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An Update of the Status of Redfish in NAFO Div. 3M

by

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INTRODUCTION

The total nominal catch has been at the level of the TAC (20,000t) in recent years. At the same time standardized catch rate has been declining. Analytical assessments are not possible because of insufficient catch-at-age data from the commercial fishery. Hence, this stock has been assessed through catch rate data in an equilibrium general production model.

METHODS AND RESULTS

The USSR has taken the largest portion of the nominal catch in recent years (Table 1). The total nominal catch has been near the level of the TAC since 1983 (Fig. 1). This fishery is prosecuted throughout the year but generally catches have been greatest during the first half (Table 2) since 1980.

A multiplicative model (Gavaris 1980) was employed using catch/effort data from ICNAF/NAFO Statistical Bulletins to obtain a standardized catch rate series for the years 1959 to 1984. This database had been totally re-examined in a previous assessment (Atkinson MS 1985) as participating country-gear-TC's were re-evaluated and modifications made to the inclusion list to provide for a database going back to 1959. This had been necessitated because a change in fleet composition in the early 1970's and a lack of data for some years in the 1960's previously only allowed for incorporation of catch/effort data from 1972 onwards.

Catch and/or effort data less than 10 units and less than five data points of country-gear-TC or month parameters were deleted from the analysis as it was thought rounding of these numbers could cause bias in the data. Finally, only catches comprising more than 50% redfish were selected.

The within category type groupings and their estimated power coefficients are shown in Table 3. The final regression was highly significant (Table 4). The data were weighted stepwise by $\log_{10}$ effort since a tighter fit resulted in a plot of expected normal values versus residuals compared to a similar plot with an unweighted regression. The standardized catch rate series is shown in Table 5 and Fig. 3. Standardized effort is displayed in Fig. 2. The revised catch rate series shows a general decline through the 1960's followed by a sharp increase from 1967 through 1970. Since then rates declined to 1979, increased moderately to 1982, and again declined since then.

A general production analysis was run on the standardized CPUE and effort data. The effort data were used in regressions initially being unlagged and subsequently lagged 6, 8, and 10 years (Gulland 1961). The regression using unlagged effort data was not significant. Regresions using the series of lagged effort data were all significant. The residuals from the lagged effort regressions were checked for serial correlation by plotting the standardized residual for one year against the standardized residual from the following year and computing a correlation coefficient. This procedure was chosen over the Durbin-Watson statistic because the latter sometimes leads to inconclusive results. The apriori hypothesis was that the regression using unlagged effort should result in significant serial correlation among the residuals (because of the nature of the data) while the appropriate lagging period would not show significant serial correlation.

The results are:

LAG	d	r	p-value
6	18	.505	*(.02<P<.05)
8	16	.556	*(.01<P<.02)
10	14	.341	NS(P>.10)

The lag10 correlation of residuals is not significant. Regressions of CPUE on effort using unlagged effort and effort lagged 10 years are shown in Fig. 4 and 5. The equilibrium general production parabola derived from the lag10 regression is shown in Fig. 6. The following results were obtained from general production runs:

LAG	MSY	$Effort_{MSY}$	2/3 $Effort_{MSY}$	Yield 2/3 $Effort_{MSY}$
6	16860	13258	8839	14,987
8	16986	13245	8830	15,099
10	17700	12803	8535	15,733

Commercial frequencies were unavailable for the 1985 fishery. There was no Canadian research survey to 3M in 1986.

DISCUSSION

The present TAC of 20,000 t has not been changed since 1979. Catch rates have been on the decline since 1982. This was anticipated as the relatively strong year classes of the early 1970's passed through the fishery. The last assessment of this stock suggested a gradual decrease in biomass from 1983 to 1985 (Atkinson MS 1985 (Table 6)) estimated from Canadian research cruises in those years. These surveys also indicated that there was a substantial decrease of young fish (early 1980's year classes) in 1984 and 1985 as compared to 1982 and 1983. The USSR research surveys did not show the decline to be as drastic as the Canadian surveys (see NAFO Redbooks 1983, 1984, 1985). If this decline is in fact real then recruitment to the late 1980's fishery does not appear as strong as previously anticipated. The status of these year classes could not be monitored further due to the lack of a Canadian research survey to the area in 1986 and therefore further comment is not possible. Analytical assessments are not possible with this stock due to insufficient catch-at-age data.

The general production runs based on regressions of CPUE on effort lagged 6, 8, and 10 years indicated an equilibrium yield at 2/3 MSY effort in the range of 15,000 t. However, further analysis of the regressions indicated that all were not significant when the 1970 and 1971 data points were removed. The results generated from the general production model are therefore to be used with caution as the regressions are dependent on the 1970 and 1971 points. There seems to be no evidence to suggest a change in the TAC from 20,000 t for 1987.

