



Serial No. N7411

NAFO SCR Doc. 23/024

SCIENTIFIC COUNCIL MEETING - JUNE 2023

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

by

R. Alpoim¹

¹ Instituto Português do Mar e da Atmosfera, IPMA
R. Alfredo Magalhães Ramalho 6, 1495-006 Algés, Lisboa, Portugal.

Abstract

The present assessment evaluates the status of the 3M American plaice stock. Due to the lack of ALKs for recent years the previous models used to assess this stock, and illustrative to give the advice, were not update, therefore the assessment is done base in the catches and the survey data.

All of the 1991 to 2005 year-classes were estimated to be weak. Two pulses of recruitment were observed from 2008-2012 and 2015-2018 but with less strength than those before the middle 90s, since then the recruitment is poor. Both EU survey (1988-2022) stock biomass and abundance recorded a minimum in 2007, due to recruitment failure. Both indices increased from 2007 to 2017. As of 2017, EU survey biomass seems to show a small increase, but is due to the growth of existing year classes. EU survey abundance, despite a small variation, shows a stable trend or even a slight drop. Fishing mortality index (C/B) declined from the mid-1980s to the mid-2000s and since then fluctuated at or below 0.1. The stock is at levels similar to the mid-1990s, when the fishery was closed.

Introduction

General considerations

On Flemish Cap American plaice mainly occurs at depths shallower than 600 m. The last full assessment was done in 2020 (Alpoim, 2020).

Catch trends and TAC regulation

Nominal catches from 1960-2021 were obtained from NAFO Secretariat and recalculated from NAFO statistical data base, using the NAFO STATLANT 21A Extraction Tool 3 June 2023. The STATLANT 21A for 2021 is incomplete and for 2022 is not available. STACFIS catches, since 1988, were estimated based in several sources, but in recent years are estimated by the NAFO Catch Estimation Strategy Advisory Group (CESAG). 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 tonnes. Till the end of the 1960's catches remained at a low level within 80 tonnes and 150 tonnes, jumping to a higher 600 - 1 100 tonnes level on the early-1970's. Since 1974 this stock became regulated and catches ranged from 600 tonnes (1981) to 5 600 tonnes (1987). After 1987 catches declined to 300 tonnes (1996), following the fast decline of the stock biomass and the reduction of the Spanish directed effort (1992). From 1986 to 1989 and in 1995 catches exceed the TAC. Since 1997 catches have remained low and declined to a historical minimum in 2012 (63 tonnes). Catches increased afterwards, oscillating between 100 tonnes (2021) and 300 tonnes (2019) and are taken as bycatch mainly in the Div. 3M cod and redfish



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

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 summarized 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 (1988-2022) (González Troncoso *et al.*, 2023 - SCR 23/003).

EU- Spain/Portugal has 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 30 min. The fishing gear used was a Lofoten gear with effective 30 mm mesh size in the codend. The full description of the survey could be found in the survey protocol (Vázquez *et al.*, 2014).

In June 2003 a new Spanish research vessel, the RV “*Vizconde de Eza*” (VE), replaced the RV “*Cornide de Saavedra*” (CS) that had 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 1988-2002 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 35 mm 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 CS were transformed to the R/V VE scale to make them comparable. The results of the calibration shown that the new RV VE is 33% more efficient than the former RV CS as regards American plaice (González-Troncoso and Casas, 2005 – SCR 05/29). Data from 1988-2002 R/V CS were converted to R/V VE, 2003-2022 data are original from R/V VE (González-Troncoso *et al.*, 2023 - SCR 23/003).

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

The stock length composition matrix was updated since the last assessment (Alpoim, 2020; González-Troncoso *et al.*, 2021, 2022 and 2023). Length compositions (Table 3 and Fig. 4) from 1988 to 2022 were given by the EU survey.

Length weight relationships

Length weight relationships for the 3M American plaice (1988-2022) were calculated with EU survey length/weight data from both males and females (González-Troncoso, *pers. comm.* 2023) and used in this assessment on an annual basis (Table 4).

Stock abundance-at-age

Unfortunately, the age length keys (ALK) for the years 2020-2022 were not available. Therefore, it was not possible to update any age-dependent data, matrices or analyses. Consequently, it was not possible to update any age-dependent data, matrices or analyses, for either the stock or the catches.

Recruitment proxy

The maximum mean length for ages 1 to 4 were calculated based on the EU survey mean length at age 1988-2019 matrix. The abundance less than 16cm was considered a proxy for age 1, the abundance less than 24cm was considered a proxy for ages 1 to 2, the abundance less than 32cm was considered a proxy for ages 1 to 3 and finally the abundance less than 36cm was considered a proxy for ages 1 to 4. The trends of these survey abundances are shown in Fig. 5.

Commercial Data

Length composition of the commercial catch and by-catch

The length compositions presented in the 2020 Portuguese and Russian Research Reports (Vargas *et al.*, 2021; Fomin and Pochtar, 2021) were used to estimate the length composition of the 2020 total catch. The length composition presented in the 2021 Portuguese Research Report (Vargas *et al.*, 2022) was used to estimate the length composition of the 2020 total catch. The length compositions presented in the 2022 Portuguese Research Report (Vargas *et al.*, 2023) were used to estimate the length composition of the 2022 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:

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

where N_{LC} is the number observed in length-class LC and \bar{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 5. The commercial catch at length matrix (Alpoim, 2020) was updated with the 2020, 2021 and 2022 data (Table 6 and Fig. 6).

Assessment

Due to the lack of ALKs, the previous models used to assess this stock, and illustrative to give the advice, were not update, therefore the assessment is done base in the catches and the survey data.

Comments on trends on stock indicators

The two former USSR-Russian survey series showed a decreasing trend in biomass and abundance between 1976 and 1993 (Fig. 3). The Russian surveys in 2001-2002 show very low estimates of biomass and abundance. From 1978 till 1985 Canadian series was stable, with survey biomass and abundance around 6 700 tonnes and

10 million fish. A continuous decline in abundance and biomass is observed since the beginning of EU survey 1988 (Tables 2 and Fig. 3) till 2007 when the abundance and biomass reached the lowest values of this series (1 053 tonnes and 1.4 million fishes). From 2008 to 2011, due to improved recruitment (in particular the 2006 year-class), biomass and abundance indices increased rapidly. From 2012 to 2014, abundance declined mainly due to the entry of the weak 2010-2011 year-classes. From 2014 to 2017, recruitment has improved slightly and the EU's survey abundance shows an upward trend on that period. The EU's survey biomass from 2008 to 2017 shows the same trend, but with a faster upward trend due to the growth of existing year classes (Alpoim, 2020). Results of the 1996 Canadian survey are comparable with the 1996 EU survey (Fig. 3) (Alpoim *et al.*, 2002; Alpoim, 2003; González-Troncoso *et al.*, 2023). As of 2017, EU survey abundance, despite a small variation, shows a stable trend or even a slight drop. EU survey biomass seems to show a small increase, but is due to the growth of existing year classes.

