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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 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 show an increased in 2006 and 2007 but continue to be at a low level. There are no changes in the perception of the stock status from last assessment (2006). This stock continues to be in a very poor condition, despite the apparent good recruitment of the 2006 year class (age 1 in 2007) that remains to be confirmed in the next years, indices from the EU survey and XSA indicates no sign of recruitment from 1991 to 2005 year classes with only weak year-classes expected to be recruited to the SSB within at least four years. 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-1960's 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 1960's catches remained at a low level within 80 tons and 150 tons, jumping to a higher 600-1 100 tons level on the early-1970's. 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 2006 and 2007 were estimated to be 45 and 77 tons respectively (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 02/62) and in the 2003 update (Alpoim, 2003 - SCR 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 (1988-2007), (Vázquez and González Troncoso, 2008 – SCR 08/34).

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 730m. 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, 2003-2007 data are original from R/V Vizconde de Eza (Vázquez and González Troncoso, 2008; Casas and González Troncoso, 2005).

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

Biomass and abundance estimates

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

Stock length composition.

Length compositions from 1988 to 2007 were given by the EU survey (Vázquez and González Troncoso, 2008; Casas and González Troncoso, 2007). (Table 3)

Length weight relationships

Length weight relationships for the 3M American plaice (1988-2007) were calculated with EU survey length/weight data from both males and females (Vazquez and Casas, *pers. comm*. 2008) 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. Since 2001 both age reader and criteria used are the same.

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 3M American plaice stock for the period 1988-2007 (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 2006 Portuguese and Russian Research Reports (Vargas *et al.*, 2007; Vazkov *et al.*, 2007) were used to estimate the length composition of the 2006 total catch. The length compositions presented in the 2007 Portuguese and Russian Research Reports (Vargas *et al.*, 2008; Vazkov *et al.*, 2008) was used to estimate the length composition of the 2007 total catch.

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 (Table 4).

The breakdown of the total catch is presented in Table 7. The commercial catch at length matrix (Alpoim, 2006) was updated with the 2006 and 2007 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 1988-2007 (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 1988-2007 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 5. 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 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 2007 abundance and biomass were the lowest of this series (1 053 tons and 1.4 millions fishes). Results of the 1996 Canadian survey are comparable with the 1996 EU survey (Fig. 3) (Alpoim *et al.*, 2002; Alpoim, 2003; Vázquez and González Troncoso, 2008).

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, from 2003 till 2005 this index declined again being at a minimum in 2005 (0.011) since then increase being in 2007 at 0.071 (Table 13 and Fig. 6).

The 1991 year-class, that was the best represented in the EU survey till 2005 (Table 5) is now in the 16+ group and lost is strength. Since 1991, all the recruiting year-classes were poorly represented in the EU survey, in 2007 age 1 appears to have some importance but that must be confirmed in future years. Survey spawning biomass is declining as well since 1988 reaching a minimum in 2007.

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 17 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. The 2003 and 2004 mean is at the level of the 1991-2000 period (Fig.8). This recruitment failure seems not to be caused by the shrimp fishery developed in Flemish Cap since the beginning of 1990´s, because estimation of by-catch gives 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 $F_{0.1}$ = 0.162 and an F_{max} = 0.346 (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 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 2007. The survey biomass can be considered representative of the mean annual biomass (EU survey is conducted around the middle of the year). The 2007 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 F's for the last age through 1988-2007 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.
- Final estimates not shrunk towards mean F.
- The earliest year to be used for tuning the VPA was 1994.
- Minimum 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, 11 and 12.

Biomass and spawning stock biomass show a steady decline in the recent years to very low levels. Recruitment from 1991 to 2005 year class were at a very low level, the 2007 year class, in the EU survey, appears to be strong but that must be confirmed in future years. The rate of exploitation decreased till 2005 but in the last two years increase and is around 0.06.

If the 2007 point is take out, the SSB-R(Age 1) Scatter plot, based in the XSA results (Fig.10), show also a very poor recruitment for an SSB less than 5 000 tons (Fig 10).
In Fig 11 it is plotted the XSA survey index of stock reproductive potential calculated as described before. This plot show a continuous decrease from 1990 to 1997 (the lowest value), from 1997 to 2001 this index increase but after that decrease again to low levels. In 2001 and 2002, although the values of this index are higher than those in the previous period didn't generate good recruitments due to the poor level of SSB (Fig.11).

Retrospective Analysis

A 2007-2003 retrospective analysis was carried out in order to determine the bias on the biomass, female spawning stock biomass (SSB), fishing mortality (mean F: ages 3-13 and 8-11) and recruitment (age 1) estimates from consecutive assessments back in time (Table 18 and Fig. 13).

The retrospective analysis show some bias in the Fs of the 2003 and 2004 runs but in recent years is rather consistent. This analysis for both total biomass and SSB show quite consistent stock trends during the period. By other hand recruitment show a very inconsistent retrospective pattern probably because the poor recruitment at age 1.

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.

Despite the apparent good recruitment of the 2006 year class that remains to be confirmed in the next years, indices from the EU survey and XSA indicates no sign of recruitment from 1991 to 2005 year class, with only weak year-classes expected to be recruited to the SSB for at least the next four years.

Both the ratio of catch to EU survey biomass (F-index) and XSA fishing mortality declined from the mid-1980s to the mid-1990s and then fluctuated between 0.05 and 0.1 from 1996 to 2007 with the exception of 2005. Recent F is 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 four 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 1960-2007, Stacfis estimates (t) from 1988-2007 and TAC (t) from 1974-2008 of American plaice from NAFO Division 3M.

Year	Nominal catches (2)														
	Country										Flatfishes (NS)	Yellowtail f.	GRAND	STACFIS	TAC
	Canada	Japan	USSR/SUN	Poland	E/ESP	E/GBR	E/PRT	E/DEU	Other	Total	Total	Total	TOTAL	estimates	
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	-	-	14	-	89	-	162	-	3	268	24	135	427	149	0
2002	-	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	-	58	-	3	108	0	0	108	81	0
2005 (1)	-	-	-	-	59	-	11	-	14	84	1	3	88	45	0
2006 (1)	-	-	5	-	32	-	34	-	13	84	0	0	84	46	0
2007 (1)	-	-	-	-	41	-	30	-	5	76	0	0	76	76	0
2008															0

(1) - Provisional

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

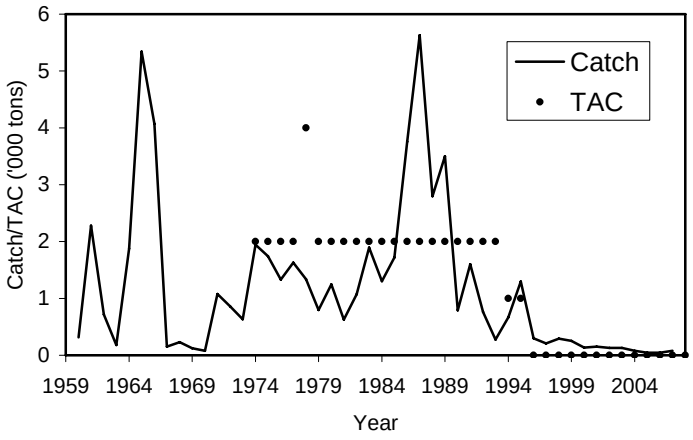


Fig.1 . American plaice in Div.3M: nominal catches and agreed TAC's

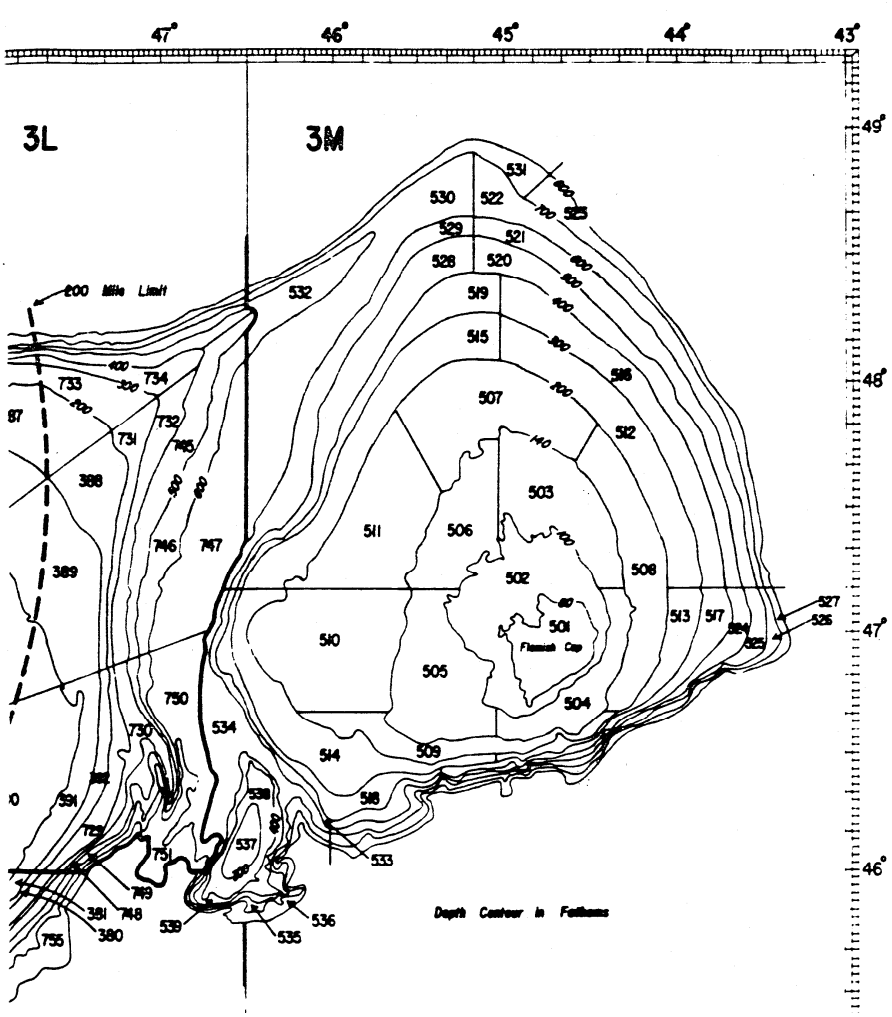


Fig. 2. Stratification scheme for stratified- randowm groundfish surveys in Div 3M. (Bishop 1994).

