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An Assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M

by

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Abstract

The present assessment evaluates the status of the Division 3M American plaice stock. The catch at age matrix, EU survey abundance at age and the respective mean weights were updated. Both surveys and XSA estimated declines to very low values for abundance, biomass and SSB. Both *F* index (C/B ratio from the EU survey) and XSA fishing mortality were at a very low level in the last years. There are no changes in the perception of the stock status from last assessment (2004). This stock continues to be in a very poor condition, with only weak year-classes recruiting to SSB for the next five years at least. Although the level of catches is low since 1996, this stock has been kept at a very low level with no sign of recovery.

Introduction

Catch trends and TAC regulation

On Flemish Cap American plaice mainly occurs at depths shallower than 600 m.

In the early 1960s catches were relatively low with the exception of 1961. Catches were high between 1964 and 1966, with a peak in 1965 of 5 341 tons. Till the end of the 1960s catches remained at a low level within 80 tons and 150 tons, jumping to a higher 600-1 100 tons level on the early 1970s. Since 1974 this stock became regulated and catches ranged from 600 tons (1981) to 5 600 tons (1987). From 1986 to 1989 catches exceed the TAC. Catches declined to 275 tons in 1993, following the fast decline of the stock biomass and the 1992 reduction of the Spanish directed effort. Catch for 2005 was estimated to be 45 tons (Table 1 and Fig.1).

Since 1974 till 1993 a TAC of 2 000 tons has been in effect for this stock with the exception of 1978 (TAC of 4 000 tons). A reduction to 1 000 tons was agreed for 1994 and 1995, and finally a moratorium was agreed thereafter (Table 1 and Fig.1).

In the recent year catches of 3M American plaice by Contracting Parties are mainly a by-catch of trawl fisheries directed to other species.

Survey data

The plan of stratification of the Flemish Cap (Bishop, 1994) used by the surveys is presented in Fig. 2.

In the 2002 assessment (Alpoim *et al.,* 2002 - SCR Doc. 02/62) and in the 2003 update (Alpoim, 2003 - SCR Doc. 03/44) of the status of the stock several historical survey data were analysed, this analysis is resume in Fig 3. Since 2003 only EU-Spain/Portugal survey was conducted. This was the only survey updated and used in this assessment.

EU-Spain/Portugal Survey (1988-2005) (González Troncoso *et al*, 2006 – SCR Doc. 06/16) (Vazquez and Casas, *pers. comm.* 2006)

EU- Spain/Portugal conducted a random bottom trawl survey up to a depth of 730 metres (400 fathoms) on Flemish Cap since 1988. All surveys had a stratified design following NAFO specifications. The surveys were conducted in June-July of each year. Towing speed was around 3.5 knots. Trawling effective time is 35 min. The fishing gear used was a Lofoten gear with effective 30mm mesh size in the codend.

In June 2003 a new Spanish research vessel, the RV "*Vizconde de Eza*" (VE), replaced the RV "*Cornide de Saavedra*" (CS) that has carried out the whole EU survey series, with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-02 survey indices available for several target species, the original time series needed to be converted to the new RV units.

During 2003 and 2004 Flemish Cap surveys, 130 pairs of parallel hauls (selected at random from the annual coverage of the bank) were performed simultaneously by the two vessels, at depths less than 730 m. Those pairs of parallel hauls were distributed over the swept area trying in one hand to maximize the sampled area and on the other to guarantee a large enough number of hauls with acceptable catches of all target species, namely the ones from severely depleted stocks (cod and American plaice). Both vessels were fishing with the same gear, a Lofoten trawl gear with 35mm mesh size at the codend, which remained unchanged throughout the series. With the comparative fishing trials concluded and the conversion factors estimated, the indices from R/V *Cornide de Saavedra* were transformed to the R/V *Vizconde de Eza* scale to make them comparable. The results of the calibration shown that the new RV *Vizconde de Eza* is 33% more efficient than the former RV *Cornide de Saavedra* as regards American plaice (González Troncoso and Casas, 2005). 1988-2002 data are transformed R/V *Cornide de Saavedra* data, 2003-2005 data are original from R/V *Vizconde de Eza* (Casas and González Troncoso, 2005).

The methodological aspects and results of the calibration are presented in SCR Doc. 05/29 (González Troncoso and Casas, 2005).

Biomass and abundance estimates

Estimates for biomass and abundance are presented in Table 2 and Fig. 3.

Length composition of the stock.

Length compositions from 1988 to 2005 were given by the EU survey (Vazquez and Casas, *pers. comm.* 2006). (Table 3)

Length weight relationships

Length weight relationships for the Div. 3M American plaice (1988-2005) were calculated with EU survey length/weight data from both males and females (Vazquez and Casas, *pers. comm.* 2006) and used in this assessment on an annual basis (Table 4).

Stock abundance-at-age

The EU survey series presents different age reading criteria due to changes in the age reader along the series. The series can be split in two periods: the first from 1988 to 1992 that follows the criteria of one age reader and a second period from 1993 to 2001 in which several age readers have a very good agreement between them. Some effort have been spent in order to revisit the otoliths from the former years under the present accepted criteria, but, due to the size of the otoliths collections from several years and to the deterioration of some sets due to the enhancing methods used before, this work is difficult to achieve. In order to have the same criteria for all the series a combined age length key from 1993 to 2001 was used backwards over 1988-1992.

The age-length keys used in 2003 and 2004 became from the sampling of the two RV (*Vizconde de Eza* and *Cornide Saavedra*) in order to have a more complete AL key.

Abundance-at-age of the stock is presented in Table 5.

Stock mean weights at age

The annual EU survey length weight relationships were used to calculate mean weights at age in the Div. 3M American plaice stock for the period 1988-2005 (Table 6). For assessment purposes, on the years/ages where weight at age data are missing, the average mean weights at age for all the period were used.

Maturity ogive

The criteria applied in this work was the same applied in previous years. The spawning stock biomass was calculated as 50% of age 5 and age 6 plus.

Commercial Data

Length composition of the commercial catch and by-catch

The length compositions presented in the 2004 Portuguese and Spanish Research Reports (Vargas *et al.*, 2005; Gonźalez *et al.*, 2005) were used to estimate the length composition of the 2004 total catch. The length composition presented in the 2005 Spanish Research Report (Gonźalez *et al.*, 2006) was used to estimate the length composition of the 2005 total catch. The length composition presented in the 2005 Russian national report (Vazkov *et al.*, 2006) was not used due to the very small number of fish sampled.

From these length distributions a mean weight in the catch was derived in order to transform the correspondent catch in weight into a catch number. Each mean weight was calculated as:

$$\overline{W} = \frac{\sum (N_{LC} * \overline{W}_{LC})}{\sum N_{LC}}$$

where N_{LC} is the number observed in length-class LC and $\overline{W}_{LC}$ is the mean weight of the length-class LC. Mean weights at length were given by the length/weight relationships from the EU bottom trawl survey series.

The breakdown of the total catch is presented in Table 7. The commercial catch at length matrix (Alpoim and Ávila de Melo, 2004) was updated with the 2004 and 2005 data (Table 8).

Catch at age

The catch-at-age was given by the same age length keys already used to get survey abundance-at-age (Table 9).

Catch mean weights-at-age

The annual EU survey length weight relationships were used to calculate mean weights-at-age in the catch of 3M American plaice for the period 1988-2005 (Table 10). Missing weights were filled with the respective average catch mean weight-at-age for all the period. Average mean weight at age 1 from the stock was also assumed on the commercial catch for that age.

Partial recruitment vector

In order to generate an observed partial recruitment vector, an F index was first derived from the 1988-2005 ratios at each age between the sum of the annual permilles on the commercial catch and the correspondent sum of permilles for the EU survey abundance. Those indicators of F at age were then standardised to its highest value, recorded at age 12. Assuming a flat top recruitment curve this observed partial recruitment vector was adjusted to a general logistic curve (Table 11, Fig. 4). The expected values were used in the yield per recruit analysis.

Vectors used in yield-per-recruit analysis

An yield-per-recruit analysis was conducted incorporating the following sets of vectors (Table 12A), all of them considered to be representative, in terms of growth and maturity, of Div. 3M American plaice:

1) Mean weights at age in the commercial catch.
2) Mean weights at age in the stock.
3) Female maturity ogive at age.
4) Expected partial recruitment vector.
5) Natural mortality set at 0.2.

Assessment Results

Comments on trends on stock indicators.

The two former USSR-Russian survey series showed a decreasing trend in biomass and abundance between 1972 and 1993. The Russian surveys in 2001-2002 show very low estimates of biomass and abundance. From 1978 till 1985 Canadian series is stable, with survey biomass and abundance around 6 700 tons and 10 million fish. A continuous decline in abundance and biomass is observed since the beginning of EU survey. The 2000 abundance and biomass were the lowest of this series (1 606 tons and 2.1 millions fishes) and improved little since then. Results of the 1996 Canadian survey are comparable with the 1996 EU survey (Fig. 3) (Alpoim *et al.*, 2002 and Alpoim, 2003).

A proxy to fishing mortality has been giving by the ratio between catch and EU survey biomass for ages fully recruited to the fishery (ages 8-11). This index falls to 0.034 in 1993 and from 1994 till 2003 fluctuates around 0.09, since 2003 this index declined again being at a minimum in 2005 (0.011) (Table 13 and Fig. 6).

Age 14, corresponding to the 1991 year-class, was the best represented in the 2005 EU survey (Table 5). Since 1991, all the recruiting year-classes were poorly represented in the EU survey. Survey spawning biomass is declining as well since 1988 reaching a minimum in 2000 and remaining at a very low level in 2005.

Age 3 is the first age to appear in all the years of the EU survey series, so it was used to evaluate the stock/ recruitment relationship. Only 15 points are available, showing very poor recruitment for an SSB less than 9 000 tons (Tab.14, Fig. 7).

In Fig 8 it is plotted an EU survey index of stock reproductive potential, the log of the R/SSB ratio for each year-class and with both sexes included in spawning biomass. Before 1991, an average of 0.121 recruits at age 3 were produced per Kg of SSB, from 1991 till 2000 this average was reduced to only 0.011 recruits per Kg of SSB. The 2001 and 2002 mean (0.086 recruits per Kg of SSB) although is higher than the previous period didn't generated good recruitments due to the poor level of SSB (Fig.8). This recruitment failure seems not to be caused by the shrimp fishery developed in Flemish Cap since the beginning of 1990s, because estimation of by-catch gives a very low figures for American plaice (Kulka, 1999).

Yield-per-recruit analyses

An yield-per-recruit analysis was conducted, incorporating the sets of vectors already described. This analysis give a $F_{0.1}$ = 0.165 and an F_{max} = 0.365 (Tab. 12, Fig. 5).

XSA

An XSA was performed using the Lowestoft VPA Suite (Darby and Flatman, 1994). The input files for XSA analysis are presented in Table 15. Natural mortality was assumed constant at 0.2. The month with a peak of spawning for Div. 3M American plaice is May (Serebryakov *et al.*, 1987) and was used to estimate of the proportion of F and M before spawning.

The ratios between annual catches and EU survey bottom biomass were considered to be a proxy of mean fishing mortalities from 1988 to 2005. The survey biomass can be considered representative of the mean annual biomass (EU survey is conducted around the middle of the year). The 2005 *F* index was multiplied by the observed PR to have a starting guess of *F* at age in the terminal year. In order to get the *Fs* for the last age through 1988-2005 the selection at age 15 was multiplied by the F index of each year. The rest of the data were already described above. Several XSA frameworks have been tested, and the adopted in this assessment has the following settings:

- No year weights were applied, due to the short time series.
- Age 12 was considered to be the first age at which *q* is independent of age.
- Terminal year survivor estimates not shrunk towards mean F.
- A shrink survivor estimates with a mean *F* for the 5 older true ages in 1990-1994 period was used.
- The Log (S.E.), for the F means to which the estimates are shrunk, was 1.0.
- The earliest year to be used for tuning the VPA was 1994.
- Minimun Log (S.E.) for the terminal population estimates derived from each fleet (Threshold se) was 0.5.