The recruitment proxy indicates that the best represented year-classes at the beginning of the series (1988) till 2007, lost its strength (Tab. 3 and Figs 4 and 5). In the period between 1992 and 2007, all the recruiting was poorly represented in the EU survey. Two pulses of recruitment were observed from 2008-2012 and 2015-2018 but with less strength than those before the middle 90s, since then the recruitment is poor (Fig 5).

Commercial catches of American plaice resulting from bycatch in other fisheries have slightly declined over the past three years. Although cod and redfish TACs have varied, based on the values of the American plaice bycatch, it is not possible to say that the stock has improved considerably.

A proxy to fishing mortality (F) has been giving by the ratio between catch and EU survey total biomass. Despite the variability, decreased, from high values in the beginning of the series (1988), to 0.016 in 2005. Since then this F index fluctuated at or below 0.1 (Table 7, Fig. 7).

Conclusions

All of the 1991 to 2005 year-classes were estimated to be weak. Two pulses of recruitment were observed from 2008-2012 and 2015-2018 but with less strength than those before the middle 90s, since then the recruitment is poor.

Both EU survey stock biomass and abundance recorded a minimum in 2007, due to consistent year-to-year recruitment failure from the 1991 to 2005 year-classes. Both indices increased from 2007 to 2017. As of 2017, EU survey biomass seems to show a small increase, but is due to the growth of existing year classes. EU survey abundance, despite a small variation, shows a stable trend or even a slight drop.

Fishing mortality index (C/B) declined from the mid-1980s to the mid-2000s and since then fluctuated at or below 0.1.

Stock status

The stock has increased since 2007 due to improved recruitment but these increase was halted in recent years, the stock is at levels similar to the mid-1990s, when the fishery was closed. Recruitment is low. Both catches and F remain low.

Acknowledgements

This study was supported by the European Commission (DG Mare), IPMA, CSIC-IEO and CSIC-IIM.

References

Alpoim R., Darby C. and Ávila de Melo, A. M., 2002. An assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. NAFO SCR Doc. 02/62. Serial No. N4674. 37p.

- Alpoim R., 2003. A stock status update of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. NAFO SCR Doc. 03/44. Serial No. N4862. 12p.
- Alpoim R., 2020. An assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. NAFO SCR Doc. 20/039. Serial No. N7087. 47p.
- Bishop C.A., - 1994. Revisions and additions to stratification schemes used during research vessel surveys in NAFO Subareas 2 and 3. NAFO SCR Doc 94/43. Serial No. N2413, 23p.
- Fomin, K. and Pochtar, M., 2021. Russian research report for 2020. NAFO SCS Doc. 21/09, Serial No. N7168, 36 p.
- González-Troncoso, D., Casas, J.M. and Ramiro, L., 2021. Results from Bottom Trawl Survey on Flemish Cap of June-July 2021. NAFO SCR Doc. 21/005REV, Serial No. N7166. 68p.
- González-Troncoso, D., Garrido, I., Rábade, S., Fabeiro, M., Román, E., Tarrío, C., Casas, J.M., and Alpoim, R., 2022. Results from Bottom Trawl Survey on Flemish Cap of June-July 2021. NAFO SCR Doc. 22/004, Serial No. N7268. 66p.
- González-Troncoso, D., Rábade, S., Casas, J.M., Irene Garrido, I., Fabeiro, M., Román, E. and Alpoim, R., 2023. Results from Bottom Trawl Survey on Flemish Cap of June-July 2022. NAFO SCR Doc. 23/003, Serial No. N7381. 89p.
- González Troncoso, D. and Casas, J.M., 2005. Calculation of the Calibration Factors from the Comparative Experience between the R/V *Cornide de Saavedra* and the R/V *Vizconde de Eza* in Flemish Cap in 2003 and 2004. NAFO SCR Doc.05/29. Serial No. N5115. 8p.
- Vargas J., Alpoim, R., Santos E. and Ávila de Melo A. M., 2021. Portuguese research report for 2000. NAFO SCS Doc. 21/05. Serial No. N7161. 24p.
- Vargas J., Alpoim, R., Santos E. and Ávila de Melo A. M., 2022. Portuguese research report for 2021. NAFO SCS Doc. 22/13. Serial No. N7290. 55p.
- Vargas J., Alpoim, R., Santos E. and Ávila de Melo A. M., 2023. Portuguese research report for 2022. NAFO SCS Doc. 23/13. Serial No. N7393. 28p.
- Vázquez, A., Casas, J.M. and Alpoim, R., 2014. Protocols of the EU bottom trawl survey of Flemish Cap. Scientific Council Studies, 46: 1–42. doi:10.2960/S.v46.m1

Table 1. Nominal catches (tonnes) from 1960-2022, STACFIS catches (tonnes) from 1988-2022 and TAC (tonnes) from 1974-2022 of American plaice from NAFO Division 3M.

