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Assessment of the Redfish Stocks in NAFO Division 3M (Flemish Cap) in 1994

by

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Introduction

There are three species of redfish commercially fished on Flemish Cap: deepsea redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The term beaked redfish is used for S. mentella and S. fasciatus combined. Because of the difficulties with identification and separation, all three species are reported together under redfish in the commercial fishery. Data from the commercial fishery separated by species are provided only through sampling data.

Description of the fishery

Directed fishing on redfish on 3M in 1994 was mainly conducted by non-contracting parties, Russia and Portugal. This is a reasonable change in comparison to 1993 when other contracting parties were also engaged in this fishery. This change is reflected in the amount of the total estimated catch of about 11000 t in comparison to 29000 t in 1993. The reduction in catches is mainly caused by less effort of nearly all participating fleets. 60% of the catches are taken by non-contracting parties.

The Portuguese trawler and gillnet fleets operated from January to October on Flemish Cap with about 40% less effort in the trawl fishery and 10% less effort in the gillnet fishery compared to 1993. Russian trawlers were fishing from the second half of July until the beginning of October . The Spanish pair-trawl fleet operated mainly in the first half of the year on Flemish Cap whereas the Cuban fleet in 1994 was not fishing on Flemish Cap. Except for a few Portuguese gillnetters mostly bottom trawls were used.

The Non-Contracting Party fishery is assumed to be directed on redfish.The Russian, Japanese and Baltic states fishery is also directed on redfish. Because of good cod catches the Spanish and Portuguese fleets aimed at cod (except a few Portuguese gillnetters) and the redfish catches are mainly taken as by-catch in the cod fishery.

Nominal catches by countries and STACFIS total catch estimates are shown in Table 1 and Figure 1.

Catches doubled TAC in 1987 and were about three times higher in 1989. In the period from 1991 to 1993 catches have been at the TAC level and were falling to substantially less than the TAC in 1994:

Recent catches ('000 tons) are as follows:

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
TAC	20	20	20	20	20	50	50	43	30	26	26
Catch	20	29	44	23	58[1]	81[1]	48[1]	43[1,2]	29[1,2]	11[1,2]	

[1] Includes estimates of non-reported catches from various sources
[2] Provisional

Commercial fisheries data

Sampling data:

The following sampling data were available from the 1994 redfish fisheries on Flemish Cap:

Spanish pair trawler fleet	redfish as by-catch in the cod fishery length composition of redfish by-catch in March and April
Russian trawler fleet	directed redfish fishery with bottom trawls length composition of redfish catch in July (sex separated)
Portuguese trawler fleet	redfish as by-catch in the cod fishery length and age composition from March (*S.mentella*,sex separated) length and age composition from June (*S.marinus*,sex separated)
Portuguese gillnet fleet	redfish as by-catch in the cod fishery (14% directed effort on redfish) length and age composition from Oct/Nov (*S.mentella*, sex separated)

The amount of catches covered by the samples (total sample weight: ca. 2 tons) is estimated at about 4000 tons out of 11315 tons estimated total catch.

The Portuguese sampling data on *S. mentella* from trawl catches suggest a mode for males at 26 cm and two modes for females at 22 cm and 27 cm. The respective age composition, derived from the (July) trawl research survey also suggest ages 7 and 8 as dominant.

Gillnet catches of *S. mentella*, (sampled in October and November) were dominated, for both males and females, by a relatively large range of lengths between 31 cm and 45 cm, with a mode at 39 cm.

This length range corresponds to ages older than 11 years for males and females. The information available also suggests that mean length and mean weight in the catch increased from 1993 to 1994 (mean length by about 1.5 cm).

Information on *S. marinus* from the trawl fishery again suggests that catches were dominated by fish with a large range of lengths, between 26- 37 cm for males and 24-47 cm for females.

Age composition is spread for a large range of ages, with the 12 years old dominant for males and 15 years old for females.

In the Spanish samples of the pair-trawl fishery two modes at about 17 to 20 cm and at about 35 cm can be observed which are also represented in the Russian sampling data with the second mode less pronounced.

CPUE data:

In 1994 a standardized CPUE data series was used which consisted of official 21B data up to 1987 for all countries involved in the redfish fishery on Flemish Cap. From 1988 onwards the Portuguese official 21B data were substituted by observer data whereas official 21B data were used for the other countries (CPUE94, tables 2,3,4,5, and fig. 4,5).
For this assessment the same data base was used with updated official 21B data and the relevant data from Portugal. Updates effect the series back to 1992.(CPUE95, fig. 4,5).

For reasons of comparison a series was calculated which incorporates only official 21B data up to 1993.(CPUE95NEW, tables 2,3,4,5 and fig. 2,3).

CPUE94 and CPUE95 both expose a decline of standardized CPUE from 1992 to 1993 in terms of tons per day. In terms of tons per hour , however, CPUE94 indicate a slight decrease from 1992 to 1993 whereas CPUE95 indicate a slight increase.

A time series of standardized CPUE data (observer data) from the Portuguese directed redfish fishery 1988 - 1994 was available (tables 6,7). This series indicate also a decrease from 1992 to 1993 and a considerable increase from 1993 to 1994, but the latter is subject to large standard error (fig. 6).

CPUE95NEW was compared to CPUE94 and CPUE95 (fig. 4,5). This gives quite another picture of the development from 1992 to 1993. This series indicate a reasonable increase in tons per day instead of a decrease seen in CPUE94 and CPUE95 (fig. 4,5).

It is not clear which effects are imposed when official 21B data (which are subject to future revisions) and observer data from only one part of the fishing fleets are mixed up and used in a multiplicative model. It is questioned whether the 21B series with adjusted figures for Portugal for the years 1988 to 1993 can provide a better understanding. As the official 21B data are in doubt there is only one possible source of data left: observer based data from the directed redfish fishery.

The relevant 1994 data provided by Portugal are based only on a few samples which is reflected in the large standard error and leads to the conclusion that changes in CPUE from 1993 to 1994 may not be significant. However, the trends in the time series of the Portuguese CPUE and the EU bottom trawl survey generally agree (fig. 7).

There are in addition some general problems in using CPUE as an indicator of stock situation especially for redfish. There are only few fleets operating on Flemish Cap which regularly aim at redfish. Most of the fleets fish redfish as an alternative when cod is less plentiful or cod quotas are restrictive. A greater proportion of redfish will be taken as by-catch when cod fishing becomes more profitable. Also the vertical distribution of redfish varies widely in space and time and therefore the availability of this species to the bottom trawl and gillnets which are mostly used in the redfish fishery on Flemish Cap is also subject to high variability. It can be concluded that CPUE data from redfish fisheries are not appropriate as an

indicator of the state of redfish stocks on Flemish Cap.