The XSA diagnostics and the plot of the log catchability residuals are presented in Table 16 and in Fig. 9. The XSA outputs are presented in Table 17 and in Fig. 10 and 11.

SSB-R Scatter plot based in the XSA results (Fig.10) show also a very poor recruitment for an SSB less than 5 000 tons.

Biomass and spawning stock biomass show a steady decline in the recent years to very low levels. Since 1991 recruitment is kept at a very low level. The rate of exploitation decreased in recent years and is at a low level.

Conclusions

All results indicate that the stock suffered a continuous decline, even with catches kept at a low level since 1996. A general decrease is observed in the biomass and abundance estimated by the several surveys. The same trends are in the XSA results, ending at a very low biomass and SSB on the terminal year.

Indices from the EU survey and XSA indicates no sign of recruitment since 1991 with only weak year-classes expected to be recruited to the SSB within at least five years.

F estimates from the XSA and EU survey (age 8-11) decreased in recent years and is at present at a very low level.

Stock status

This stock continues to be in a very poor condition, with only weak year-classes expected to be recruit to the SSB on the next five years. Although the level of catches since 1996 is low, all the analysis indicates that this stock is kept at a very low level with no sign of recovery.

Acknowledgements

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TABLE 1 - Nonimal catches (t) from 1960-2005, Stacfis estimates (t) from 1988-2005 and TAC (t) from 1974-2006 of American plaice from NAFO Division 3M.

Year	Nominal catches (2)													STACFIS estimates	TAC
	Country										Flatfishes (NS)	Yellowtail f.	GRAND		
	Canada	Japan	USSR/SUN	Poland	E/ESP	E/GBR	E/PRT	E/DEU	Other	Total	Total	Total	TOTAL		
1960	-	-	-	-	-	-	-	-	-	0	316	0	316		
1961	-	-	-	-	-	-	-	-	-	0	2282	0	2282		
1962	14	-	-	-	-	-	-	-	-	14	707	0	721		
1963	-	-	51	108	-	20	-	-	-	179	0	0	179		
1964	-	-	1831	8	-	37	-	-	-	1876	0	0	1876		
1965	19	-	4964	216	-	83	-	-	2	5284	57	0	5341		
1966	-	-	4003	17	-	53	-	-	-	4073	0	0	4073		
1967	57	-	-	63	-	33	-	-	1	154	0	0	154		
1968	100	-	121	-	-	4	-	-	-	225	6	0	231		
1969	12	-	113	-	-	-	-	-	-	125	0	0	125		
1970	-	-	62	-	-	-	-	-	-	62	17	0	79		
1971	-	-	1079	-	-	-	-	-	-	1079	0	0	1079		
1972	-	-	665	8	17	65	-	-	106	861	0	0	861		
1973	68	-	312	39	-	85	-	-	-	504	3	127	634		
1974	211	-	1110	-	-	607	-	-	-	1928	3	12	1943		2000
1975	140	-	958	-	8	80	522	-	-	1708	5	31	1744		2000
1976	191	-	809	15	28	-	149	-	-	1192	0	137	1329		2000
1977	30	-	987	7	18	-	457	1	118	1618	0	10	1628		2000
1978	7	49	581	21	36	2	486	100	51	1333	3	0	1336		4000
1979	10	63	457	2	16	-	248	-	-	796	4	0	800		2000
1980	1	1	909	5	3	-	232	34	-	1185	64	0	1249		2000
1981	-	47	309	-	276	-	-	-	-	632	0	0	632		2000
1982	-	53	1002	-	17	-	-	-	-	1072	3	0	1075		2000
1983	-	9	1238	-	434	-	208	-	-	1889	3	0	1892		2000
1984	-	1	711	-	204	-	196	190	-	1302	1	0	1303		2000
1985	-	2	971	-	163	-	266	318	-	1720	0	0	1720		2000
1986	-	3	962	-	1048	-	1741	-	-	3754	0	3	3757		2000
1987	-	-	501	-	4137	-	969	-	-	5607	20	0	5627		2000
1988	-	78	228	-	1608	-	941	-	6	2861	127	1	2989	2800	2000
1989	-	402	88	-	2166	-	1238	-	-	3894	72	0	3966	3500	2000
1990	-	308	-	-	102	-	359	-	21	790	38	94	922	790	2000
1991	-	450	5	-	605	2	996	-	24	2082	3	1	2086	1600	2000
1992	-	50	-	-	390	-	314	-	11	765	0	1	766	765	2000
1993	-	49	-	-	244	-	231	-	181	705	46	20	771	275	2000
1994	-	-	-	-	3	-	251	-	-	254	0	84	338	669	1000
1995	-	-	-	-	125	-	118	-	-	243	14	0	257	1300	1000
1996	-	-	-	-	105	-	29	-	8	142	2	28	172	300	0
1997	-	-	-	-	56	-	52	-	-	108	0	0	108	208	0
1998	-	-	-	-	140	-	47	-	1	188	3	2	193	294	0
1999	-	-	4	-	220	-	18	-	1	243	5	0	248	255	0
2000	-	-	55	-	169	-	27	-	1	252	1	6	259	133	0
2001 (1)	-	-	14	-	89	-	162	-	3	268	24	135	427	149	0
2002 (1)	-	5	4	-	74	-	73	-	1	157	66	32	255	128	0
2003 (1)	-	3	7	-	75	-	28	-	17	130	0	15	145	131	0
2004 (1)	-	4	4	-	39	-	57	-	3	107	0	0	107	81	0
2005 (1)	-	-	-	-	58	-	11	-	14	83	0	3	86	45	0
2006															0

(1) - Provisional

(2) - Recalculated from NAFO statistical data base using the FISHSTAT Plus program by FAO.

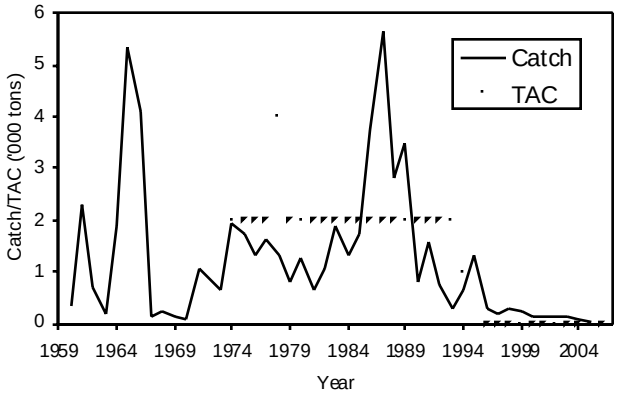


Fig.1 . American plaice in Div.3M: nominal catches and agreed TAC's

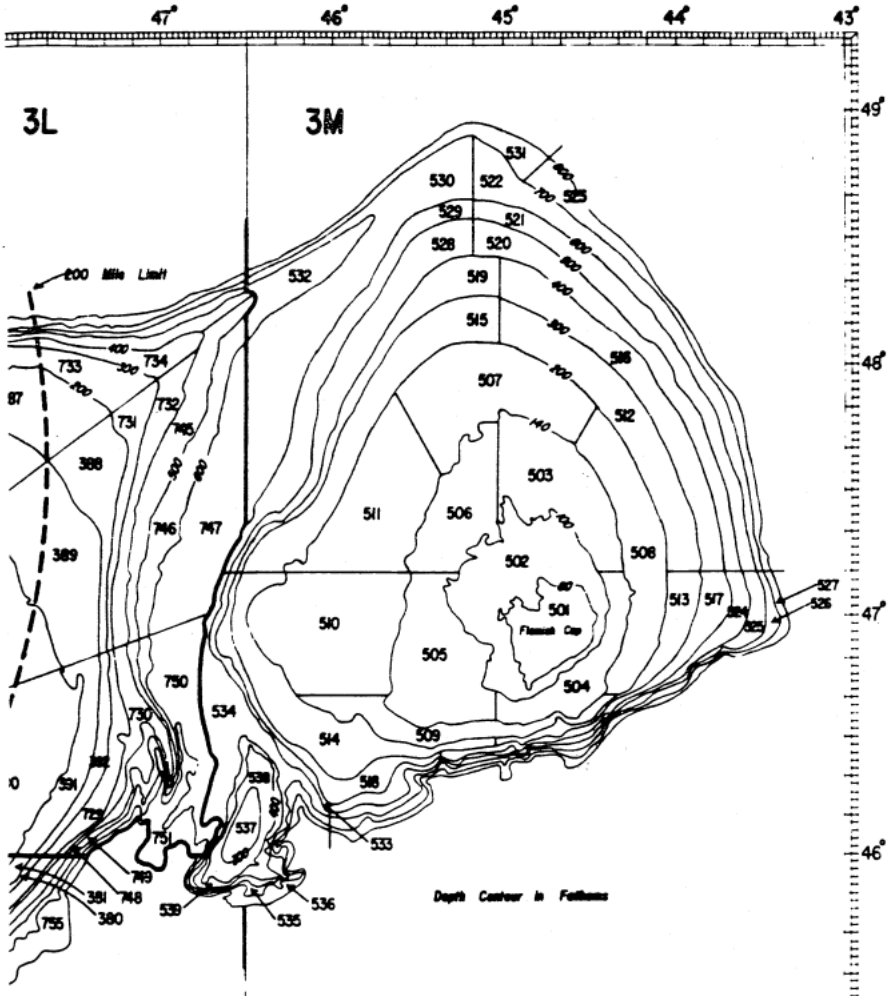


Fig. 2. Stratification scheme for stratified- randowm groundfish surveys in Div 3M. (Bishop 1994).

Table 2 - EU - surveys in Div. 3M from 1988-2005: estimates of biomass (t) and abundance (000's) of A. plaice.

	Depth range	Area	Year																	
Stratum	(m)	(sq. n. mi.)	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
501	128-146	342	1306	1000	505	1078	709	1079	661	2230	1462	381	156	372	345	1043	141	1292	1507	1038
502	148-183	838	2845	3602	1375	2663	1714	1267	1199	1335	943	740	1587	1810	976	835	1262	713	768	796
503	185-256	628	1367	1118	1668	1247	631	444	325	252	168	495	284	97	21	93	75	17	427	101
504	185-256	348	2199	461	817	320	557	572	853	489	268	203	343	53	100	85	128		395	359
505	185-256	703	2599	3093	1830	1407	837	1291	1230	549	500	619	744	73	56	112	189	82	72	45
506	185-256	496	479	1130	954	501	601	305	808	123	32	13	35	40	25	37	63	29	26	71
507	258-366	822	1174	531	837	389	639	319	316	249	72	83	47	19	15	28	52	30	84	31
508	258-366	646	417	164	263	251	727	487	171	132	56	123	165	3		45	43	14	55	175
509	258-366	314	103	163	343		373	205	20	500	55	36					1	9	77	18
510	258-366	951	2323	1491	2000	1308	1406	1459	2236	708	415	287	36	72	45	95	36	54	45	87
511	258-366	806	1186	1168	1316	401	372	292	303	109	68	32	29	37	23	27	59	29	69	35
512	367-549	670	9	19	45	17	11	15	33	12	32	7				4		11		
513	367-549	249	3		20					3										
514	367-549	602	8	8	7	389	29		24	15	4		4	9						
515	367-549	666	23	99	3	97	37	109	40	68	23	7	7					6		4
516	550-731	634	5			4	9	12	5											
517	550-731	216																		
518	550-731	210																		
519	550-731	414				15	4	5	3	11										
total biomass			16046	14047	11983	10087	8656	7861	8227	6785	4098	3026	3437	2585	1606	2404	2049	2286	3525	2760
s.e.			1845	2048	1276	1180	954	1040	1373	1083	912	708	751	869	332	429	729	748	740	684
mean catch per tow (kg)			19.95	17.47	14.90	12.55	10.76	9.79	10.23	8.44	5.09	3.76	4.27	3.21	2.00	2.99	2.55	2.86	4.38	3.43
s.e.			2.29	2.55	1.59	1.47	1.19	1.29	1.71	1.35	1.13	0.88	0.93	1.08	0.41	0.53	0.91	0.93	0.92	0.85
total abundance (000's)			27410	27391	20946	17643	13728	11648	11247	9376	5658	3770	3800	2672	2132	3168	1971	2769	4015	3326
mean number per tow			34.09	34.01	26.05	21.79	17.05	14.47	13.96	11.66	7.02	4.69	4.73	3.32	2.65	3.94	2.45	3.44	4.99	4.14

