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An Assessment of Division 3M Redfish

by

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Introduction

There are three species of redfish which are commercially fished in the Division 3M: beaked redfish (*Sebastes mentella*), golden redfish (*S. marinus*) and American redfish (*S. fasciatus*). The species are not identified in commercial catches and considered as a single stock. Only in Spanish surveys the species have been identified separately starting since 1991.

From 1979 to 1985, catches were at or below the TAC level (20 000 tons) (Fig. 1, Table 1). Catches began to increase in 1986 and reached its maximum in 1990 (83 000 tons). For 1992 the catch was estimated to be 33 000 tons which is about 77% of the agreed TAC.

Nearly half of the total catch in 1992 was taken by South Korea (8 400 tons), Portugal (5 500 tons), and Germany (3 400 tons) (Table 2). No data except the total catch were received from Russian fishing fleets, but it was considered that Russian catch was well below quota allocated. Catch rate data were obtained only from Portugal.

Commercial Fishery Data

Catch and Effort

Catch and effort data were obtained from 1959 to 1989 from ICNAF/NAFO Statistical Bulletins and were combined with provisional 1990-1991 NAFO data. In addition, catch rate data available in Portuguese research reports from NAFO SCS Document series for 1989-1992 from the annual Portuguese sampling program were also incorporated into this database. Only those data where redfish comprised more than 50% of the total catch were selected for further analysis except those data that met this criteria for Portugal prior to 1989 because they were considered confounded with cod directed effort.

The catch/effort data were analyzed with a multiplicative model (Gavaris 1980) to derive a standardized catch rate series in tons per hour and additional series utilizing effort in days fished. Effects included in the model were a combination country-gear-tonnage class category type (CGT), NAFO division, month, and a category type representing the amount of bycatch associated with each observation.

In the usual practise, catch or effort data of less than 10 units were eliminated prior to analysis as were most category types where there was less than five samples in the database except the year category type. However, for the analysis utilizing the effort in terms of days fished catch less than 10 tons or effort less than an arbitrarily chosen 5 days were eliminated prior to analysis. For all analyses an unweighted regression was run because of unknown percentages of prorating prior to 1984.

The regression for utilizing effort in hours was significant ($p < .05$), explaining 65% of the variation in catch rates (Table 3). All

category types were significant. There is much variability in the series prior to 1974 (Table 4, Fig. 2a). Generally catch rates were stable from 1974 to 1984 and thereafter increased to 1987. A trend of decline occured to 1991. The 1992 data suggest an increase but is based only on the information from the Portuguese fleet.

The regression for using effort in days fished was significant ($p < .05$), explaining 71% of the variation in catch rates (Table 5). All category types were significant. There is much variability in the series prior to 1974 (Table 6, Fig. 2b). Generally catch rates were stable from 1974 to 1984. Catch rates increased sucessively to 1987. A sharp decline occurred in 1988 and the rate returned to a level comparable to the prior period when it was stable and continued at this level to 1991. The 1992 data indicate an increase but again is based only on the information the Portuguese fleet.

Commercial fishery sampling

No sampling data of commercial fisheries of Russia, EEC - Germany and South Korea from 1992 were available. Length frequencies from the Portuguese trawl fishery in 1992 indicated lengths 26-30 cm predominated in the catches and lengths 33-39 cm predominated in the Portuguese gillnet catches (Avila de Melo et al., MS 1993).

Research Survey Data

The results from EEC trawl survey data indicated a decrease in trawlable biomass from 1988 to 1991. The 1992 estimate represented an increase to the 1991 level but this is uncertain. The increase was due primarily to *S. mentella* and juvenile redfish (<15 cm) (Table 7, Fig. 3).

Russian trawl/acoustic survey of 1992 could cover only 15 strata of 19 usually employed (80% of total area). The results of the survey indicated an increase of pelagic component of the total biomass and a decrease of the bottom component in 1992 (Table 8). The total biomass decreased slightly from the estimate of 1991. The results from the historic series of total biomass calculations represent the acoustic portion above 4 m and the estimate derived from the concurrent trawl survey (Vaskov and Ivanov MS 1993).