Research survey data

There are two survey series which give information on the state of the redfish stocks on Flemish Cap(fig.8). A Russian bottom trawl survey was conducted in the period 1983 to 1993. Acoustic estimates are available from the same survey series since 1988. Unfortunately this survey was not continued in 1994. Since 1988 the EU conducted a bottom trawl survey providing estimates of all three redfish species.

Year	EU	Russia (bottom)	Russia (bottom + pelagic)
1983		154900	
1984		132300	
1985		51900	
1986		309500	
1987		106400	
1988	158222	47000	379000
1989	136633	83300	365900
1990	104193	17700	246400
1991	63846	45400	107700
1992	104477	18200	99500
1993	62589	69800	147100
1994	126011		

Biomass in tons

The increase in total biomass from 1993 to 1994 is mainly due to a drastic increase of *S. marinus* biomass and juvenile redfish biomass (SCR 95/26). In comparison to 1993 S. marinus biomass in 1994 is at the same level as *S. mentella* biomass. Fish of length of length of 25 to 28 cm (age 8) are dominating the golden redfish stock and the beaked redfish biomass was dominated by length range 18 to 20 cm (age group 5).

The sudden drastic increase of the golden redfish biomass which is not due to juveniles proves the perception of a highly variable biomass time series caused by variable availability of this species to the survey gear mainly due to changes in the spatial distribution.

There was also length frequencies information available from a japanese deepwater survey in Division 3M which has taken place the first time in 1994. A mode at 21 cm and a peak at 30 cm are observed.

Canadian deepwater trawl surveys in 1991, 1994 and 1995 covered depth ranges from 650-1800 m, 750-1500 m and 500-1700 m respectively in the western parts of Flemish Cap in Division 3M. Biomass estimates ranged from 142 tons in 1991 to 7714 tons in 1994 and 4399 tons in 1995.

State of the stocks

From EU survey results the trawlable biomass of the redfish stocks on Flemish Cap was estimated at about 126000 tons. Although there is no information on the absolute biomass of the redfish stocks the trawlable biomass estimates of the two survey series are back at levels seen in 1989 and 1990. There is expectation of good recruitment indicated by the increase of juvenile redfish biomass. Fishing mortality is expected to have been reduced reasonably due to the reduction of effort from 1993 to 1994. If present effort levels are kept in future years the probability of a further recovery of the redfish stocks on Flemish Cap is increasing.

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TABLE 1. Nominal catches of Redfish in Div. 3M for 1983-1993 (1991-93 are provisional).

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
CAN	0	0	0	0	0	0	0	0	2	0	10	0
CUB	2324	1562	1831	1764	1757	1759	1765	4195	1772	2303	945	
DDR	40	98	0	88	0	0	0	4025				
GRL	0	0	0	0	0	0	0	0	0	1	0	26
JPN	390	389	313	400	131	393	885	2082	1432	1424	967	488
SUN/RUS	1451	1500	1570	1504	1987	1374	1393	3458	2466	2937	2035	2980
LVA										7441	5099	94
LTU										0	2128	
EST											2188	47
E GER	0	769	848	145	0	0	2	91	5847	3443	0	0
E ESP	589	282	281	643	825	146	211	1916	472	204	100	610
E GBR	0	0	0	0	0	0	0	0	5	0	0	0
E PRT	1667	2123	1306	1078	2182	7101	1301	1166	3787	3198	4781	5630
KOR-S	0	0	0	5	0	43	1788	8332	2936	8350	2962	
FAROE IS.	0	0	0	0	0	0	0	0	0	16	0	
NORWAY	0	0	0	0	0	0	0	0	0	0	0	8
TOTAL	1952	2022	2028	2887	4441	2318	4769	6688	4091	2931	2121	9883
STACFIS estimates of total catches including catches of Non-Contracting Parties												
TOTAL	1952	2022	2028	2887	4441	2318	5810	8104	4848	4331	2899	1131

Table 2. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for redfish in in Div. 3M. Effort is measured in hours fished (1993 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.775
MULTIPLE R SQUARED..... 0.601

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.567E1	2.567E1	
REGRESSION	77	2.651E2	3.443E0	11.825
Country|Gear|TC	28	1.739E2	6.211E0	21.333
Month	11	1.100E1	1.000E0	3.435
Bycatch PCT	4	8.088E0	2.022E0	6.946
Year	34	3.991E1	1.174E0	4.032
RESIDUALS	605	1.761E2	2.911E⁻1	
TOTAL	683	4.669E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
Country|Gear|TC	20127	INTERCEPT	0.858	0.170	683
Month	4				
Bycatch PCT	95				
Year	59				
(1)	2125	1	0.001	0.201	10
	2155	2	0.233	0.272	5
	3125	3	⁻0.833	0.177	12
	3154	4	0.056	0.213	8
	3155	5	0.339	0.149	21
	4127	6	⁻0.123	0.166	14
	4157	7	0.375	0.123	35
	10127	8	⁻0.014	0.211	8
	11155	9	0.160	0.225	7
	11157	10	0.215	0.240	6
	14124	11	⁻0.584	0.166	16
	14125	12	⁻1.286	0.175	12
	14126	13	⁻1.060	0.135	24
	14127	14	⁻0.694	0.107	47
	14156	15	⁻1.106	0.240	6
	16127	16	⁻0.843	0.194	13
	17126	17	⁻0.290	0.145	21
	17127	18	⁻0.481	0.160	18
	20114	19	⁻1.874	0.163	35
	20116	20	⁻0.601	0.221	12
	20156	21	⁻0.079	0.150	20
	20157	22	0.469	0.079	142
	25126	23	0.454	0.158	19
	25127	24	0.726	0.132	36
	27125	25	0.291	0.237	6
	31156	26	⁻0.425	0.565	1
	31157	27	⁻0.045	0.239	9
	34156	28	0.239	0.262	8
(2)	1	29	⁻0.310	0.109	40
	2	30	⁻0.400	0.103	46
	3	31	⁻0.358	0.090	69
	5	32	⁻0.163	0.095	58
(3)	6	33	⁻0.380	0.093	67
	7	34	⁻0.285	0.093	73
	8	35	⁻0.349	0.094	68
	9	36	⁻0.459	0.098	56
	10	37	⁻0.397	0.104	48
	11	38	⁻0.315	0.107	43
	12	39	⁻0.169	0.119	32
	55	40	⁻0.349	0.117	35
	65	41	⁻0.412	0.086	55
	75	42	⁻0.171	0.092	50
	85	43	⁻0.106	0.067	100
(4)	60	44	0.518	0.435	2
	61	45	0.722	0.333	4
	62	46	0.353	0.333	4
	63	47	0.366	0.309	5
	64	48	⁻0.026	0.590	1
	65	49	0.226	0.303	5
	66	50	⁻0.259	0.598	1
	67	51	⁻0.233	0.598	1
	68	52	0.274	0.303	5
	69	53	0.128	0.355	3
	70	54	1.011	0.266	7
	71	55	0.626	0.215	14
	72	56	0.087	0.203	17
	73	57	⁻0.042	0.248	8
	74	58	0.170	0.200	22
	75	59	0.151	0.198	23
	76	60	⁻0.125	0.212	22
	77	61	⁻0.238	0.201	26
	78	62	⁻0.068	0.195	32
	79	63	⁻0.442	0.186	50
	80	64	⁻0.197	0.189	35
	81	65	⁻0.066	0.194	28
	82	66	⁻0.136	0.192	29
	83	67	⁻0.236	0.195	29
	84	68	⁻0.241	0.200	24
	85	69	⁻0.207	0.209	20
	86	70	0.177	0.221	15
	87	71	0.286	0.213	19
	88	72	⁻0.245	0.212	18
	89	73	⁻0.488	0.198	37
	90	74	⁻0.542	0.183	66
	91	75	⁻0.601	0.185	42
	92	76	⁻0.564	0.216	34
	93	77	⁻0.425	0.279	10