Year	Nominal catches (1)										Flatfishes (NS) Total	Yellowtail f. Total	GRAND TOTAL	STACFIS catches	TAC
	Country														
	Canada	Japan	USSR/SUN	Poland	E/ESP	E/GBR	E/PRT	E/DEU	Other	Total					
1960	-	-	-	-	-	-	-	-	-	0	316	-	316	-	-
1961	-	-	-	-	-	-	-	-	-	0	2282	-	2282	-	-
1962	14	-	-	-	-	-	-	-	-	14	707	-	721	-	-
1963	-	-	51	108	-	20	-	-	-	179	-	-	179	-	-
1964	-	-	1831	8	-	37	-	-	-	1876	-	-	1876	-	-
1965	19	-	4964	216	-	83	-	-	2	5284	57	-	5341	-	-
1966	-	-	4003	17	-	53	-	-	-	4073	-	-	4073	-	-
1967	57	-	-	63	-	33	-	-	1	154	-	-	154	-	-
1968	100	-	121	-	-	4	-	-	-	225	6	-	231	-	-
1969	12	-	113	-	-	-	-	-	-	125	-	-	125	-	-
1970	-	-	62	-	-	-	-	-	-	62	17	-	79	-	-
1971	-	-	1079	-	-	-	-	-	-	1079	-	-	1079	-	-
1972	-	-	665	8	17	65	-	-	106	861	-	-	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	-	137	1329	-	2000
1977	30	-	987	7	18	-	457	1	118	1618	-	10	1628	-	2000
1978	7	49	581	21	36	2	486	100	51	1333	3	-	1336	-	4000
1979	10	63	457	2	16	-	248	-	-	796	4	-	800	-	2000
1980	1	1	909	5	3	-	232	34	-	1185	64	-	1249	-	2000
1981	-	47	309	-	276	-	-	-	-	632	-	-	632	-	2000
1982	-	53	1002	-	17	-	-	-	-	1072	3	-	1075	-	2000
1983	-	9	1238	-	434	-	208	-	-	1889	3	-	1892	-	2000
1984	-	1	711	-	204	-	196	190	-	1302	1	-	1303	-	2000
1985	-	2	971	-	163	-	266	318	-	1720	-	-	1720	-	2000
1986	-	3	962	-	1048	-	1741	-	-	3754	-	3	3757	-	2000
1987	-	-	501	-	4137	-	969	-	-	5607	20	-	5627	-	2000
1988	-	78	228	-	1608	-	941	-	6	2861	127	1	2989	2800	2000
1989	-	402	88	-	2166	-	1238	-	-	3894	72	-	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	-	1	766	765	2000
1993	-	49	-	-	244	-	231	-	181	705	46	20	771	275	2000
1994	-	-	-	-	3	-	251	-	-	254	-	84	338	669	1000
1995	-	-	-	-	125	-	118	-	-	243	14	-	257	1300	1000
1996	-	-	-	-	105	-	29	-	8	142	2	28	172	300	0
1997	-	-	-	-	56	-	52	-	-	108	-	-	108	208	0
1998	-	-	-	-	140	-	47	-	1	188	3	2	193	294	0
1999	-	-	4	-	220	-	18	-	1	243	5	-	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	-	3	7	-	75	-	28	-	17	130	-	15	145	131	0

Year	Nominal catches (1)										Flatfishes (NS) Total	Yellowtail f. Total	GRAND TOTAL	STACFIS catches	TAC
	Country														
	Canada	Japan	USSR/SUN	Poland	E/ESP	E/GBR	E/PRT	E/DEU	Other	Total					
2004	-	4	4	-	39	-	58	-	3	108	-	-	108	81	0
2005	-	-	-	-	59	-	11	-	14	84	1	3	88	45	0
2006	-	-	5	-	32	-	34	-	12	83	-	-	83	46	0
2007	-	-	-	-	41	-	32	-	5	78	-	34	112	76	0
2008	-	-	1	-	15	-	16	-	33	65	-	1	66	68	0
2009	-	-	24	-	17	-	35	-	11	87	-	6	93	70	0
2010	-	-	22	-	10	-	26	-	4	62	3	-	65	65	0
2011	1	-	-	-	13	-	32	-	17	63	-	-	63	63	0
2012	-	-	24	-	21	-	102	-	10	157	-	1	158	123	0
2013	-	-	22	-	66	-	146	-	12	246	-	-	246	246	0
2014	-	-	23	2	69	-	113	-	39	246	-	-	246	247	0
2015	-	-	23	-	68	-	111	-	18	220	-	-	220	268	0
2016	-	-	16	-	25	2	123	-	7	173	-	-	173	161	0
2017	-	-	13	-	12	-	104	-	30	159	-	-	159	157	0
2018	-	2	4	-	12	-	104	-	75	197	-	-	197	215	0
2019	-	3	5	-	27	-	208	-	57	300	-	7	307	302	0
2020	-	-	1	-	11	-	161	-	9	182	-	-	182	187	0
2021 (2)	-	-	1	-	16	-	-	-	18	35	-	-	35	104	0
2022 (3)	-	-	-	-	-	-	-	-	-	-	-	-	0	128	0
2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0

(1) - Recalculated from NAFO statistical data base using the NAFO STATLANT 21A Extraction Tool, on 3-June--2023 and information from NAFO Secretariat.