Length frequencies (in terms of percent size composition) suggest a mode at 11-12 cm (corresponding to the 1989-90 year classes) that is proportionately abundant.

References

Avila de Melo, a.,M. L. M. Godinho, R. R. Alpoim and E. Santos. MS 1993. Portuguese Research Report for 1992. NAFO SCS Doc., No. 15, Serial No. N2224. 48 p.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci., 37: 2272-2275.

Vaskov, A. A. and T. O. Ivanov. MS 1993. Stock Assessment of Redfish in Div. 3M by the data from 1992 Trawl-Acoustic Survey. NAFO SCR Doc., No. 11, Serial N2188, 7 p.

TABLE 1. Redfish in Div. 3M: catches and TACs ('000 tons)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TAC	20	20	20	20	20	20	20	50	50	43	30
Catch	20	20	20	29	44	23	58[1,2]	83[1,2]	55[1,2]	33[1,2]	

[1] Includes estimates of unreported catch.
[2] Provisional.

TABLE 2. Nominal catches of Redfish in Div. 3M for 1982-1992[1,2] (1990-92 are provisional).

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
CUB	1853	2324	1562	1831	1764	1757	1759	1765	4195	1772	2303
DDR	0	40	98	0	88	0	0	0	4025	0	0
GRL	0	0	0	0	0	0	0	0	0	0	1
JPN	392	390	389	313	400	131	393	885	2081	1432	1353
SUN/RUS	10916	14517	15005	15703	15045	19875	13747	13937	34581	24661	2937
LVA	0	0	0	0	0	0	0	0	0	0	7741
LTU	0	0	0	0	0	0	0	0	0	0	0
E DEU	41	0	769	848	145	0	0	2	91	5847	3350
E ESP	31	589	282	281	643	825	146	211	1916	472	206
E GBR	3	0	0	0	0	0	0	0	0	5	0
E PRT	1408	1667	2123	1306	10783	21823	7101	13012	11673	3787	3198
OTHERS	38	0	0	0	5	0	43	17885	8332	2938	8350
TOTAL	14684	19527	20228	20282	28873	44411	23189	47697	66894	40914	29439

[1] 1982-91 are from SCS Doc. 93/5
[2] 1992 Reported catches

TABLE. 3. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for redfish in Div. 3M. Effect is measured in hours fished. (1990-1992 based on provisional data.)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.803
MULTIPLE R SQUARED..... 0.645