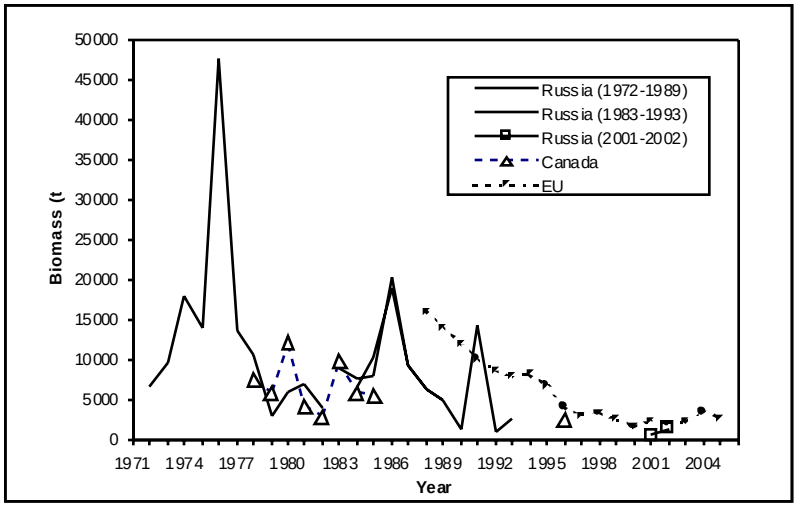


Fig.3A. American plaice in Div. 3M: trends in biomass in the surveys.

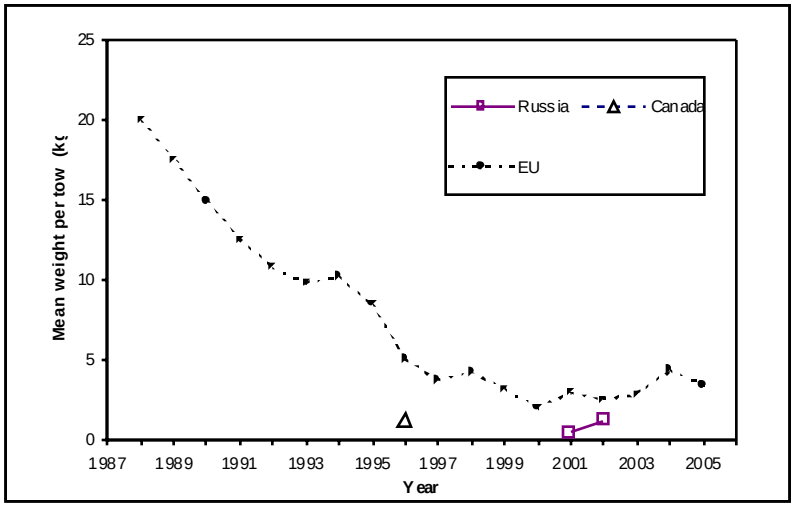


Fig.3C. American plaice in Div. 3M: mean weight per tow in the surveys.

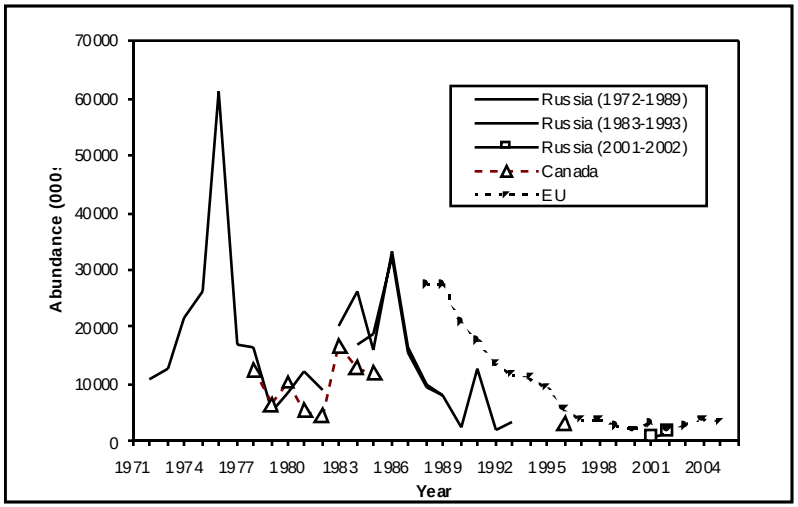


Fig.3B. American plaice in Div. 3M: trends in abundance in the surveys.

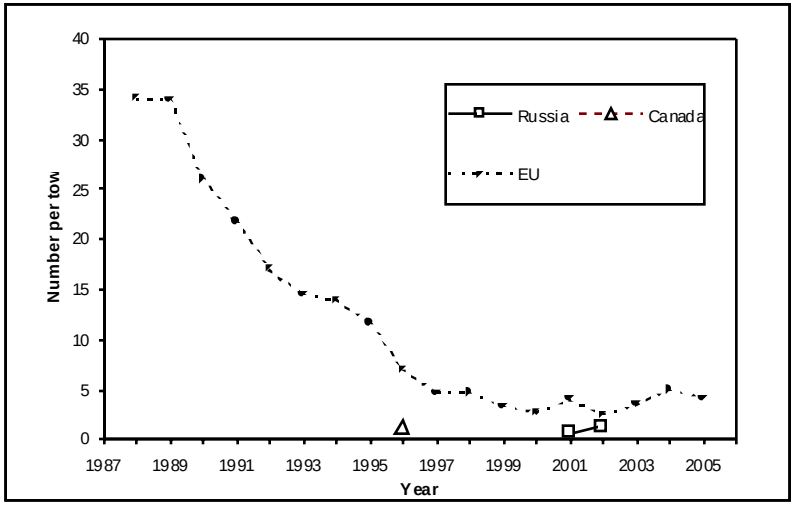


Fig.3D. American plaice in Div. 3M: mean number per tow in the surveys.

Table 3: Length composition (absolute frequencies in '000) of the 3M american plaice stock, EU survey 1988-2005.

Length group	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Length group
4							7												4
6				20															6
8				20															8
10		41	8	27								7	8						10
12	68	14		46					8	8			7			7			12
14	555	14		48	48														14
16	1274	104	149	136	230		8	14	7	8						6	13		16
18	295	327	411	101	443	19	31	15	32	16			7	8			7	8	18
20	55	1205	146	77	253	37	33				16		8	31		7	22	8	20
22	166	2836	188	461	131	191	31		14		16		16			14	66	39	22
24	295	3199	391	828	272	565	44	45	38	30	8	8	8	8	9	13	109	24	24
26	575	1602	690	469	360	619	129	45	24	60	8	15	8	31	8	7	127	40	26
28	932	499	1301	456	392	360	297	113	68	44	45	31	44	54	32	27	73	48	28
30	1434	637	2964	782	452	657	729	212	111	30	15	8	31	23	24	72	69	149	30
32	2459	998	2836	1625	568	563	965	639	286	189	77	54	69	68	32	64	57	178	32
34	3019	2020	1600	2522	1105	595	864	663	352	181	219	121	133	200	73	129	122	138	34
36	3582	3495	1726	2749	2251	1302	1161	1292	757	426	413	256	250	365	109	336	403	250	36
38	2651	2627	1790	2269	2042	1397	1710	1688	1040	678	401	258	258	682	145	482	404	419	38
40	2740	1959	1427	1384	1576	1439	1511	1420	979	456	500	316	289	443	195	413	459	420	40
42	2873	1680	1282	787	1266	1178	594	930	594	321	379	209	250	265	106	376	455	370	42
44	2663	2017	1492	1020	630	936	708	472	356	295	375	205	130	172	96	136	263	227	44
46	788	1165	1318	883	604	705	803	451	232	216	339	218	221	138	189	123	134	139	46
48	467	527	763	582	602	349	729	405	312	285	285	327	156	177	289	136	197	177	48
50	203	191	291	184	331	397	419	468	233	317	330	260	133	211	310	206	344	203	50
52	162	164	101	117	120	236	273	279	104	153	235	271	76	187	233	142	412	261	52
54	72	47	46	28	40	62	117	183	66	29	90	60	21	98	77	45	208	109	54
56	55	15	21	14	7	24	76	31	34	21	44	35	7		44	21	54	104	56
58	28	6	6	7		16		6	6	7	6	6		6		8	20	16	58
60								6	6			6							60
62							6												62
64																			64
66					6														66
Total	27410	27391	20946	17643	13728	11648	11247	9376	5658	3770	3800	2672	2132	3168	1971	2769	4015	3326	Total
mean length	36.6	34.3	36.4	36.6	37.5	38.6	40.0	40.8	40.7	41.7	43.3	44.3	41.6	41.8	45.8	41.8	42.5	42.3	

Table 4: Length weight relationships of 3M American plaice.

Year	a	b	n
1988	0.0048	3.2121	1211
1989	0.0055	3.1810	1192
1990	0.0043	3.2420	1314
1991	0.0043	3.2404	1032
1992	0.0048	3.2130	1296
1993	0.0030	3.3362	1036
1994	0.0029	3.3373	1065
1995	0.0027	3.3474	772
1996	0.0048	3.1978	571
1997	0.0046	3.2116	435
1998	0.0044	3.2260	442
1999	0.0043	3.2294	452
2000	0.0082	3.0444	411
2001	0.0044	3.2074	570
2002	0.0029	3.3242	225
2003	0.0044	3.2292	400
2004	0.0064	3.1222	602
2005	0.0043	3.2177	345

Table 5: Population abundance (000s) at age (yrs) of A. plaice from surveys in Div. 3M during EU survey 1988-2005.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+	Total
1988	483	1339	1619	3955	3725	3423	5016	3004	1802	1157	669	418	230	358	138	74	27410
1989	55	1827	6621	2682	2787	2544	3794	2548	1616	1089	672	429	221	332	117	57	27391
1990	8	665	1581	5311	2456	1802	2785	2066	1427	995	648	432	242	337	128	62	20946
1991	154	353	1628	2530	2796	1945	2645	1855	1283	879	575	378	186	262	91	83	17643
1992	24	795	886	1210	1544	1682	2433	1642	1142	813	541	363	187	287	108	71	13728
1993		27	1536	1082	775	447	4116	467	782	367	257	299	354	1065	32	42	11648
1994	7	47	45	2134	1034	878	983	3425	322	654	224	221	252	519	490	9	11247
1995		29	115	741	2127	1368	1377	913	1536	161	181	145	145	292	219	28	9376
1996	8	39	116	260	585	1666	894	545	403	630	144	78	82	109	69	28	5658
1997	8	16	110	25	122	419	1204	270	413	293	487	129	25	93	47	110	3770
1998		25	31	47	72	266	622	903	526	356	301	288	88	113	57	105	3800
1999	7		23	65	79	80	241	472	510	255	338	207	121	117	59	98	2672
2000	16	25	7	84	106	153	119	153	392	427	231	185	74	56	46	59	2132
2001		40	52	58	104	56	111	268	438	581	478	420	190	162	111	99	3168
2002			32	65	17	89	66	126	159	190	297	221	249	142	131	187	1971
2003	7	6	32	93	80	58	79	147	300	258	431	426	272	272	148	160	2769
2004		117	280	73	79	107	105	127	246	316	285	598	426	404	327	525	4015
2005		31	111	288	106	106	126	102	224	206	225	252	353	403	252	540	3326