(2) - STATLANT incomplete

(3) - STATLANT not available

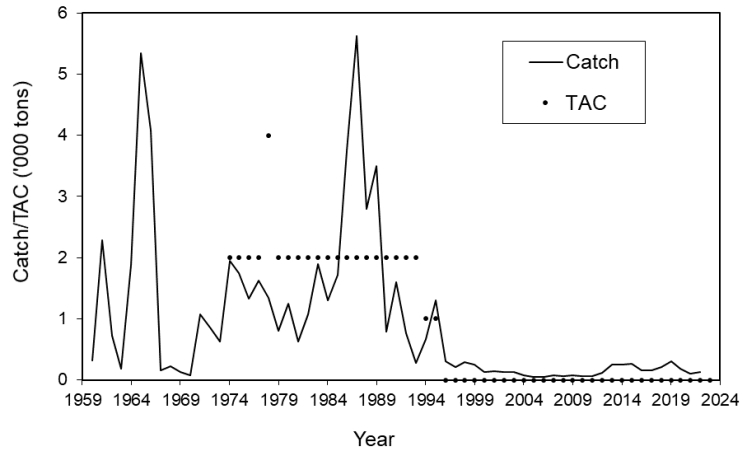


Figure 1. American plaice in Div. 3M: STACFIS catches and agreed TAC's

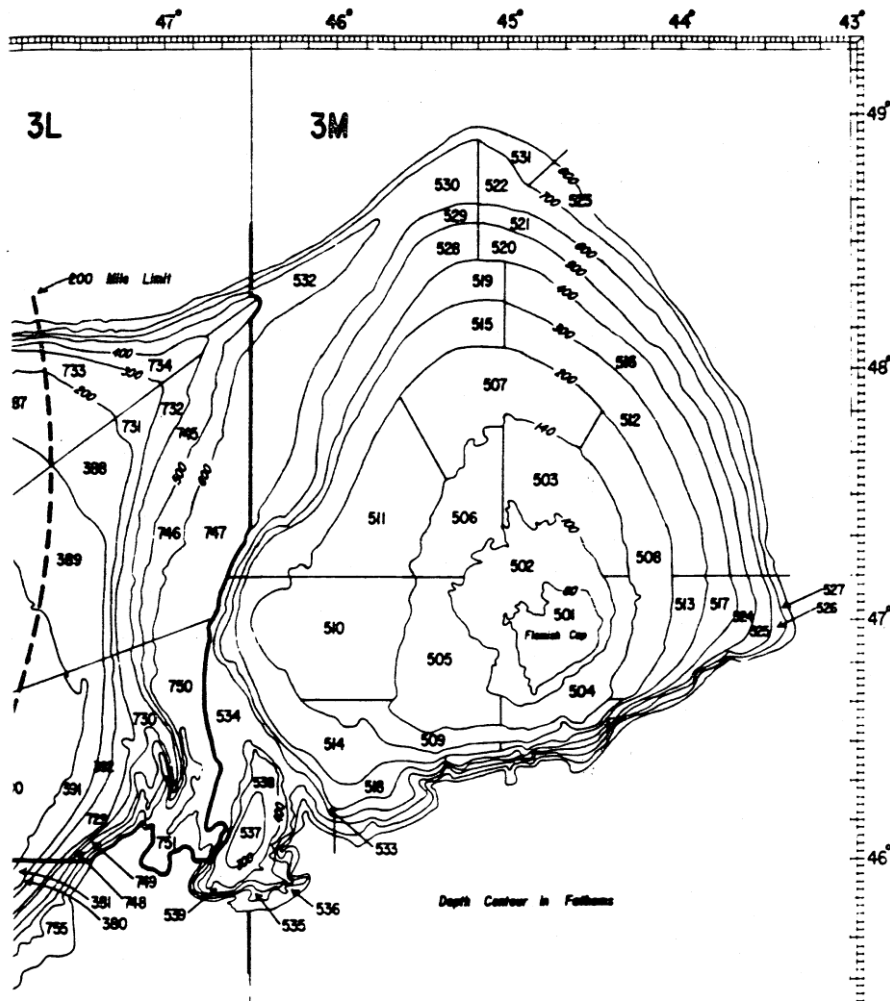


Figure 2. Stratification scheme for stratified-random groundfish surveys in Div 3M (Bishop 1994).

Table 2. EU surveys in Div.3M from 1988-2019: estimates of biomass (tonnes) 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
501	128-146	342	1306	1000	505	1078	709	1079	661	2230	1462	381	156	372	345	1043	141	1292
502	148-183	838	2845	3602	1375	2663	1714	1267	1199	1335	943	740	1587	1810	976	835	1262	713
503	185-256	628	1367	1118	1668	1247	631	444	325	252	168	495	284	97	21	93	75	17
504	185-256	348	2199	461	817	320	557	572	853	489	268	203	343	53	100	85	128	
505	185-256	703	2599	3093	1830	1407	837	1291	1230	549	500	619	744	73	56	112	189	82
506	185-256	496	479	1130	954	501	601	305	808	123	32	13	35	40	25	37	63	29
507	258-366	822	1174	531	837	389	639	319	316	249	72	83	47	19	15	28	52	30
508	258-366	646	417	164	263	251	727	487	171	132	56	123	165	3		45	43	14
509	258-366	314	103	163	343		373	205	20	500	55	36					1	9
510	258-366	951	2323	1491	2000	1308	1406	1459	2236	708	415	287	36	72	45	95	36	54
511	258-366	806	1186	1168	1316	401	372	292	303	109	68	32	29	37	23	27	59	29
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
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
s.e.			1845	2048	1276	1180	954	1040	1373	1083	912	708	751	869	332	429	729	748
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
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
total abundance (000's)			27410	27391	20946	17643	13728	11648	11247	9376	5658	3770	3800	2672	2132	3168	1971	2769
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

Table 2. cont.

Stratum	Depth range (m)	Area (sq. n. mi.)																
			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
501	128-146	342	1507	1038	714	284	144	548	716	693	462	329	181	410	219	1014	764	945
502	148-183	838	768	796	354	209	513	370	1084	1141	1272	1202	1872	1248	1307	4379	1807	831
503	185-256	628	427	101	74	101	147	74	103	364	468	266	223	462	488	410	534	1042
504	185-256	348	395	359	109	153	440	36	91	1201	749	671	258	376	178	342	285	801
505	185-256	703	72	45	63	81	88	72	200	190	716	267	328	443	592	277	421	1602
506	185-256	496	26	71	61	99	37	57	34	160	185	341	187	309	282	314	751	805
507	258-366	822	84	31	37	20	47	32	28	160	156	166	208	117	253	215	389	289
508	258-366	646	55	175	163	58	128	47	49	65	187	156	249	220	346	114	241	206
509	258-366	314	77	18				77			30	25		2	12	2		121
510	258-366	951	45	87	97	24	163	54	115	35	123	153	105	86	325	190	403	336
511	258-366	806	69	35	19	22	50	64	26	33	121	121	185	124	308	188	397	559
512	367-549	670						11			11					10	16	18
513	367-549	249													2			20
514	367-549	602								32				3	3	16	39	28
515	367-549	666		4		3	7	1		10	13		5	22	10	4	51	52
516	550-731	634																
517	550-731	216																
518	550-731	210															12	
519	550-731	414																
total biomass			3525	2760	1691	1053	1766	1442	2446	4084	4491	3698	3800	3821	4325	7475	6109	7654
s.e.			740	684	342	159	300	327	526	780	534	439	671	556	481	1547	558	852
mean catch per tow (kg)			4.38	3.43	2.10	1.31	2.20	1.79	3.04	5.08	5.59	4.61	4.73	4.76	5.37	9.29	7.60	9.52
s.e.			0.92	0.85	0.43	0.20	0.37	0.41	0.65	0.96	0.67	0.54	0.84	0.70	0.60	1.93	0.70	1.07
total abundance (000's)			4015	3326	2188	1401	3263	2839	4962	6917	6614	4670	4477	4951	6525	10127	7187	7796
mean number per tow			4.99	4.14	2.72	1.74	4.06	3.53	6.17	8.60	8.23	5.81	5.57	6.16	8.12	12.60	8.94	9.70

Table 2. cont.

Stratum	Depth range (m)	Area (sq. n. mi.)			
			2021	2022	2023
501	128-146	342	1360	1583	411
502	148-183	838	1793	3603	2096
503	185-256	628	436	982	914
504	185-256	348	571	596	467
505	185-256	703	1107	447	467
506	185-256	496	680	534	755
507	258-366	822	495	419	255
508	258-366	646	119	293	192
509	258-366	314	35		17
510	258-366	951	482	230	282
511	258-366	806	462	667	751
512	367-549	670	128	7	9
513	367-549	249		4	25
514	367-549	602	13		
515	367-549	666	72	6	13
516	550-731	634			
517	550-731	216			
518	550-731	210			
519	550-731	414			
total biomass			7752	9372	6654
s.e.			987	1382	999
mean catch per tow (kg)			9.64	11.66	8.28
s.e.			1.23	1.72	1.24
total abundance (000's)			7250	8812	5785
mean number per tow			9.01	10.96	7.19