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	P-VALUE
INTERCEPT	1	1.939E1	1.939E1	
REGRESSION	74	2.695E2	3.641E0	13.588
Country¦Gear¦TC (1)	26	1.758E2	6.761E0	25.231
Month (2)	11	8.026E0	7.296E-1	2.723
Bycatch PCT (3)	4	1.139E1	2.846E0	10.621
Year (4)	33	2.856E1	8.654E-1	3.229
RESIDUALS	554	1.485E2	2.680E-1	
TOTAL	629	4.373E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
CGT	20127	INTERCEPT	0.861	0.164	629
Month	4				
Bycatch PCT	95				
Year	59				
(1)	2125	1	-0.106	0.194	10
	2155	2	0.106	0.262	5
	3125	3	-0.892	0.171	12
	3154	4	-0.105	0.207	8
	3155	5	0.237	0.146	21
	4127	6	-0.234	0.162	14
	4157	7	0.198	0.126	31
	10127	8	-0.064	0.204	8
	11155	9	0.014	0.219	7
	11157	10	0.070	0.233	6
	14124	11	-0.956	0.203	9
	14125	12	-1.354	0.170	12
	14126	13	-1.161	0.132	24
	14127	14	-0.818	0.107	46
	14156	15	-1.173	0.231	6
	16127	16	-0.859	0.186	13
	17116	17	-0.575	0.197	11
	17126	18	-0.620	0.142	37
	17127	19	-0.818	0.212	8
	20114	20	-1.938	0.158	35
	20116	21	-0.622	0.212	12
	20156	22	-0.162	0.164	16
	20157	23	0.371	0.081	132
	25126	24	0.244	0.175	14
	25127	25	0.644	0.153	25
	27125	26	0.158	0.229	6
(2)	1	27	-0.306	0.109	37
	2	28	-0.317	0.104	42
	3	29	-0.342	0.090	64
	5	30	-0.159	0.093	57
	6	31	-0.301	0.094	60
	7	32	-0.241	0.093	65
	8	33	-0.261	0.094	63
	9	34	-0.388	0.097	54
	10	35	-0.450	0.107	40
	11	36	-0.250	0.106	39
	12	37	-0.191	0.116	31
(3)	55	38	-0.518	0.117	33
	65	39	-0.456	0.085	53
	75	40	-0.238	0.088	51
	85	41	-0.143	0.064	109
(4)	60	42	0.661	0.418	2
	61	43	0.770	0.320	4
	62	44	0.451	0.320	4
	63	45	0.446	0.297	5
	64	46	0.204	0.567	1
	65	47	0.293	0.291	5
	66	48	-0.223	0.575	1
	67	49	-0.139	0.574	1
	68	50	0.381	0.291	5
	69	51	0.153	0.341	3
	70	52	1.070	0.256	7
	71	53	0.687	0.207	14
	72	54	0.100	0.195	17
	73	55	-0.057	0.238	8
	74	56	0.232	0.194	21
	75	57	0.030	0.193	21
	76	58	-0.071	0.205	22
	77	59	-0.170	0.194	26
	78	60	0.030	0.189	32
	79	61	-0.277	0.181	43
	80	62	-0.148	0.183	33
	81	63	-0.007	0.187	28
	82	64	-0.063	0.185	29
	83	65	-0.187	0.188	29
	84	66	-0.170	0.193	24
	85	67	-0.113	0.202	20
	86	68	0.274	0.214	15
	87	69	0.370	0.207	19
	88	70	-0.127	0.205	18
	89	71	-0.320	0.195	44
	90	72	-0.395	0.179	77
	91	73	-0.401	0.221	23
	92	74	0.011	0.366	3

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

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.843
MULTIPLE R SQUARED..... 0.711

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.334E3	3.334E3	
REGRESSION	71	2.487E2	3.503E0	15.192
Country¦Gear¦TC (1)	23	1.643E2	7.143E0	30.979
Month (2)	11	3.595E0	3.268E-1	1.418
Bycatch PCT (3)	4	8.878E0	2.219E0	9.626
Year (4)	33	1.261E1	3.820E-1	1.657
RESIDUALS	439	1.012E2	2.306E-1	
TOTAL	511	3.684E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
CGT	20127	INTERCEPT	3.278	0.164	511
Month	4				
Bycatch PCT	95				
Year	59				
(1)	2125	1	0.141	0.194	9
	3125	2	-0.822	0.185	9
	3154	3	-0.044	0.201	8
	3155	4	0.294	0.157	17
	4127	5	-0.370	0.162	13
	4157	6	-0.089	0.133	31
	10127	7	-0.090	0.209	7
	10157	8	-0.060	0.233	9
	11155	9	-0.153	0.215	7
	14124	10	-1.011	0.208	8
	14125	11	-1.333	0.175	11
	14126	12	-1.401	0.149	18
	14127	13	-1.194	0.126	31
	14156	14	-1.341	0.238	5
	16127	15	-0.774	0.243	8
	17116	16	-0.434	0.206	9
	17126	17	-0.456	0.175	18
	20114	18	-1.610	0.180	31
	20116	19	-0.886	0.207	11
	20156	20	-0.487	0.190	11
	20157	21	0.452	0.091	125
	25126	22	-0.043	0.180	13
	25127	23	0.599	0.159	23
(2)	1	24	-0.251	0.116	27
	2	25	-0.187	0.110	33
	3	26	-0.157	0.095	50
	5	27	-0.043	0.093	52
	6	28	-0.036	0.096	50
	7	29	-0.028	0.098	50
	8	30	0.020	0.097	53
	9	31	-0.178	0.101	42
	10	32	-0.190	0.109	34
	11	33	-0.025	0.108	33
	12	34	0.070	0.123	24
(3)	55	35	-0.476	0.127	28
	65	36	-0.470	0.091	42
	75	37	-0.329	0.092	44
	85	38	-0.117	0.069	87
(4)	60	39	0.016	0.399	2
	61	40	-0.242	0.309	4
	62	41	0.682	0.563	1
	63	42	0.221	0.308	4
	64	43	-0.427	0.538	1
	65	44	-0.310	0.279	5
	66	45	-0.276	0.565	1
	67	46	-1.131	0.556	1
	68	47	-0.145	0.332	3
	69	48	-0.380	0.397	2
	70	49	-0.197	0.307	4
	71	50	-0.281	0.229	8
	72	51	-0.077	0.192	14
	73	52	-0.218	0.227	8
	74	53	-0.064	0.190	20
	75	54	-0.181	0.191	18
	76	55	-0.239	0.207	17
	77	56	-0.362	0.195	23
	78	57	-0.351	0.192	27
	79	58	-0.411	0.185	29
	80	59	-0.389	0.192	23
	81	60	-0.285	0.194	20
	82	61	-0.440	0.195	23
	83	62	-0.448	0.189	27
	84	63	-0.393	0.205	17
	85	64	-0.235	0.208	17
	86	65	0.091	0.223	12
	87	66	0.124	0.213	16
	88	67	-0.428	0.214	14
	89	68	-0.401	0.200	37
	90	69	-0.465	0.189	58
	91	70	-0.558	0.220	29
	92	71	-0.147	0.364	3

