



SCIENTIFIC COUNCIL MEETING - JUNE 1994

An assessment of American plaice stock in Division 3M (1994)

by

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Ref. SCR. Doc. 93/82; 94/22; SCS Doc. 94/3; 94/13; 94/16.

Introduction

Since 1974, when this stock started to be regulated, reported catches ranged from 600 tons in 1981 to the highest value of 5600 tons in 1987. After that catches declined drastically to 275 tons in 1993. Reported catches for 1993 are 456 t, but estimated catches from Canadian surveillance and other sources suggested 275 t as a more realistic value.

The observed reduction in the catches in the last two years is due in part to the shift in the target species to Greenland halibut for the Spanish fleet.

Since 1979 a TAC of 2000 tons has been agreed for this stock. For 1994 a reduction to 1000 t was agreed (Fig. 1).

Recent TAC and Catches ('000) are as follows:

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
TAC	2	2	2	2	2	2	2	2	2	2	1
Catch	1.3	1.7	3.8	5.6	2.8	3.5	0.8 ¹	1.6	0.8	.3	

¹ Provisional.

Input Data

Commercial fishery data

Length compositions are available for Spanish small-freezers and pair-trawlers. A limited sample is also available from Portuguese gill netters. Age length keys for the commercial fishery are available from Spain.

Small-freezer catches ranged between 21-60 cm with a peak at 40 cm. The pair trawler catches were dominated by fish with length between 29 and 62 cm with a main peak at 40 and another at 50 cm.

Ages 5 to 7 were dominant in the catches (Table 1). However there are some discrepancies between catch at age from the commercial catches and survey data, where ages 5 and 7 are less represented. The otolith readers were not the same for the survey and for the commercial catches.

Catch at age matrix

ages	1988	1989	1990	1991	1992	1993
3	34	188	11	14	15	27
4	204	150	184	102	30	30
5	642	507	57	545	86	70
6	1161	998	95	288	282	86
7	790	1041	169	412	73	79
8	1003	499	229	363	148	39
9	289	446	156	222	133	23
10	93	213	69	63	62	19
11	24	169	10	7	36	2
12	52	40	2	3	19	0
13	55	20	2	0	22	0
14	14	8	1	0	0	0
15	27	0	0	0	0	0
Catch (t)	2800	3500	800	1600	800	275

Table 1.- Catch at age for the period 1988-93

Mean weights at age in the catch (Table 2) do not indicate any trend

Mean Weight at age in the catch

Ages	1988	1989	1990	1991	1992	1993	Mean
3	0.181	0.247	0.237	0.117	0.201	0.145	0.188
4	0.264	0.371	0.358	0.304	0.292	0.271	0.310
5	0.293	0.449	0.488	0.472	0.456	0.377	0.422
6	0.445	0.681	0.579	0.619	0.649	0.611	0.597
7	0.619	0.867	0.845	0.873	0.754	0.915	0.812
8	0.864	0.960	0.992	1.064	0.978	1.303	1.027
9	1.001	1.156	1.101	1.282	1.183	1.265	1.165
10	1.198	0.975	1.125	1.380	1.271	1.468	1.236
11	1.233	1.588	2.006	1.477	1.491	1.731	1.588
12	1.504	1.677*	1.887	1.671	1.645		1.677
13	1.806	1.843*	1.726		1.997		1.843
14	1.674	1.716*	1.758				1.716
15	1.755						1.755

* estimated as a mean from the remaining years

Table 2.- Mean weight at age in the catch for the period 1988-90.

Research survey data

The series of research surveys conducted by the EC since 1988 was continued in July 1993. A Russian survey was also conducted in July 1993. From the EC survey, biomass continued to decrease from 6,492 t in 1992 to 5,949 t in 1993 (Table 3, Fig 2) and abundance followed a similar decrease from 10.4 million in 1992 to 9.3 million in 1993 (Table 3). From the Russian surveys, an opposite tendency is observed. Biomass increased from 1 000 ton in 1992 to 2 700 t in 1993 (Table 3) and abundance also increased from 1.5 million in 1992 to 3.6 million in 1993. Differences in the mean weight per fish in both surveys were detected, but these differences did not follow the same pattern in the series. The Russian survey is more variable but the 3 lowest values are 1990, 1992 and 1993. On the other hand the 1993 survey was not conducted in the same month.

Survey data

year	EEC		Russia	
	Num.	Biomass	Num.	Biomass
1983				8900
1984				7500
1985				7800
1986				20200
1987				9300
1988	21219	11868	10000	6500
1989	20500	10533	8300	5000
1990	16631	9101	2600	1200
1991	13932	7565	12700	14400
1992	10363	6492	1900	1000
1993	9268	5949	3600	2700

Table 3.- American plaice: abundance and biomass in the surveys.

