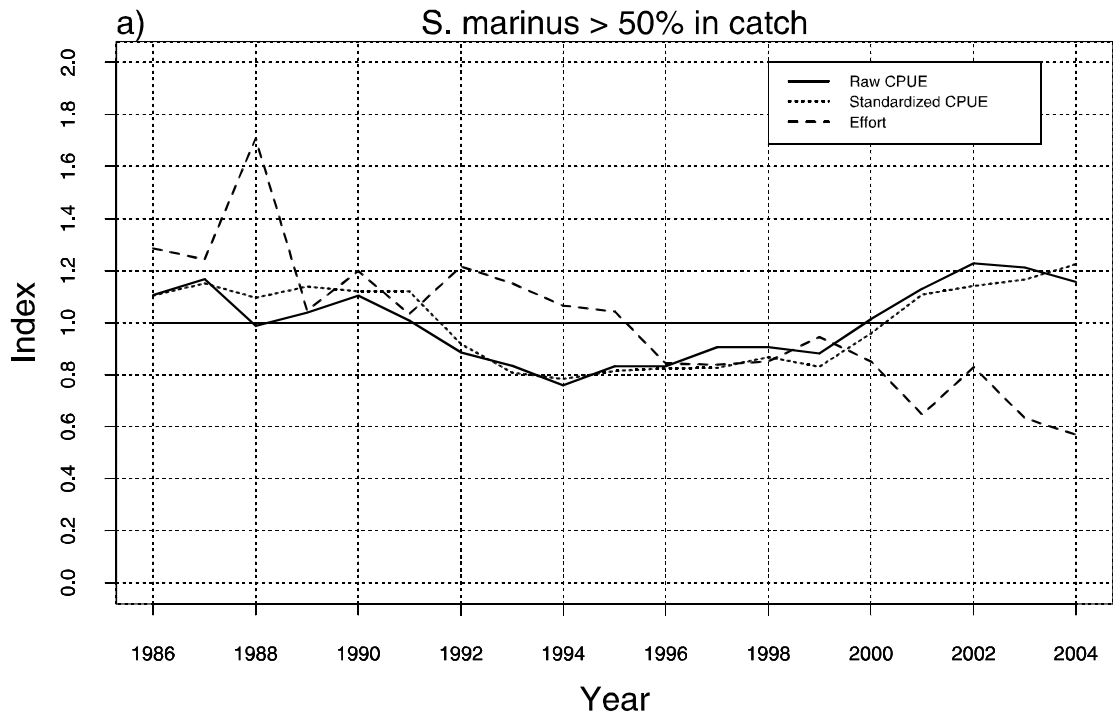


Figure 8.2.1 CPUE indices, relative to 1986, of demersal *S. mentella* from Icelandic bottom-trawl fishery in Division Va. The CPUE indices are based on a GLM model, based on data from log-books and where at least 50% of the total catch in each tow was demersal *S. mentella*. Also shown is the fishing effort.

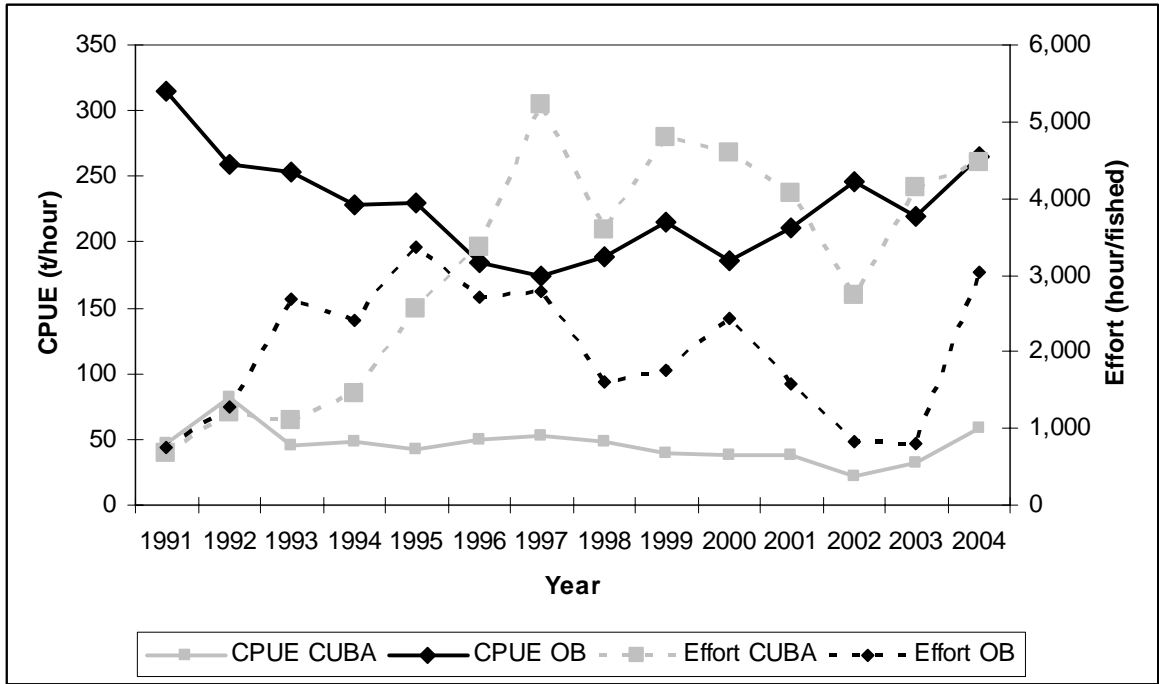


Figure 8.2.2 CPUE (solid lines) and effort (dotted lines) from the Faroese CUBA pair-trawlers (grey) and otterboard trawlers (black) in ICES Division Vb 1991-2004.