Table 3. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for redfish in in Div. 3M. Effort is measured in days fished (1993 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....	0.818
MULTIPLE R SQUARED.....	0.669

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.942E3	3.942E3	
REGRESSION	75	2.660E2	3.547E0	14.381
Country|Gear|TC	26	1.784E2	6.861E0	27.818
Month	11	5.620E0	5.109E-1	2.071
Bycatch PCT	4	8.493E0	2.123E0	8.609
Year	34	1.444E1	4.246E-1	1.722
RESIDUALS	534	1.317E2	2.466E-1	
TOTAL	610	4.340E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
Country|Gear|TC	20127	INTERCEPT	3.310	0.167	610
Month	4				
Bycatch PCT	95				
(1)	2125	1	0.279	0.197	9
	3125	2	-0.727	0.188	9
	3154	3	0.106	0.203	8
	3155	4	0.420	0.158	17
	4127	5	-0.273	0.163	13
	4157	6	0.085	0.123	35
	10126	7	-0.280	0.209	8
	10127	8	-0.057	0.198	8
	10157	9	-0.004	0.195	9
	11155	10	-0.044	0.214	7
	14124	11	-0.717	0.171	13
	14125	12	-1.244	0.175	11
	14126	13	-1.277	0.147	18
	14127	14	-1.091	0.120	32
	14156	15	-1.266	0.243	5
	16127	16	-0.694	0.249	8
	17126	17	-0.552	0.112	51
	20114	18	-1.592	0.185	31
	20116	19	-0.885	0.214	11
	20156	20	-0.397	0.160	15
	20157	21	0.562	0.084	134
	25126	22	0.100	0.157	17
	25127	23	0.593	0.132	31
	31157	24	-0.251	0.235	8
	34156	25	-0.322	0.259	7
	34157	26	-0.200	0.278	5
(2)	1	27	-0.261	0.109	33
	2	28	-0.256	0.104	39
	3	29	-0.195	0.090	59
	5	30	-0.018	0.089	60
	6	31	-0.116	0.090	64
	7	32	-0.085	0.093	60
	8	33	-0.091	0.093	60
	9	34	-0.262	0.096	49
	10	35	-0.175	0.100	45
	11	36	-0.094	0.104	38
	12	37	0.111	0.115	30
(3)	55	38	-0.467	0.114	34
	65	39	-0.407	0.086	48
	75	40	-0.232	0.087	49
	85	41	-0.093	0.066	93
(5)	60	42	-0.022	0.410	2
	61	43	-0.270	0.319	4
	62	44	0.628	0.579	1
	63	45	0.199	0.317	4
	64	46	-0.487	0.552	1
	65	47	-0.299	0.287	5
	66	48	-0.427	0.581	1
	67	49	-1.142	0.574	1
	68	50	-0.160	0.339	3
	69	51	-0.446	0.409	2
	70	52	-0.249	0.318	4
	71	53	-0.325	0.236	8
	72	54	-0.101	0.198	14
	73	55	-0.187	0.227	9
	74	56	-0.168	0.194	20
	75	57	-0.264	0.197	18
	76	58	-0.339	0.212	17
	77	59	-0.461	0.198	23
	78	60	-0.479	0.196	27
	79	61	-0.523	0.189	29
	80	62	-0.494	0.196	23
	81	63	-0.381	0.198	20
	82	64	-0.525	0.195	25
	83	65	-0.537	0.190	30
	84	66	-0.549	0.206	18
	85	67	-0.377	0.210	17
	86	68	-0.237	0.209	18
	87	69	-0.073	0.198	28
	88	70	-0.529	0.200	25
	89	71	-0.503	0.194	37
	90	72	-0.573	0.185	57
	91	73	-0.602	0.181	51
	92	74	-0.425	0.214	32
	93	75	-0.307	0.260	13

Table 4. Standardized catch rate series for Div. 3M redfish from a multiplicative model utilizing hours fished as a measure of effort.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED	
YEAR	MEAN	S.E.	MEAN	S.E.
1959	0.8576	0.0290	2.688	0.455
1960	1.3757	0.1824	4.179	1.708
1961	1.5797	0.1039	5.331	1.676
1962	1.2109	0.1016	3.691	1.148
1963	1.2233	0.0881	3.762	1.093
1964	0.8313	0.3365	2.245	1.201
1965	1.0831	0.0830	3.278	0.926
1966	0.5986	0.3458	1.771	0.958
1967	0.6247	0.3448	1.818	0.982
1968	1.1318	0.0834	3.441	0.974
1969	0.9855	0.1163	2.924	0.970
1970	1.8685	0.0600	7.274	1.757
1971	1.4834	0.0312	5.020	0.881
1972	0.9442	0.0228	2.940	0.442
1973	0.8160	0.0414	2.563	0.516
1974	1.0279	0.0220	3.199	0.472
1975	1.0082	0.0210	3.138	0.453
1976	0.7330	0.0258	2.377	0.380
1977	0.6199	0.0208	2.128	0.306
1978	0.7893	0.0198	2.522	0.353
1979	0.4151	0.0149	1.739	0.212
1980	0.6604	0.0158	2.222	0.278
1981	0.7913	0.0180	2.530	0.338
1982	0.7212	0.0174	2.359	0.311
1983	0.6216	0.0189	2.134	0.292
1984	0.6168	0.0219	2.121	0.312
1985	0.6503	0.0259	2.188	0.350
1986	1.0344	0.0326	3.202	0.574
1987	1.1438	0.0274	3.582	0.589
1988	0.6129	0.0263	2.108	0.340
1989	0.3698	0.0202	1.658	0.235
1990	0.3152	0.0151	1.574	0.193
1991	0.2565	0.0147	1.484	0.180
1992	0.2933	0.0278	1.530	0.253
1993	0.4325	0.0575	1.732	0.410