REFERENCES

Atkinson, D. B. MS 1985. The redfish of NAFO Div. 3M. NAFO SCR Doc. 85/VI/48.

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.

Gulland, J. A. 1961. Fishing and stocks of fish at Iceland. U.K. Min. Agric. Fish. Food, Fish. Invest. (Ser. 2), 23(4): 52 p.

Table 1: Nominal catches of redfish in Division 3M by country and year.

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
Canada (M)+	-	-	4,040	1,402	486	443	218	12	-	-	-	-
Canada (N)	8	659	4,328	3,392	3,861	4,686	60	517	2	-	-	-
France (M)	3	-	-	546	242	67	15	7	-	-	-	-
France (SP)	-	-	-	25	-	-	-	-	-	-	-	-
FRG	35	4	44	10	300	-	73	-	41	-	769	-
GDR	-	-	-	-	-	-	1,290	15	-	40	98	-
Japan	-	-	-	138	321	636	976	386	392	390	389	87
Poland	17	1	30	11	83	13	292	-	-	-	-	-
Portugal	790	2,464	518	854	455	666	985	659	1,408	1,667	2,123	294
Romania	-	-	-	-	24	4	-	-	-	-	-	-
Spain	-	-	-	52	31	13	29	488	31	589	282	-
UK	3,679	552	-	376	20	-	-	-	3	-	-	-
USSR	30,139	12,393	8,038	9,507	9,251	10,441	10,430	10,434	10,916	14,517	15,005	13,861
Ireland	-	-	-	2,503	767	-	-	-	-	-	-	-
Norway	-	2	-	-	-	-	-	-	-	-	-	-
Cuba	-	-	-	1,451	863	1,527	1,549	1,373	1,853	2,324	1,562	1,853
Bulgaria	-	-	-	-	58	1,578	50	-	-	-	-	-
Kor-S	-	-	-	-	-	-	-	-	38	-	-	-
EEC (Un.Sp.)	-	-	-	-	-	-	-	-	-	-	-	967
TOTAL	34,671	16,075	16,998	20,267	16,762	20,074	15,967	13,891	14,684	19,527	20,228	17,062

* Provisional.
\+ Maritimes and Quebec were combined prior to 1979.

Table 2: Nominal catches of redfish in Division 3M by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1974	35	1,486	3,388	4,500	6,687	7,323	2,151	2,092	1,971	1,920	1,976	1,142	34,671	
1975	983	920	917	2,042	1,012	1,191	1,039	1,873	1,564	1,819	1,615	1,100	16,075	
1976	2	2	180	2,950	1,580	1,130	686	7,415	2,473	277	283	20	16,998	
1977	417	532	2,786	1,847	1,821	3,649	4,284	1,416	590	243	81	98	20,267	a
1978	394	354	963	1,156	1,026	4,017	1,004	1,650	1,301	2,996	1,067	834	16,762	
1979	790	1,560	896	4,237	5,147	2,394	1,393	56	111	1,486	1,369	635	20,074	
1980	1,212	1,341	4,751	2,852	1,377	735	-	1,083	1,126	471	293	726	15,967	
1981	198	849	2,671	5,120	1,615	711	698	952	847	7	149	74	13,891	
1982	987	295	2,222	2,825	2,328	1,484	1,292	2,209	543	241	125	133	14,684	
1983	2,393	1,014	1,128	2,260	2,395	3,099	3,384	1,529	1,500	691	51	83	19,527	
1984*	159	1,725	2,465	4,283	3,773	3,679	1,148	912	900	419	449	316	20,228	
1985*	265	526	565	860	2,022	64	5,389	4,319	617	287	439	1,709	17,062	

* Provisional.
a includes a catch of 2,503t from month 'unknown'.

Table 3: Parameter estimates from the analysis of catch/effort for redfish in Division 3M using a multiplicative model.

Country-Gear-TC	Estimate	Month	Estimate
USSR OTB 4	-1.479	Jan.	-0.179
		Dec.	
CAN(N) OTB 5	-0.793		
		Mar.	-0.156
JPN OTB 6	-0.564		
POL OTB 7		Feb.	
		Apr.	
CAN(M) OTM 4		May	
CAN(MQ) OTB 5	0.000	Jun.	
USSR OTB 7		Jul.	0.000
CUBA OTB 7		Aug.	
		Sep.	
CAN(M) OTB 5		Oct.	
CAN(MQ) OTM 5	0.371	Nov.	
CUBA OTM 7			
CAN(N) OTM 5			
POR OTB 6	0.495		
USSR OTM 7			

Table 4: Regression of multiplicative model for redfish in Division 3M.