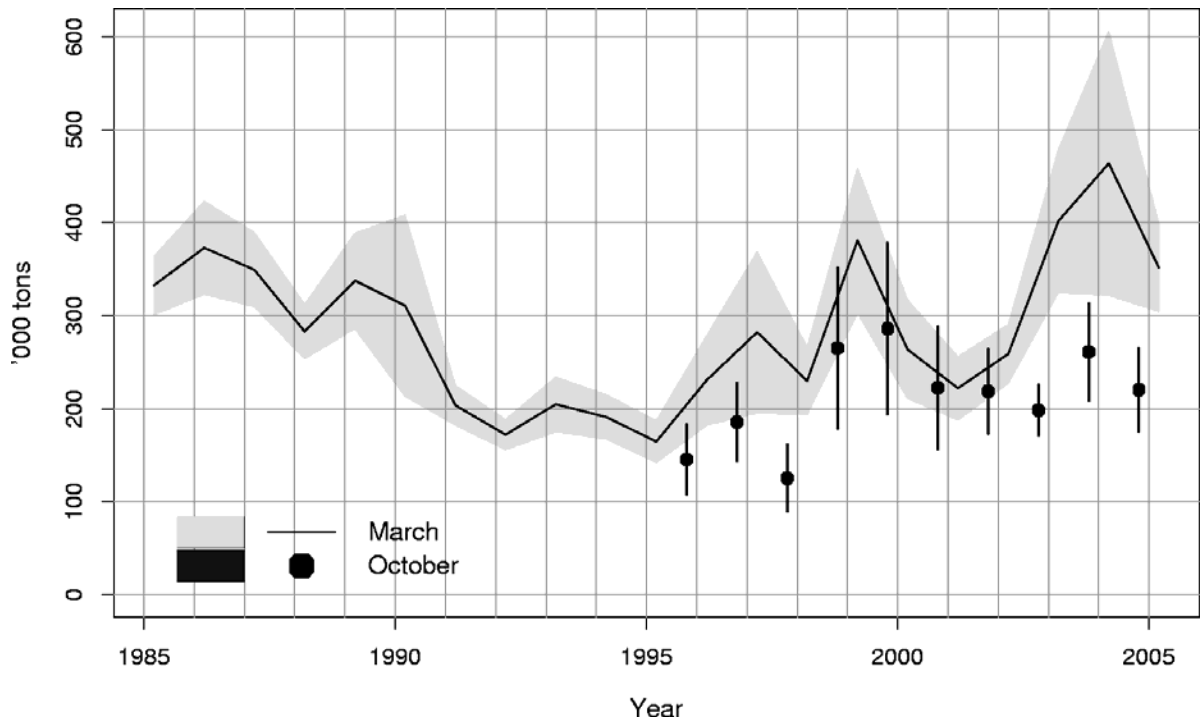


Figure 8.2.3 Total biomass indices from the groundfish surveys in March 1985-2005 (line) and October 1996-2004 (points). The shaded area and the vertical bar show ± 1 standard error in the estimate of the indices.

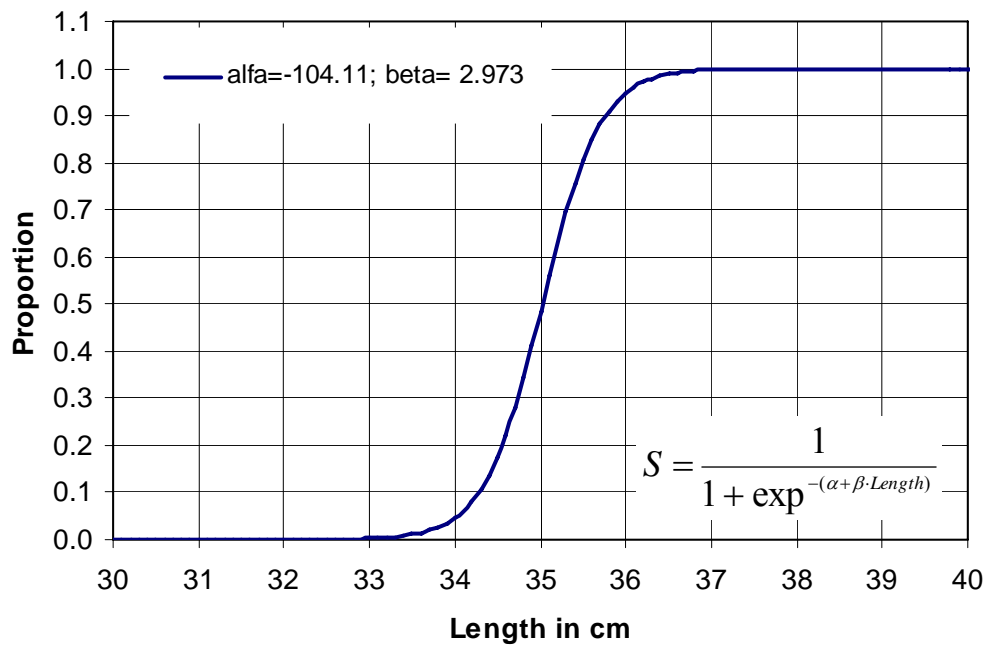


Figure 8.2.4 Selection pattern of *S. marinus* from the spring groundfish survey used to estimate the abundance of the fishable stock abundance. $L_{50} = 35$ cm.

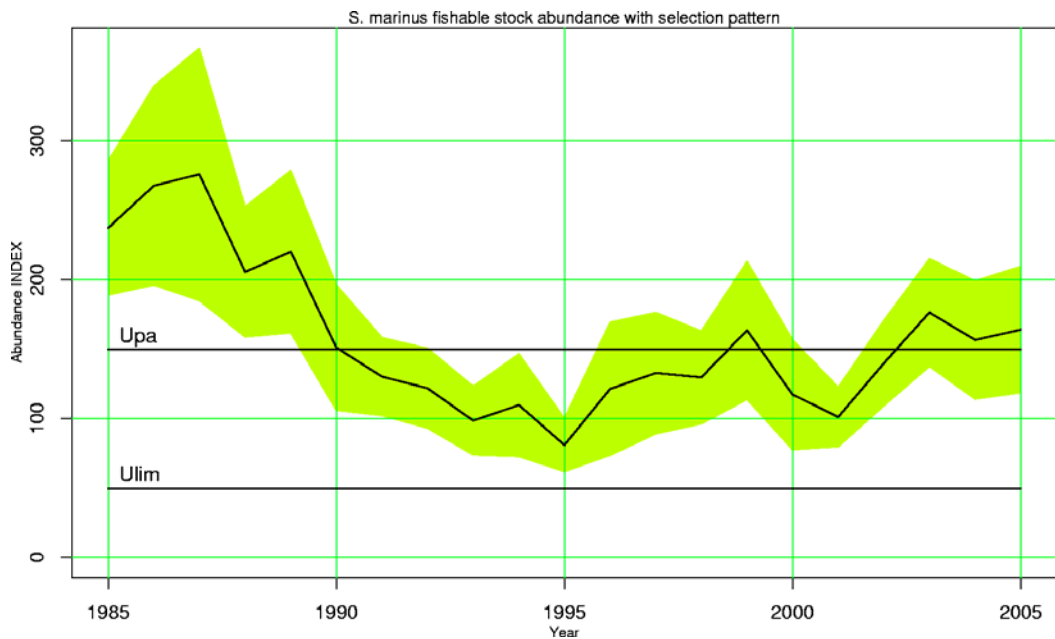


Figure 8.2.5 Index on fishable stock of *S. marinus* from Icelandic groundfish survey 1985-2005 and 95% confidence intervals. The index is based on all strata at depths from 0-400 m.