Table 6 - Weights at age of the 3M American plaice stock (Kg) from EU surveys, 1988-2005.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1988	0.027	0.048	0.152	0.338	0.495	0.620	0.721	0.786	0.801	0.820	0.876	0.959	1.201	1.208	1.537	1.742
1989	0.013	0.090	0.151	0.295	0.523	0.630	0.725	0.815	0.839	0.856	0.912	0.991	1.181	1.186	1.462	1.646
1990	0.010	0.062	0.189	0.312	0.425	0.564	0.709	0.829	0.857	0.893	0.956	1.029	1.179	1.200	1.412	1.578
1991	0.015	0.070	0.157	0.341	0.478	0.563	0.660	0.770	0.799	0.829	0.886	0.953	1.141	1.157	1.417	1.634
1992	0.029	0.063	0.158	0.315	0.516	0.616	0.684	0.758	0.807	0.832	0.910	1.000	1.182	1.190	1.408	1.712
1993		0.061	0.160	0.295	0.407	0.579	0.727	0.755	0.798	0.874	0.906	0.932	1.075	1.218	1.839	1.628
1994	0.001	0.062	0.162	0.316	0.490	0.568	0.650	0.808	0.954	0.917	1.025	1.025	1.271	1.228	1.540	1.895
1995		0.044	0.191	0.330	0.488	0.624	0.668	0.789	0.888	1.222	1.279	1.468	1.518	1.515	1.563	2.082
1996	0.017	0.055	0.190	0.332	0.469	0.589	0.708	0.823	0.929	0.864	1.081	1.390	1.307	1.519	1.649	1.777
1997	0.017	0.049	0.171	0.236	0.427	0.559	0.673	0.643	0.859	0.998	1.007	1.215	1.275	1.437	1.607	1.515
1998		0.090	0.174	0.260	0.384	0.514	0.652	0.778	0.826	1.027	1.239	1.322	1.501	1.513	1.606	1.650
1999	0.010		0.166	0.315	0.440	0.546	0.568	0.773	0.849	0.998	1.178	1.275	1.462	1.705	1.563	1.587
2000	0.016	0.091	0.115	0.245	0.409	0.522	0.614	0.673	0.756	0.748	0.848	0.939	1.222	1.177	1.295	1.386
2001		0.072	0.210	0.245	0.374	0.434	0.528	0.603	0.622	0.702	0.703	0.853	1.076	1.321	1.427	1.487
2002			0.191	0.287	0.398	0.444	0.668	0.757	0.711	0.871	1.098	1.151	1.298	1.415	1.486	1.524
2003	0.017	0.041	0.134	0.327	0.361	0.457	0.543	0.669	0.674	0.735	0.794	0.858	0.886	1.028	1.314	1.499
2004		0.110	0.182	0.307	0.457	0.565	0.594	0.691	0.710	0.754	0.785	0.837	0.999	1.092	1.240	1.490
2005		0.094	0.180	0.295	0.396	0.527	0.643	0.620	0.747	0.792	0.795	0.827	0.885	0.920	1.048	1.413
mean	0.016	0.069	0.169	0.299	0.441	0.551	0.652	0.741	0.801	0.874	0.960	1.057	1.203	1.279	1.467	1.625

Table 7: Criteria applied to convert total catches in weight to total catches in number, 2004-2005.

YEAR	TOTAL CATCH (ton)	BREAKDOWN TOTAL CATCH (ton)	LENGTHS COMPOSITION				Mean Weight (Kg)	TOTAL CATCH IN NUMBER (000's)
			Country	Source	Gear	Paper		
2004	81.1	32.0	Spain	Commercial	OTB	scs 05/8	0.955	33.5
		49.1	Portugal	Commercial	OTB	scs 05/6	0.788	62.3
2005	45	45	Spain	Commercial	OTB	scs 06/9	1.193	37.7
		0	Russia	Commercial	OTB	scs 06/7	0.108	0.0

Table 8: Length composition (absolute frequencies in '000) of the 3M American plaice catches, 1988-2005.

length group	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
16		19.3	0.8				0.7	3.0										
18		60.5	3.9				2.9	3.2										
20	6.9	126.5	2.0		5.3	1.8	3.3											
22	10.4	88.0	8.2	5.8	1.3	6.9	3.2						0.3	0.1			0.1	
24	65.6	35.8	10.4	6.6	1.4	14.3	4.8	9.7	5.1		0.2			0.2			0.1	
26	186.5	41.3	20.2	0.0	7.4	16.1	18.3	9.7	0.4		0.2		0.7	0.5	0.3	0.02		
28	345.3	131.2	43.2	23.2	23.7	17.1	30.6	24.3	10.0		0.5		9.4	3.0	1.1	0.1	1.3	
30	276.2	226.7	91.7	28.2	37.5	23.2	71.1	45.4	31.6		0.7		16.3	10.0	2.2	0.5	2.3	
32	303.9	365.4	131.9	109.7	36.7	23.0	94.4	136.9	63.4		1.8	5.2	21.5	18.1	5.1	2.5	4.2	
34	611.2	569.3	96.5	203.1	61.0	19.9	81.3	142.1	98.4	14.6	4.0	10.4	23.4	22.5	17.9	3.0	4.5	0.2
36	621.5	603.5	86.9	283.0	90.5	28.5	88.0	225.2	86.5	13.0	6.2	25.9	23.6	29.7	27.9	10.8	7.9	0.5
38	372.9	477.8	71.1	147.1	122.7	37.5	128.1	294.5	74.7	24.4	15.6	51.9	24.5	31.1	24.7	15.2	12.8	1.5
40	372.9	356.7	70.6	146.2	108.2	29.4	112.6	249.8	47.4	37.8	22.6	15.6	23.0	28.9	24.1	25.1	12.8	3.9
42	473.1	696.1	82.1	147.7	57.1	34.6	44.9	166.2	47.2	22.8	17.8	20.8	17.1	22.2	22.9	22.1	9.8	3.6
44	397.1	630.2	125.0	320.8	67.8	32.6	55.2	86.1	23.3	8.1	44.0	36.3	12.9	18.1	12.8	5.5	12.3	1.5
46	158.8	405.0	132.8	295.7	79.8	25.6	63.3	84.6	14.1	17.2	36.5	31.1	11.6	14.3	10.7	16.0	7.1	2.7
48	76.0	97.4	73.9	120.1	86.9	23.0	59.4	78.4	12.7	33.5	30.9	46.7	9.8	12.6	9.8	10.9	6.0	5.4
50	62.2	68.0	30.3	106.6	63.2	22.0	35.4	94.0	8.4	24.4	37.8	25.9	6.5	6.5	6.4	14.8	6.5	8.0
52	72.5	35.8	9.6	9.1	33.1	12.7	24.3	58.5	2.8	16.3	36.1	10.4	6.9	3.6	5.4	6.9	5.6	6.6
54	34.5	27.5	6.7	3.0	10.3	3.8	10.8	40.2	0.6	4.1	5.3		0.8	1.5	1.9	3.0	2.4	3.4
56	17.3	13.8	3.4	0.004	5.4	1.6	7.4	7.2	0.3	1.7	4.4		0.4	0.5	0.2	0.2	0.2	0.5
58	3.5		0.8	0.002	4.8	0.7		1.5			0.03			0.1			0.04	
60					0.01	0.1		1.5						0.04				
62			0.1			0.001	0.6							0.1		1.0		
64														0.01				
Total ('000)	4468.2	5075.7	1102.2	1955.9	904.0	374.5	940.5	1762.1	527.0	218.0	264.8	280.2	208.7	223.8	173.5	137.5	95.8	37.7
mean length	37.9	38.7	39.5	41.6	41.8	39.6	39.5	40.8	37.9	44.6	46.7	43.9	39.3	40.3	41.3	44.1	42.8	48.4

Table 9 - Catch at age (000s) of the 3M American plaice, 1988-2005.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+	Total
1988		7	311	731	549	440	720	532	386	265	173	118	65	102	43	25	4468
1989		175	209	573	527	482	886	715	520	356	230	148	80	118	39	19	5076
1990		7	49	183	112	87	158	147	110	78	55	39	24	33	13	7	1102
1991		1	19	133	185	168	342	331	243	174	124	84	50	68	23	12	1956
1992		4	17	76	75	76	136	124	100	77	60	46	31	45	23	14	904
1993			47	42	26	11	112	13	24	12	9	11	15	49	2	2	375
1994		4	6	219	98	77	75	254	24	48	16	17	20	40	43	1	941
1995		6	24	167	458	235	231	155	250	31	35	30	30	58	45	7	1762
1996			13	60	101	173	63	41	23	34	6	3	3	3	2	0.4	527
1997					4	17	61	12	28	23	35	13	3	9	4	10	218
1998			0.3	1	2	7	28	57	36	31	32	33	8	14	7	10	265
1999				4	6	8	27	59	60	35	40	21	9	5	3	5	280
2000		0.2	0.1	19	25	25	12	13	33	35	17	13	6	3	3	4	209
2001			5	6	16	8	10	21	30	41	35	29	10	6	3	3	224
2002			1	8	4	17	13	21	22	23	24	17	12	4	3	5	174
2003			0.02	2	2	2	3	6	13	12	23	25	16	15	9	10	138
2004		0.1	1	2	3	3	4	4	8	10	8	16	10	9	7	9	96
2005				0	0	0	1	1	2	2	2	3	5	5	4	12	38

Table 10 - Mean weight at age of the 3M American plaice catch (Kg), 1988-2005.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1988		0.097	0.200	0.312	0.449	0.572	0.684	0.762	0.790	0.823	0.886	0.981	1.215	1.271	1.590	1.736
1989		0.079	0.165	0.342	0.479	0.617	0.750	0.842	0.860	0.882	0.928	0.985	1.136	1.185	1.484	1.717
1990		0.072	0.191	0.320	0.424	0.558	0.738	0.889	0.924	0.963	1.031	1.095	1.223	1.262	1.481	1.618
1991		0.115	0.189	0.367	0.480	0.598	0.763	0.891	0.929	0.962	1.035	1.087	1.188	1.206	1.361	1.477
1992		0.086	0.210	0.327	0.487	0.606	0.723	0.855	0.919	0.966	1.074	1.169	1.373	1.381	1.574	1.666
1993			0.162	0.296	0.394	0.580	0.756	0.813	0.865	0.979	1.039	1.059	1.179	1.339	1.819	1.627
1994		0.061	0.155	0.314	0.487	0.562	0.653	0.824	0.969	0.954	1.068	1.065	1.318	1.289	1.561	1.895
1995		0.044	0.190	0.335	0.494	0.626	0.684	0.816	0.925	1.244	1.320	1.474	1.532	1.547	1.571	2.108
1996			0.225	0.331	0.425	0.535	0.671	0.733	0.852	0.825	1.002	1.302	1.202	1.385	1.539	1.333
1997					0.445	0.639	0.726	0.682	0.949	1.059	1.097	1.270	1.261	1.509	1.508	1.513
1998			0.185	0.269	0.396	0.554	0.776	0.889	0.950	1.140	1.337	1.380	1.461	1.509	1.589	1.613
1999				0.365	0.495	0.536	0.581	0.786	0.872	0.943	1.109	1.194	1.337	1.445	1.439	1.389
2000		0.115	0.115	0.268	0.359	0.444	0.566	0.637	0.706	0.692	0.782	0.891	1.225	1.140	1.290	1.389
2001			0.263	0.283	0.340	0.401	0.471	0.595	0.615	0.691	0.703	0.805	0.975	1.150	1.298	1.534
2002			0.231	0.341	0.398	0.436	0.622	0.692	0.658	0.734	0.813	0.850	0.992	1.349	1.378	1.470
2003			0.232	0.419	0.419	0.554	0.613	0.754	0.746	0.786	0.868	0.949	0.968	1.084	1.311	1.567
2004		0.125	0.242	0.331	0.432	0.539	0.554	0.704	0.716	0.788	0.795	0.815	0.926	0.998	1.100	1.333
2005				0.436	0.573	0.721	0.902	0.806	0.928	0.977	0.941	1.045	1.116	1.181	1.292	1.442
mean		0.088	0.197	0.333	0.443	0.560	0.680	0.776	0.843	0.912	0.991	1.079	1.201	1.290	1.455	1.579

Table11: American plaice exploitaion pattern given by the generalized logit of the 1988-05 observed partial recruitment (See text).