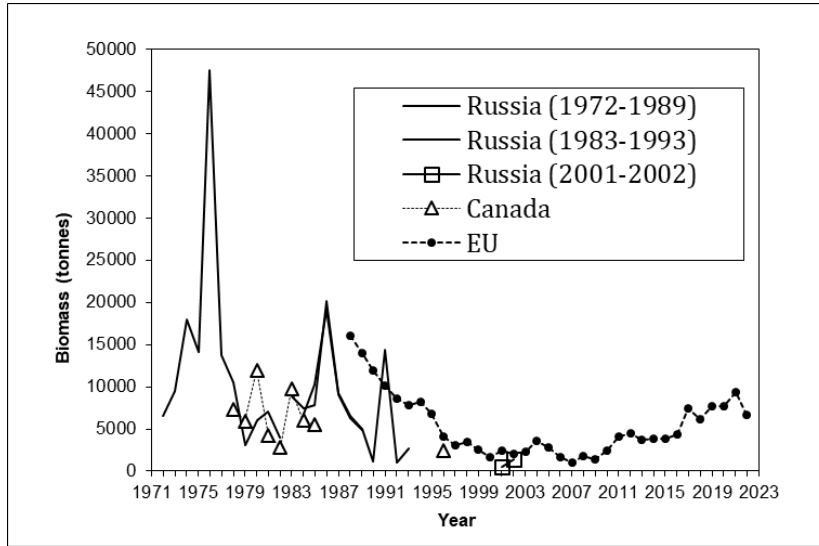


Figure 3A. American plaice in Div. 3M: trends in biomass in the surveys.

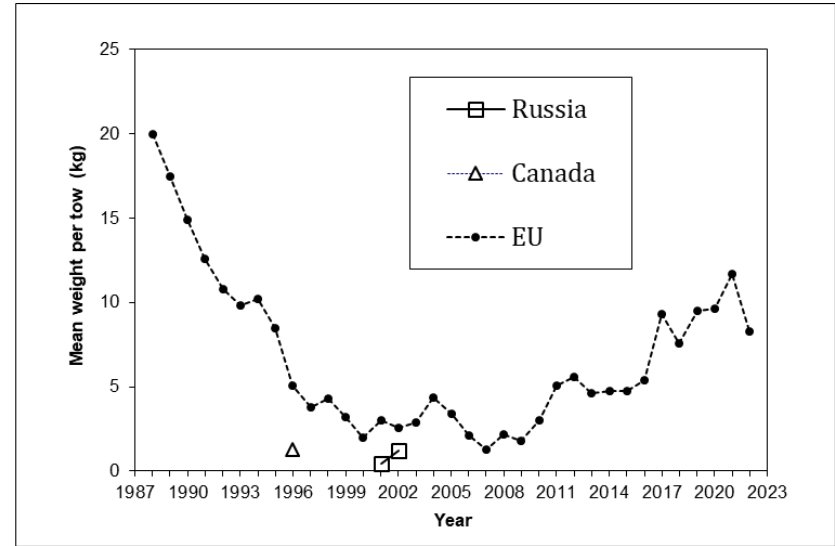


Fig.3C. American plaice in Div. 3M: mean weight per tow in the surveys.

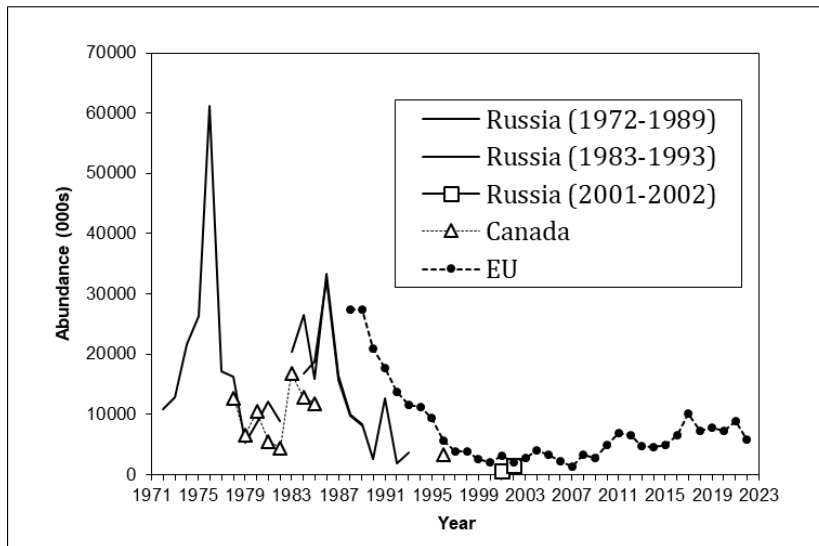


Fig.3B. American plaice in Div. 3M: trends in abundance in the surveys.

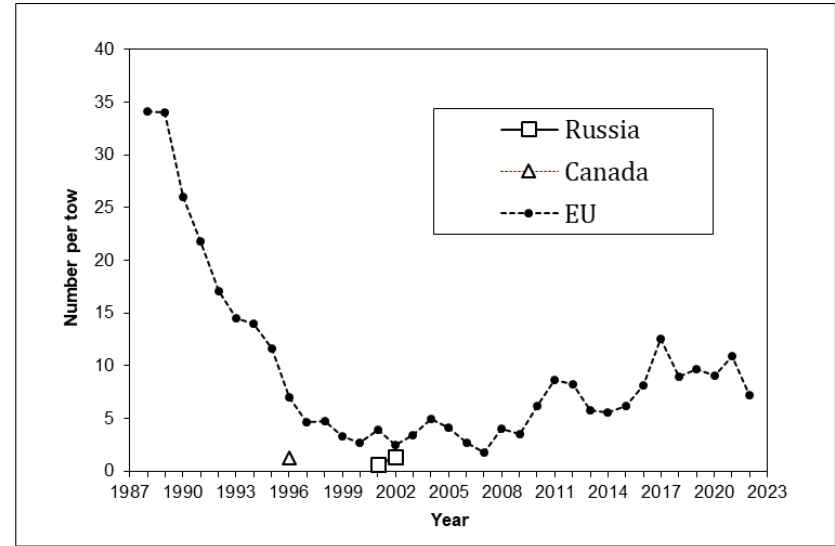


Fig.3D. American plaice in Div. 3M: mean number per tow in the surveys.

Table 3. Length composition (absolute frequencies in '000) of the 3M American plaice stock, EU survey 1988-2022.

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
68																			68
Total	27410	27391	20946	17643	13728	11648	11247	9376	5658	3770	3800	2672	2132	3168	1971	2769	4015	3326	Total
Mean length (cm)	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	Mean length (cm)

Table 3. cont.