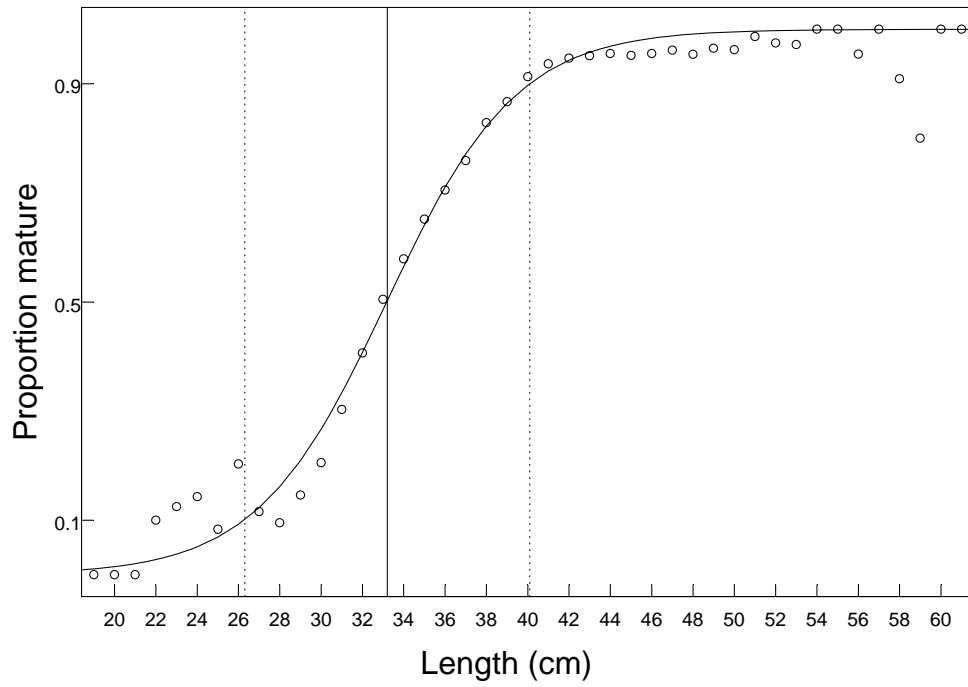


Figure 8.2.6 The proportion of mature *S. marinus* as a function of length from the commercial catch in Va 1995-2004 (all data pooled). The data points show the observed proportion mature and the lines the fitted maturity. The solid vertical lines indicates the point where 50% of the fish mature and the two dotted lines indicates the 10% and 90% probability of being mature.

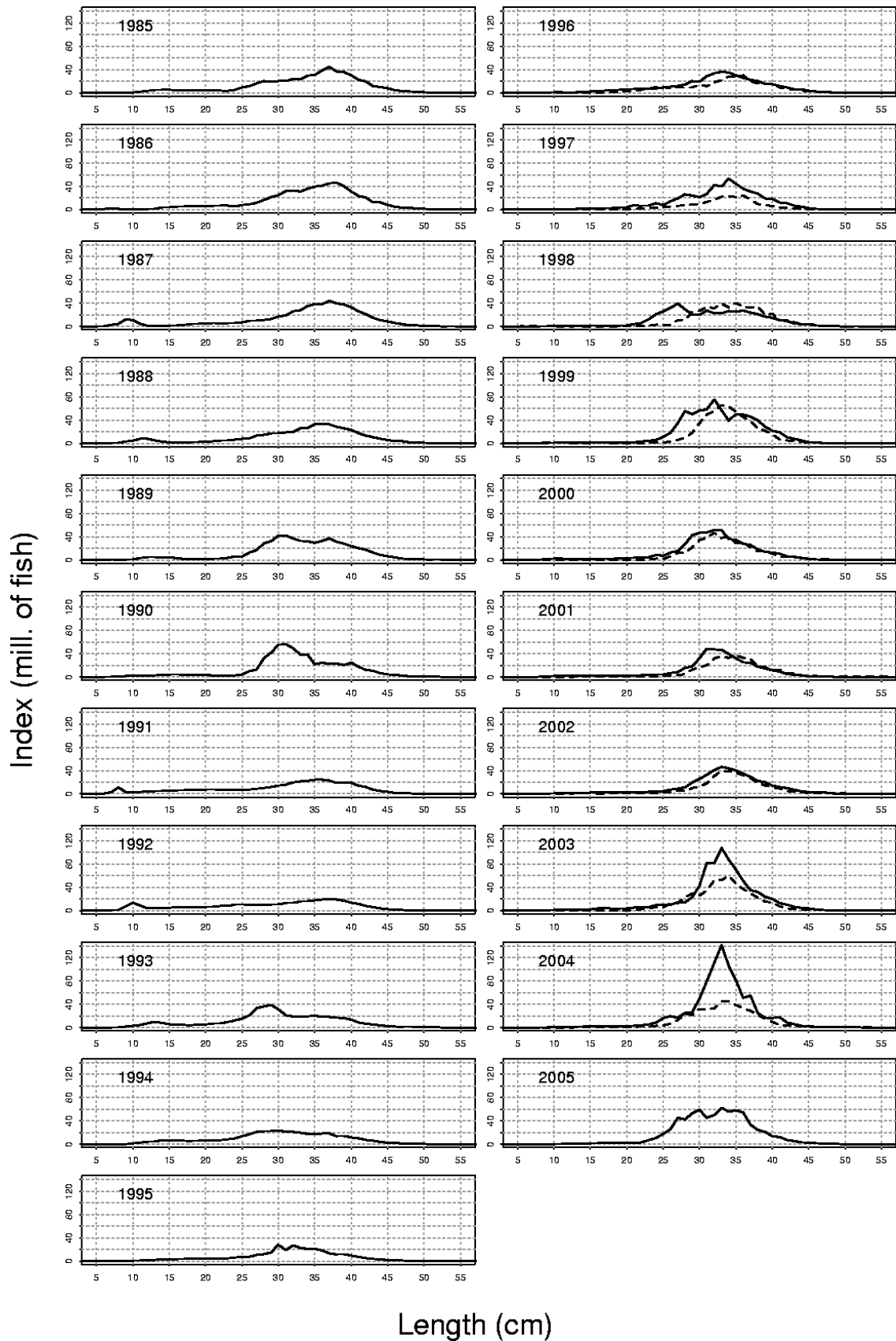


Figure 8.2.7 Length distribution of *S. marinus* in the bottom trawl surveys in March 1996--2004 (solid line) and in October 1996--2005 (broken lines) conducted in Icelandic waters.