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.222

Table 5. Standardized catch rate series for Div. 3M redfish from a multiplicative model utilizing days fished as a measure of effort.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED	
YEAR	MEAN	S.E.	MEAN	S.E.
1959	3.3104	0.0278	30.570	5.071
1960	3.2880	0.1678	27.868	10.963
1961	3.0405	0.1004	22.506	6.961
1962	3.9383	0.3241	49.378	26.001
1963	3.5090	0.0983	35.991	11.022
1964	2.8229	0.2997	16.385	8.345
1965	3.0110	0.0787	22.089	6.084
1966	2.8834	0.3256	17.182	9.065
1967	2.1681	0.3179	8.435	4.405
1968	3.1508	0.1124	24.979	8.152
1969	2.8646	0.1685	18.242	7.190
1970	3.0610	0.0996	22.982	7.081
1971	2.9856	0.0471	21.880	4.696
1972	3.2098	0.0228	27.714	4.165
1973	3.1234	0.0329	25.292	4.553
1974	3.1423	0.0207	25.931	3.718
1975	3.0466	0.0212	23.559	3.419
1976	2.9710	0.0266	21.786	3.533
1977	2.8497	0.0205	19.356	2.760
1978	2.8319	0.0207	19.012	2.723
1979	2.7871	0.0169	18.214	2.363
1980	2.8169	0.0191	18.744	2.582
1981	2.9292	0.0208	20.954	3.008
1982	2.7854	0.0200	18.154	2.559
1983	2.7737	0.0181	17.960	2.410
1984	2.7618	0.0249	17.688	2.777
1985	2.9337	0.0270	20.982	3.429
1986	3.0732	0.0277	24.117	3.993
1987	3.2376	0.0216	28.512	4.169
1988	2.7816	0.0217	18.069	2.652
1989	2.8076	0.0196	18.567	2.590
1990	2.7373	0.0163	17.333	2.209
1991	2.7087	0.0139	16.866	1.980
1992	2.8855	0.0268	19.998	3.257
1993	3.0034	0.0478	22.266	4.813

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.231

Table 6.

CPUE DIRIGIDA

ARTE ARRASTO DE FUNDO

DIVISÃO	ESPÉCIE	NAVIO	ANO	MÊS	DIAS	HORAS	CPUE	CAPTURA t
3M	RED	1	88	4	13	186	0.798	
3M	RED	1	88	5	17	201	0.935	
3M	RED	1	88	6	13	193	0.409	
3M	RED	3	89	1	25	313	0.383	
3M	RED	3	89	2	7	105	0.495	
3M	RED	1	89	2	1	18	0.518	
3M	RED	3	89	3	17	255	0.684	
3M	RED	1	89	3	15	160	0.654	
3M	RED	5	89	3	16	173	0.352	
3M	RED	1	89	4	30	408	0.930	
3M	RED	4	89	5	5	48	1.485	
3M	RED	1	89	5	19	201	1.548	
3M	RED	4	89	6	3	41	0.528	
3M	RED	2	89	6	1	17	0.829	
3M	RED	2	89	7	16	307	0.457	
3M	RED	4	89	7	5	81	0.438	
3M	RED	4	89	8	12	207	0.524	
3M	RED	2	89	8	7	118	0.509	
3M	RED	1	89	8	4	75	0.391	
3M	RED	1	89	9	4	75	0.367	
3M	RED	5	90	1	2	14	1.240	
3M	RED	5	90	2	5	64	0.377	
3M	RED	1	90	2	1	12	0.178	
3M	RED	2	90	2	4	36	0.345	
3M	RED	11	90	2	3	18	0.425	
3M	RED	11	90	3	5	41	0.459	
3M	RED	2	90	3	12	166	0.587	
3M	RED	1	90	3	3	33	0.288	
3M	RED	5	90	4	10	151	0.349	
3M	RED	2	90	4	4	33	0.907	
3M	RED	1	90	4	9	88	0.897	
3M	RED	11	90	4	7	64	1.852	
3M	RED	11	90	5	9	91	1.047	
3M	RED	1	90	5	1	10	0.297	
3M	RED	2	90	5	1	14	0.209	
3M	RED	2	90	7	10	182	0.521	
3M	RED	1	90	7	6	115	0.417	
3M	RED	11	90	7	4	78	0.340	
3M	RED	11	90	8	11	200	0.363	
3M	RED	1	90	8	6	105	0.403	
3M	RED	2	90	8	27	535	0.554	
3M	RED	4	90	9	6	100	1.038	
3M	RED	2	90	9	11	183	0.477	
3M	RED	1	90	9	7	129	0.400	
3M	RED	11	90	9	6	104	0.693	
3M	RED	2	90	10	6	84	0.435	
3M	RED	1	90	10	5	67	0.398	
3M	RED	1	90	11	5	49	0.753	
3M	RED	1	90	12	3	34	0.554	
3M	RED	1	91	4	6	73	0.858	
3M	RED	4	91	4	5	63	1.344	
3M	RED	11	91	4	4	40	1.398	

3M	RED	11	91	5	10	109	0.552
3M	RED	4	91	5	2	27	0.683
3M	RED	1	91	5	3	38	0.473
3M	RED	1	91	8	1	11	0.407
3M	RED	4	91	8	5	82	0.491
3M	RED	4	91	9	2	36	0.463
3M	RED	11	91	9	7	121	0.300
3M	RED	11	91	10	8	144	0.268
3M	RED	4	91	10	9	160	0.393
3M	RED	4	91	11	18	286	0.694
3M	RED	11	91	11	16	254	0.655
3M	RED	4	91	12	7	95	0.562
3M	RED	1	92	3	6	69	0.980
3M	RED	2	92	3	7	74	0.400
3M	RED	4	92	3	8	88	1.193
3M	RED	4	92	4	6	71	1.097
3M	RED	1	92	4	11	160	1.356
3M	RED	7	92	4	5	66	1.095
3M	RED	7	92	5	5	64	0.874
3M	RED	4	92	5	9	88	0.983
3M	RED	1	92	5	13	163	0.744
3M	RED	1	93	4	6	69	0.201
3M	RED	1	93	8	19	323	0.317
3M	RED	1	93	9	5	75	0.317
3M	RED	1	93	11	1	9	0.818
3M	RED	1	94	8	2	18	0.420
3M	RED	8	94	8	1	17	0.278
3M	RED	8	94	9	1	14	0.434
3M	RED	8	94	10	3	31	1.165

Table 7. ANOVA results, regression coefficients and standardized CPUE from a multiplicative model utilized to derive a standardized catch rate series for redfish in Div. 3M based on logbook data from the Portuguese trawler fleet. Effort is measured in hours fished and data are from the directed fishery.