TABLE 5. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for redfish in Div. 3M. Effect is measured in days fished. (1990-1992 based on provisional data.)

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1959	1.6301	0.0960	5.564	1.685	59	11
1960	0.8606	0.0270	2.668	0.436	60	22
1961	1.5215	0.1685	4.813	1.897	61	13
1962	1.3121	0.0943	4.051	1.217	62	15
1963	1.3065	0.0818	4.054	1.137	63	16
1964	1.0646	0.3115	2.837	1.469	64	23
1965	1.1535	0.0769	3.488	0.950	65	19
1966	0.6371	0.3194	1.843	0.964	66	36
1967	0.7215	0.3185	2.006	1.049	67	33
1968	1.2412	0.0776	3.806	1.041	68	18
1969	1.0136	0.1074	2.986	0.954	69	23
1970	1.9304	0.0559	7.664	1.789	70	9
1971	1.5472	0.0293	5.295	0.900	71	13
1972	0.9602	0.0212	2.956	0.428	72	24
1973	0.8034	0.0383	2.505	0.486	73	29
1974	1.0927	0.0212	3.375	0.489	74	22
1975	0.8904	0.0205	2.758	0.393	75	27
1976	0.7892	0.0243	2.487	0.386	76	31
1977	0.6903	0.0199	2.258	0.317	77	34
1978	0.8905	0.0189	2.760	0.378	78	28
1979	0.5839	0.0149	2.035	0.248	79	39
1980	0.7128	0.0159	2.314	0.291	80	35
1981	0.8535	0.0172	2.662	0.348	81	30
1982	0.7972	0.0167	2.517	0.324	82	33
1983	0.6735	0.0180	2.223	0.297	83	37
1984	0.6906	0.0209	2.258	0.325	84	37
1985	0.7478	0.0248	2.386	0.374	85	36
1986	1.1344	0.0311	3.501	0.614	86	25
1987	1.2309	0.0268	3.864	0.629	87	23
1988	0.7338	0.0254	2.352	0.373	88	37
1989	0.5409	0.0209	1.944	0.280	89	46
1990	0.4660	0.0156	1.808	0.225	90	50
1991	0.4594	0.0311	1.783	0.312	91	51
1992	0.8715	0.1119	2.585	0.842	92	36