Table 2 - EU - surveys in Div.3M from 1988-2007: estimates of biomass (t) and abundance (000's) of A.plaice.

Stratum	Depth range (m)	Area (sq. n. mi.)	Year																			
			1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
501	128-146	342	1306	1000	505	1078	709	1079	661	2230	1462	381	156	372	345	1043	141	1292	1507	1038	714	284
502	148-183	838	2845	3602	1375	2663	1714	1267	1199	1335	943	740	1587	1810	976	835	1262	713	768	796	354	209
503	185-256	628	1367	1118	1668	1247	631	444	325	252	168	495	284	97	21	93	75	17	427	101	74	101
504	185-256	348	2199	461	817	320	557	572	853	489	268	203	343	53	100	85	128		395	359	109	153
505	185-256	703	2599	3093	1830	1407	837	1291	1230	549	500	619	744	73	56	112	189	82	72	45	63	81
506	185-256	496	479	1130	954	501	601	305	808	123	32	13	35	40	25	37	63	29	26	71	61	99
507	258-366	822	1174	531	837	389	639	319	316	249	72	83	47	19	15	28	52	30	84	31	37	20
508	258-366	646	417	164	263	251	727	487	171	132	56	123	165	3		45	43	14	55	175	163	58
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	97	24
511	258-366	806	1186	1168	1316	401	372	292	303	109	68	32	29	37	23	27	59	29	69	35	19	22
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		3
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	1691	1053
s.e.			1845	2048	1276	1180	954	1040	1373	1083	912	708	751	869	332	429	729	748	740	684	342	159
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	2.10	1,31
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	0.43	0,20
total abundance (000's)			27410	27391	20946	17643	13728	11648	11247	9376	5658	3770	3800	2672	2132	3168	1971	2769	4015	3326	2188	1401
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	2.72	1.74

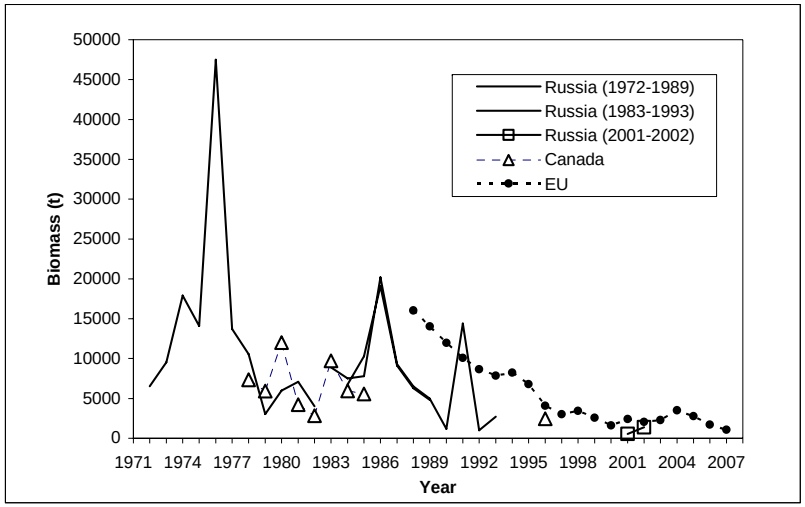


Fig.3A. American plaice in Div. 3M: trends in biomass in the surveys.

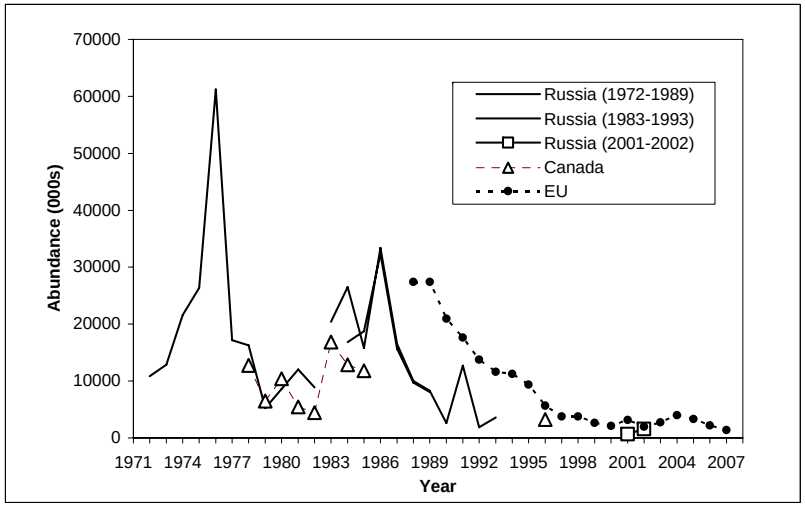


Fig.3B. American plaice in Div. 3M: trends in abundance in the surveys.

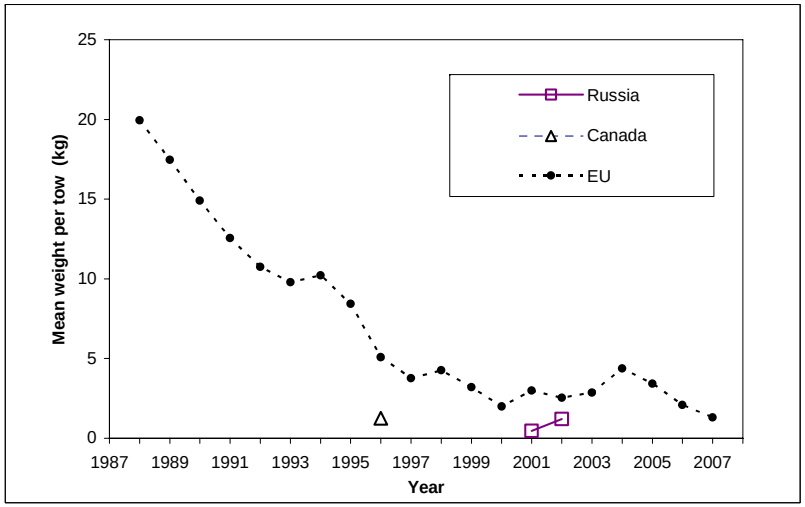


Fig.3C. American plaice in Div. 3M: mean weight per tow in the surveys.

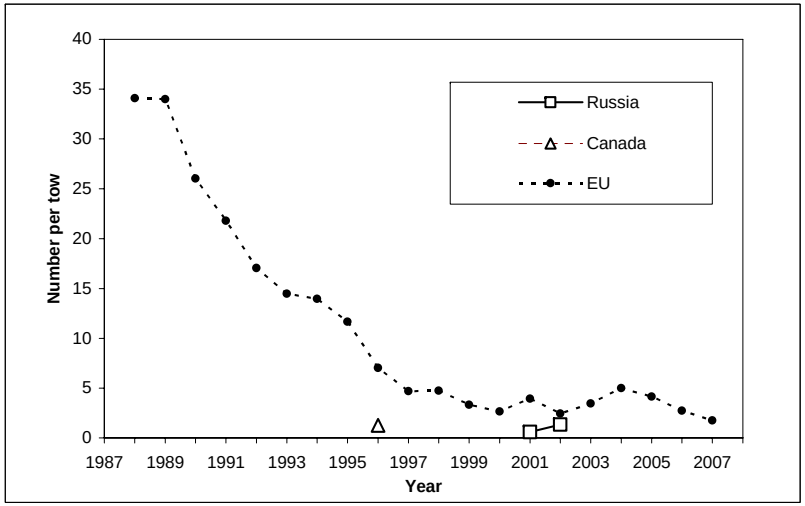


Fig.3D. American plaice in Div. 3M: mean number per tow in the surveys.

Table 3: Length composition (absolute frequencies in '000) of the 3M american plaice stock, EU survey 1988-2007.