Age composition was dominated by the 1986 year class at age 7, which should be fully recruited to the fishery in 1994. The 1990 year-class that appeared in 1992 as the second most abundant at age two since 1988, also appears in 1993 as the second most dominant at age three. The 1991 year class appears to be very weak at age 2. In the 1993 survey there appears to be an inconsistency compared with previous surveys, with ages 12 and older seeming to be more abundant in 1993. This could possibly be due to the change in the otolith reader (Table 4).

Age	1988	1989	1990	1991	1992	1993
2	2284	454	359	309	736	9
3	625	6847	775	911	679	1365
4	3040	1500	7083	1877	910	969
5	1975	3238	897	4461	1471	643
6	3020	3006	2475	1836	3423	320
7	4154	2868	1717	2009	913	3110
8	4258	1691	1657	1566	1090	339
9	1492	587	1030	675	624	592
10	207	261	485	232	289	286
11	109	34	90	8	138	198
12	61	14	15	48	74	229
13			31		16	280
14			17			865
15						28
16						35

Table 4.- Abundance by age group in the EEC survey series (SCR Doc. 94/22).

The spawning stock biomass (50% of age 5 and 100% of age 6+), as estimated from the EEC surveys, increased in 1993 to a value close to the 1990-91, due to the recruitment of the 1986 year-class:

Year	1988	1989	1990	1991	1992	1993
S.S.B.	8.5	5.8	5.3	5.7	3.6*	5.0

* Estimated using mean weight at age in the catch.

Estimation of Parameters

The catch at age matrix was updated with the data of 1993

using the length and age composition available from the commercial catches and the age-length key from the Spanish commercial catches. This matrix was checked by the sum of products and adjusted to the catches.

Last year an analytical assessment was attempted using L/S method but was rejected (SCR. 93/82).

In order to get an overall view on the situation in the most recent period, last year we constructed a catch curve using 1988-90 age distribution of the catches (Fig. 3). In this curve, ages 8 to 11 appear to be fully recruited to the fishery, and from this catch curve, we have estimated the partial recruitment vector (Table 5) and the mean F for this period for these ages, estimated to be 0.53.

Estimation of P.R. from the catch curve.

From the regression line we calculated the expected log(catch) value for each age not fully recruited. The difference between this expected value and that observed gives us a crude estimate of the partial recruitment pattern:

$$IPR_i = e^{(Ln(C_i) - Ln(C_i'))}$$

Where

- IPR_i = Partial recruitment index for age i
- C_i = Catch of age i
- C_{i'} = Estimated catch for age i

We then generated the catch vector from a stock in equilibrium with 1000 recruits at age 3 exposed to a mortality constructed from F = 0.53 (the value estimated from the catch curve) and a P.R.. This P.R. was modified until the calculated catch curve matched that observed. The resulting IPR is given below

Age	Num.	Est.	Num./Est.	IPR
3	234	66859	0.00	0.004
4	538	32258	0.02	0.02
5	1206	15564	0.08	0.08
6	2254	7509	0.30	0.30
7	2000	3623	0.55	0.55
8	1731	1748	0.99	1.00
9	891	843	1.06	1.00
10	375	407	0.92	1.00
11	203	196	1.04	1.00
12	94	95	0.99	1.00
13	77	46	1.68	1.00
14	22	22	1.01	1.00

Annual F = 0.53

AGES	P.R.	F	Num.	Catch	Ln(C)	Est.	Num/Est
3	0.03	0.02	1000	14	2.660	7.896	0.005
4	0.07	0.04	806	27	3.282	7.166	0.021
5	0.20	0.11	636	58	4.061	6.436	0.093
6	0.40	0.21	468	81	4.399	5.706	0.270
7	0.60	0.32	310	77	4.343	4.976	0.531
8	0.99	0.52	185	69	4.233	4.246	0.987
9	1.00	0.53	89	34	3.516	3.516	1.000
10	1.00	0.53	43	16	2.786	2.786	1.000
11	1.00	0.53	21	8	2.056	2.056	1.000
12	1.00	0.53	10	4	1.326	1.326	1.000
13	1.00	0.53	5	2	0.596	0.596	1.000
14	1.00	0.53	2	1	-0.134	-0.134	1.000

Table 5.- Estimation of P.R. from the catch curve for the period 1988-90.

Taking into account that the EEC survey was conducted in July, we can consider it as an index of the biomass at the middle of the year, so we can obtain an index of F by dividing the catch by the biomass. Now we can estimate the catchability of the survey as:

$$q = \frac{C88+C89+C90}{F*(B88+B89+B90)}$$

where

- C = catch in weight for ages 8-11
- B = Biomass in the survey for ages 8-11
- F = Fishing mortality estimated in the catch curve = 0.53.