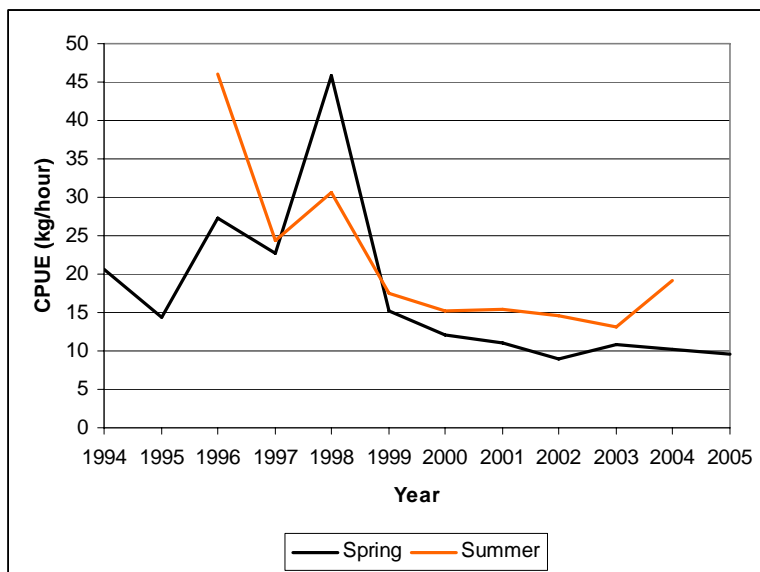


Figure 8.2.8 CPUE of *S. marinus* in the Faeroes spring groundfish survey 1994-2005 and the summer groundfish survey 1996-2004 in ICES Division Vb.

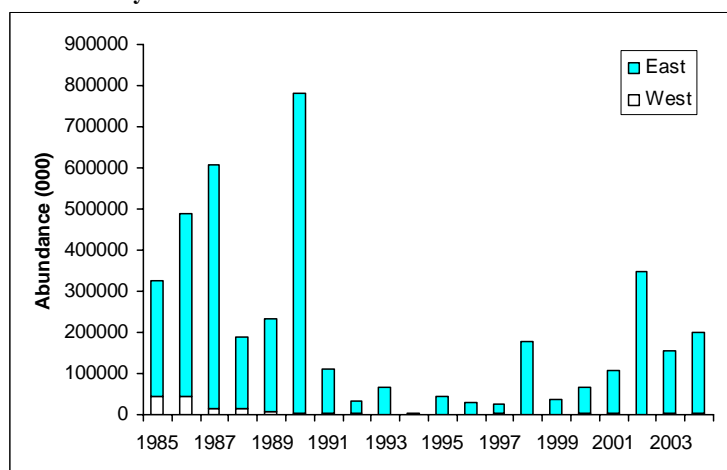


Figure 8.2.9 *S. marinus* (≥ 17 cm). Survey abundance indices for East and West Greenland from the German groundfish survey 1985-2004.

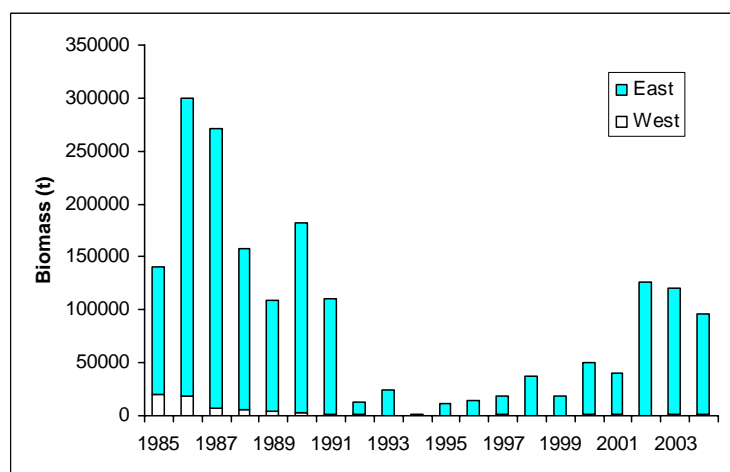


Figure 8.2.10 *S. marinus* (≥ 17 cm). Survey biomass indices for East and West Greenland from the German groundfish survey 1985-2004.

