Northwest Atlantic Fisheries Organization

Serial No. N997

NAFO SCR Doc. 85/48

SCIENTIFIC COUNCIL MEETING - JUNE 1985

The Redfish of NAFO Div. 3M

by

D. B. Atkinson
Fisheries Research Branch, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland A1C 5X1

Introduction

The use of a multiplicative model to examine the catch and effort data in recent years, coupled with the exclusion of a number of country-gear-TC combinations from the analysis resulted in gaps in the data. Because of this, recent assessments have only examined data from 1972 on. This time series was considered to be too short to enable the use of an equilibrium general production model. Because there is insufficient catch at age data from the commercial fishery, analytical assessments are not possible. As a result, the status of this stock has been monitored through examination of the catch rate series and research vessel data only. The present TAC is 20,000 t.

Methods and Results

The USSR has predominated this fishery in recent years (Table 1). Although the TAC's were not acheived during 1980-1982, they were again caught in 1983 and 1984. The fishery is prosecuted throughout the year (Table 2), but has been greatest during the first half of the year since 1980.

The historic catch/effort database was totally re-examined before running the multiplicative model (Gavaris 1980). First, the participating country-gear-TC's were re-evaluated and modifications to the inclusion list made. This allowed for the inclusion of data going back to 1959. Second, corrected Maritimes data have been included. Finally, all catches and effort of less than 10 units were deleted from the analysis as it was thought that rounding of these small numbers may introduce a systematic bias to the data. Only catches comprising >50 % redfish were used. The data were weighted step-wise by $\log_{10}$(catch x effort) since this weighting improved the regression without altering the overall trends in the data. There were no significant differences between months so these were combined. The various combinations and their parameters are summarized in Table 3.

The regression results (Table 4) indicate significance. The resultant effort and catch rate series are shown in Table 5 and Fig. 2 and 3. The revised catch rate series shows a gradual decline from 1960 to 1967 followed by an increase to the highest level recorded in 1970. Since then, rates declined until 1979, showed a moderate increase through 1981, then delined slightly once more. The 1982 catch rate (1.570) is at the long term average of 1.571, but the 1983 provisional rate (1.241) is somewhat lower.

Regression of CPUE on effort using unlagged data (Gulland 1961) was not significant (Fig. 4) but those using 6 8 and 10 year lags were (Fig. 5, 7 and 9). The resultant equilibrium general production runs (Fig. 6, 8 and 10) indicate yields at 2/3 $effort_{msy}$ of about 15,000 t in each case.

Only 2 commercial frequencies were available for the 1984 fishery (Fig. 11). If representative, these indicate that the fishery is concentrating on the strong year classes of the early 1970's. This has been noted previously (Atkinson MS 1984).

The results of Canadian research surveys to 3M (Table 6) suggest that this stock is fairly stable. The high numbers per tow caught in 1982 and 1983 were young fish of the late 1970's-early 1980's year classes (Fig. 12). There has been a significant decrease in the quantity of these fish since the 1982 and 1983 surveys. The data suggest a gradual decrease in biomass from 1983-1985. Paleheimq Z's calculated on the numbers caught per tow at age during these surveys are shown in Table 7. These are highly variable but tend suggest that fishing on the relatively strong year classes of the early 1970's has been below $F_{0.1}$ =0.15. F's on older fish appear to be even lower.

Discussion

The present TAC of 20,000 t was based upon assessments done in 1978 (Mari and Domiquez MS 1978, McKone MS 1978). These assessments utilized equilibrium general production models with effort lagged 6, 8 and 10 years. The Cuban results, based on catch per day of TC 7 vessels, suggested an MSY of 16,000-24,000 t while the Canadian assessment, based on catch per day of TC 4 vessels, suggested an MSY of 15,000-17,000 t. Since it was felt that the stock was in good condition, the TAC was raised from 16,000 t to 20,000 t and has remained at this level since then. The equilibrium general production models presented here, based on catch per hour, indicate MSY levels similar to those suggested by McKone (MS 1978) ie. 16,000-17,000 t. The yield at 2/3 $effort_{msy}$ is somewhat lower than this, about 15,000 t. Recent catch rates are below the rates suggested by the models presented here (about 1.8 t/hr).