Length group	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Length group
4							7														4
6				20																	6
8				20																20	8
10		41	8	27								7	8							174	10
12	68	14		46					8	8			7			7			7	13	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	14	13	20
22	166	2836	188	461	131	191	31		14		16		16			14	66	39	7		22
24	295	3199	391	828	272	565	44	45	38	30	8	8	8	8	9	13	109	24	14		24
26	575	1602	690	469	360	619	129	45	24	60	8	15	8	31	8	7	127	40	7	7	26
28	932	499	1301	456	392	360	297	113	68	44	45	31	44	54	32	27	73	48	31		28
30	1434	637	2964	782	452	657	729	212	111	30	15	8	31	23	24	72	69	149	49		30
32	2459	998	2836	1625	568	563	965	639	286	189	77	54	69	68	32	64	57	178	62	41	32
34	3019	2020	1600	2522	1105	595	864	663	352	181	219	121	133	200	73	129	122	138	90	59	34
36	3582	3495	1726	2749	2251	1302	1161	1292	757	426	413	256	250	365	109	336	403	250	230	106	36
38	2651	2627	1790	2269	2042	1397	1710	1688	1040	678	401	258	258	682	145	482	404	419	387	121	38
40	2740	1959	1427	1384	1576	1439	1511	1420	979	456	500	316	289	443	195	413	459	420	364	202	40
42	2873	1680	1282	787	1266	1178	594	930	594	321	379	209	250	265	106	376	455	370	221	148	42
44	2663	2017	1492	1020	630	936	708	472	356	295	375	205	130	172	96	136	263	227	123	87	44
46	788	1165	1318	883	604	705	803	451	232	216	339	218	221	138	189	123	134	139	98	67	46
48	467	527	763	582	602	349	729	405	312	285	285	327	156	177	289	136	197	177	169	81	48
50	203	191	291	184	331	397	419	468	233	317	330	260	133	211	310	206	344	203	97	101	50
52	162	164	101	117	120	236	273	279	104	153	235	271	76	187	233	142	412	261	91	61	52
54	72	47	46	28	40	62	117	183	66	29	90	60	21	98	77	45	208	109	35	60	54
56	55	15	21	14	7	24	76	31	34	21	44	35	7		44	21	54	104	85	33	56
58	28	6	6	7		16		6	6	7	6	6		6		8	20	16			58
60								6	6			6							7	7	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	2188	1401	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	42.1	38.9	

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
2006	0.0058	3.1403	312
2007	0.0042	3.2301	209

Table 5: Population abundance (000s) at age (yrs) of A. plaice from surveys in Div. 3M during EU survey 1988-2007.

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
2006	7	28	37	107	133	139	72	57	123	163	200	193	192	211	200	326	2188
2007	207	7	13	35	106	119	49	49	35	47	76	122	143	82	75	236	1401

Table 6 - Weights at age of the 3M American plaice stock (Kg) from EU surveys, 1988-2007.

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
2006	0.018	0.119	0.212	0.350	0.475	0.600	0.711	0.673	0.715	0.679	0.792	0.845	0.769	0.876	0.925	1.294
2007	0.010	0.079	0.128	0.354	0.588	0.621	0.695	0.987	0.912	0.949	0.783	0.767	0.913	0.874	0.873	1.537
mean	0.015	0.072	0.169	0.305	0.450	0.557	0.657	0.750	0.803	0.868	0.943	1.032	1.167	1.239	1.411	1.604

Table 7: Criteria applied to convert total catches in weight to total catches in number, 2006-2007.

YEAR	TOTAL CATCH (ton)	BREAKDOWN TOTAL CATCH (ton)	LENGTHS COMPOSITION				Mean Weight (Kg)	TOTAL CATCH IN NUMBER (000's)
			Country	Source	Gear	Paper		
2006	45.8	15.0	Russia	Commercial	OTB	scs 07/06	0.719	20.9
		30.8	Portugal	Commercial	OTB	scs 07/09	0.649	47.4
2007	76.8	5.0	Russia	Commercial	OTB	scs 08/06	1.115	4.5
		71.8	Portugal	Commercial	OTB	scs 08/05	0.564	127.3

Table 8: Length composition (absolute frequencies in '000) of the 3M American plaice catches, 1988-2007.

length group	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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				1.9
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		0.2	3.4
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		2.4	7.9
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		2.9	16.5
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	11.2	17.4
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	7.8	21.4
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	10.9	19.5
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	11.2	11.7
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	8.4	15.4
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	3.9	6.4
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	4.3	4.5
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	1.3	2.2
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	1.8	2.2
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	0.4	0.4
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	1.1	0.6
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	0.2	0.2
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					0.1	
62			0.1			0.001	0.6							0.1		1.0				
64														0.01						
66																				
68																			0.1	
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	68.3	131.8
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	40.2	38.2

Table 9 - Catch at age (000s) of the 3M American plaice, 1988-2007.

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
2006			1	5	7	4	2	3	4	7	7	5	6	6	5	6	68
2007			2	22	22	17	6	4	3	4	8	14	11	8	6	5	132

Table 10 - Mean weight at age of the 3M American plaice catch (Kg), 1988-2007.

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
2006			0.275	0.377	0.438	0.596	0.674	0.534	0.678	0.627	0.719	0.747	0.692	0.732	0.790	1.144
2007			0.177	0.306	0.472	0.567	0.614	0.778	0.604	0.816	0.612	0.691	0.723	0.653	0.716	1.202
mean		0.088	0.200	0.334	0.444	0.562	0.676	0.764	0.823	0.893	0.958	1.043	1.152	1.231	1.385	1.539

Table11: American plaice exploitaion pattern given by the generalized logit of the 1988-07 observed partial recruitment (See text).

Age	F at age index	Observed PR	Logit PR	Squared difference
1	0.000	0.000	0.053	0.003
2	0.168	0.147	0.147	0.000
3	0.464	0.406	0.407	0.000
4	1.083	0.949	0.948	0.000
5	1.142	1.000	1.000	0.000
6	0.989	0.866	1.000	0.018
7	0.947	0.829	1.000	0.029
8	1.083	0.949	1.000	0.003
9	1.097	0.961	1.000	0.002
10	1.131	0.990	1.000	0.000
11	1.128	0.988	1.000	0.000
12	1.125	0.985	1.000	0.000
13	1.022	0.895	1.000	0.011
14	1.045	0.915	1.000	0.007
15	0.963	0.844	1.000	0.024
16	0.856	0.750	1.000	0.062
		Minimum sum of squares		0.157

Curve parameters	*a*	*b*	*m*
	-27.497	7.076	0.144

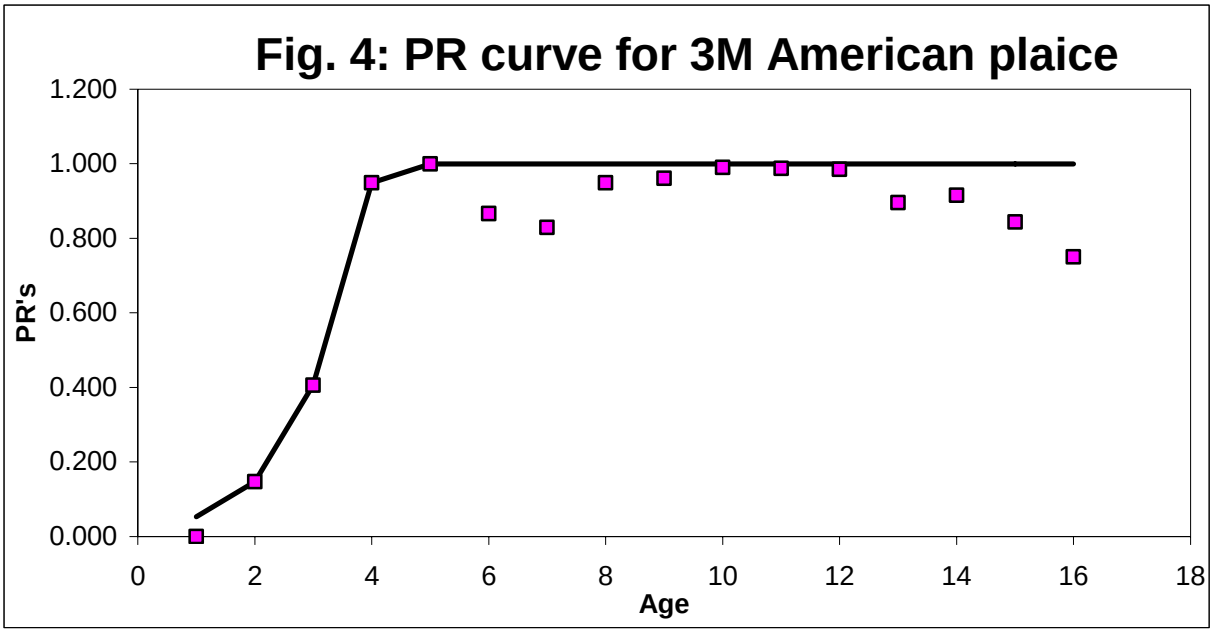


Table 12 A: Yield per recruit parameters for 3M American plaice.