Age	F at age index	Observed PR	Logit PR	Squared difference
1	0.000	0.000	0.010	0.000
2	0.178	0.156	0.142	0.000
3	0.447	0.393	0.459	0.004
4	0.967	0.849	0.738	0.012
5	1.054	0.926	0.890	0.001
6	0.958	0.841	0.956	0.013
7	0.941	0.826	0.983	0.024
8	1.079	0.948	0.993	0.002
9	1.100	0.966	0.997	0.001
10	1.130	0.992	0.999	0.000
11	1.130	0.992	1.000	0.000
12	1.139	1.000	1.000	0.000
13	1.045	0.918	1.000	0.007
14	1.069	0.939	1.000	0.004
15	1.009	0.886	1.000	0.013
16	1.090	0.957	1.000	0.002
		Minimum sum of squares		0.084

Curve parameters	*a*	*b*	*m*
	0.077	0.958	15.279

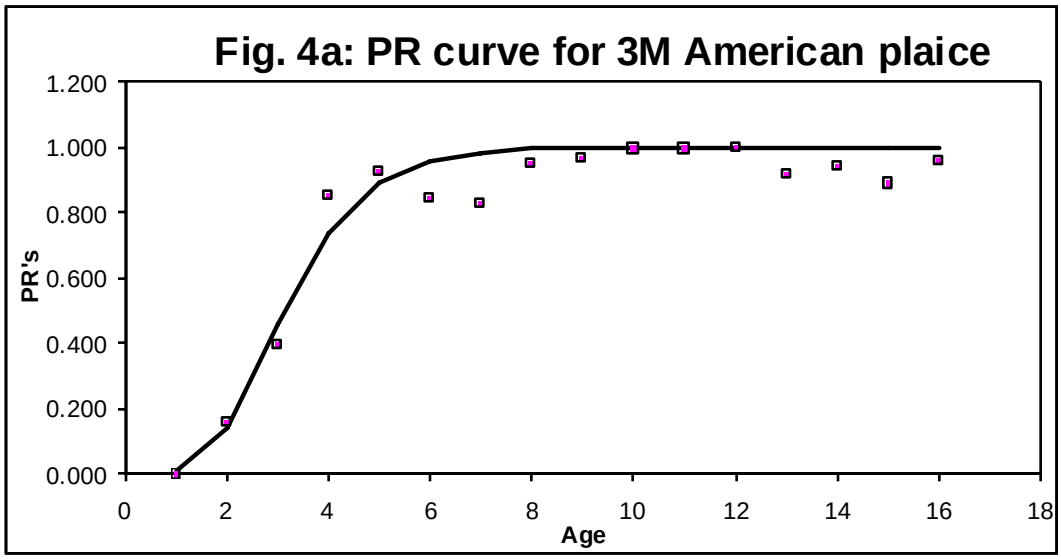


Table 12 A: Yield per recruit parameters for 3M American plaice.

Age	mean weights 1988-05		og mat (%)	PR 88-05	Ref. M
	stock	catch			
1	0.016	*0.016*	0.000	0.010	0.20
2	0.069	*0.088*	0.000	0.142	0.20
3	0.169	*0.197*	0.000	0.459	0.20
4	0.299	*0.333*	0.000	0.738	0.20
5	0.441	*0.443*	0.500	0.890	0.20
6	0.551	*0.560*	1.000	0.956	0.20
7	0.652	*0.680*	1.000	0.983	0.20
8	0.741	*0.776*	1.000	0.993	0.20
9	0.801	*0.843*	1.000	0.997	0.20
10	0.874	*0.912*	1.000	0.999	0.20
11	0.960	*0.991*	1.000	1.000	0.20
12	1.057	*1.079*	1.000	1.000	0.20
13	1.203	*1.201*	1.000	1.000	0.20
14	1.279	*1.290*	1.000	1.000	0.20
15	1.467	*1.455*	1.000	1.000	0.20
16+	1.625	*1.579*	1.000	1.000	0.20

Table 12 B: Yield per recruit results for 3M American plaice.

	Ref F	B	Y	SSB	Slope
	0.000	2422	0	1974	2,059
	0.000	2422	0	1974	1,578
	0.035	1917	55	1478	930
	0.070	1575	88	1145	570
	0.105	1333	108	912	359
	0.140	1154	120	742	229
F0.1	**0.165**	**1053**	**126**	**647**	**206**
	0.175	1019	128	615	146
	0.210	912	133	517	92
	0.245	827	137	439	55
	0.280	758	139	377	30
	0.315	700	140	327	11
Fmax	**0.365**	**632**	**140**	**269**	**0**
	0.385	609	140	250	-10
	0.420	573	140	220	-16
	0.455	541	139	195	-21
	0.490	513	138	173	-24
	0.525	489	138	155	-27

Fig.5 - Yield, B and SSB per recruit curve for 3M American plaice

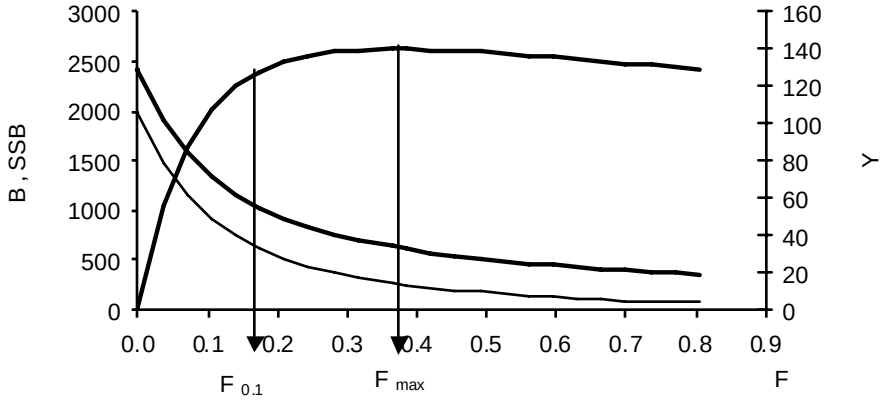


Table 13 - Trend of the 3M American plaice F index based in EU survey series (ages 8-11).

Year	Catch (tons)	Survey (tons)	C/B
1988	1082	5338	0.203
1989	1576	4979	0.317
1990	364	4443	0.082
1991	817	3692	0.221
1992	336	3335	0.101
1993	53	1531	0.034
1994	295	3903	0.076
1995	443	2512	0.176
1996	84	1525	0.055
1997	97	1311	0.074
1998	163	1874	0.087
1999	176	1450	0.121
2000	69	915	0.076
2001	84	1178	0.072
2002	65	700	0.093
2003	44	833	0.053
2004	23	724	0.032
2005	6	573	0.011

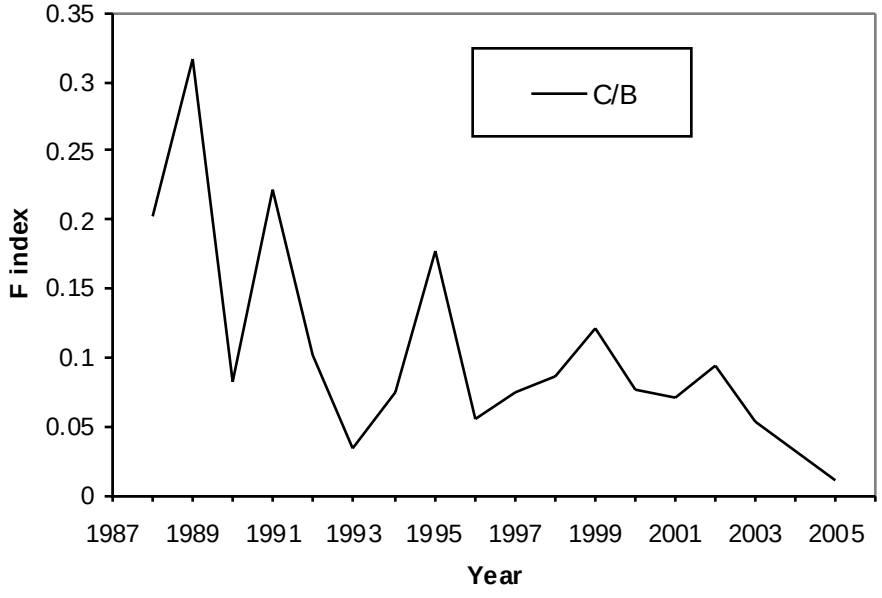


Fig. 6. Trend of the 3M American plaice F index based in EU survey.

Table 14. Evolution of Recruit ('000) and SSB ('000 tons) EU survey index during the period 1988-2005.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SSB	13.5	11.4	9.4	8.3	7.6	7.0	7.3	6.1	3.8	2.9	3.4	2.5	1.6	2.4	2.0	2.2	3.4	2.6
Age 3 recruits	1619	6621	1581	1628	886	1536	45	115	116	110	31	23	7	52	32	32	280	111

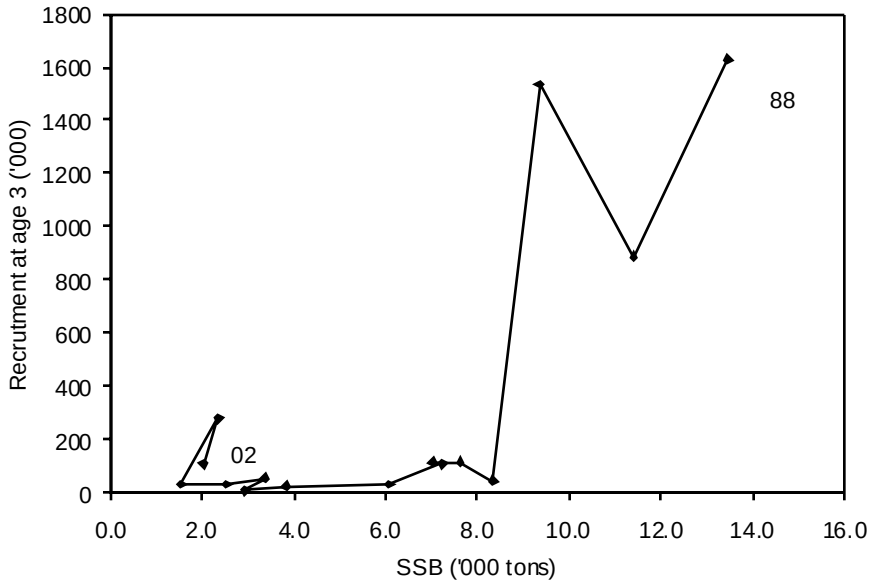


Fig. 7. SSB-Recruitment scatter plot based in EU survey series.

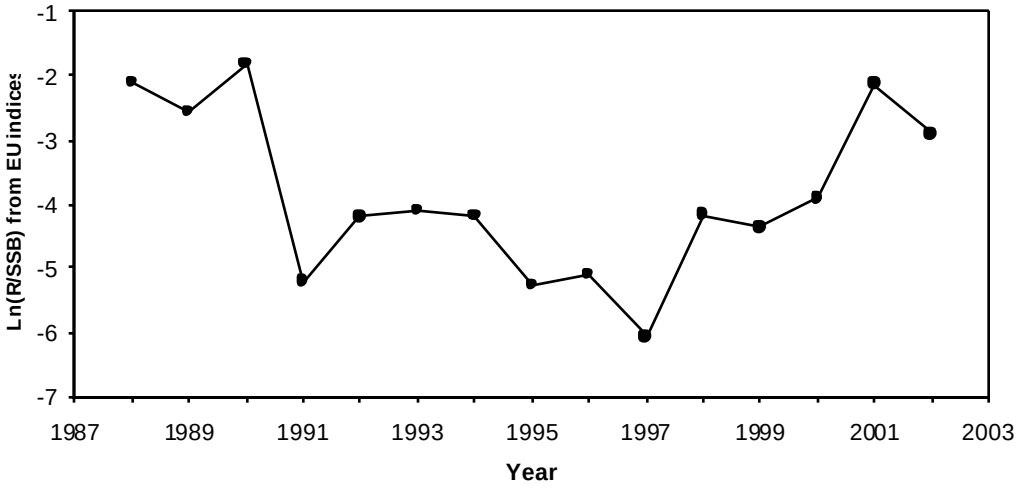


Fig. 8. Recruit at age 3 produced per kg of SSB index from EU indices.