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.715
MULTIPLE R SQUARED..... 0.511

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.670E1	2.670E1	
REGRESSION	24	1.083E1	4.511E-1	2.392
Ship (1)	7	1.247E0	1.781E-1	0.944
Month (2)	11	5.481E0	4.983E-1	2.642
Year (3)	6	2.526E0	4.209E-1	2.232
RESIDUALS	55	1.037E1	1.886E-1	
TOTAL	80	4.790E1		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
Ship	1	INTERCEPT	-0.049	0.284	80
Month	4				
Year	88				
(1)	2	1	0.035	0.164	12
	3	2	-0.199	0.334	3
	4	3	0.334	0.160	15
	5	4	-0.189	0.270	4
	7	5	0.049	0.366	2
	8	6	0.081	0.517	3
	11	7	0.232	0.168	12
(2)	1	8	-0.099	0.395	2
	2	9	-0.865	0.232	6
	3	10	-0.567	0.204	9
	5	11	-0.347	0.177	12
	6	12	-0.695	0.311	3
	7	13	-0.856	0.246	5
	8	14	-0.774	0.195	11
	9	15	-0.633	0.200	9
	10	16	-0.649	0.244	5
	11	17	-0.209	0.289	3
	12	18	-0.445	0.343	2
(3)	89	19	0.077	0.299	17
	90	20	-0.158	0.303	29
	91	21	-0.355	0.322	15
	92	22	0.150	0.336	9
	93	23	-0.778	0.377	3
	94	24	0.012	0.534	4

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.
1988	-0.0487	0.0809	1.006	0.283
1989	0.0282	0.0352	1.112	0.209
1990	-0.2065	0.0277	0.883	0.147
1991	-0.4034	0.0375	0.721	0.140
1992	0.1009	0.0465	1.189	0.256
1993	-0.8266	0.0757	0.463	0.126
1994	-0.0364	0.2267	0.946	0.429

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.253

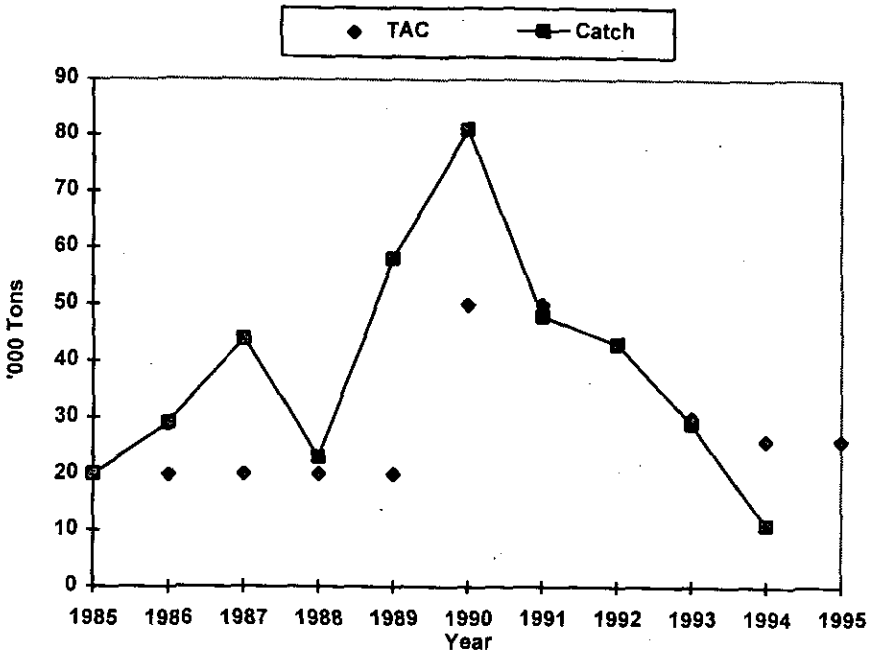

Fig. 1 3M Redfish Catches and TACs

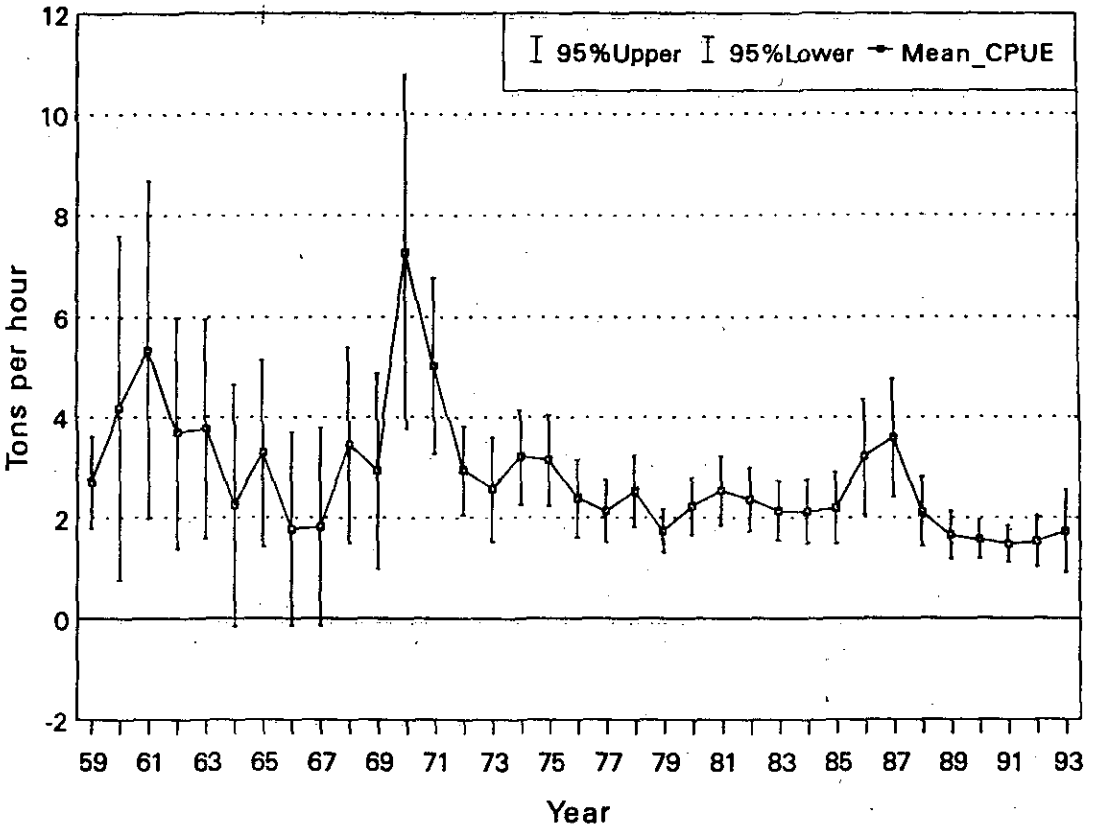

Fig. 2. Standardized CPUE and approximate 95% confidence interval for Div. 3M redfish based on effort in hours fished.