With this q (0.519) and with the ratio C/B (0.15), we can assess the value of F for the different years in which we have information of the survey and the catch (Table 6).

This method provides biased estimates when the catchability of the survey changes with age. However these biases are not very large (SCR 94/**) and the estimates of F are used to indicate as an overall trend and broad levels.

Fishing mortality.

Biomass 8-11

Year	survey	catch	C/B	F
88	6066	1298	0.21	0.41
89	2573	1470	0.57	1.10
90	3262	497	0.15	0.29
91	2481	768	0.31	0.60
92	2141	435	0.20	0.39
93	1075	111	0.10	0.20
88-90	11901	3265	0.27	0.53

$$q = 0.518830$$

Table 6.- Catchability of the survey estimated from ages 8-11 for the period 1988-90 and annual F's for the period 1988-93.

Although the value of F for 1993 could be an overestimate due to the fact that ages 8-11 in the survey appear to be distributed over a wider range of ages in the 1993 survey than in previous surveys, a drastic decrease in F from the high value of 1989 to the value estimated for 1993 is obvious. This is consistent with the shift towards deeper water (toward other species) which occurred in this fishery in 1992. The fishing mortality found in 1993 is approximately equal to the natural mortality.

Prognosis, despite the high variability in the Russian research survey results, it appears that the stock has steadily declined in recent years. It is believed that this decline is due to excessive fishing mortality at least in the period 1988-91. In order to halt the decline of the stock, only a non-directed fishery should be permitted, which leads to a recommended TAC which should not exceed 1000 tons for 1995.

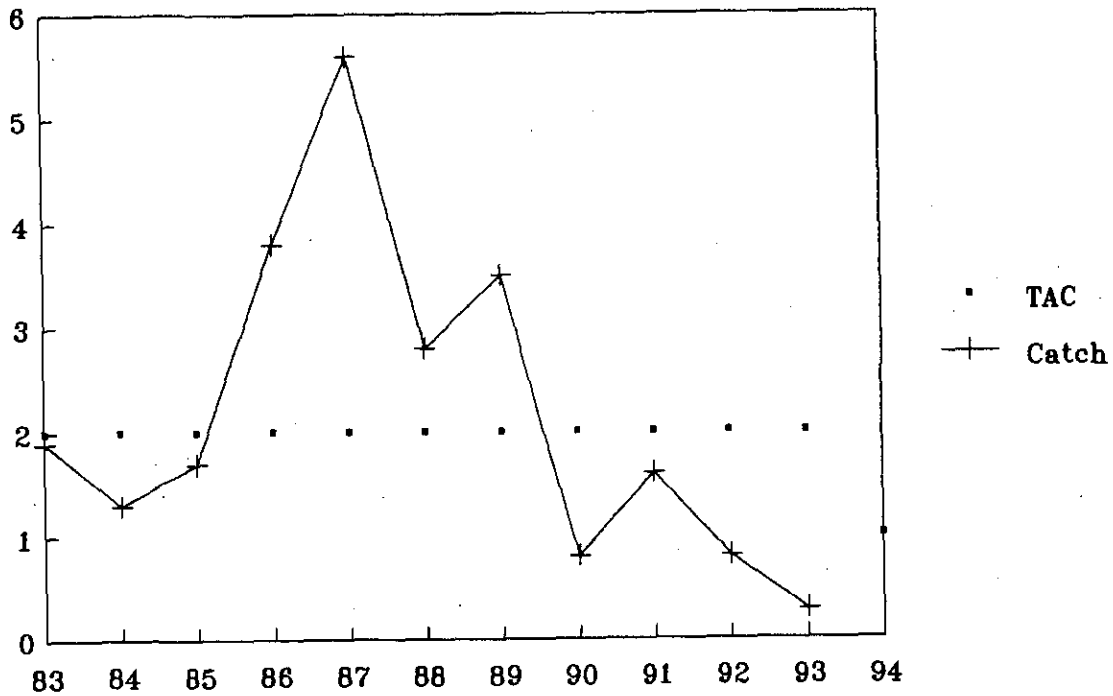


Fig. 1.- American plaice in Div. 3M: catches and TACs.