Table 15: Lowestoft XSA input files for 3M American plaice (2006 assessment)

AMERICAN PLAICE NAFO DIVISION 3M INDEX OF INPUT FILES JUNE 2006
1
pla3mla.txt
pla3mcn.txt
pla3mcw.txt
pla3msw.txt
pla3mnm.txt
pla3mmo.txt
pla3mpf.txt
pla3mpm.txt
pla3mfo.txt
pla3mfn.txt
pla3mtun.txt

AMERICAN PLAICE NAFO 3M CATCH NUMBERS thousands
1 2
1988 2005
1 16
1

0.000	7.173	311.143	730.939	549.470	439.632	720.274	532.354	386.160	264.927	173.455	117.634	64.944	102.356	42.774	24.999
0.000	175.482	209.362	573.039	526.509	481.596	886.452	715.483	519.799	355.616	229.522	147.672	80.390	117.524	38.517	18.755
0.000	6.843	48.514	183.081	112.480	86.964	158.021	146.640	109.896	78.140	55.217	39.041	24.185	33.081	13.221	6.859
0.000	0.826	18.908	132.757	185.009	168.106	341.718	331.450	242.806	173.529	124.320	84.203	49.967	67.842	22.925	11.569
0.000	4.055	16.669	75.811	75.174	76.423	135.610	123.772	99.740	76.833	60.036	46.126	31.165	45.422	22.935	14.216
0.000	0.000	46.566	42.316	26.310	10.898	111.805	13.051	23.865	12.333	8.865	10.874	14.948	48.678	1.740	2.265
0.000	3.947	5.540	218.845	97.846	77.178	75.464	253.952	23.683	47.534	16.248	16.864	20.150	39.615	42.826	0.830
0.000	6.202	24.070	167.228	457.569	234.940	230.745	154.915	250.209	31.301	34.815	29.966	29.784	58.238	45.446	6.630
0.000	0.000	13.477	60.135	101.313	172.912	63.443	41.371	23.070	34.003	6.211	2.755	3.395	2.958	1.545	0.411
0.000	0.000	0.000	0.000	4.127	16.665	61.358	12.153	27.868	22.766	34.742	13.361	2.599	8.714	3.699	9.932
0.000	0.000	0.311	0.795	1.779	6.961	27.531	56.541	36.400	30.980	31.954	32.958	7.613	13.894	6.838	10.197
0.000	0.000	0.000	3.687	5.715	7.562	26.536	58.790	60.383	34.501	40.136	20.555	9.220	4.569	3.244	5.283
0.000	0.163	0.109	19.370	24.736	25.180	11.505	13.399	33.195	34.508	17.427	13.385	5.704	3.081	2.956	3.939
0.000	0.000	5.460	6.313	15.595	7.634	10.087	20.963	30.316	41.413	35.175	28.772	10.327	5.885	3.041	2.790
0.000	0.000	1.310	7.507	3.971	17.199	13.147	20.828	22.316	22.896	23.896	16.694	12.272	3.689	3.027	4.771
0.000	0.000	0.018	1.635	1.813	1.740	3.117	6.465	13.057	12.298	22.889	24.817	15.526	15.103	8.891	10.150
0.000	0.061	1.466	1.742	2.988	3.077	4.142	4.227	8.421	9.758	8.405	15.530	10.408	9.371	7.340	8.877
0.000	0.000	0.000	0.058	0.235	0.407	0.927	0.626	1.871	2.474	1.950	2.846	5.218	5.262	4.246	11.595

AMERICAN PLAICE NAFO 3M CATCH WEIGHT AT AGE kg
1 3
1988 2005
1 16
1

0.016	0.097	0.200	0.312	0.449	0.572	0.684	0.762	0.790	0.823	0.886	0.981	1.215	1.271	1.590	1.736
0.016	0.079	0.165	0.342	0.479	0.617	0.750	0.842	0.860	0.882	0.928	0.985	1.136	1.185	1.484	1.717
0.016	0.072	0.191	0.320	0.424	0.558	0.738	0.889	0.924	0.963	1.031	1.095	1.223	1.262	1.481	1.618
0.016	0.115	0.189	0.367	0.480	0.598	0.763	0.891	0.929	0.962	1.035	1.087	1.188	1.206	1.361	1.477
0.016	0.086	0.210	0.327	0.487	0.606	0.723	0.855	0.919	0.966	1.074	1.169	1.373	1.381	1.574	1.666
0.016	*0.088*	0.162	0.296	0.394	0.580	0.756	0.813	0.865	0.979	1.039	1.059	1.179	1.339	1.819	1.627
0.016	0.061	0.155	0.314	0.487	0.562	0.653	0.824	0.969	0.954	1.068	1.065	1.318	1.289	1.561	1.895
0.016	0.044	0.190	0.335	0.494	0.626	0.684	0.816	0.925	1.244	1.320	1.474	1.532	1.547	1.571	2.108
0.016	*0.088*	0.225	0.331	0.425	0.535	0.671	0.733	0.852	0.825	1.002	1.302	1.202	1.385	1.539	1.333
0.016	*0.088*	*0.197*	*0.333*	0.445	0.639	0.726	0.682	0.949	1.059	1.097	1.270	1.261	1.509	1.508	1.513
0.016	*0.088*	0.185	0.269	0.396	0.554	0.776	0.889	0.950	1.140	1.337	1.380	1.461	1.509	1.589	1.613
0.016	*0.088*	*0.197*	0.365	0.495	0.536	0.581	0.786	0.872	0.943	1.109	1.194	1.337	1.445	1.439	1.389
0.016	0.115	0.115	0.268	0.359	0.444	0.566	0.637	0.706	0.692	0.782	0.891	1.225	1.140	1.290	1.389
0.016	*0.088*	0.263	0.283	0.340	0.401	0.471	0.595	0.615	0.691	0.703	0.805	0.975	1.150	1.298	1.534
0.016	*0.088*	0.231	0.341	0.398	0.436	0.622	0.692	0.658	0.734	0.813	0.850	0.992	1.349	1.378	1.470
0.016	*0.088*	0.232	0.419	0.419	0.554	0.613	0.754	0.746	0.786	0.868	0.949	0.968	1.084	1.311	1.567
0.016	0.125	0.242	0.331	0.432	0.539	0.554	0.704	0.716	0.788	0.795	0.815	0.926	0.998	1.100	1.333
0.016	0.088	0.197	0.436	0.573	0.721	0.902	0.806	0.928	0.977	0.941	1.045	1.116	1.181	1.292	1.442

AMERICAN PLAICE NAFO 3M STOCK WEIGHT AT AGE kg
1 4
1988 2005
1 16
1

0.027	0.048	0.152	0.338	0.495	0.620	0.721	0.786	0.801	0.820	0.876	0.959	1.201	1.208	1.537	1.742
0.013	0.090	0.151	0.295	0.523	0.630	0.725	0.815	0.839	0.856	0.912	0.991	1.181	1.186	1.462	1.646
0.010	0.062	0.189	0.312	0.425	0.564	0.709	0.829	0.857	0.893	0.956	1.029	1.179	1.200	1.412	1.578
0.015	0.070	0.157	0.341	0.478	0.563	0.660	0.770	0.799	0.829	0.886	0.953	1.141	1.157	1.417	1.634
0.029	0.063	0.158	0.315	0.516	0.616	0.684	0.758	0.807	0.832	0.910	1.000	1.182	1.190	1.408	1.712
0.016	0.061	0.160	0.295	0.407	0.579	0.727	0.755	0.798	0.874	0.906	0.932	1.075	1.218	1.839	1.628
0.001	0.062	0.162	0.316	0.490	0.568	0.650	0.808	0.954	0.917	1.025	1.025	1.271	1.228	1.540	1.895
0.016	0.044	0.191	0.330	0.488	0.624	0.668	0.789	0.888	1.222	1.279	1.468	1.518	1.515	1.563	2.082
0.017	0.055	0.190	0.332	0.469	0.589	0.708	0.823	0.929	0.864	1.081	1.390	1.307	1.519	1.649	1.777
0.017	0.049	0.171	0.236	0.427	0.559	0.673	0.643	0.859	0.998	1.007	1.215	1.275	1.437	1.607	1.515
0.016	0.090	0.174	0.260	0.384	0.514	0.652	0.778	0.826	1.027	1.239	1.322	1.501	1.513	1.606	1.650
0.010	*0.069*	0.166	0.315	0.440	0.546	0.568	0.773	0.849	0.998	1.178	1.275	1.462	1.705	1.563	1.587
0.016	0.091	0.115	0.245	0.409	0.522	0.614	0.673	0.756	0.748	0.848	0.939	1.222	1.177	1.295	1.386
0.016	0.072	0.210	0.245	0.374	0.434	0.528	0.603	0.622	0.702	0.703	0.853	1.076	1.321	1.427	1.487
0.016	*0.069*	0.191	0.287	0.398	0.444	0.668	0.757	0.711	0.871	1.098	1.151	1.298	1.415	1.486	1.524
0.017	0.041	0.134	0.327	0.361	0.457	0.543	0.669	0.674	0.735	0.794	0.858	0.886	1.028	1.314	1.499
0.016	0.110	0.182	0.307	0.457	0.565	0.594	0.691	0.710	0.754	0.785	0.837	0.999	1.092	1.240	1.490
0.016	0.094	0.180	0.295	0.396	0.527	0.643	0.620	0.747	0.792	0.795	0.827	0.885	0.920	1.048	1.413

AMERICAN PLAICE NAFO 3M LANDINGS tons
1 1
1988 2005
1 16
5
2800.0
3500.0
790.0
1600.0
765.0
275.0
669.0
1300.0
300.0
208.0
294.0
255.0
133.0
149.0
128.0
131.0
81.1
45.0

Table 15: count

AMERICAN PLAICE NAFO 3M NATURAL MORTALITY
1 5
1988 2005
1 16
3
0.2

AMERICAN PLAICE NAFO 3M PROPORTION MATURE AT AGE
1 6
1988 2005
1 16
2
0.00 0.00 0.00 0.00 0.50 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

AMERICAN PLAICE NAFO 3M PROPORTION OF F BEFORE SPAWNING
1 7
1988 2005
1 16
3
0.42

AMERICAN PLAICE NAFO 3M PROPORTION OF M BEFORE SPAWNING
1 8
1988 2005
1 16
3
0.42

AMERICAN PLAICE NAFO 3M F ON OLDEST AGE GROUP BY YEAR
1 9
1988 2005
1 16
5
0.180
0.281
0.073
0.196
0.089
0.030
0.067
0.156
0.049
0.066
0.077
0.108
0.067
0.064
0.083
0.047
0.029
0.010

AMERICAN PLAICE NAFO 3M F AT AGE IN LAST YEAR
1 10
1988 2005
1 16
2
0.000 0.002 0.004 0.010 0.010 0.010 0.009 0.011 0.011 0.011 0.011 0.011 0.010 0.011 0.010 0.011