Age	mean weights 1988-07		og mat (%)	PR 88-07	Ref. M
	stock	catch			
1	0.015	*0.015*	0.000	0.053	0.20
2	0.072	*0.088*	0.000	0.147	0.20
3	0.169	*0.200*	0.000	0.407	0.20
4	0.305	*0.334*	0.000	0.948	0.20
5	0.450	*0.444*	0.500	1.000	0.20
6	0.557	*0.562*	1.000	1.000	0.20
7	0.657	*0.676*	1.000	1.000	0.20
8	0.750	*0.764*	1.000	1.000	0.20
9	0.803	*0.823*	1.000	1.000	0.20
10	0.868	*0.893*	1.000	1.000	0.20
11	0.943	*0.958*	1.000	1.000	0.20
12	1.032	*1.043*	1.000	1.000	0.20
13	1.167	*1.152*	1.000	1.000	0.20
14	1.239	*1.231*	1.000	1.000	0.20
15	1.411	*1.385*	1.000	1.000	0.20
16+	1.604	*1.539*	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	2416	0	1961	2,084
	0.000	2416	0	1961	1,591
	0.035	1895	56	1450	931
	0.070	1546	88	1111	566
	0.105	1299	108	874	352
	0.140	1119	120	704	222
F0.1	**0.162**	**1030**	**126**	**621**	**208**
	0.175	982	128	576	139
	0.210	876	133	479	85
	0.245	791	136	402	48
	0.280	722	138	341	23
	0.315	664	138	292	4
Fmax	**0.346**	**622**	**139**	**256**	**0**
	0.385	575	138	218	-16
	0.420	540	138	190	-22
	0.455	510	137	167	-27
	0.490	483	136	146	-30
	0.525	459	135	129	-32

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

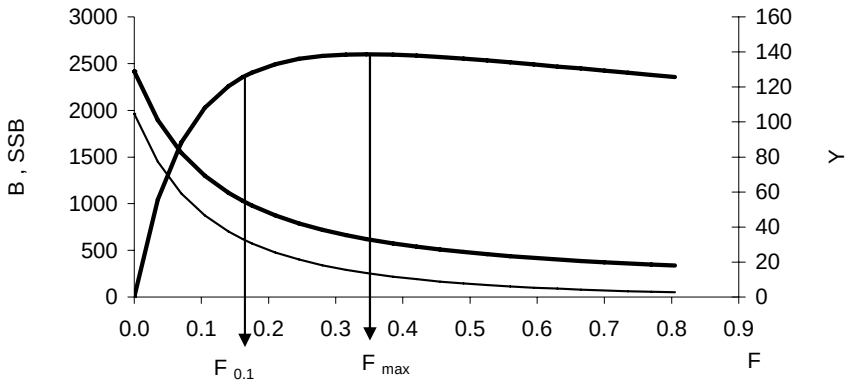


Table 13 - Trend of the 3M American plaice F index based in EU survey series (ages 8-11).

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
2006	13	395	0.033
2007	13	184	0.071

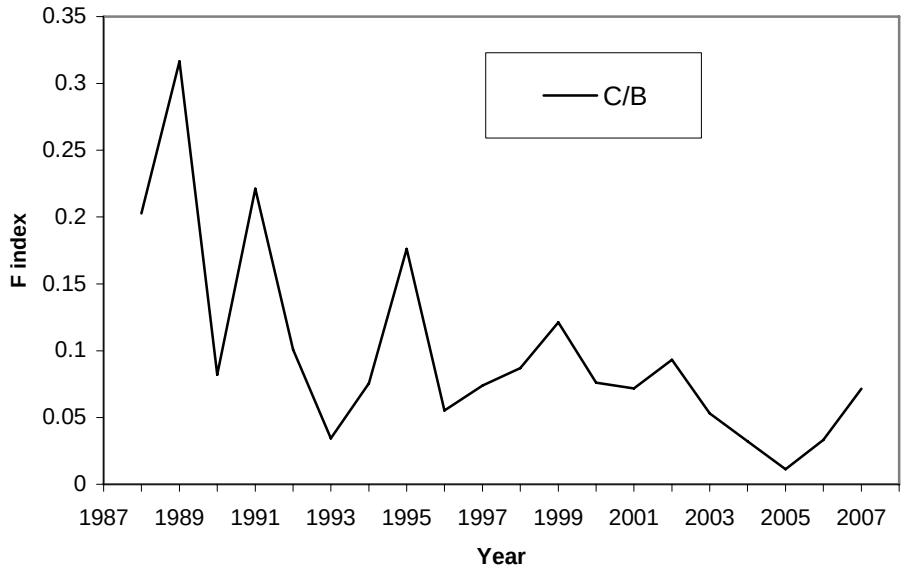


Fig. 6. Trend of the 3M American plaice F index based in EU survey.

Table 14. Evolution of Recruit ('000) and SSB ('000 tons) EU survey index during the period 1988-2007.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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	1.7	1.0
Age 3 recruits	1619	6621	1581	1628	886	1536	45	115	116	110	31	23	7	52	32	32	280	111	37	13

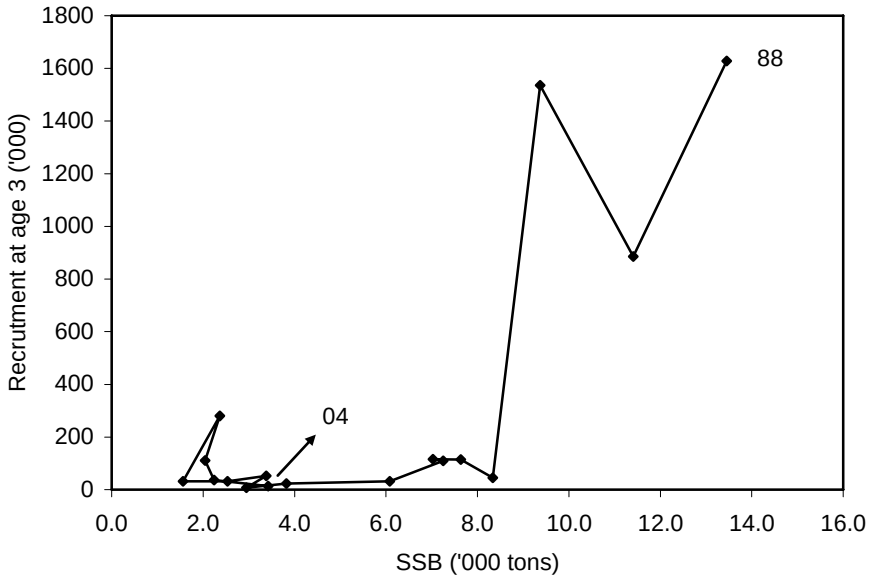


Fig. 7. SSB-Recruitment scatter plot based in EU survey series.

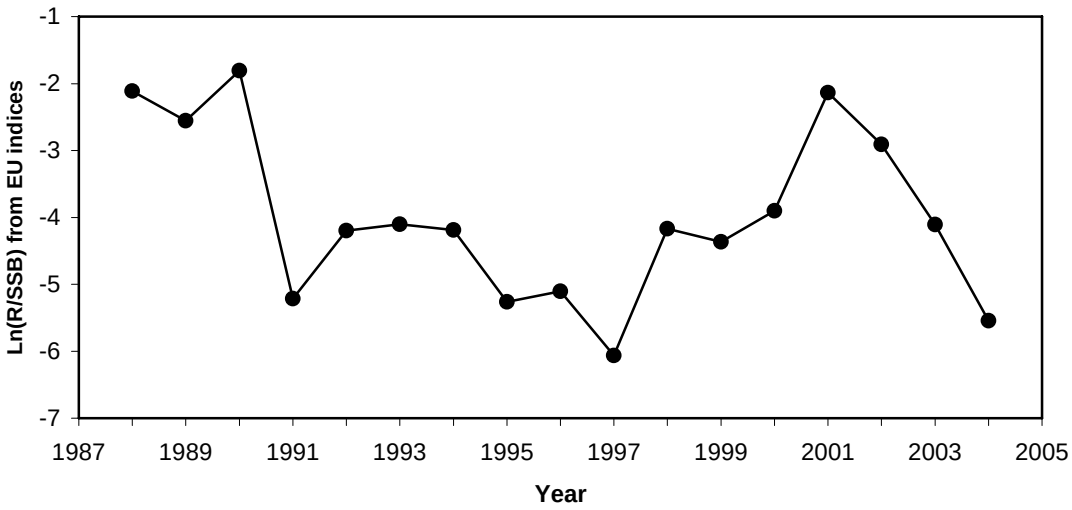


Fig. 8. Recruit at age 3 produced per kg of SSB index from EU indices.

Table 15: Lowestoft XSA input files for 3M American plaice (2008 assessment)

AMERICAN PLAICE NAFO DIVISION 3M INDEX OF INPUT FILES JUNE 2008
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 LANDINGS tons
1 1
1988 2007
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
45.8
76.8

AMERICAN PLAICE NAFO 3M CATCH NUMBERS thousands
1 2
1988 2007
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
0.000	0.000	0.859	5.373	7.441	4.493	2.172	2.958	3.848	6.616	6.628	5.314	6.224	5.512	4.797	6.065
0.000	0.000	1.918	21.693	21.885	16.890	6.026	3.864	3.409	3.501	8.490	13.740	11.357	8.088	6.142	4.761

AMERICAN PLAICE NAFO 3M CATCH WEIGHT AT AGE kg
1 3
1988 2007
1 16
1

0.015	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
0.015	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
0.015	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
0.015	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
0.015	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
0.015	*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
0.015	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
0.015	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
0.015	*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
0.015	*0.088*	*0.200*	*0.334*	0.445	0.639	0.726	0.682	0.949	1.059	1.097	1.270	1.261	1.509	1.508	1.513
0.015	*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
0.015	*0.088*	*0.200*	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
0.015	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
0.015	*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
0.015	*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
0.015	*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
0.015	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
0.015	*0.088*	*0.200*	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
0.015	*0.088*	0.275	0.377	0.438	0.596	0.674	0.534	0.678	0.627	0.719	0.747	0.692	0.732	0.790	1.144
0.015	*0.088*	0.177	0.306	0.472	0.567	0.614	0.778	0.604	0.816	0.612	0.691	0.723	0.653	0.716	1.202

AMERICAN PLAICE NAFO 3M STOCK WEIGHT AT AGE kg
1 4
1988 2007
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
0.015	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
0.015	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
0.015	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	*0.072*	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
0.015	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
0.015	*0.072*	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
0.015	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
0.015	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
0.018	0.119	0.212	0.350	0.475	0.600	0.711	0.673	0.715	0.679	0.792	0.845	0.769	0.876	0.925	1.294
0.010	0.079	0.128	0.354	0.588	0.621	0.695	0.987	0.912	0.949	0.783	0.767	0.913	0.874	0.873	1.537

Table 15: cont.