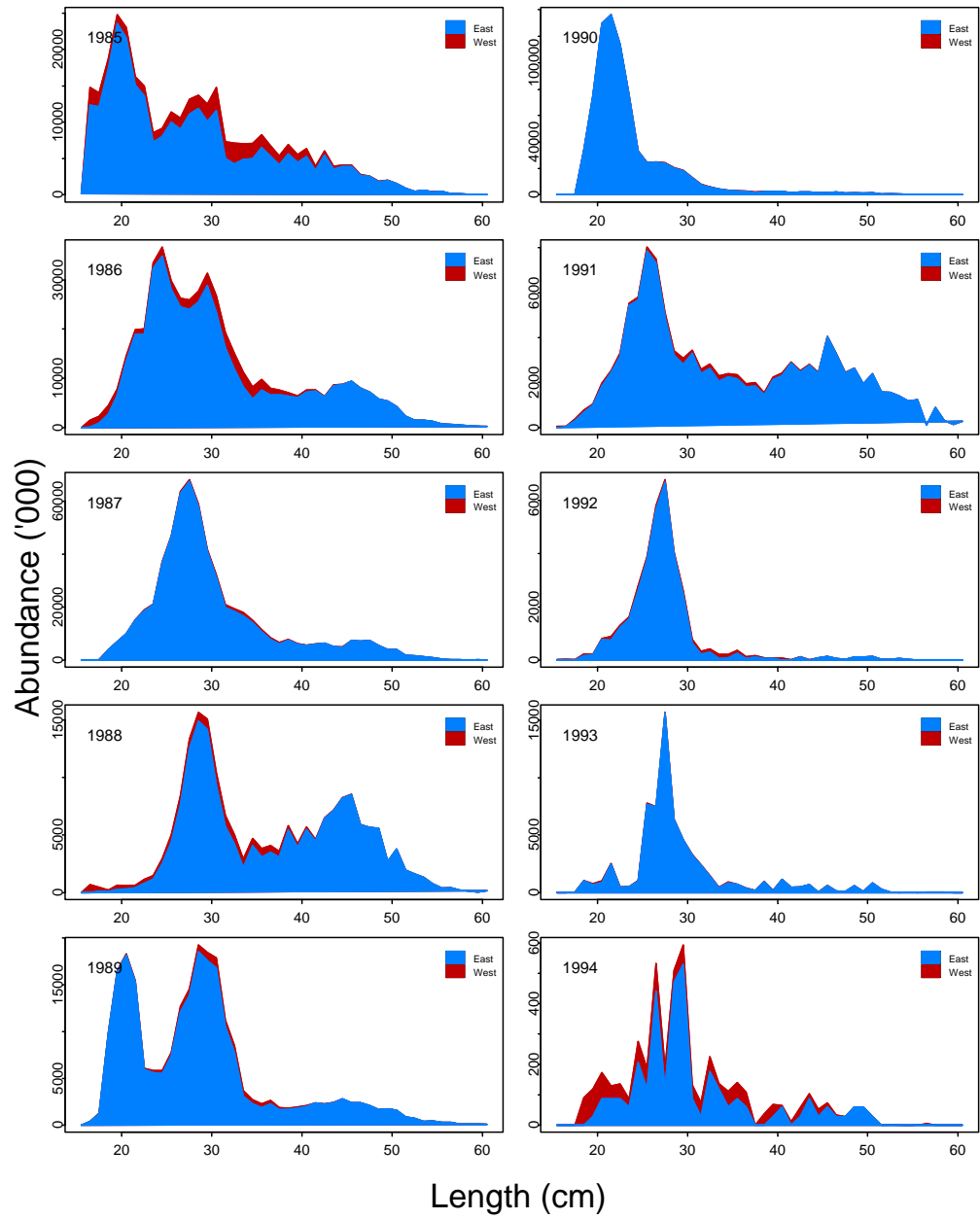


Figure 8.2.11 *S. marinus* (>17 cm). Length frequencies for East and West Greenland 1985-1994.

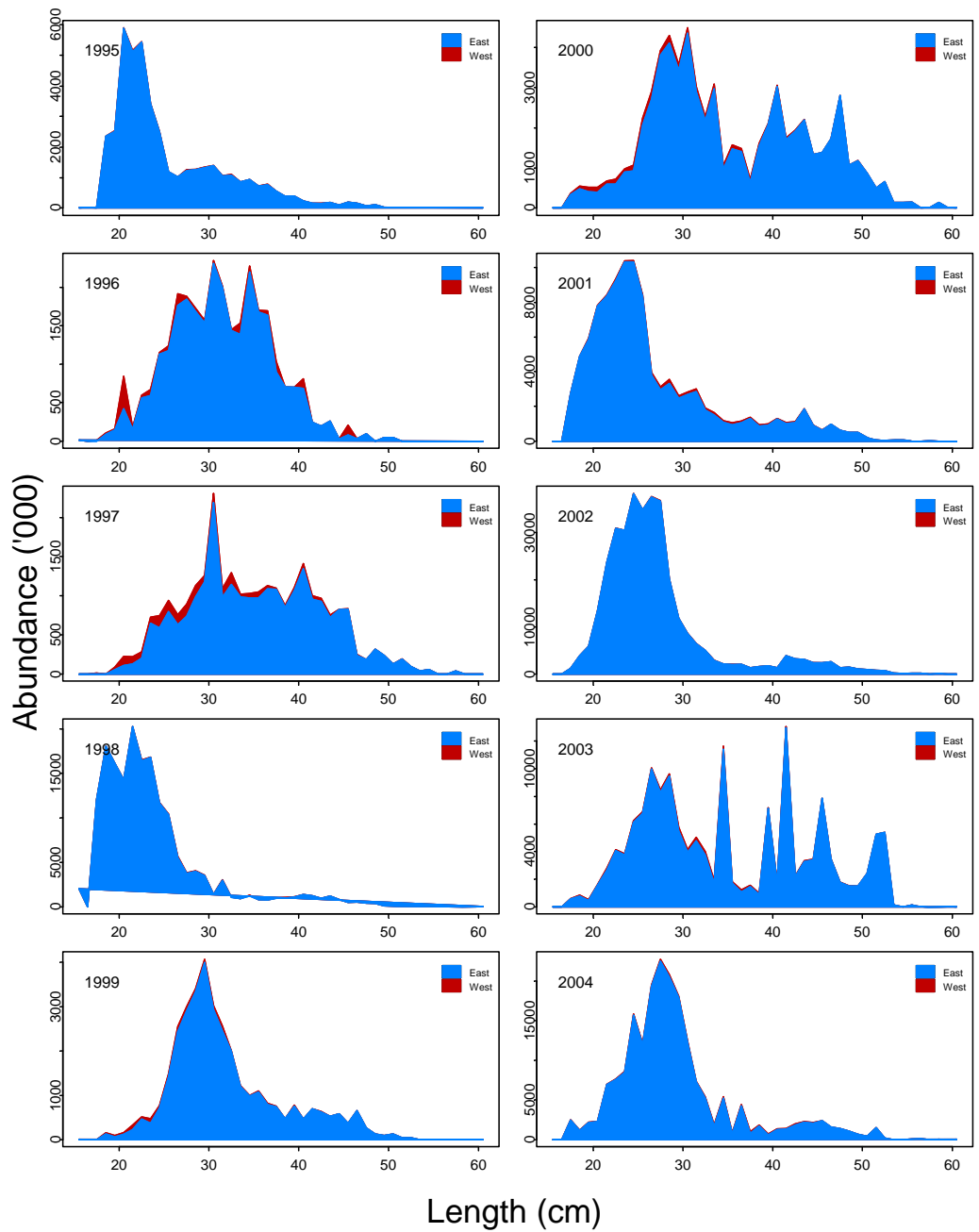


Figure 8.2.11 Continued. *S. marinus* (>17 cm). Length frequencies for East and West Greenland 1995-2004.