multiple r.....0.830
multiple r squared.....0.689

analysis of variance

source of variation	df	sums of squares	mean squares	f-value
intercept	1	2.215e1	2.215e1	
regression	33	1.421e2	4.306e0	23.088
type 1	6	6.059e1	1.010e1	54.123
type 2	2	1.357e0	6.786e^{-1}	3.637
type 3	25	1.147e1	4.589e^{-1}	2.459
residuals	343	6.400e1	1.866e^{-1}	
total	377	2.283e2		

Table 5: The predicted catch rate for redfish in Division 3M.

year	total catch	catch rate mean	s.e.	effort
1959	51977	1.655	0.156	31404
1960	8388	1.963	0.477	4273
1961	15517	2.464	0.488	6297
1962	6958	1.640	0.346	4243
1963	7035	1.437	0.301	4895
1964	17647	1.136	0.363	15535
1965	33427	1.527	0.272	21886
1966	7241	0.786	0.449	9215
1967	729	0.633	0.362	1151
1968	4963	1.364	0.263	3638
1969	2801	1.503	0.397	1864
1970	3168	2.739	0.555	1156
1971	8033	2.466	0.331	3257
1972	41946	1.889	0.187	22210
1973	22352	1.889	0.267	11835
1974	34671	1.847	0.168	18777
1975	16075	1.701	0.165	9452
1976	16998	1.388	0.135	12247
1977	20267	1.450	0.142	13975
1978	16762	1.317	0.121	12727
1979	20074	1.235	0.106	16251
1980	15957	1.537	0.152	10383
1981	13891	1.620	0.175	8572
1982	14684	1.793	0.197	8191
1983	19527	1.449	0.145	13478
1984	20228	1.303	0.150	15526

average c.v. for the mean:0.182

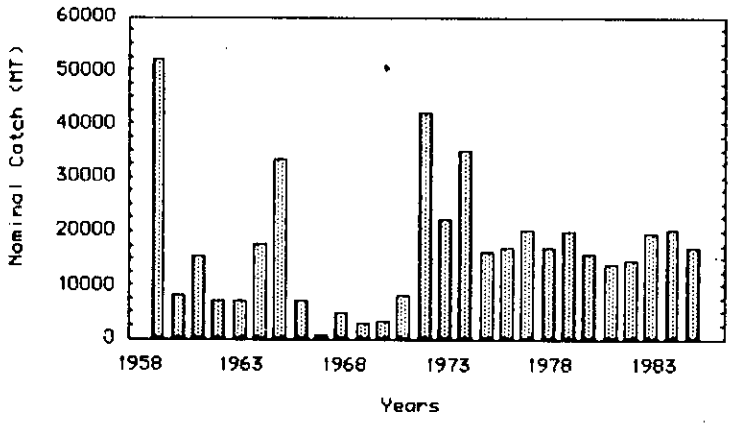

Fig. 1: Nominal catches of redfish from Division 3M, 1959-1985. (1984 and 1985 are provisional)

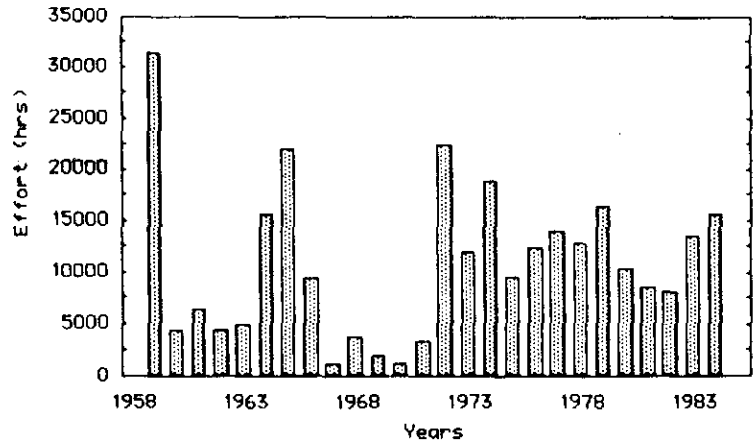

Fig. 2: Standardized effort for redfish in Division 3M, 1959-1984. (1984 is provisional)