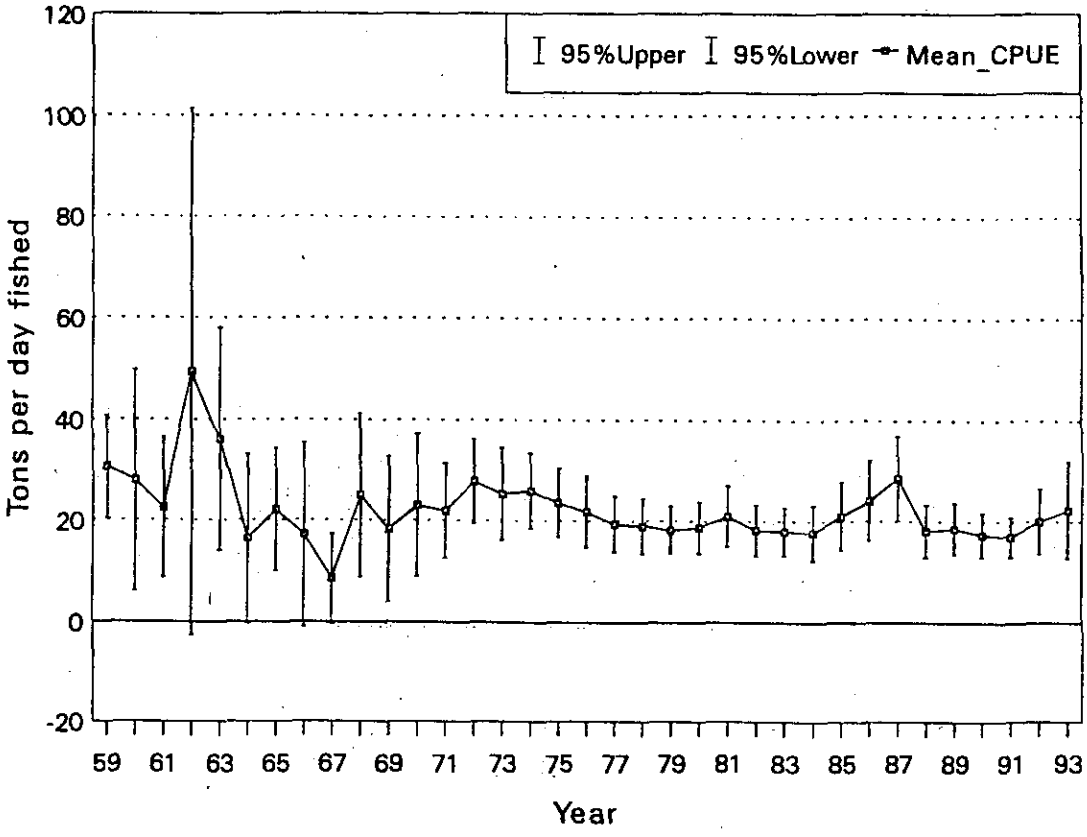

Fig. 3. Standardized CPUE and approximate 95% confidence interval for Div. 3M redfish based on effort in days fished.

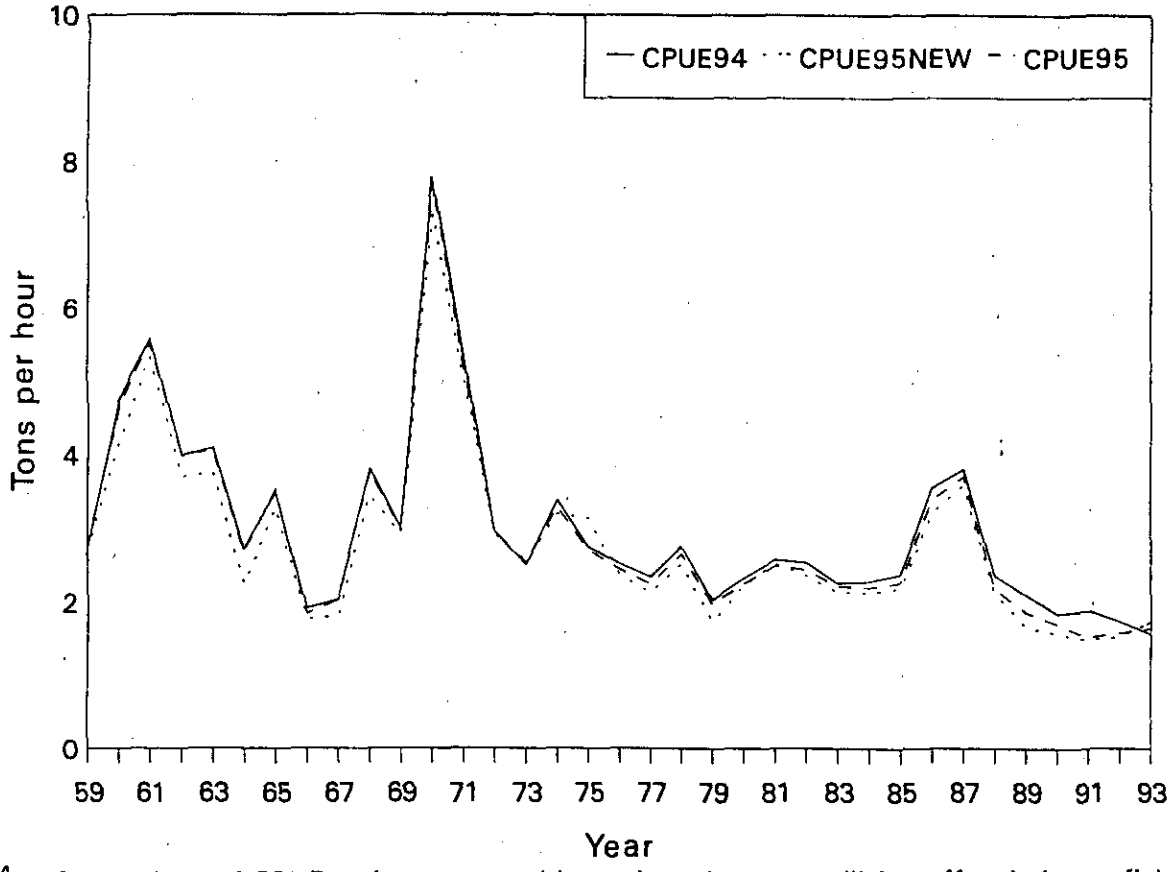

Fig. 4. Comparison of CPUE series generated by various datasets utilizing effort in hours fished. CPUE94 is from last years assessment, CPUE95 is analysis with updated data and CPUE95NEW contains same data as CPUE95 except Portuguese data is from NAFO database instead of Portuguese observers.