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.222

TABLE 6. Standardized catchrate 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.	CATCH	EFFORT
1959	3.2777	0.0270	29.362	4.796	59	2
1960	3.2941	0.1600	27.922	10.750	60	2
1961	3.0360	0.0951	22.285	6.721	61	3
1962	3.9595	0.3075	50.447	25.982	62	1
1963	3.4984	0.0946	35.395	10.644	63	2
1964	2.8510	0.2869	16.824	8.410	64	4
1965	2.9678	0.0757	21.018	5.682	65	3
1966	3.0021	0.3090	19.351	9.987	66	3
1967	2.1467	0.3003	8.262	4.212	67	8
1968	3.1328	0.1095	24.372	7.857	68	3
1969	2.8977	0.1599	18.787	7.230	69	4
1970	3.0808	0.0943	23.314	7.001	70	3
1971	2.9965	0.0452	21.965	4.620	71	3
1972	3.2004	0.0220	27.246	4.024	72	3
1973	3.0596	0.0340	23.525	4.306	73	3
1974	3.2142	0.0215	27.631	4.037	74	3
1975	3.0965	0.0214	24.566	3.575	75	3
1976	3.0387	0.0268	23.122	3.767	76	3
1977	2.9154	0.0214	20.497	2.986	77	4
1978	2.9267	0.0215	20.727	3.023	78	4
1979	2.8666	0.0179	19.553	2.609	79	4
1980	2.8884	0.0197	19.967	2.793	80	4
1981	2.9927	0.0214	22.143	3.227	81	4
1982	2.8375	0.0218	18.955	2.789	82	4
1983	2.8295	0.0195	18.827	2.622	83	4
1984	2.8849	0.0266	19.829	3.217	84	4
1985	3.0428	0.0286	23.198	3.899	85	4
1986	3.3684	0.0365	31.998	6.069	86	3
1987	3.4015	0.0311	33.165	5.808	87	3
1988	2.8499	0.0306	19.109	3.321	88	5
1989	2.8764	0.0248	19.678	3.086	89	5
1990	2.8127	0.0198	18.510	2.597	90	5
1991	2.7194	0.0324	16.756	2.996	91	5
1992	3.1302	0.1104	24.299	7.865	92	4

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.239

TABLE 7. EEC-Spain trawl survey estimation of Redfish biomass in Div. 3M for 1988-92 (mt) (SCR Doc. 93/24).

		Beaked redfish			
	S. marinus	*S. mentella*	*S. fasciatus*	Juvenile	Total
1988	15289		142933		158222
1989	22918		113675		136633
1990	14690		72893	16601	104193
1991	4093	48554	7198	4001	63846
1992	4130	71810	5308	23229	104477

TABLE 8. Russian trawl-acoustic survey estimation of Redfish biomass in Div. 3M for 1983-92 (10^3 mt) (SCR Doc. 93/11)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Trawl	155	132	52	310	106	47	83	18	45	18
Acoustic					350	332	283	229	62	82
Total	155	132	52	310	456	379	366	247	107	100
Biomass above bottom trawl in %					77	88	77	93	58	82

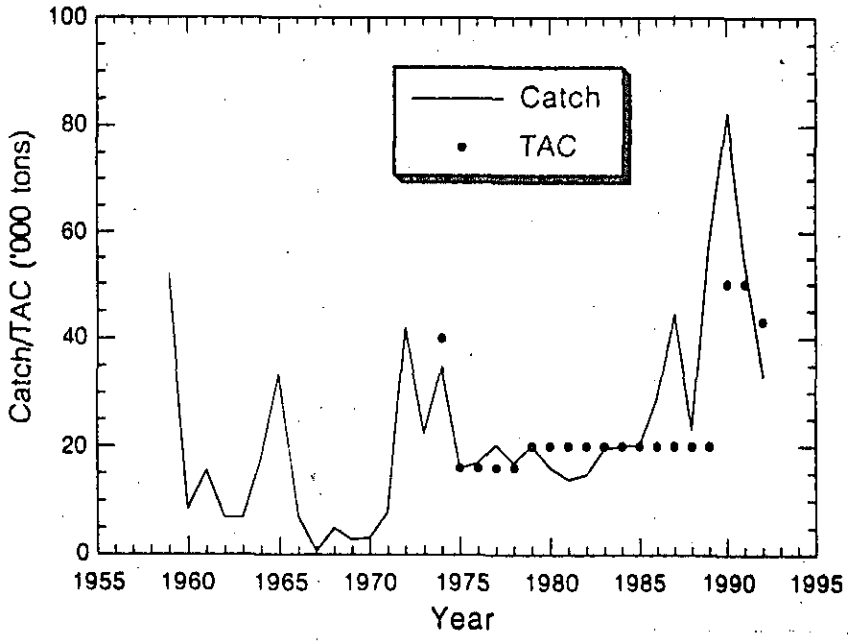

Fig. 1. Redfish in Div. 3M: catches and TACs.