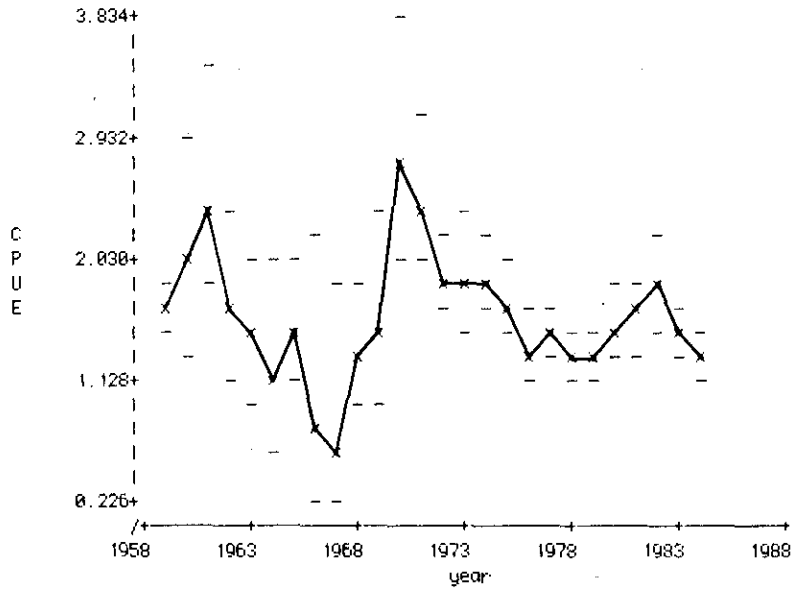

Fig. 3: Standardized CPUE (t/hr) for redfish in Division 3M, 1959-1984. (1984 Provisional)

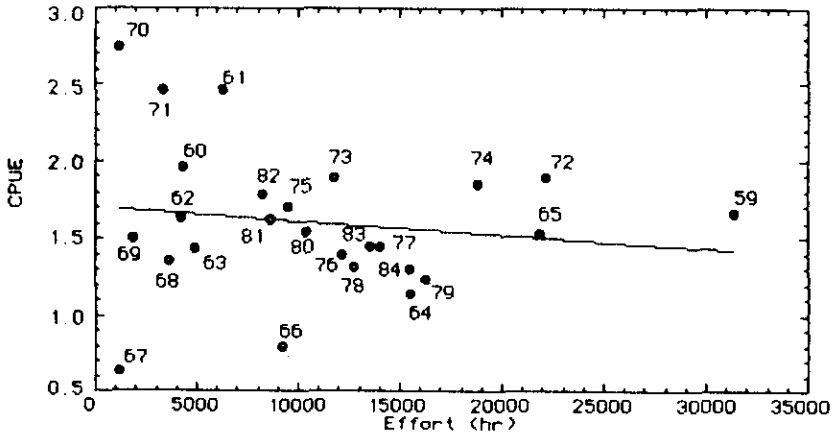

Fig.4: Regression of CPUE on effort using unlagged data for redfish in Division 3M.

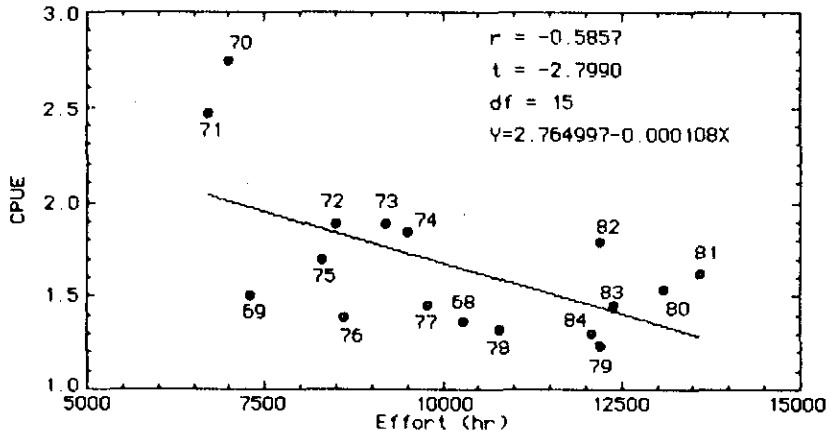

Fig.5: Regression of CPUE on effort using data lagged 10 years for redfish in Division 3M.

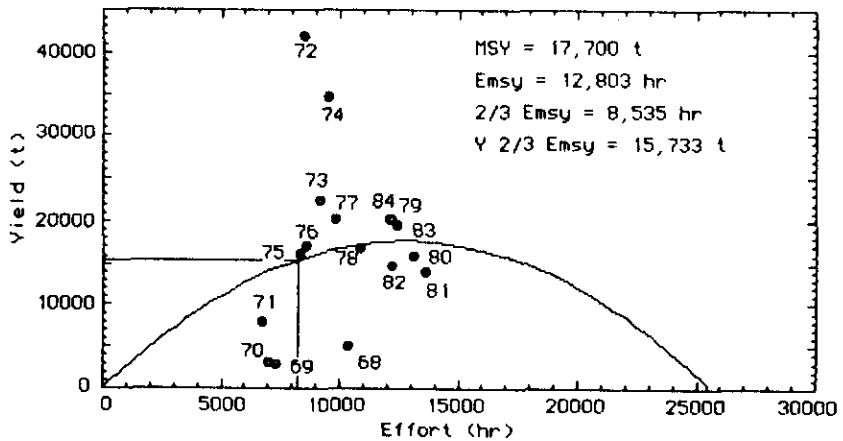

Fig.6: Equilibrium general production curve derived from regression in Figure 5.