AMERICAN PLAICE NAFO 3M NATURAL MORTALITY

```
     1     5
1988  2007
     1    16
     3
   0.2
```

AMERICAN PLAICE NAFO 3M PROPORTION MATURE AT AGE

```
     1     6
1988  2007
     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  2007
     1    16
     3
  0.42
```

AMERICAN PLAICE NAFO 3M PROPORTION OF M BEFORE SPAWNING

```
     1     8
1988  2007
     1    16
     3
  0.42
```

AMERICAN PLAICE NAFO 3M F ON OLDEST AGE GROUP BY YEAR

```
     1     9
1988  2007
     1    16
     5
 0.171
 0.267
 0.069
 0.187
 0.085
 0.029
 0.064
 0.149
 0.047
 0.062
 0.073
 0.102
 0.064
 0.060
 0.079
 0.045
 0.027
 0.010
 0.028
 0.060
```

AMERICAN PLAICE NAFO 3M F AT AGE IN LAST YEAR

```
     1    10
1988  2007
     1    16
     2
```

0.000	0.011	0.029	0.068	0.071	0.062	0.059	0.068	0.069	0.071	0.071	0.070	0.064	0.065	0.060	0.054

AMERICAN PLAICE NAFO 3M SURVEY TUNNING DATA

```
   101
EU BOTTOM TRAWL SURVEY
1988  2007
   1     1   0.5   0.6
   1    15
```

10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	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
10555	7.3	28.2	36.7	106.5	132.7	139.0	72.2	56.6	123.0	163.2	199.8	193.4	192.4	211.3	200.2
10555	207.2	6.7	13.4	35.2	105.8	119.4	49.3	48.6	34.5	47.3	75.8	122.0	143.2	82.1	74.9

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

AMERICAN PLAICE NAFO DIVISION 3M INDEX OF INPUT FILES JUNE 2008
CPUE data from file pla3mtun.txt

Catch data for 20 years. 1988 to 2007. Ages 1 to 16.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU BOTTOM TRAWL SURV	1994	2007	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 :
Final estimates not shrunk towards mean F
Minimum standard error for population estimates derived from each fleet = .500
Prior weighting not applied

Tuning converged after 103 iterations

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

Fishing mortalities

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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	0.001	0.000	0.000	0.015	0.003	0.000	0.002	0.000	0.002	0.006
4	0.001	0.008	0.049	0.033	0.027	0.004	0.005	0.000	0.009	0.068
5	0.003	0.011	0.068	0.051	0.026	0.008	0.009	0.001	0.015	0.046
6	0.009	0.018	0.059	0.027	0.073	0.014	0.017	0.002	0.020	0.043
7	0.029	0.045	0.034	0.030	0.059	0.017	0.042	0.006	0.010	0.034
8	0.065	0.081	0.029	0.081	0.080	0.037	0.029	0.008	0.025	0.023
9	0.066	0.092	0.060	0.083	0.116	0.066	0.062	0.016	0.062	0.036
10	0.100	0.082	0.069	0.098	0.084	0.086	0.064	0.023	0.072	0.074
11	0.166	0.181	0.054	0.094	0.076	0.113	0.078	0.016	0.080	0.123
12	0.231	0.153	0.084	0.120	0.059	0.105	0.104	0.034	0.056	0.236
13	0.133	0.093	0.058	0.087	0.069	0.071	0.058	0.046	0.098	0.163
14	0.355	0.110	0.041	0.078	0.040	0.113	0.056	0.038	0.063	0.178
15	0.225	0.130	0.096	0.051	0.052	0.129	0.073	0.032	0.044	0.092

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1998	394.0	664.0	629.0	738.0	575.0	829.0	1060.0	992.0	629.0	361.0
1999	586.0	323.0	543.0	514.0	604.0	469.0	672.0	839.0	761.0	482.0
2000	785.0	480.0	264.0	445.0	418.0	489.0	377.0	526.0	634.0	569.0
2001	687.0	642.0	393.0	216.0	347.0	320.0	378.0	299.0	419.0	489.0
2002	1220.0	562.0	526.0	317.0	171.0	270.0	255.0	300.0	225.0	315.0
2003	1210.0	1000.0	460.0	429.0	252.0	137.0	205.0	197.0	227.0	164.0
2004	669.0	994.0	821.0	377.0	350.0	205.0	110.0	165.0	155.0	174.0
2005	533.0	548.0	814.0	670.0	307.0	284.0	165.0	86.6	131.0	119.0
2006	542.0	436.0	449.0	667.0	549.0	251.0	232.0	134.0	70.4	106.0
2007	20800.0	444.0	357.0	366.0	541.0	443.0	202.0	188.0	107.0	54.1

Estimated population abundance at 1st Jan 2008

0.0	17100.0	363.0	291.0	280.0	423.0	347.0	160.0	151.0	84.8

Taper weighted geometric mean of the VPA populations:

1520.0	1170.0	1060.0	967.0	838.0	707.0	598.0	492.0	398.0	314.0

Standard error of the weighted Log(VPA populations) :

1.036	0.905	0.903	0.904	0.884	0.897	0.931	0.908	0.903	0.828

Table 16: Cont.

XSA population numbers (Thousands)

YEAR \ AGE	11	12	13	14	15
1998	230.0	176.0	67.7	51.4	37.4
1999	268.0	160.0	115.0	48.6	29.5
2000	364.0	183.0	112.0	85.5	35.6
2001	434.0	282.0	138.0	86.7	67.2
2002	363.0	324.0	205.0	103.0	65.6
2003	238.0	276.0	250.0	157.0	81.2
2004	123.0	174.0	203.0	191.0	115.0
2005	134.0	93.5	128.0	157.0	148.0
2006	95.6	108.0	74.0	100.0	124.0
2007	80.8	72.2	83.2	54.9	77.1

Estimated population abundance at 1st Jan 2008

41.1	58.4	46.7	57.9	37.7

Taper weighted geometric mean of the VPA populations:

256.0	196.0	149.0	111.0	63.8

Standard error of the weighted Log(VPA populations) :

0.714	0.650	0.603	0.633	0.904

Log catchability residuals.
Fleet : EU BOTTOM TRAWL SURV

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	-0.56	99.99	-0.15	0	99.99	0.25	0.69	99.99	99.99	-0.53	99.99	99.99	0.3	0
2	-0.36	-0.24	0.05	-0.48	0.09	99.99	0.43	0.6	99.99	-1.7	1.24	0.53	0.64	-0.81
3	-1.47	0	0.63	0.54	-0.35	-0.51	-1.01	0.63	-0.15	-0.04	1.57	0.65	0.14	-0.64
4	1.26	0.63	0.12	-1.63	-1.06	-0.35	0.07	0.41	0.15	0.18	0.08	0.86	-0.12	-0.6
5	0.79	1.29	0.36	-0.72	-0.68	-0.64	0.06	0.22	-0.93	0.25	-0.09	0.33	-0.02	-0.21
6	0.53	0.91	0.92	-0.23	-0.23	-0.86	-0.23	-0.82	-0.17	0.06	0.26	-0.08	0.32	-0.38
7	0.76	1.07	0.51	0.57	0.09	-0.4	-0.53	-0.6	-0.71	-0.34	0.57	0.34	-0.56	-0.78
8	1.59	0.82	0.24	-0.72	0.27	-0.2	-0.89	0.27	-0.49	0.06	0.08	0.49	-0.52	-1.01
9	0.22	0.99	-0.03	-0.17	-0.21	-0.42	-0.52	0.02	-0.36	0.24	0.43	0.47	0.52	-1.19
10	1.02	-0.25	0.45	-0.2	-0.16	-0.8	-0.45	0.02	-0.67	0.29	0.43	0.36	0.27	-0.3
11	0.03	0.09	-0.18	0.4	0.01	-0.01	-0.77	-0.2	-0.5	0.31	0.54	0.19	0.44	-0.34
12	0.06	-0.09	-0.5	-0.09	0.16	-0.11	-0.4	0.01	-0.81	0.03	0.84	0.55	0.16	0.2
13	-0.11	0.12	-0.29	-1.4	-0.12	-0.35	-0.84	-0.09	-0.23	-0.33	0.31	0.58	0.55	0.17
14	0.23	0.64	0.25	0.16	0.53	0.48	-0.87	0.21	-0.12	0.16	0.32	0.51	0.32	0.04
15	0	-0.2	-0.3	-0.33	0.08	0.31	-0.14	0.07	0.27	0.21	0.63	0.1	0.05	-0.44

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	-13.7657	-12.5375	-11.7972	-10.8619	-10.5479	-10.0581	-9.7603	-9.4854	-9.0838	-8.9499
S.E(Log q)	0.4224	0.7842	0.7847	0.7472	0.6172	0.5456	0.6272	0.7092	0.5418	0.4969