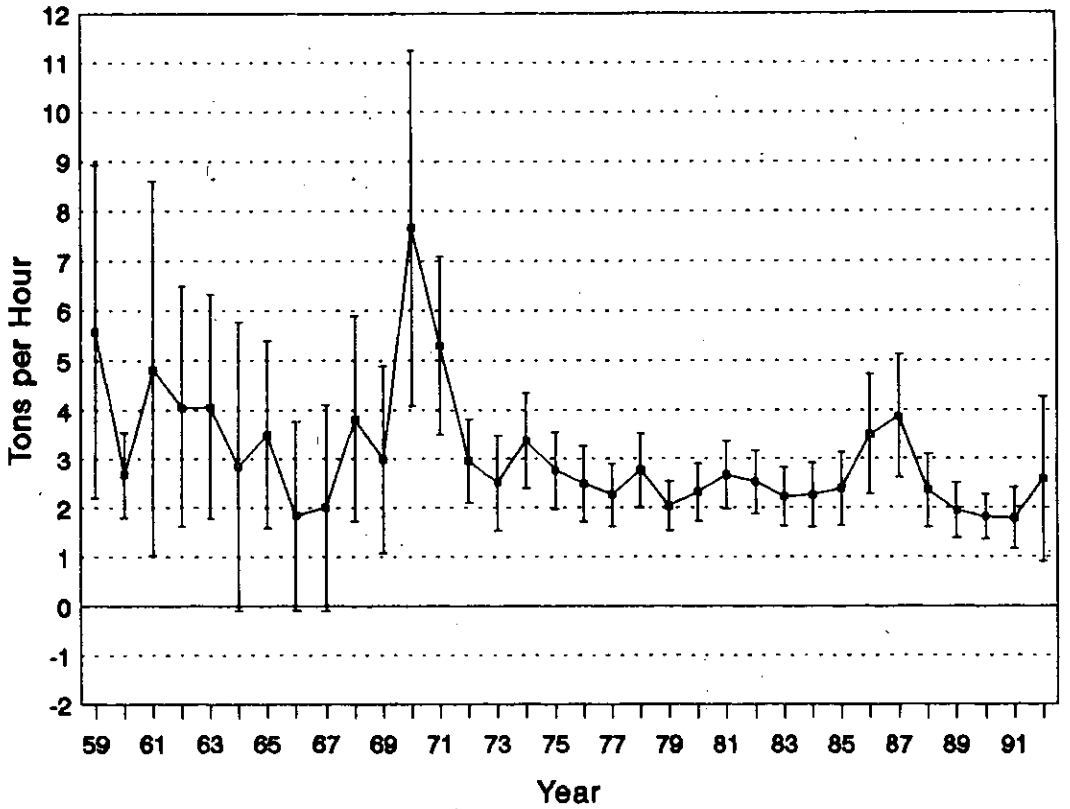

Fig. 2a. Standardized CPUE (tons per hour fished) with approximate 95% confidence intervals for Div. 3M redfish from 1959-1992.