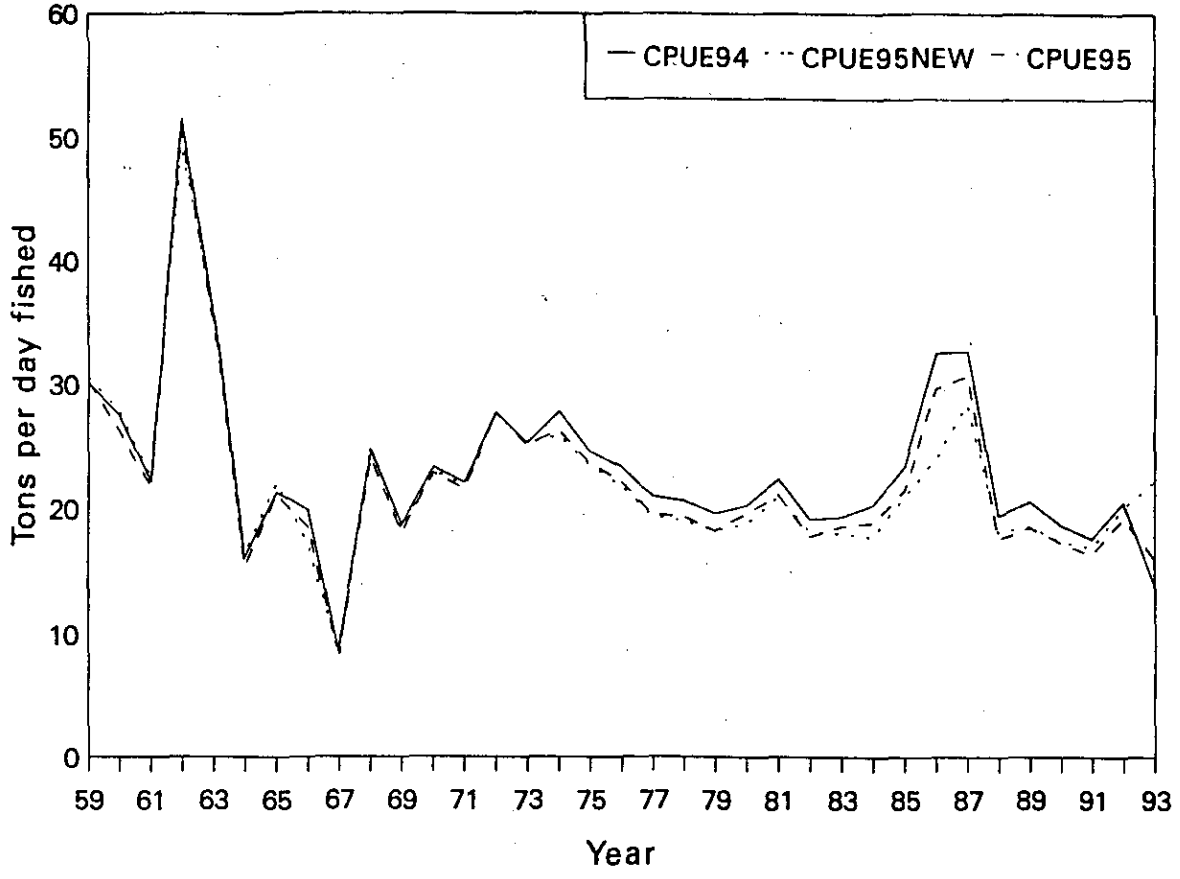

Fig. 5. Comparison of CPUE series generated by various datasets utilizing effort in days fished. CPUE94 is from last years assessment, CPUE95 is analysis with updated data and CPUE95NEW contains same data as CPUE95 except Portuguese data is from NAFO database instead of Portuguese observers.