Length group	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Length group
4																		4
6																		6
8		20																8
10		174	16	6				13	8	7	34			8	7			10
12	7	13	19	13	10		7	13		7	21			7		34	14	12
14			16	6	10				7	7	8			15				14
16			45	13		29		14	7	55	14		15		8	15	15	16
18			383	46	54	155		27	132	186	48	65	34	23	8	36	42	18
20	14	13	838	146	169	161	30	105	129	268	102	349	47	22	73	98	49	20
22	7		243	101	117	86	38	52	47	68	62	480	80	58	45	91	47	22
24	14		52	171	177	100	67	7	35	62	260	78	14		15	62	20	24
26	7	7		589	340	240	80		88	286	594	111	60	56	8	43	21	26
28	31		16	361	605	574	195	14	108	361	834	282	259	116	29	135	62	28
30	49		8	121	580	805	376	40	95	387	376	329	796	222	52	169	118	30
32	62	41	8	20	660	741	606	140	63	144	247	408	512	218	121	134	70	32
34	90	59	62	27	465	583	849	350	87	61	409	606	338	297	178	144	83	34
36	230	106	83	55	304	561	843	663	192	123	566	571	343	748	345	219	206	36
38	387	121	225	151	219	607	682	604	581	299	467	802	469	880	590	314	207	38
40	364	202	242	185	277	672	657	564	648	380	339	1254	718	680	590	591	226	40
42	221	148	192	160	296	535	768	554	552	475	405	1612	800	717	850	1068	590	42
44	123	87	95	126	78	179	519	462	488	267	308	955	611	854	1072	1487	816	44
46	98	67	64	138	80	88	251	533	411	285	181	539	384	750	923	1175	793	46
48	169	81	67	93	76	119	130	133	313	397	299	388	344	337	526	872	582	48
50	97	101	157	83	151	139	108	86	192	413	314	387	340	416	487	536	524	50
52	91	61	156	97	138	253	153	121	88	189	347	399	418	399	481	478	438	52
54	35	60	174	82	58	151	117	93	95	95	180	260	330	467	398	517	380	54
56	85	33	91	34	97	142	81	48	48	48	67	130	110	254	244	382	287	56
58				14			44	20	56	48	15	32	99	124	97	141	122	58
60	7	7	9				15	14	7	35	14	65	33	93	87	35	47	60
62												19	20	23	15	29	20	62
64											14		6	7		7	7	64
66													7	7				66
68												6						68
Total	2188	1401	3263	2839	4962	6917	6614	4670	4477	4951	6525	10127	7187	7796	7250	8812	5785	Total
Mean length (cm)	42.1	38.9	33.3	34.7	34.9	36.7	39.3	40.9	41.1	38.7	37.5	40.3	41.4	43.7	45.3	45.1	46.1	Mean length (cm)

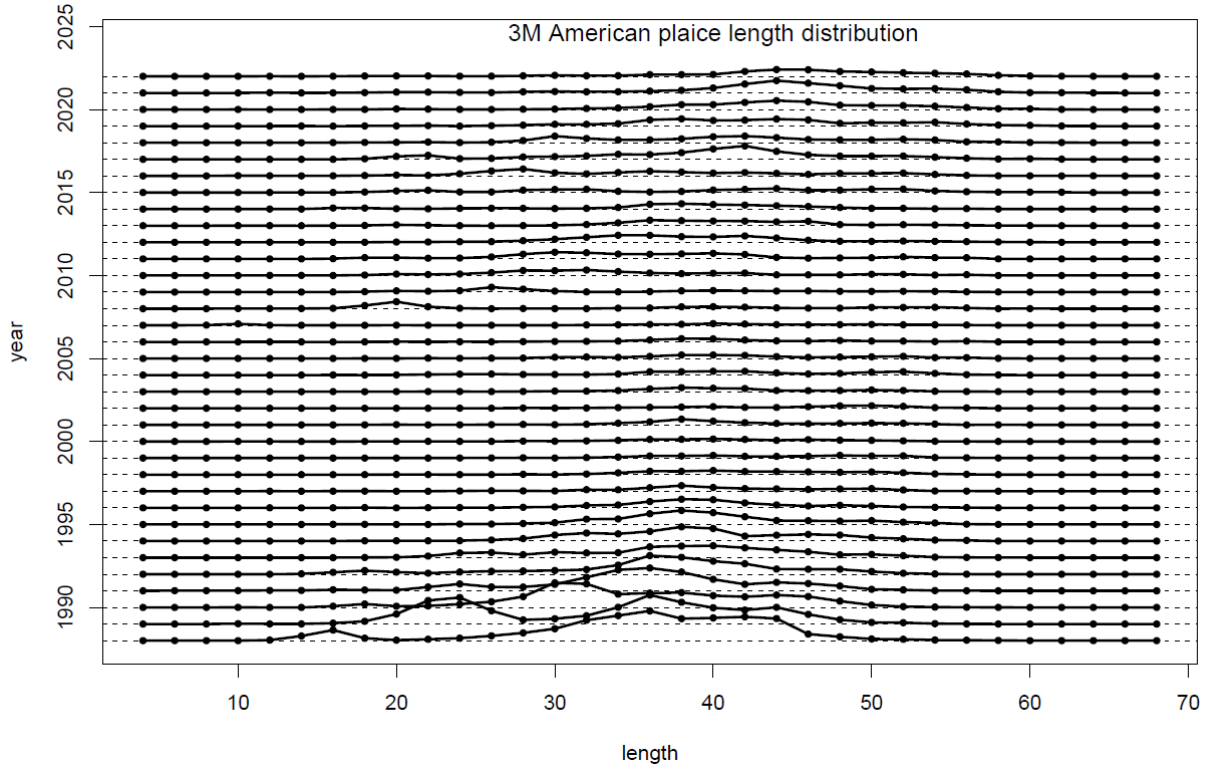


Figure 4. Length composition of the 3M American plaice stock, EU survey 1988-2022.