Age	11	12	13	14	15
Mean Log q	-8.8096	-8.6964	-8.6964	-8.6964	-8.6964
S.E(Log q)	0.3727	0.4101	0.5455	0.4265	0.2878

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	1.08	-0.526	14.31	0.87	8	0.48	-13.77
2	1.71	-0.79	16.75	0.11	12	1.37	-12.54
3	1.04	-0.108	12.01	0.37	14	0.85	-11.8
4	0.75	1.223	9.79	0.67	14	0.55	-10.86
5	0.71	2.249	9.32	0.83	14	0.38	-10.55
6	0.78	1.586	9.23	0.82	14	0.40	-10.06
7	0.74	1.769	8.80	0.80	14	0.43	-9.76
8	0.81	0.974	8.82	0.69	14	0.58	-9.49
9	1.05	-0.248	9.27	0.64	14	0.59	-9.08
10	1.30	-1.131	10.00	0.54	14	0.64	-8.95
11	1.42	-1.591	10.30	0.55	14	0.5	-8.81
12	1.28	-0.906	9.74	0.46	14	0.53	-8.70
13	0.84	0.579	8.19	0.52	14	0.45	-8.84
14	0.95	0.254	8.31	0.72	14	0.37	-8.49
15	0.98	0.161	8.59	0.86	14	0.29	-8.67

Table 16: Cont.

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age
Year class = 2006

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	17069	0.5	0	0	1	1	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
17069	0.5	0	1	0	0

Age 2 Catchability constant w.r.t. time and dependent on age
Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	363	0.426	0.496	1.16	2	1	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
363	0.43	0.5	2	1.164	0

Age 3 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	291	0.576	0.64	1.11	2	1	0.006

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
291	0.58	0.64	2	1.111	0.006

Age 4 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	280	0.462	0.334	0.72	3	1	0.068

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
280	0.46	0.33	3	0.723	0.068

Age 5 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	423	0.3	0.308	1.03	5	1	0.046

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
423	0.3	0.31	5	1.029	0.046

Age 6 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	347	0.312	0.486	1.56	5	1	0.043

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
347	0.31	0.49	5	1.559	0.043

Table 16: Cont.

Age 7 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	160	0.3	0.217	0.72	5	1	0.034

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
160	0.3	0.22	5	0.724	0.034

Age 8 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	151	0.232	0.201	0.86	8	1	0.023

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
151	0.23	0.2	8	0.865	0.023

Age 9 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	85	0.215	0.201	0.94	9	1	0.036

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
85	0.21	0.2	9	0.935	0.036

Age 10 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	41	0.224	0.211	0.94	8	1	0.074

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
41	0.22	0.21	8	0.939	0.074

Age 11 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	58	0.185	0.091	0.49	11	1	0.123

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
58	0.19	0.09	11	0.492	0.123

Age 12 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	47	0.174	0.128	0.73	12	1	0.236

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
47	0.17	0.13	12	0.732	0.236

Table 16: Cont.

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	58	0.177	0.123	0.69	12	1	0.163

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
58	0.18	0.12	12	0.693	0.163

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	38	0.16	0.158	0.99	14	1	0.178

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
38	0.16	0.16	14	0.988	0.178

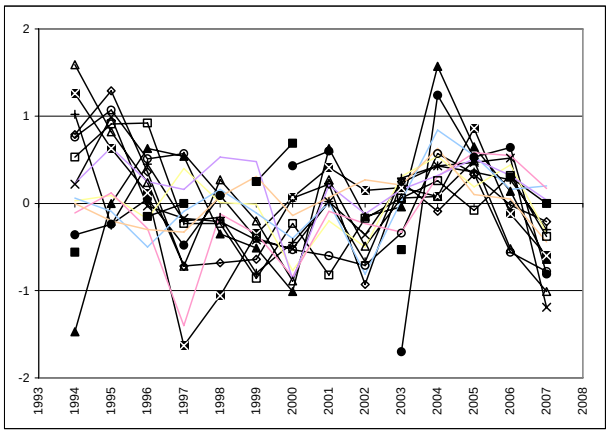
Age 15 Catchability constant w.r.t. time and age (fixed at the value for age) 12
Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	58	0.161	0.143	0.89	14	1	0.092

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
58	0.16	0.14	14	0.888	0.092

Fig.9. Log catchability residuals



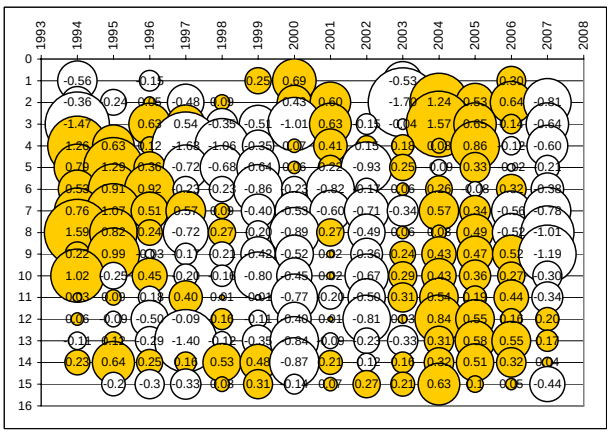


Table 17: Extended Survivor Analysis results.

YEAR	RECRUITS Age 1 (Thousands)	TOTAL BIOMASS (Tonnes)	SPAWNING BIOMASS (Tonnes)	FBAR 3-13	FBAR 8-11
1988	3754	14366	9580	0.2674	0.2878
1989	3859	11521	7091	0.4214	0.4804
1990	4465	7895	5145	0.1194	0.1203
1991	6416	7312	4227	0.3002	0.4223
1992	4150	6563	3928	0.1661	0.2975
1993	2429	6099	3681	0.0454	0.0644
1994	1311	6769	3990	0.1214	0.1935
1995	1345	6503	3830	0.2575	0.3315
1996	938	4978	3465	0.0661	0.0782
1997	811	4393	3413	0.0560	0.0836
1998	394	4215	3316	0.0732	0.0993
1999	586	3852	3047	0.0694	0.1090
2000	785	2942	2389	0.0513	0.0530
2001	687	2439	1941	0.0653	0.0891
2002	1224	2709	2165	0.0608	0.0887
2003	1215	1987	1489	0.0474	0.0754
2004	669	2082	1451	0.0428	0.0582
2005	533	2192	1571	0.0138	0.0159
2006	542	1807	1162	0.0408	0.0596
2007	20846	1888	1170	0.0774	0.0641

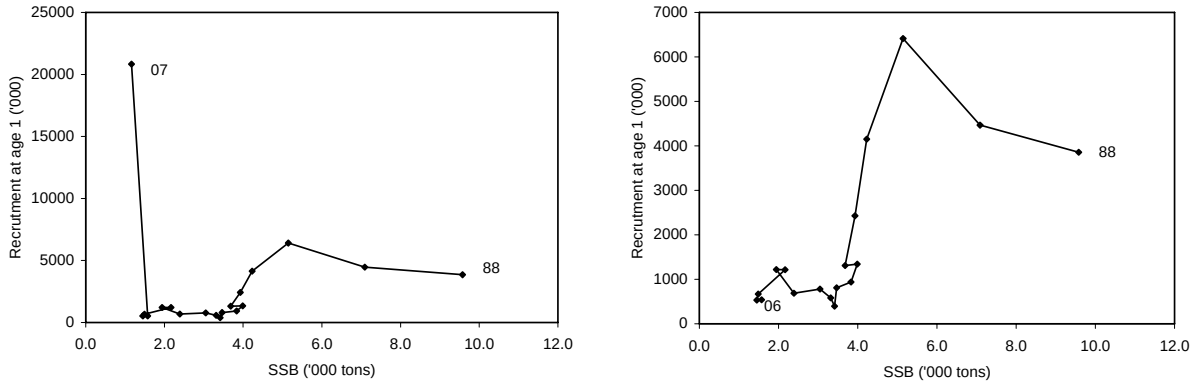


Fig. 10. SSB-Recruitment scatter plot based in XSA results.

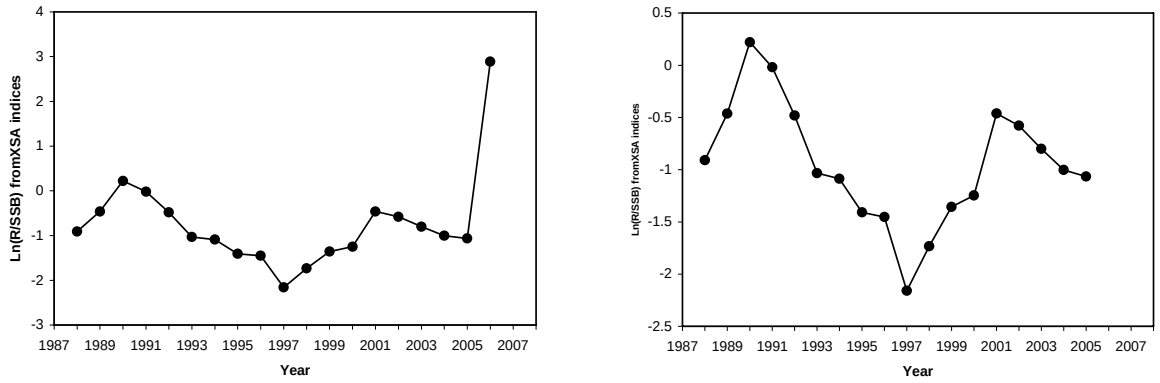


Fig. 11. Recruit at age 1 produced per kg of SSB index from XSA indices.