AMERICAN PLAICE NAFO 3M SURVEY TUNNING DATA
10 1
EU BOTTOM TRAWL SURVEY
1988 2005
1 1 0.5 0.6
1 15
1055 5 483.2 1338.8 1618.6 3955.0 3725.0 3423.3 5016.5 3003.7 1802.1 1156.9 669.2 417.7 230.1 357.9 138.1
1055 5 55.0 1826.7 6621.2 2681.7 2786.6 2544.4 3794.3 2547.7 1615.7 1088.6 672.3 428.6 221.5 332.5 117.5
1055 5 7.6 665.1 1581.3 5311.4 2455.6 1802.2 2784.7 2066.0 1427.1 994.9 647.8 432.2 242.3 337.2 128.1
1055 5 153.6 353.2 1627.9 2530.3 2795.7 1944.8 2645.4 1855.1 1282.8 878.9 575.3 378.4 185.9 261.8 90.7
1055 5 23.5 795.4 885.5 1210.3 1544.0 1681.7 2432.7 1642.2 1141.8 813.1 541.5 362.9 187.2 286.8 108.4
1055 5 0.0 27.2 1535.5 1082.4 775.0 446.8 4115.8 467.5 781.9 366.6 257.5 299.0 354.4 1064.7 32.2
1055 5 7.5 47.2 45.4 2133.9 1033.6 878.2 983.2 3425.5 321.8 654.2 224.2 221.4 252.0 519.2 490.4
1055 5 0.0 28.6 114.6 741.1 2127.1 1367.6 1376.8 913.0 1535.9 161.3 180.8 145.1 145.0 292.1 219.0
1055 5 8.0 39.1 115.9 259.7 585.5 1666.2 894.1 545.4 403.4 630.4 144.3 77.9 82.2 109.4 69.0
1055 5 8.1 16.1 110.0 24.9 122.4 418.8 1203.8 269.8 413.4 292.5 487.5 128.9 24.9 92.9 46.6
1055 5 0.0 24.7 31.5 46.5 71.9 266.5 622.2 902.6 525.8 355.8 301.0 288.5 88.0 113.4 56.7
1055 5 7.4 0.0 23.2 65.4 78.7 79.5 241.0 471.6 509.9 254.8 337.8 207.1 121.3 117.1 59.1
1055 5 15.6 25.1 6.8 84.2 105.7 153.0 118.7 153.5 391.6 427.0 231.1 185.0 74.0 55.6 46.3
1055 5 0.0 39.8 52.2 58.2 104.1 56.1 111.0 267.6 437.9 580.7 478.5 419.8 189.9 161.6 111.4
1055 5 0.0 0.0 32.2 65.5 16.5 88.8 65.9 126.3 158.6 189.6 297.4 221.4 248.7 141.8 131.4
1055 5 7.1 6.2 31.6 93.3 79.8 58.2 79.3 147.4 299.7 258.0 431.4 425.5 271.9 272.2 148.0
1055 5 0.0 117.2 279.7 73.5 79.1 106.9 104.5 127.0 246.3 315.8 285.2 598.0 426.1 404.0 326.6
1055 5 0.0 31.5 111.4 287.8 106.3 105.9 125.9 101.5 224.4 206.4 225.1 251.5 353.0 403.2 252.3

Table 16: Extended Survivor Analysis diagnostics for 2006 (Lowestoft VPA Version 3.1)

AMERICAN PLAICE NAFO DIVISION 3M INDEX OF INPUT FILES JUNE 2006
CPUE data from file pla3mtun.txt

Catch data for 18 years. 1988 to 2005. Ages 1 to 16.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU BOTTOM TRAWL SURV	1994	2005	1	15	0.5	0.6

Time series weights :
Tapered time weighting not applied

Catchability analysis :
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 12

Terminal population estimation :
Terminal year survivor estimates not shrunk towards mean F
Oldest age survivor estimates for the years 1988 to 1994 shrunk towards1.000 * the mean F of ages 10 - 14
S.E. of the mean to which the estimates are shrunk = 1.000
Minimum standard error for population estimates from each cohort age = .500
Individual fleet weighting not applied

Tuning converged after 77 iterations

Regression weights	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.018	0.000	0.001	0.000	0.000	0.010	0.002	0.000	0.001	0.000
4	0.050	0.000	0.001	0.009	0.046	0.033	0.018	0.003	0.004	0.000
5	0.068	0.004	0.004	0.011	0.073	0.048	0.026	0.005	0.007	0.001
6	0.114	0.014	0.009	0.019	0.061	0.029	0.068	0.014	0.011	0.001
7	0.069	0.054	0.029	0.043	0.035	0.031	0.064	0.016	0.042	0.004
8	0.075	0.017	0.064	0.081	0.027	0.084	0.084	0.040	0.026	0.008
9	0.064	0.066	0.065	0.090	0.060	0.079	0.120	0.069	0.068	0.015
10	0.110	0.083	0.097	0.080	0.068	0.099	0.079	0.090	0.068	0.026
11	0.054	0.157	0.160	0.176	0.053	0.092	0.076	0.106	0.082	0.017
12	0.036	0.157	0.219	0.147	0.082	0.116	0.057	0.105	0.097	0.036
13	0.051	0.043	0.126	0.087	0.055	0.084	0.066	0.069	0.059	0.043
14	0.057	0.180	0.338	0.104	0.038	0.074	0.039	0.109	0.054	0.038
15	0.027	0.093	0.209	0.122	0.090	0.048	0.049	0.124	0.071	0.031

XSA population numbers (Thousands)

YEAR \AGE	1	2	3	4	5	6	7	8	9	10
1996	871.0	1060.0	846.0	1370.0	1700.0	1780.0	1050.0	635.0	412.0	361.0
1997	865.0	713.0	866.0	680.0	1060.0	1300.0	1300.0	799.0	483.0	316.0
1998	394.0	708.0	584.0	709.0	557.0	868.0	1050.0	1010.0	643.0	370.0
1999	865.0	323.0	580.0	478.0	579.0	454.0	704.0	837.0	775.0	494.0
2000	1120.0	709.0	264.0	475.0	388.0	469.0	365.0	552.0	632.0	580.0
2001	847.0	920.0	580.0	216.0	371.0	295.0	361.0	289.0	440.0	487.0
2002	1900.0	694.0	753.0	470.0	171.0	290.0	235.0	287.0	217.0	333.0
2003	1640.0	1550.0	568.0	616.0	378.0	137.0	222.0	180.0	216.0	158.0
2004	1380.0	1340.0	1270.0	465.0	503.0	308.0	110.0	179.0	142.0	165.0
2005	0.0	1130.0	1100.0	1040.0	379.0	409.0	249.0	86.5	142.0	109.0

Estimated population abundance at 1st Jan 2006

0.0	0.0	928.0	899.0	852.0	310.0	334.0	203.0	70.3	115.0

Taper weighted geometric mean of the VPA populations:

527.0	1500.0	1300.0	1130.0	931.0	805.0	689.0	562.0	477.0	373.0

Standard error of the weighted Log(VPA populations) :

5.017	0.809	0.827	0.860	0.869	0.859	0.887	0.875	0.787	0.723

Table 16 : count.

XSA population numbers (Thousands)

YEAR \AGE	11	12	13	14	15
1996	131.0	86.3	75.2	59.5	64.8
1997	265.0	102.0	68.2	58.5	46.0
1998	238.0	185.0	71.1	53.5	40.0
1999	275.0	166.0	122.0	51.3	31.2
2000	373.0	189.0	118.0	91.4	37.9
2001	444.0	290.0	142.0	91.1	72.0
2002	362.0	331.0	211.0	107.0	69.3
2003	252.0	274.0	256.0	162.0	84.5
2004	118.0	186.0	202.0	196.0	119.0
2005	126.0	89.0	138.0	156.0	152.0

Estimated population abundance at 1st Jan 2006

	86.6	102.0	70.3	108.0	123.0

Taper weighted geometric mean of the VPA populations:

	297.0	226.0	175.0	132.0	83.6

Standard error of the weighted Log(VPA populations) :

	0.6694	0.6402	0.6181	0.646	0.6683

Log catchability residuals.

Fleet : EU BOTTOM TRAWL SURV

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	-0.31	99.99	0.14	0.16	99.99	0.07	0.55	99.99	99.99	-0.61	99.99	99.99
2	-0.2	-0.01	0.29	-0.2	0.23	99.99	0.25	0.44	99.99	-1.94	1.15	0
3	-1.37	0.05	0.76	0.68	-0.18	-0.48	-0.91	0.34	-0.41	-0.15	1.23	0.45
4	1.3	0.69	0.13	-1.55	-0.96	-0.22	0.06	0.47	-0.2	-0.12	-0.08	0.48
5	0.83	1.34	0.42	-0.71	-0.59	-0.53	0.19	0.21	-0.87	-0.1	-0.39	0.18
6	0.57	0.95	0.96	-0.16	-0.21	-0.77	-0.12	-0.68	-0.18	0.12	-0.09	-0.39
7	0.67	0.98	0.41	0.48	0.02	-0.52	-0.57	-0.63	-0.7	-0.49	0.5	-0.15
8	1.45	0.67	0.1	-0.87	0.13	-0.32	-1.06	0.18	-0.57	0.03	-0.12	0.37
9	0.14	0.91	-0.1	-0.24	-0.28	-0.49	-0.56	-0.08	-0.37	0.25	0.47	0.35
10	0.99	-0.28	0.42	-0.24	-0.19	-0.82	-0.47	0.03	-0.72	0.34	0.48	0.45
11	0.02	0.08	-0.19	0.38	0	-0.02	-0.77	-0.19	-0.47	0.28	0.61	0.27
12	0.08	-0.08	-0.48	-0.07	0.17	-0.1	-0.37	0.04	-0.77	0.1	0.83	0.66
13	-0.09	0.12	-0.28	-1.38	-0.11	-0.35	-0.83	-0.06	-0.2	-0.3	0.38	0.57
14	0.24	0.64	0.24	0.16	0.54	0.48	-0.87	0.22	-0.1	0.18	0.36	0.57
15	0.02	-0.2	-0.32	-0.33	0.07	0.31	-0.15	0.06	0.27	0.23	0.65	0.13

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8	9	10
Mean Log q	-13.9843	-12.7383	-11.8942	-10.9171	-10.6096	-10.1184	-9.6861	-9.3629	-9.0371	-8.9522
S.E(Log q)	0.4055	0.7853	0.7408	0.7425	0.6627	0.5639	0.5881	0.6777	0.4364	0.548

Age	11	12	13	14	15
Mean Log q	-8.8363	-8.7567	-8.7567	-8.7567	-8.7567
S.E(Log q)	0.3762	0.4418	0.5593	0.4658	0.294

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	-18.96	-1.866	*****	0	6	6.28	-13.98
2	3.05	-0.913	24.56	0.02	10	2.42	-12.74
3	0.92	0.213	11.5	0.44	12	0.72	-11.89
4	0.7	1.615	9.61	0.74	12	0.48	-10.92
5	0.65	2.865	9.16	0.87	12	0.33	-10.61
6	0.71	2.415	9.01	0.87	12	0.33	-10.12
7	0.75	1.605	8.82	0.81	12	0.41	-9.69
8	0.94	0.264	9.15	0.63	12	0.66	-9.36
9	1.34	-1.222	10.11	0.56	12	0.57	-9.04
10	2.63	-2.329	14.34	0.17	12	1.22	-8.95
11	1.95	-2.351	12.11	0.38	12	0.62	-8.84
12	1.25	-0.661	9.67	0.41	12	0.57	-8.76
13	0.68	1.447	7.65	0.67	12	0.33	-8.97
14	0.97	0.149	8.41	0.68	12	0.41	-8.53
15	0.97	0.227	8.58	0.88	12	0.29	-8.69

Table 16: count.

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age
Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
0	0	0	0	0	0

Age 2 Catchability constant w.r.t. time and dependent on age
Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	928	0.824	0	0	1	1	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
928	0.82	0	1	0	0

Age 3 Catchability constant w.r.t. time and dependent on age
Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	899	0.374	0.514	1.38	3	1	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
899	0.37	0.51	3	1.375	0

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	852	0.455	0.935	2.06	3	1	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
852	0.45	0.94	3	2.056	0

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	310	0.428	0.105	0.24	3	1	0.001

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
310	0.43	0.1	3	0.245	0.001

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	334	0.269	0.193	0.72	6	1	0.001

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
334	0.27	0.19	6	0.716	0.001

Table 16: count.