On the other hand, the research survey results suggest that fishing on the year classes of the early 1970's has been below $F_{0.1}$ (assumed to be 0.15) although there is considerable fluctuation in the year to year estimates. The surveys also suggest that F on the older fish has been low in recent years, a fact substantiated by the commercial frequencies available over the same period.

References

Atkinson, D.B. MS 1984. Flemish Cap Redfish. NAFO SCR DOC. 84/VI/32.

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.

Mari, A. and R. Domiquez MS 1978. An Evaluation of the Status of ICNAF Division 3M Redfish. ICNAF Res. Doc. 78/VI/56.

McKone, W.D. MS 1978. An update of Flemish Cap redfish assessment. ICNAF Res. Doc. 78/VI/48.

Table 1. Division 3M redfish catches by country and year.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
Canada (MQ)	-	-	-	4,040	1,402	486	443	218	12	-	-	-
Canada (N)	2	8	659	4,328	3,392	3,861	4,686	60	517	2	-	-
Fr. (M)	2	3	-	-	546	242	67	15	7	-	-	-
Fr. (SP.)	-	-	-	-	25	-	-	-	-	-	-	-
FRG	773	35	4	44	10	300	-	73	-	41	-	-
GDR	-	-	-	-	-	-	-	1,290	15	-	40	98
Japan	-	-	-	-	138	321	636	976	386	392	389	388
Poland	427	17	1	30	11	83	13	292	-	-	-	-
Portugal	881	790	2,464	518	854	455	666	985	659	1,408	1,667	1,031
Romania	-	-	-	-	-	24	4	-	-	-	-	
Spain	-	-	-	-	52	31	13	29	488	31	589	-
UK	241	3,679	552	-	376	20	-	-	-	3	-	-
USSR	19,964	30,139	12,393	8,038	9,507	9,251	10,441	10,430	10,434	10,916	14,517	16,633
Ireland	-	-	-	-	2,503	767	-	-	-	-	-	-
Norway	-	-	2	-	-	-	-	-	-	-	-	-
Den-G-F	62	-	-	-	-	-	-	-	-	-	-	-
Cuba	-	-	-	-	1,451	863	1,527	1,549	1,373	1,853	2,324	1,562
Bul.	-	-	-	-	-	58	1,578	50	-	-	-	-
KOR-s	-	-	-	-	-	-	-	-	-	38	-	-
EEC (US)	-	-	-	-	-	-	-	-	-	-	-	768
TOTAL	22,352	34,671	16,075	16,998	20,267	16,762	20,074	15,957	13,891	14,684	19,526	20,480

[a]Provisional.

Table 2. Division 3M redfish catches by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	NK	TOTAL
1973	53	1,285	13,264	4,468	1	961	200	101	369	1,280	308	-	62	22,352
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	2,503	20,267
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[a]	2,393	1,014	1,,128	2,259	2,395	3,099	3,384	1,529	1,500	691	51	83	-	19,526
1984[a]	132	2,374	3,951	2,464	3,481	2,331	583	3,869	704	106	174	311	-	20,480

[a]Provisional.

Table 3: Parameter estimates from the analysis of catch rates for 3M redfish using a multiplicative model.

country-gear-TC	estimate	month	estimate
		JAN	
CAN(MQ)-OTB5		FEB	
CAN(N)-OTM4		MAR	
CAN(N)-OTM5		APR	combined
CUBA-OTB7	0.522	MAY	since
CUBA-OTM7		JUN	differences
POR-OTB6		JUL	were
USSR-OTM7		AUG	not
		SEP	significant
USSR-OTB7	0.000	OCT	
		NOV	
CAN(N)-OTB5		DEC	
JAP-OTB6			
JAP-OTB7	-0.525		
JAP-OTM7			
POL-OTB7			
POR-OTB7			
USSR-OTB4	-1.449		

Table 4.Rregression of multiplicative model for 3M redfish.

multiple r.....0.829
multiple r squared.....0.687

analysis of variance

source of variation	df	sums of squares	mean squares	f_value
intercept	1	2.508e1	2.508e1	
regression	27	1.450e2	5.370e0	26.614
type 1	3	5.337e1	1.779e1	88.167
type 2	24	1.483e1	6.177e-1	3.062
residuals	328	6.618e1	2.018e-1	
total	356	2.362e2		