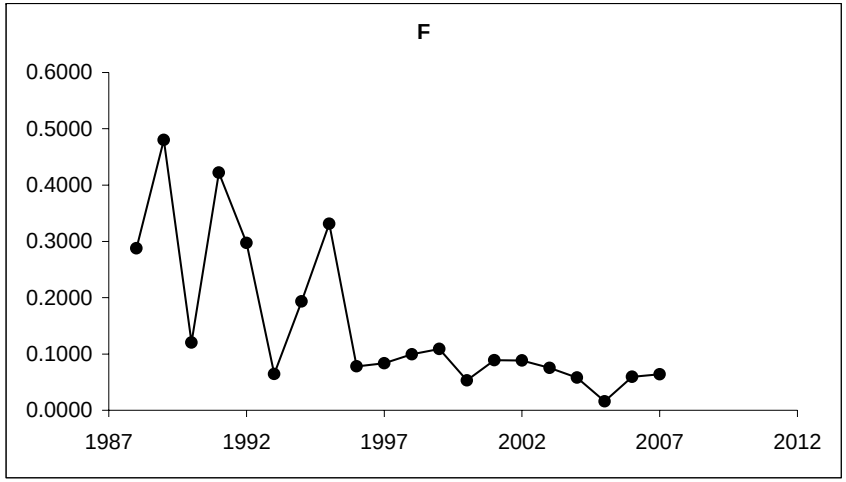
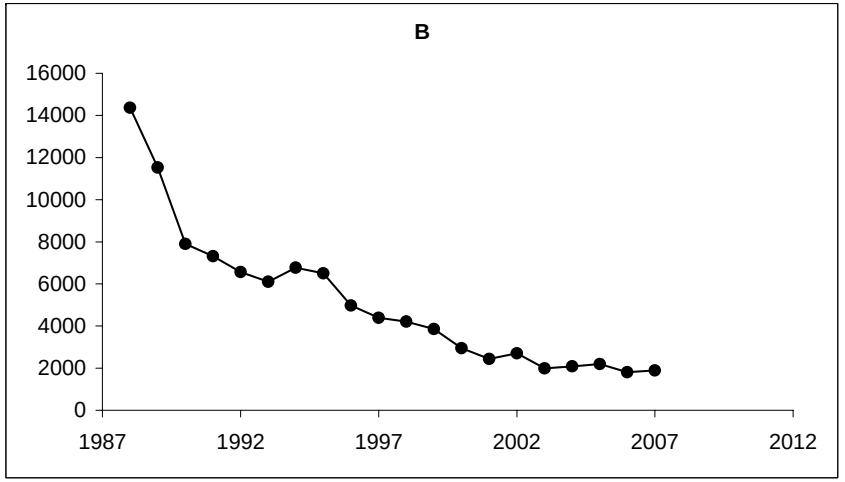


Fig.12 A. Extended Survivor Analysis results for F (age 8-11)



Tfig. 12 B. Extended Survivor Analysis results for total biomass (tons)

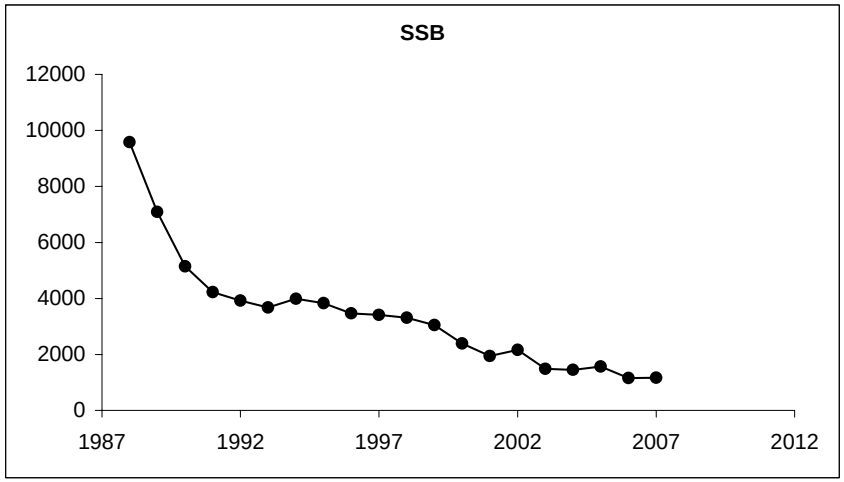


Fig. 12 C: Extended Survivor Analysis results for spawning biomass (tons)

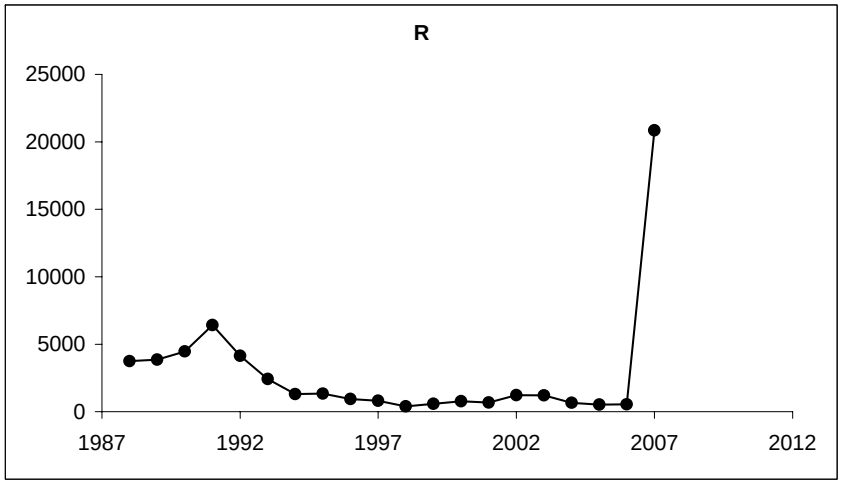


Fig.12 D: Extended Survivor Analysis results for recruits at age 1 ('000)

Table 18: XSA retrospective analysis, 2007-2003

F (3-13)	2007	2006	2005	2004	2003
1988	0.2674	0.2642	0.2658	0.2656	0.2663
1989	0.4214	0.4137	0.4176	0.4172	0.4187
1990	0.1194	0.1165	0.118	0.1179	0.1185
1991	0.3002	0.2901	0.2953	0.295	0.2974
1992	0.1661	0.1572	0.1618	0.1616	0.1642
1993	0.0454	0.0428	0.0442	0.0443	0.0453
1994	0.1214	0.1145	0.1183	0.1187	0.1224
1995	0.2575	0.2397	0.2498	0.2521	0.2651
1996	0.0661	0.0612	0.0644	0.0669	0.0755
1997	0.056	0.0514	0.0541	0.0549	0.0584
1998	0.0732	0.0666	0.0704	0.0719	0.078
1999	0.0694	0.0633	0.0675	0.0709	0.0825
2000	0.0513	0.0467	0.051	0.058	0.0757
2001	0.0653	0.0585	0.064	0.073	0.1002
2002	0.0608	0.0538	0.06	0.0735	0.1102
2003	0.0474	0.0419	0.0471	0.0591	0.0944
2004	0.0428	0.0368	0.0423	0.056	
2005	0.0138	0.0117	0.0136		
2006	0.0408	0.034			
2007	0.0774				

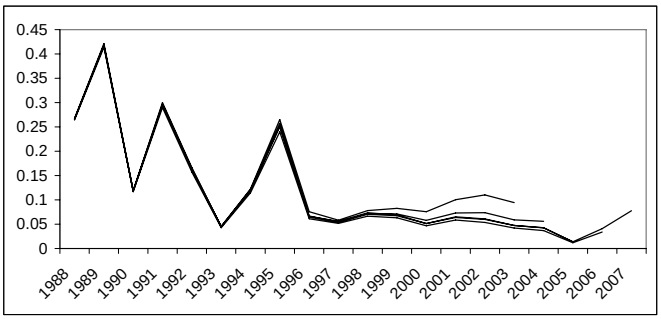


Fig. 13a: F (3-13) XSA retrospective analysis, 2007-2003

F (8-11)	2007	2006	2005	2004	2003
1988	0.2878	0.2830	0.2854	0.2849	0.2853
1989	0.4804	0.4674	0.4739	0.4725	0.4744
1990	0.1203	0.1150	0.1176	0.1171	0.1178
1991	0.4223	0.4039	0.4131	0.4116	0.4148
1992	0.2975	0.2819	0.2900	0.2894	0.2933
1993	0.0644	0.0607	0.0626	0.0627	0.0639
1994	0.1935	0.1831	0.1888	0.1898	0.1937
1995	0.3315	0.3097	0.3217	0.3243	0.3340
1996	0.0782	0.0724	0.0756	0.0763	0.0789
1997	0.0836	0.0768	0.0806	0.0816	0.0851
1998	0.0993	0.0920	0.0965	0.0977	0.1080
1999	0.1090	0.1010	0.1068	0.1109	0.1289
2000	0.0530	0.0487	0.0520	0.0562	0.0722
2001	0.0891	0.0809	0.0883	0.1038	0.1454
2002	0.0887	0.0800	0.0898	0.1144	0.1746
2003	0.0754	0.0667	0.0764	0.1017	0.1733
2004	0.0582	0.0520	0.0610	0.0853	
2005	0.0159	0.0138	0.0163		
2006	0.0596	0.0491			
2007	0.0641				