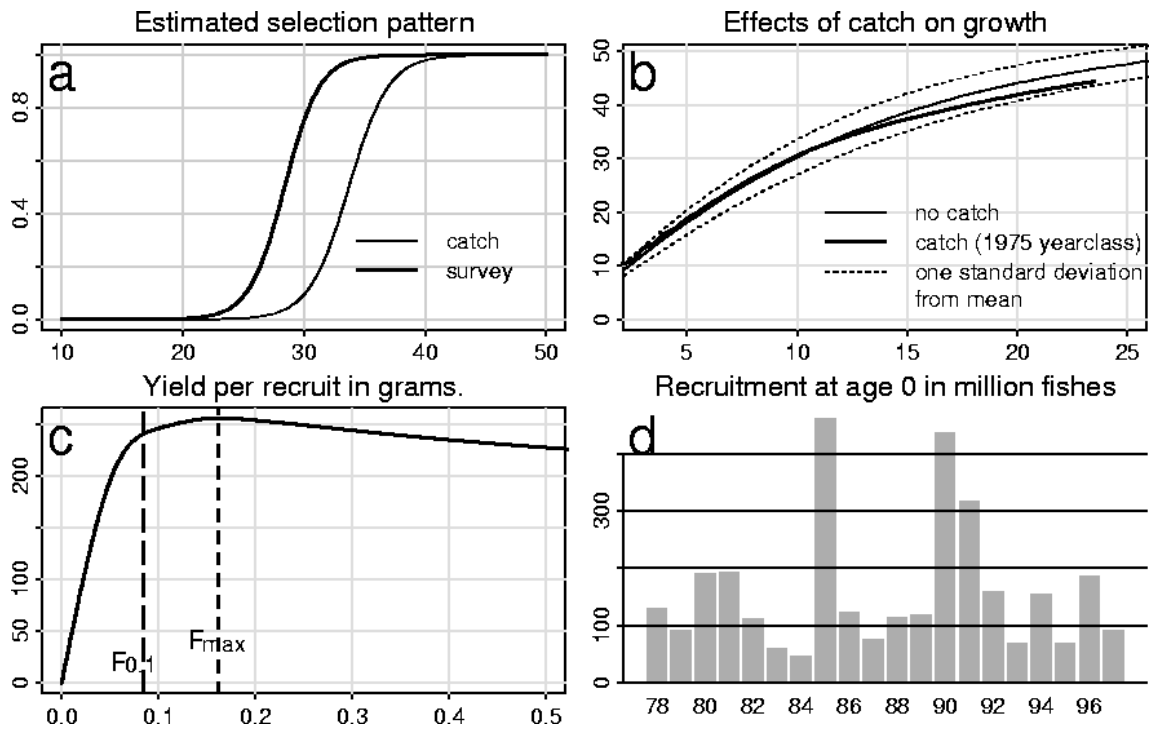


Figure 8.2.12 Results from the BORMICON model-BASE CASE, using catch data from ICES Division Va. a) Estimated selection pattern of the commercial fleet and the survey, b) Mean length (the Figure also demonstrates the effect of catch on length-at-age), c) Yield-per-recruit, and d) Estimated recruitment at age 0.

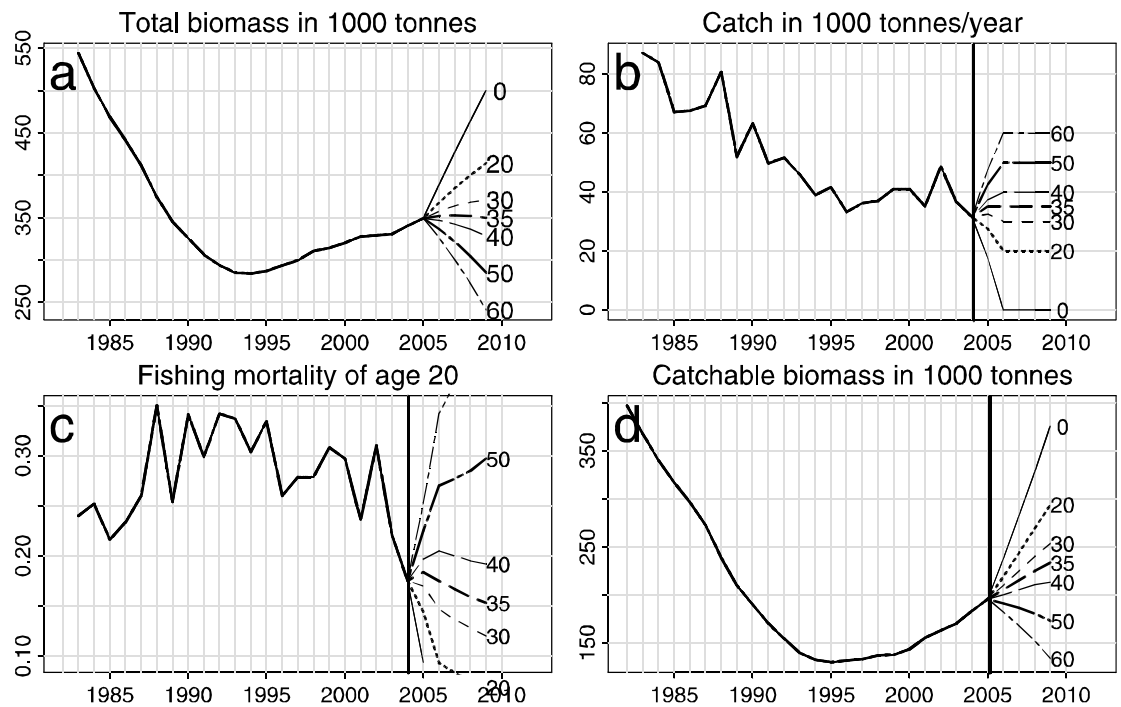


Figure 8.2.13 Results from the BASE CASE run, using catch data from ICES Division Va. The Figures show the development of biomass and F, using different catch options (0-60 000 t) after 2004.

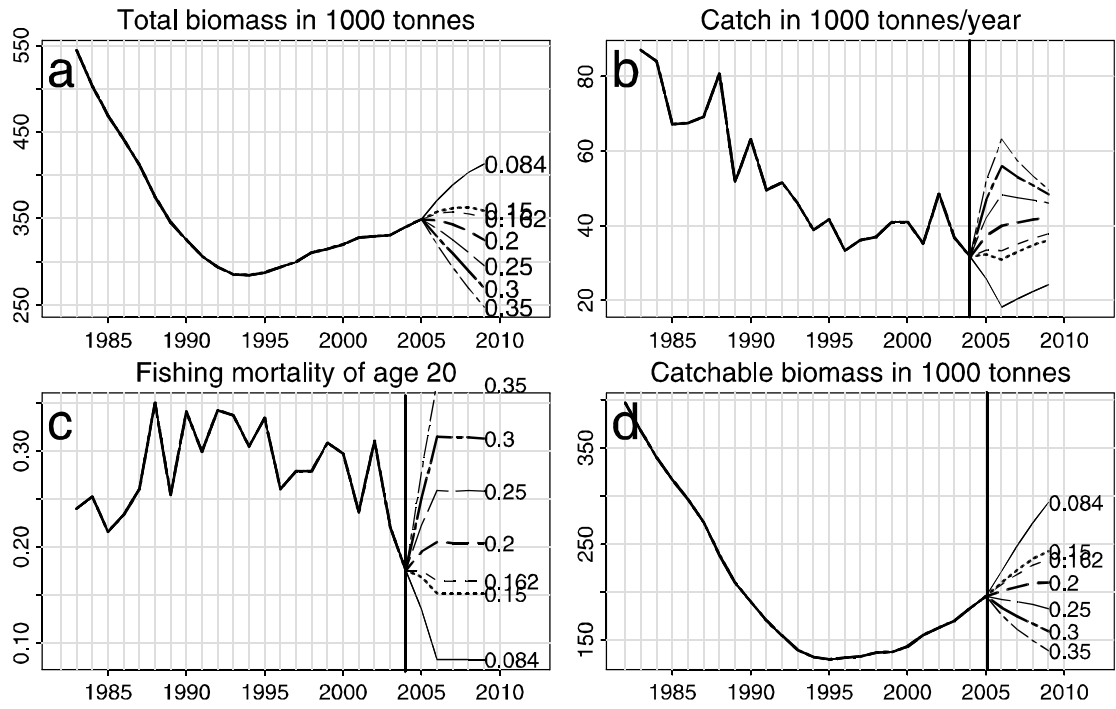


Figure 8.2.14 Results from the BASE CASE run, using catch data from ICES Division Va. The Figures show the development of biomass and F, using different effort after 2004.