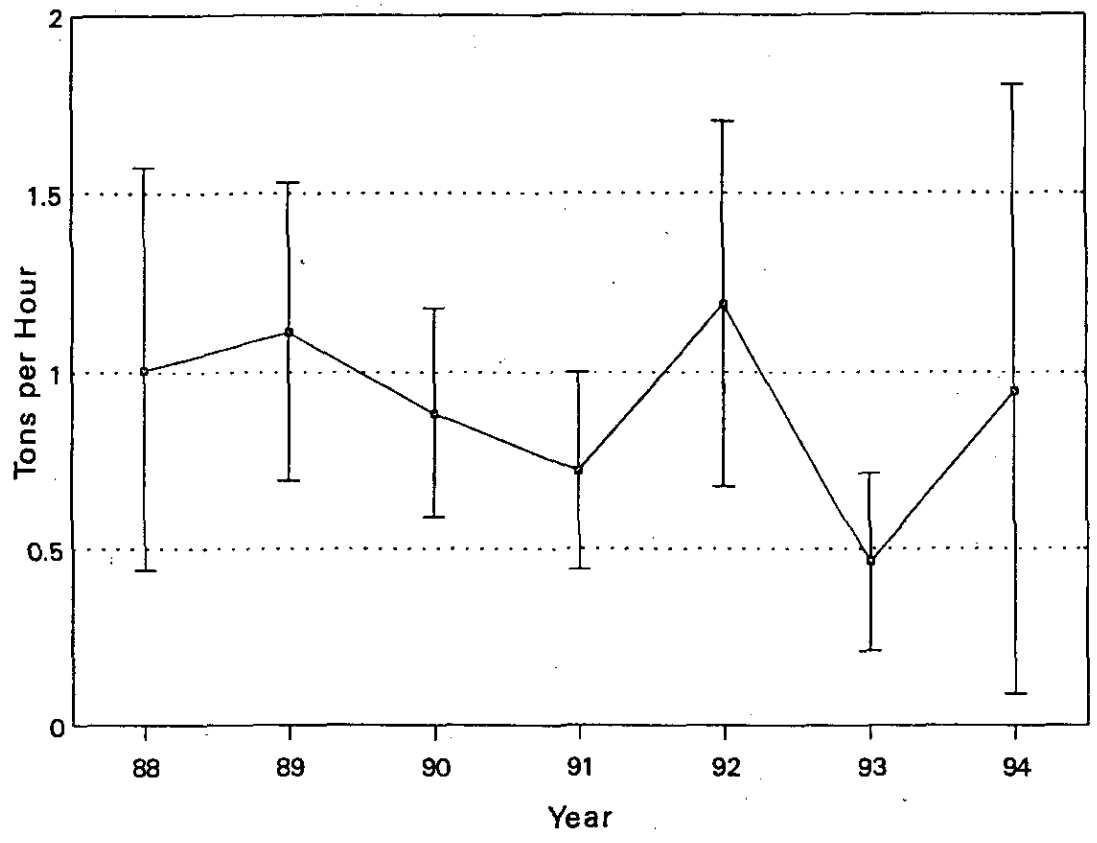

Fig. 6. Standardized CPUE and approximate 95% confidence interval for Div. 3M redfish based on logbook data from the Portuguese fleet for 1988-1994.

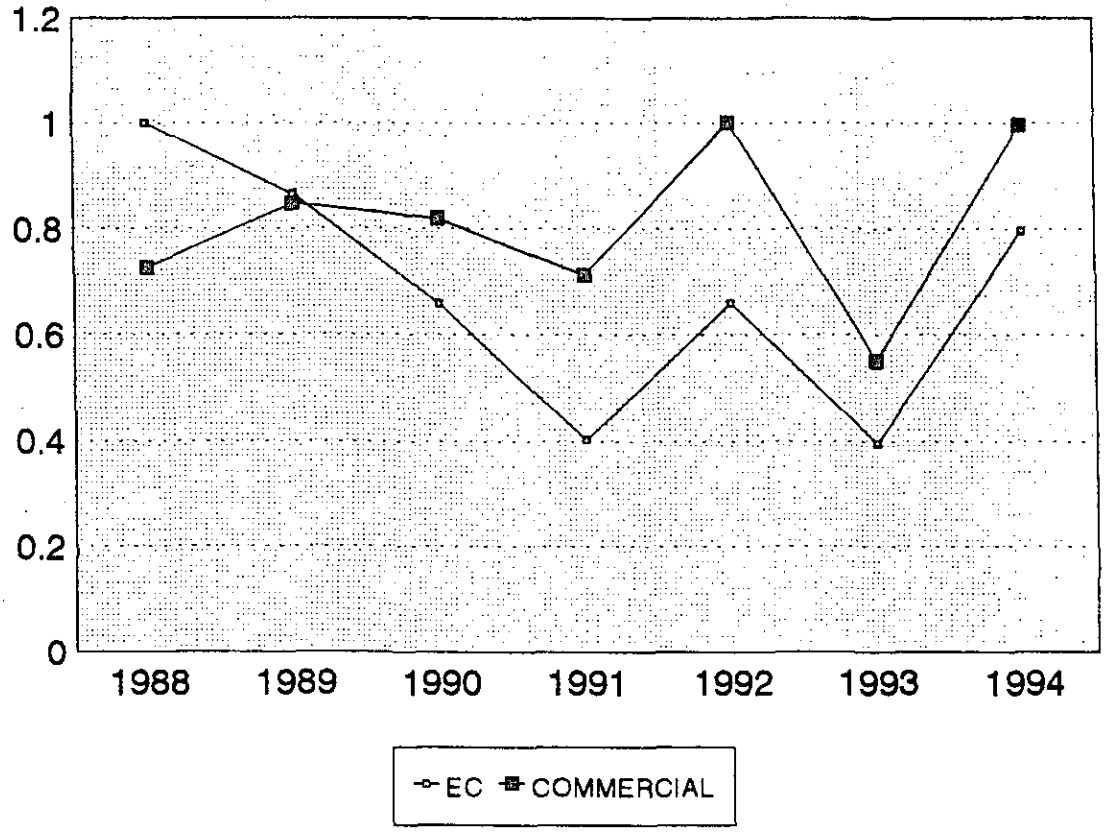

Fig. 7. Comparison between 3M redfish commercial catch rates and 3M redfish trawlable biomass indices from the EC surveys (relative values presented as a proportion of the highest value of each series)
from SCS Doc. 95/13, Fig. 4A.

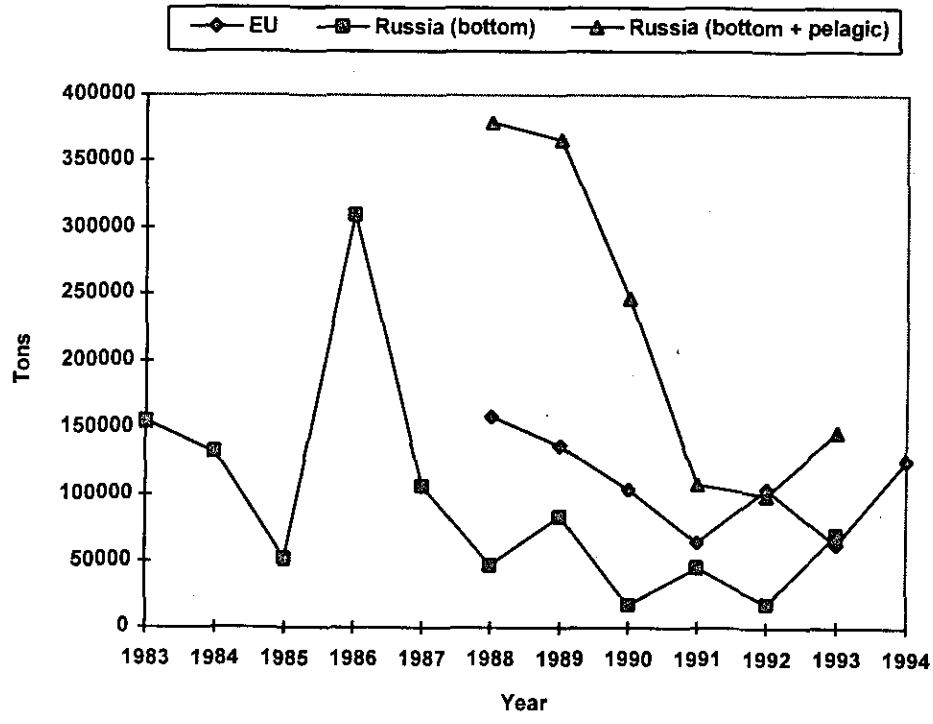

Fig. 8 3M Redfish Results of EU and USSR/Russia Surveys