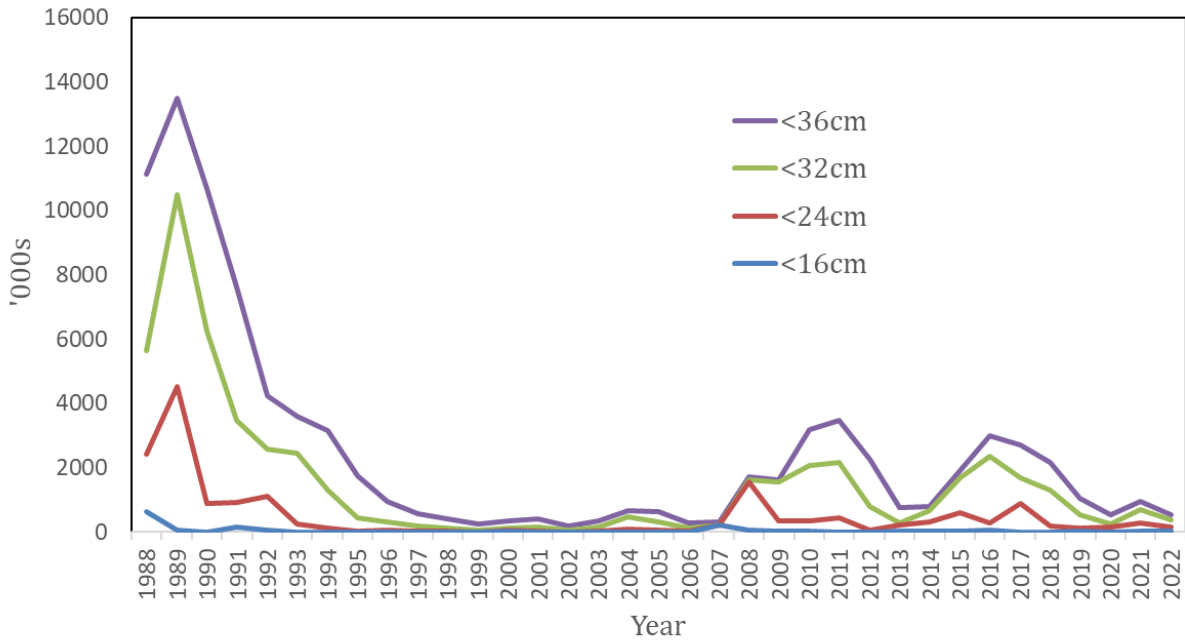


Figure 5. Recruitment proxy of the 3M American plaice stock, EU survey 1988-2022. <16cm proxy for age 1; <24cm proxy for ages 1-2; <32cm proxy for ages 1-3 and <36cm proxy for ages 1-4.

Table 4. EU survey 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	1066
1995	0.0027	3.3474	772
1996	0.0048	3.1978	571
1997	0.0046	3.2116	437
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
2008	0.0062	3.1235	410
2009	0.0051	3.1802	420
2010	0.0037	3.2660	398
2011	0.0033	3.3053	528
2012	0.0037	3.2771	752
2013	0.0042	3.2452	672
2014	0.0038	3.2786	617
2015	0.0038	3.2772	718
2016	0.0042	3.2521	946
2017	0.0035	3.2946	1095
2018	0.0051	3.2008	974
2019	0.0029	3.3359	968
2020	0.0037	3.2764	824
2021	0.0032	3.3047	899
2022	0.0032	3.3088	745

Table 5. Criteria applied to convert total catches in weight to total catches in number, 2020-2022.

YEAR	TOTAL CATCH (tonnes)	BREAKDOWN TOTAL CATCH (tonnes)	LENGTHS COMPOSITION				MEAN WEIGHT (kg)	TOTAL CATCH IN NUMBER (000's)
			Country	Source	Gear	Paper		
2020	186.5	185.7	Portugal	Commercial	OTB	scs 21/05	1.259	147.5
		0.8	Russia	Commercial	OTB	scs 21/09	1.072	0.8
2021	103.6	103.6	Portugal	Commercial	OTB	scs 22/13	1.473	70.3
2022	127.7	127.7	Portugal	Commercial	OTB	scs 23/13	0.805	158.6

Table 6. Length composition (absolute frequencies in '000) of the 3M American plaice catches, 1988-2022.

Length group	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Length group
14																			14
16		19.3	0.8				0.7	3.0											16
18		60.5	3.9				2.9	3.2											18
20	6.9	126.5	2.0		5.3	1.8	3.3												20
22	10.4	88.0	8.2	5.8	1.3	6.9	3.2						0.3	0.1			0.1		22
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		24
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			26
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		28
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		30
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		32
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	34
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	36
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	38
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	40
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	42
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	44
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	46
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	48
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	50
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	52
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	54
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	56
58	3.5		0.8	0.002	4.8	0.7		1.5			0.03			0.1			0.04		58
60					0.01	0.1		1.5						0.04					60
62			0.1			0.001	0.6							0.1		1.0			62
64														0.01					64
66																			66
68																			68
Total	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	Total
Mean length (cm)	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	Mean length (cm)

Table 6. cont.

Length group	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Length group
14					0.5				0.1	0.1								14
16					0.2				1.1									16
18						1.6		0.3	3.6	2.2	1.3							18
20					0.9	4.7	0.4	1.3	8.9	4.8	4.3						4.3	20
22					1.0	6.3	0.9	9.3	30.2	11.3	10.8						0.8	22
24					3.1	7.9	1.4	10.1	34.1	25.3	19.5						19.8	24
26		1.9			2.9	20.4	1.5	25.9	32.1	35.9	24.6						4.3	26
28	0.2	3.3	1.0		2.3	47.1	4.0	36.9	53.8	53.6	46.2			1.1				28
30	2.4	7.9	1.6		7.9	51.0	5.0	43.3	49.3	73.5	85.8	0.5		1.6	0.01		7.6	30
32	2.9	16.4	1.0	3.7	10.0	39.9	17.3	75.1	31.2	60.6	84.9			6.0	0.1			32
34	11.2	17.3	3.1	2.4	19.0	16.8	17.3	37.2	31.9	47.2	58.3	1.7	1.1	10.2	1.1	0.3		34
36	7.8	21.3	5.7	15.9	11.7	7.2	18.1	43.2	16.3	33.3	27.8	2.8	5.0	18.0	4.8		6.8	36
38	10.9	19.4	5.7	14.7	13.7	3.0	27.1	39.2	31.2	26.9	15.3	4.0	13.8	25.0	8.4		18.9	38
40	11.2	11.6	5.2	23.2	5.9	5.5	23.3	23.6	34.6	29.0	11.9	10.0	15.1	48.2	12.5	13.9	12.8	40
42	8.4	15.3	5.2	12.2	3.5	0.7	20.3	21.7	25.4	19.4	4.6	10.2	14.8	53.6	17.3		11.7	42
44	3.9	6.4	2.1	3.7	2.5		21.7	18.7	22.1	14.7	3.4	15.1	20.6	46.3	19.6	14.9	20.6	44
46	4.3	4.5	4.1	4.9	2.9		10.9	11.7	14.6	9.3	1.6	21.3	20.2	29.2	17.3	7.8	9.9	46
48	1.3	2.2	4.1	4.9	1.4	0.4	3.5	12.9	19.6	14.6	1.9	13.1	20.3	19.9	12.5	7.5	5.5	48
50	1.8	2.2	5.2	8.6	2.0	0.4	2.4	10.4	7.5	14.4	3.0	15.4	21.7	22.6	13.9	6.9	16.6	50
52	0.4	0.4	6.2		1.7		1.3	3.9	3.6	10.0	2.3	14.8	18.6	11.8	13.8	0.5	9.0	52
54	1.1	0.6	6.2		0.7		0.8	4.2	2.9	5.3	1.4	11.5	10.3	11.5	10.6	6.9	4.0	54
56	0.2	0.2	2.1		1.9		0.5	3.4	1.1	3.6	0.7	3.2	6.0	3.3	6.7		1.7	56
58			2.6		2.6		0.0	2.1	4.8	1.2	0.6	1.7	2.3	2.4	5.2		0.7	58
60	0.1		2.1		1.3			0.2	0.03	1.3	0.1	0.9	2.0	2.1	2.8	6.9		60
62								0.1		0.5	0.1		1.1	0.6	1.1			62
64					0.5						0.03				0.34	6.94		64
66					0.2													66
68	0.1														0.01			68
Total	68.3	131.1	63.1	94.1	100.3	212.8	177.7	434.7	459.9	497.9	410.3	126.2	172.9	313.5	148.3	72.7	155.1	Total
Mean length (cm)	40.2	38.2	46.1	41.6	38.0	30.8	39.6	36.2	34.7	35.2	32.7	47.9	47.5	44.3	47.9	49.8	40.7	Mean length (cm)