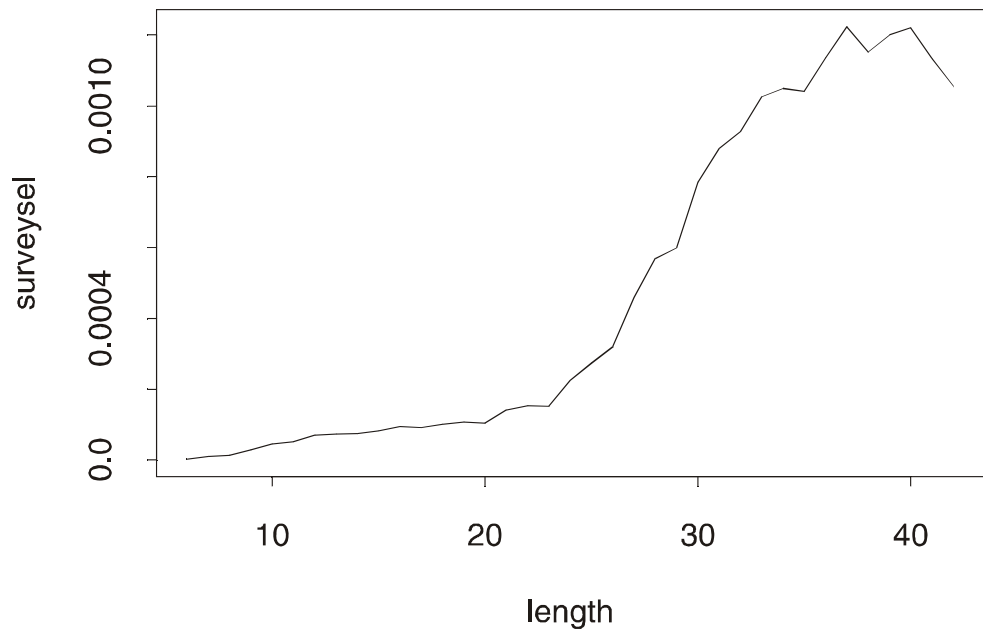


Figure 8.2.15 Estimated selection pattern as a function of length from the BASE CASE for *S. marinus* in the Icelandic groundfish survey.

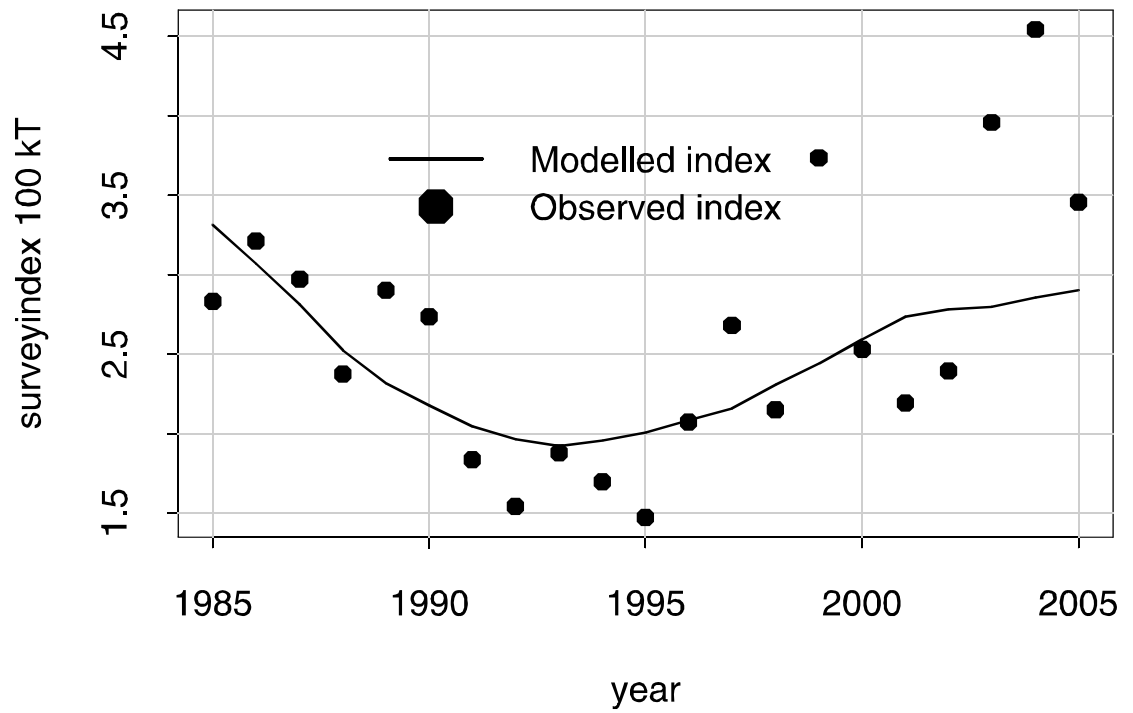


Figure 8.2.16 Results from the BASE CASE run, using only catch data from ICES Division Va. The Figure show comparison of observed and modelled survey biomass (total biomass).