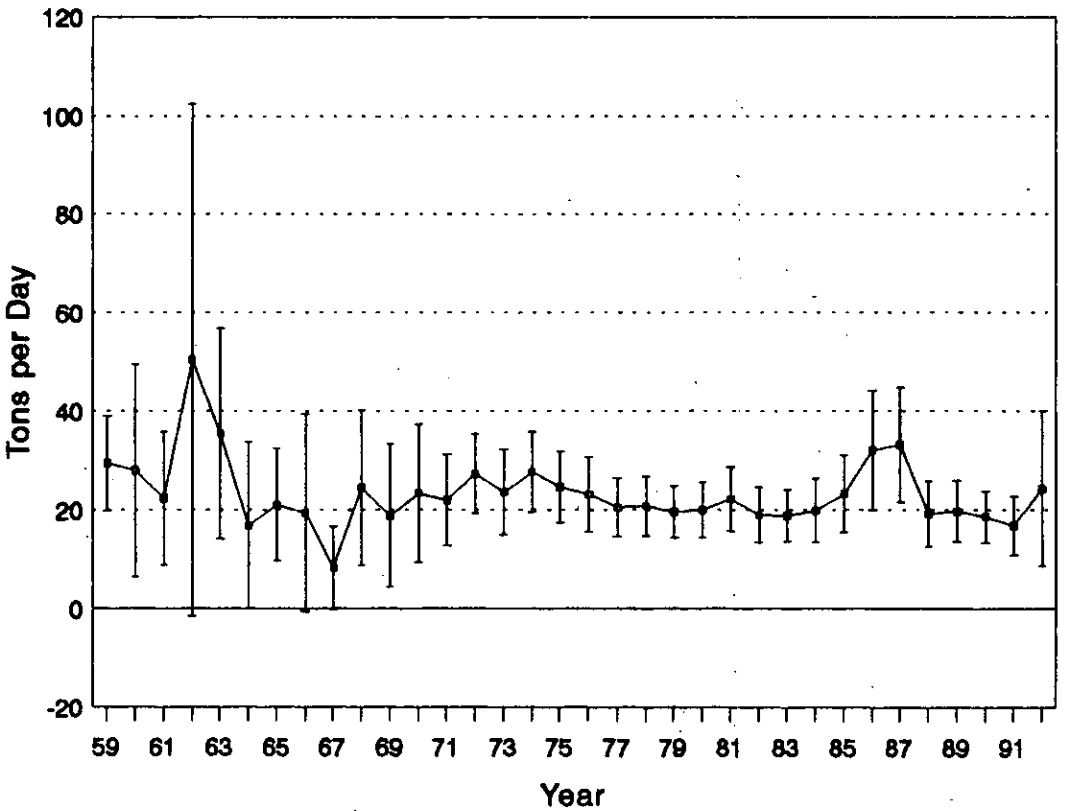

Fig. 2b. Standardized CPUE (tons per day fished) with approximate 95% confidence intervals for Div. 3M redfish from 1959-1992.

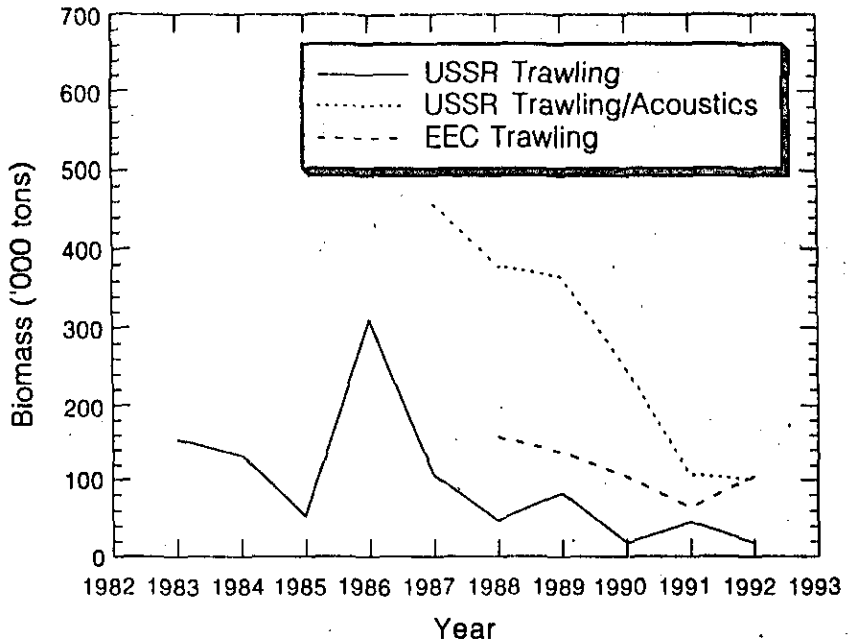

Fig. 3. Redfish in Div. 3M: biomass estimates from research vessel data.