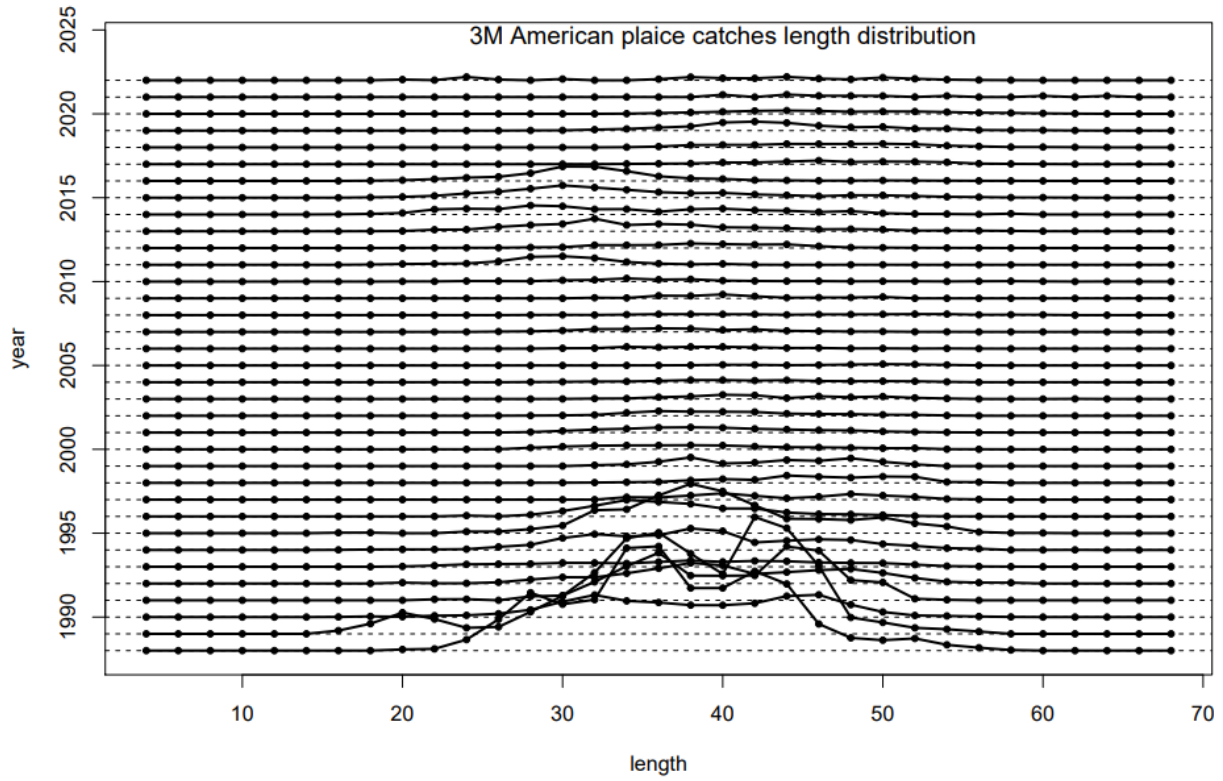
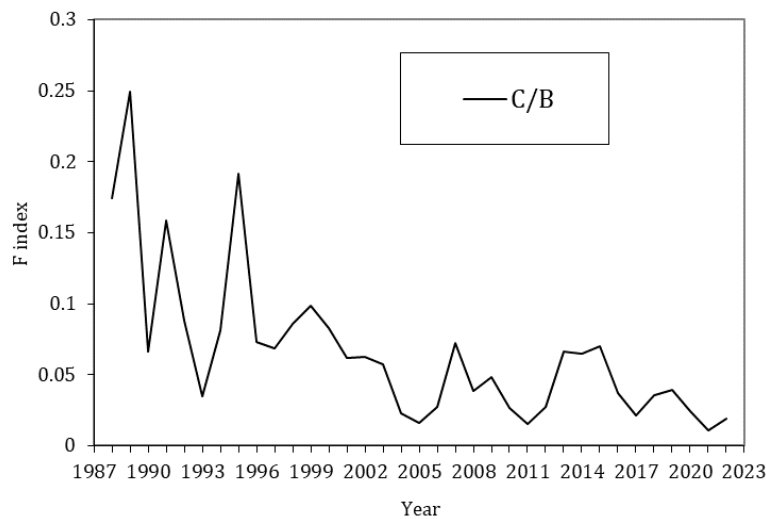


Figure 6. Length composition of the 3M American plaice catches, 1988-2022.

Table 7. Trend of the 3M American plaice F index based in EU survey series (all ages).

Year	Catch (tonnes)	Survey (tonnes)	C/B
1988	2800	16046	0.174
1989	3500	14047	0.249
1990	790	11983	0.066
1991	1600	10087	0.159
1992	765	8656	0.088
1993	275	7861	0.035
1994	669	8227	0.081
1995	1300	6785	0.192
1996	300	4098	0.073
1997	208	3026	0.069
1998	294	3437	0.086
1999	255	2585	0.099
2000	133	1606	0.083
2001	149	2404	0.062
2002	128	2049	0.062
2003	131	2286	0.057
2004	81	3525	0.023
2005	45	2760	0.016
2006	46	1691	0.027
2007	76	1053	0.073
2008	68	1766	0.039
2009	70	1442	0.049
2010	65	2446	0.027
2011	63	4084	0.015
2012	123	4491	0.027
2013	246	3698	0.067
2014	247	3800	0.065
2015	268	3821	0.070
2016	161	4325	0.037
2017	157	7475	0.021
2018	215	6109	0.035
2019	302	7654	0.039
2020	187	7752	0.024
2021	104	9372	0.011
2022	128	6654	0.019

**Figure 7.** Trend of the 3M American plaice F index based in EU survey.