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	203	0.246	0.069	0.28	7	1	0.004

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
203	0.25	0.07	7	0.279	0.004

Age 8 Catchability constant w.r.t. time and dependent on age
Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	70	0.277	0.256	0.92	6	1	0.008

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
70	0.28	0.26	6	0.922	0.008

Age 9 Catchability constant w.r.t. time and dependent on age
Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	115	0.211	0.104	0.49	9	1	0.015

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
115	0.21	0.1	9	0.492	0.015

Age 10 Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	87	0.199	0.143	0.72	10	1	0.026

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
87	0.2	0.14	10	0.719	0.026

Age 11 Catchability constant w.r.t. time and dependent on age
Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	102	0.199	0.158	0.79	10	1	0.017

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
102	0.2	0.16	10	0.792	0.017

Age 12 Catchability constant w.r.t. time and dependent on age
Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	70	0.175	0.185	1.05	12	1	0.036

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
70	0.18	0.18	12	1.054	0.036

Table 16: count.

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	108	0.178	0.17	0.96	12	1	0.043
Weighted prediction :							
Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F		
108	0.18	0.17	12	0.957	0.043		

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	123	0.173	0.142	0.82	12	1	0.038
Weighted prediction :							
Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F		
123	0.17	0.14	12	0.823	0.038		

Age 15 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	120	0.169	0.167	0.99	12	1	0.031
F shrinkage mean	0	1				0	0
Weighted prediction :							
Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F		
120	0.17	0.17	12	0.992	0.031		

Fig.9. Log catchability residuals

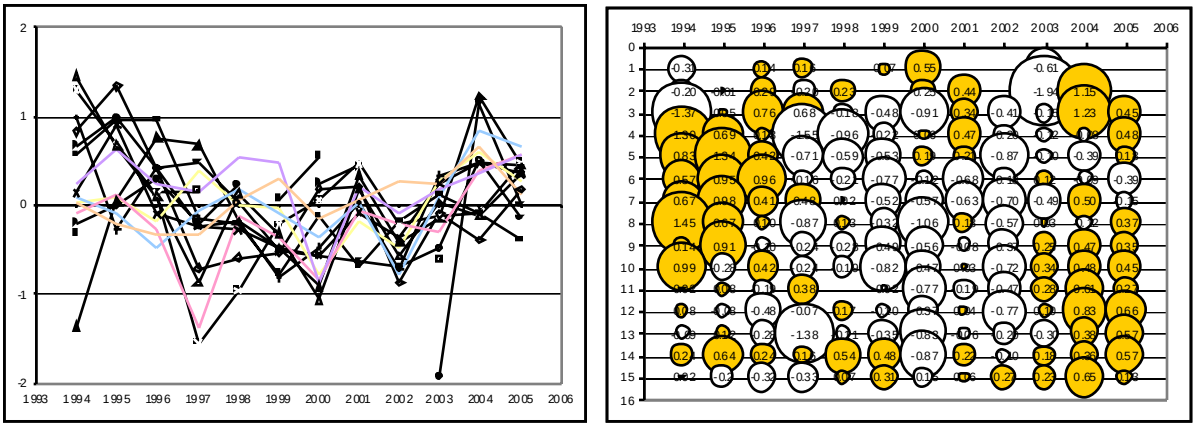


Table 17: Extended Survivor Analysis results.

YEAR	RECRUITS Age 1 (Thousands)	TOTAL BIOMASS (Tonnes)	SPAWNING BIOMASS (Tonnes)	FBAR 3-13	FBAR 8-11
1988	3814	15012	10168	0.2429	0.2655
1989	3913	12003	7537	0.3855	0.4477
1990	4533	8370	5560	0.1097	0.1179
1991	6485	7627	4496	0.2791	0.4131
1992	4139	6834	4166	0.1619	0.2900
1993	2535	6332	3870	0.0442	0.0626
1994	1270	6906	4095	0.1183	0.1888
1995	1291	6637	3938	0.2498	0.3217
1996	871	5080	3549	0.0644	0.0756
1997	865	4482	3498	0.0541	0.0806
1998	394	4289	3397	0.0704	0.0965
1999	865	3908	3107	0.0675	0.1068
2000	1124	3004	2421	0.0510	0.0520
2001	847	2535	1968	0.0640	0.0883
2002	1899	2846	2193	0.0600	0.0898
2003	1637	2154	1526	0.0471	0.0764
2004	1384	2385	1551	0.0423	0.0610
2005		2566	1711	0.0136	0.0163

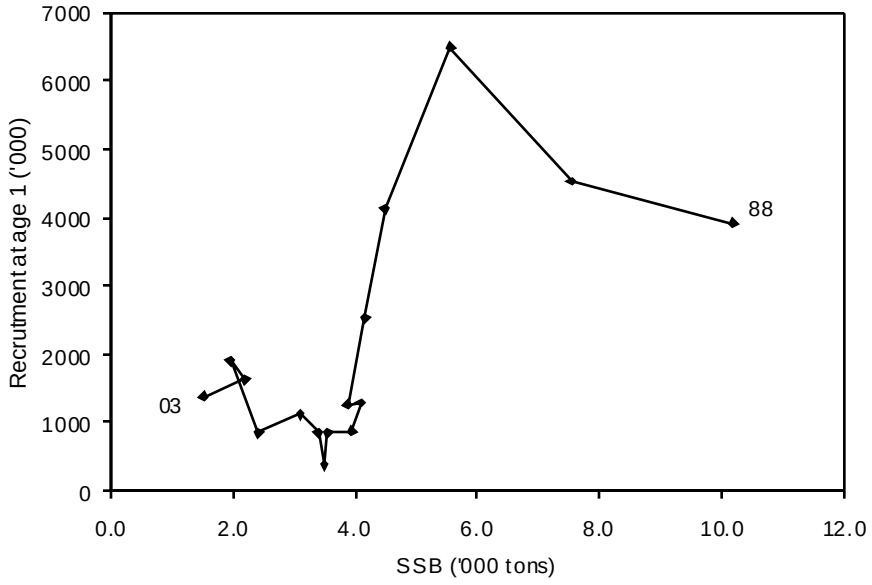


Fig. 10. SSB-Recruitment scatter plot based in XSA results.

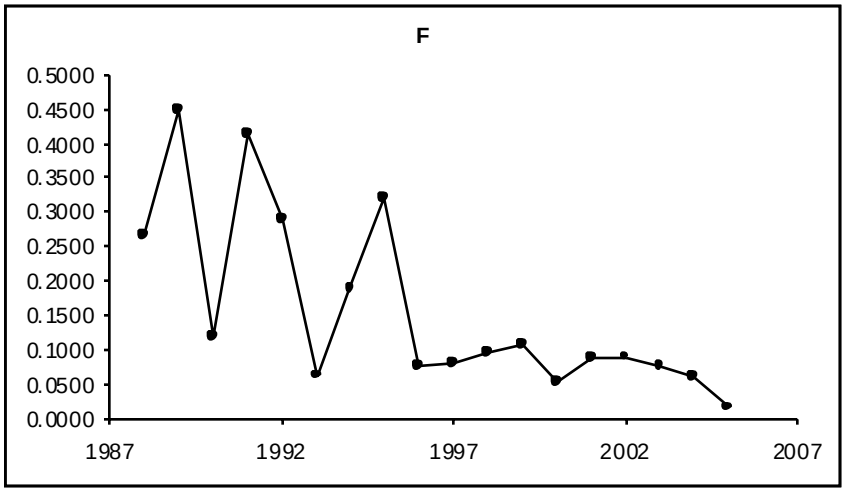
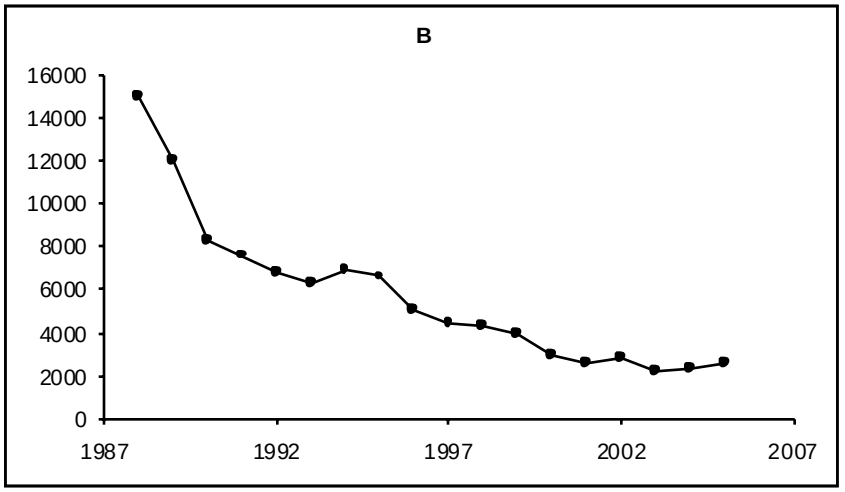


Fig.11 A. Extended Survivor Analysis results for F (age 8-11)



Tfig. 11 B. Extended Survivor Analysis results for total biomass (tons)

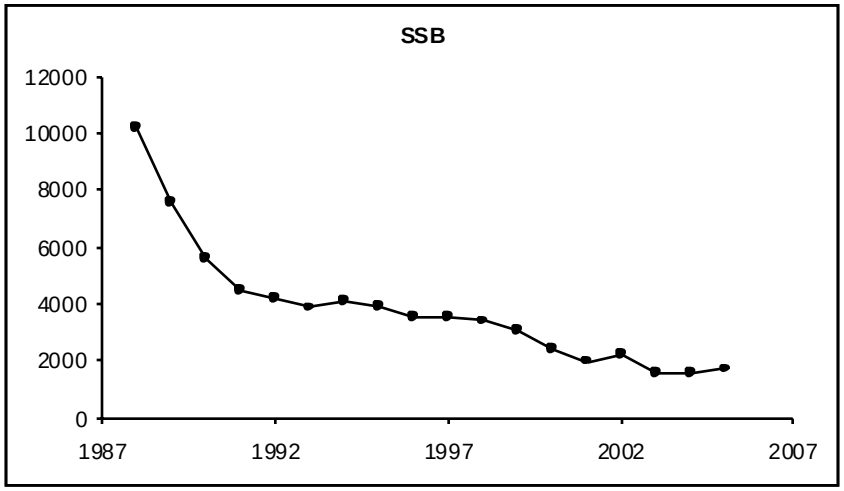


Fig. 11 C: Extended Survivor Analysis results for spawning biomass (tons)

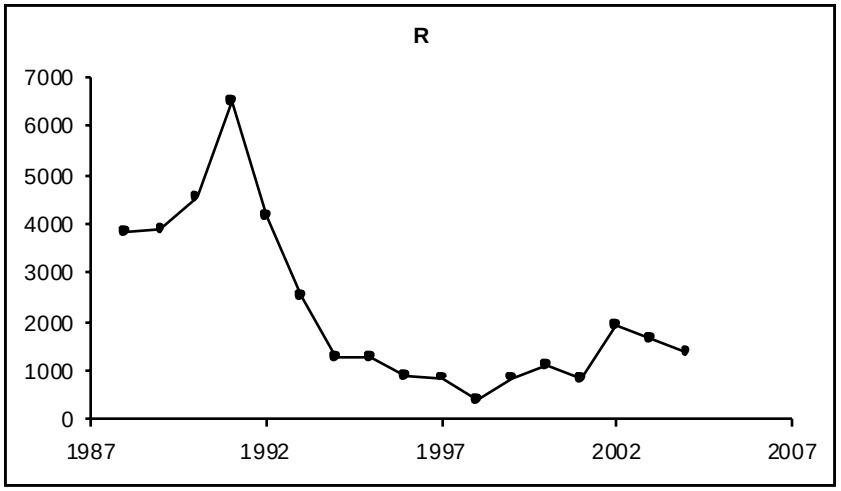


Fig.11 D: Extended Survivor Analysis results for recruits at age 1 ('000)