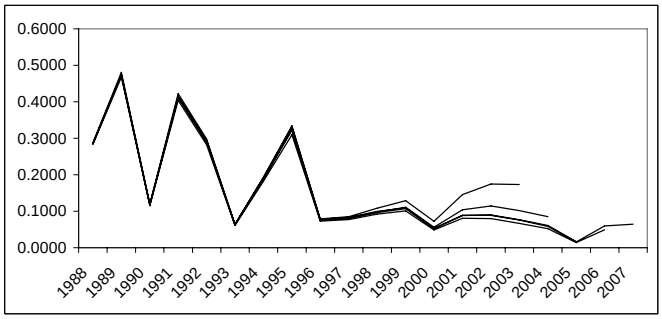


Fig. 13b: F (8-11) XSA retrospective analysis, 2007-2003

TOTALBIO	2007	2006	2005	2004	2003
1988	14366	14655	14506	14527	14482
1989	11521	11813	11660	11675	11622
1990	7895	8191	8034	8043	7976
1991	7312	7610	7446	7446	7336
1992	6563	6896	6705	6685	6501
1993	6099	6441	6237	6193	5930
1994	6769	7166	6918	6830	6440
1995	6502	6906	6635	6467	5943
1996	4979	5355	5080	4845	4255
1997	4393	4756	4482	4225	3654
1998	4215	4574	4288	3990	3379
1999	3853	4204	3910	3582	2951
2000	2942	3251	3004	2695	2143
2001	2439	2748	2535	2262	1773
2002	2708	3083	2845	2504	1894
2003	1987	2327	2154	1846	1340
2004	2083	2531	2384	1917	
2005	2192	2708	2566		
2006	1807	2410			
2007	1888				

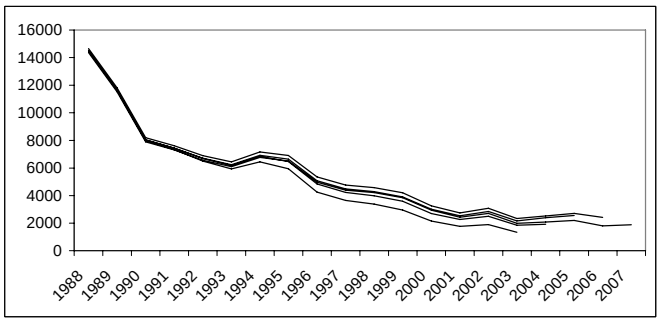


Fig. 13c: Biomass (thousand tons) XSA retrospective analysis, 2007-2003

TOTSPBIO	2007	2006	2005	2004	2003
1988	9581	9809	9692	9715	9689
1989	7091	7316	7200	7220	7190
1990	5146	5357	5248	5264	5231
1991	4227	4431	4324	4334	4298
1992	3928	4156	4035	4039	3993
1993	3681	3908	3785	3785	3726
1994	3991	4254	4106	4103	3980
1995	3830	4099	3938	3914	3671
1996	3465	3720	3550	3474	3135
1997	3413	3691	3498	3361	2959
1998	3315	3606	3397	3209	2742
1999	3047	3328	3107	2878	2385
2000	2389	2620	2421	2184	1745
2001	1942	2150	1968	1752	1375
2002	2165	2410	2192	1929	1448
2003	1489	1691	1526	1313	940
2004	1451	1699	1551	1341	
2005	1571	1863	1711		
2006	1162	1457			
2007	1170				

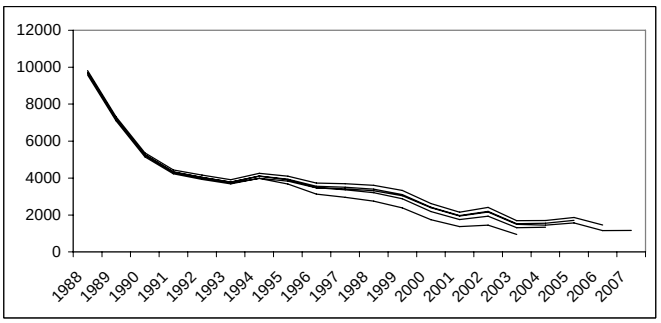


Fig. 13d: SSB (thousand tons) XSA retrospective analysis, 2007-2003

Table 18: cont.

RECRUITS	2007	2006	2005	2004	2003
1988	3754	3891	3814	3799	3707
1989	3859	4017	3913	3894	3789
1990	4465	4685	4533	4506	3979
1991	6416	6686	6485	6358	5749
1992	4150	4368	4139	3760	3175
1993	2429	2744	2535	2181	1591
1994	1311	1415	1270	999	710
1995	1345	1442	1291	1047	789
1996	938	1010	871	679	454
1997	811	962	865	699	520
1998	394	474	394	360	203
1999	586	852	865	741	562
2000	785	1066	1124	1136	861
2001	687	976	847	656	533
2002	1224	1646	1899	319	150
2003	1215	1687	1637	1696	482
2004	669	1152	1384	0	
2005	533	1261	0		
2006	542	964			
2007	20846				

RECRUITS	2007	2006	2005	2004	2003
1988	3754	3891	3814	3799	3707
1989	3859	4017	3913	3894	3789
1990	4465	4685	4533	4506	3979
1991	6416	6686	6485	6358	5749
1992	4150	4368	4139	3760	3175
1993	2429	2744	2535	2181	1591
1994	1311	1415	1270	999	710
1995	1345	1442	1291	1047	789
1996	938	1010	871	679	454
1997	811	962	865	699	520
1998	394	474	394	360	203
1999	586	852	865	741	562
2000	785	1066	1124	1136	861
2001	687	976	847	656	533
2002	1224	1646	1899	319	150
2003	1215	1687	1637	1696	482
2004	669	1152	1384	0	
2005	533	1261	0		
2006	542	964			
2007					

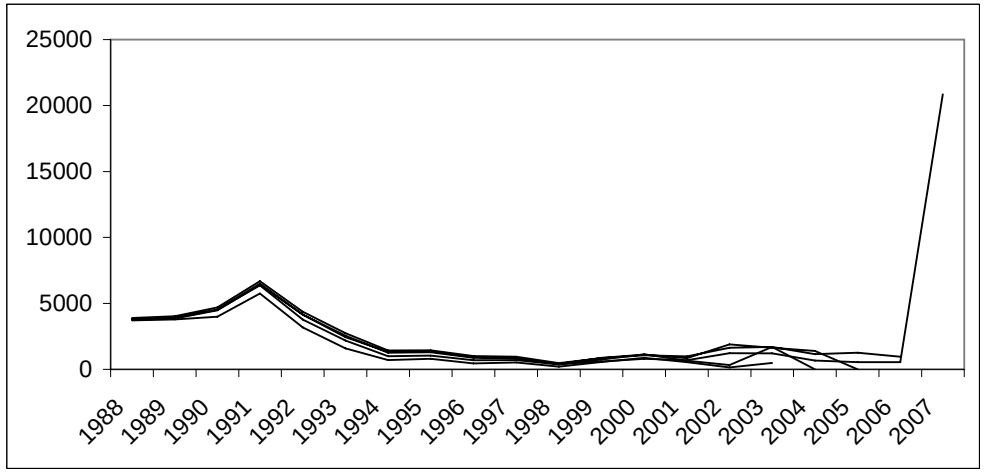


Fig. 13e: Recruitment (thousands - age 1) XSA retrospective analysis, 2007-2003

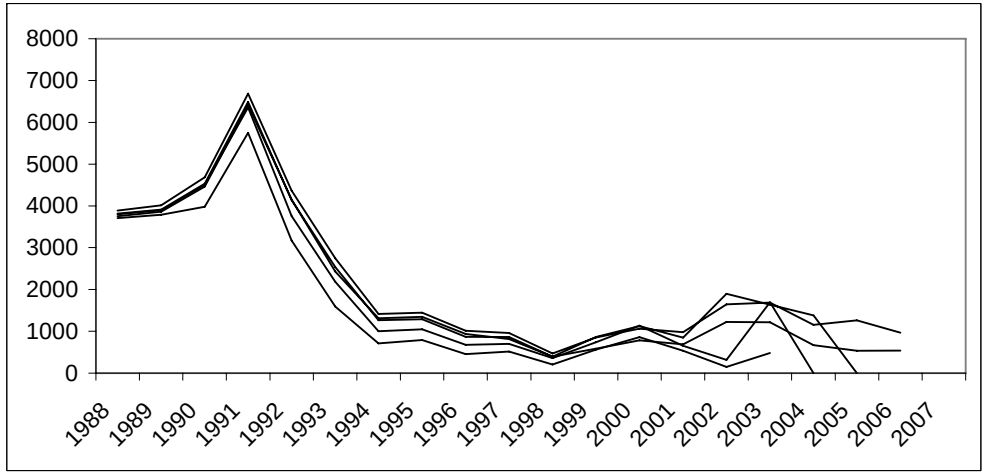


Fig. 13f: Recruitment (thousands - age 1) XSA retrospective analysis, 2007-2003 (without 2007 point)