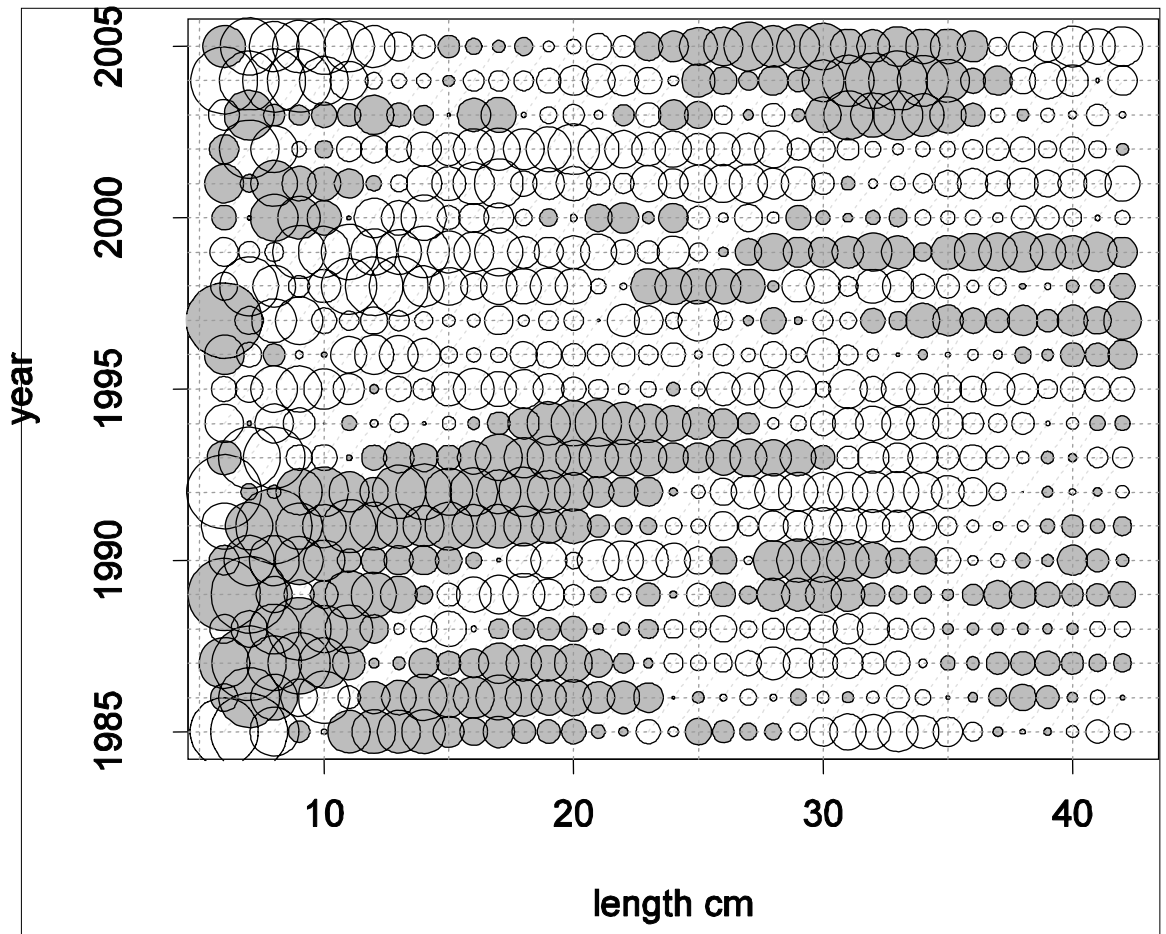


Figure 8.2.17 Results from the BASE CASE run, using catch data from ICES Division Va. Residuals from fit to survey data $\log(I_{sur}/I_{mod})$. The shaded circles show positive residuals (survey results exceed model prediction).

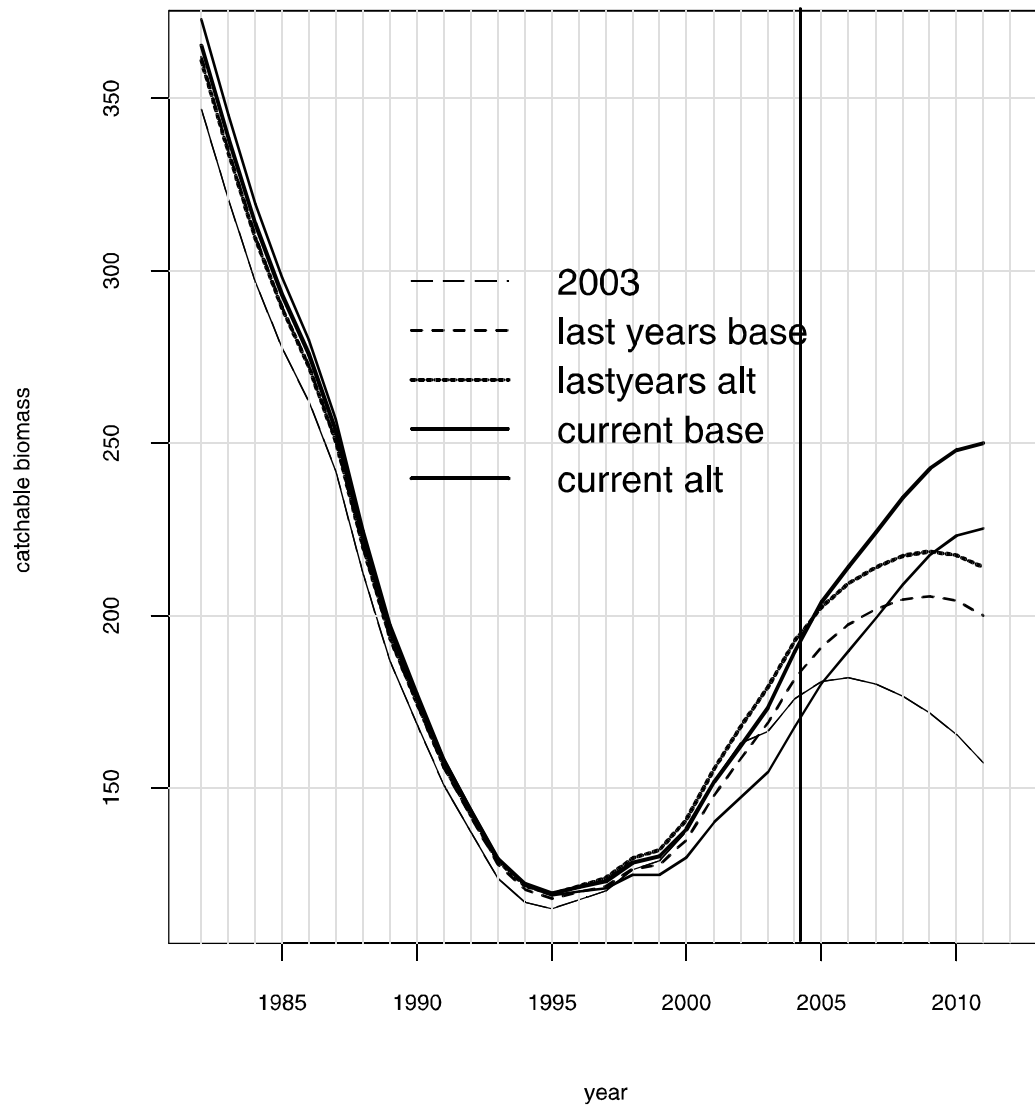


Figure 8.2.18 Comparison of catchable biomass (in thousand tonnes) using the data obtained now and last year, for same settings. Results are obtained using only the catch history from ICES Division Va.