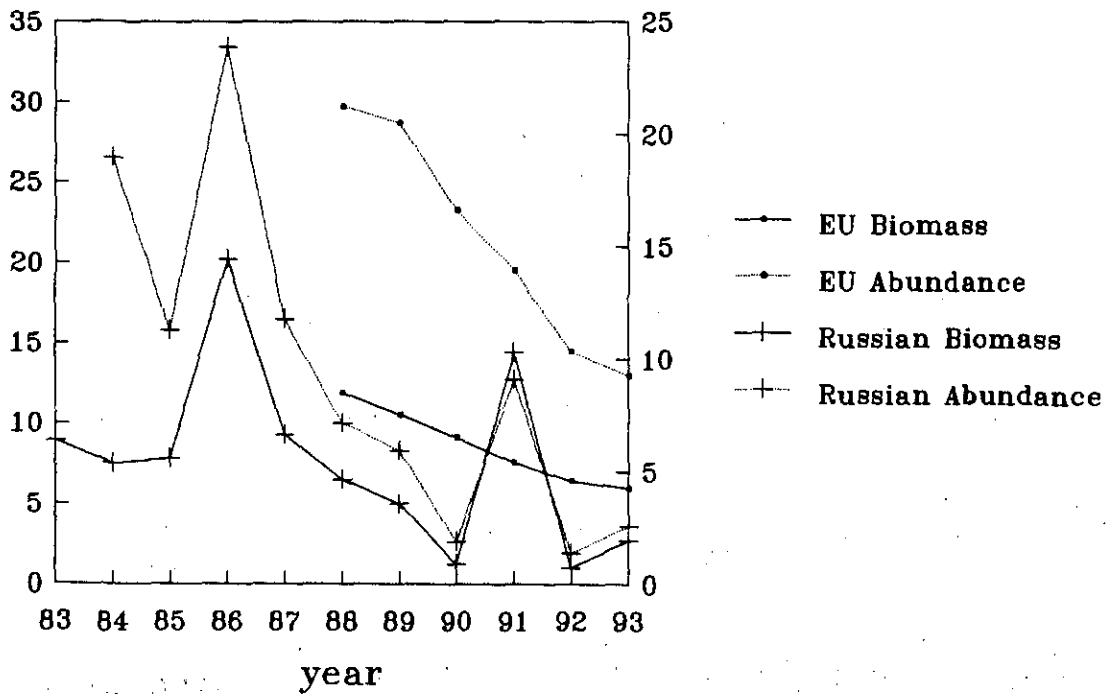


Fig. 2.- Abundance and biomass in the E.U. and Russian surveys.

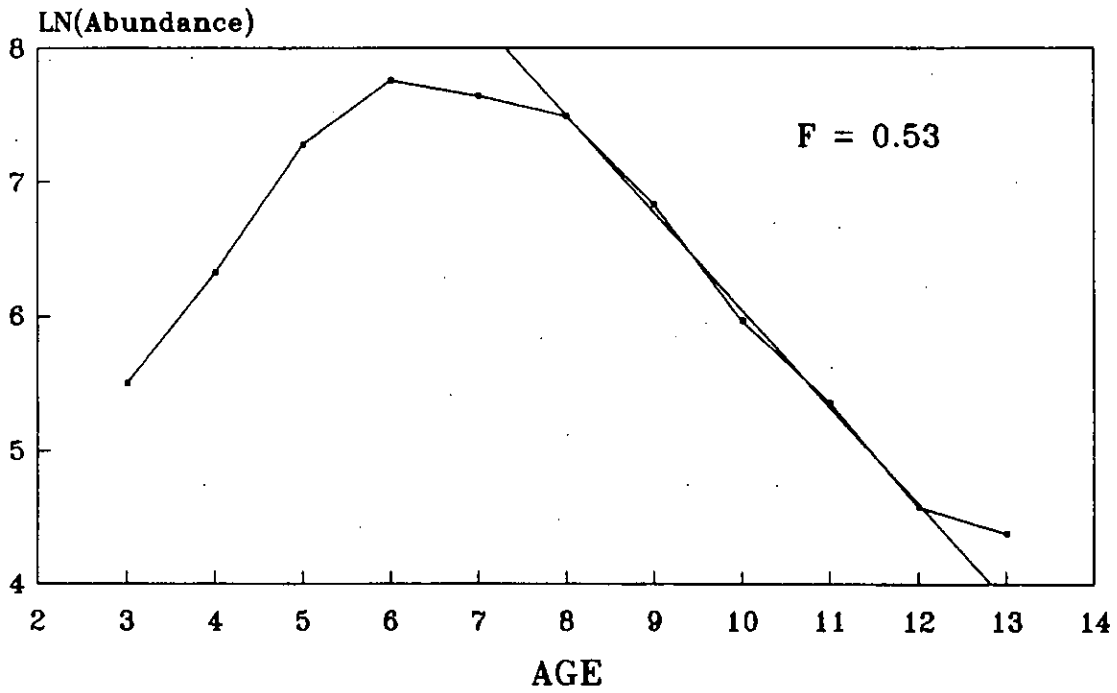


Fig. 3.- Catch curve for the period 1988-90.