Table 5: Predicted catch rate for 3M redfish

year	total catch	catch rate mean	s.e.	effort
1959	51977	1.635	0.152	31786
1960	8388	1.919	0.462	4370
1961	15517	2.345	0.475	6618
1962	6958	1.528	0.318	4554
1963	7035	1.372	0.297	5128
1964	17647	1.113	0.348	15861
1965	33427	1.531	0.293	21839
1966	7241	0.707	0.458	10243
1967	729	0.570	0.369	1279
1968	4963	1.358	0.278	3655
1969	2801	1.499	0.411	1869
1970	3168	3.108	0.632	1019
1971	8033	2.517	0.379	3192
1972	41946	1.979	0.193	21197
1973	22352	1.770	0.250	12626
1974	34671	1.790	0.165	19365
1975	16075	1.792	0.182	8970
1976	16998	1.281	0.146	13272
1977	20267	1.324	0.153	15303
1978	16762	1.125	0.128	14904
1979	20074	1.134	0.110	17694
1980	15957	1.440	0.161	11078
1981	13891	1.637	0.189	8484
1982	14684	1.570	0.185	9350
1983	19526	1.241	0.136	15739

average c.v. for the mean: 0.197

Table 6: Mean numbers and weights of redfish caught per standard tow and corresponding estimates of minimum trawlable biomass and abundance from Canadian research cruises to 3M, 1978-1985.

Year	# Sets	#/Tow	Abundance	Wt/Tow	Biomass (t)
1978	134	723.71	573,347	343.30	271,995
1979	95	382.17	302,795	175.98	139,427
1980	130	861.43	682,513	334.56	265,074
1981	142	683.16	541,272	279.26	221,257
1982*	108	1106.07	698,665	160.44	101,344
1983	142	1207.75	956,903	218.92	173,451
1984	129	486.81	385,699	183.53	145,412
1985	129	444.61	352,268	164.58	130,394

*The following strata were missed due to bad weather:

Stratum	Depth (fath)
515	201-300
516	301-400
517	301-400
518	301-400
519	301-400

Table 7: Numbers of redfish caught at age (sexes combined) per standard tow during Canadian research cruises to 3M, 1978-1985, showing paleheimo Z's for groups of year classes.

Age	1978	1979	1980	1981	1982	1983	1984	1985
1	0	0.57	0	0.02	6.68	0.08	0	0
2	0	2.77	0.18	70.66	153.46	8.42	6.25	0.02
3	0.12	1.24	0.42	0.03	307.33	154.19	2.78	0.41
4	1.20	1.09	0.31	0.28	253.85	200.21	6.99	0.74
5	1.46	0.96	0.59	0.40	33.84	261.17	14.46	4.00
6	11.69	3.60	1.01	0.55	4.62	169.99	32.94	28.09
7	35.43	9.87	8.40	1.93	1.56	28.36	41.26	72.35
8	90.25	33.61	75.77	17.88	2.96	5.44	15.24	46.29
9	26.96	45.44	178.21	60.45	3.25	4.84	6.92	4.77
10	5.97	8.29	121.36	95.80	9.28	4.80	7.48	1.74
11	1.68	2.78	55.18	78.83	18.93	7.27	4.25	2.86
12	8.58	2.12	22.56	31.63	33.71	8.98	8.04	5.08
13	4.70	3.37	17.40	27.46	27.60	14.19	16.09	5.04
14	10.52	5.09	7.26	23.98	20.67	30.46	28.75	15.72
15	20.63	16.67	7.40	19.92	13.87	43.74	35.99	25.09
16	41.24	11.32	16.64	24.89	24.78	30.37	38.76	28.50
17	37.68	31.24	34.65	22.43	13.43	33.99	32.04	25.44
18	46.86	35.86	29.86	20.05	8.31	16.88	36.15	23.77
19	33.80	15.25	33.46	15.31	12.53	18.39	19.70	11.06
20	47.34	7.17	26.99	20.32	8.35	12.00	18.70	15.73
21	38.40	11.00	21.23	24.08	6.21	15.46	16.29	15.96
22	9.79	12.79	7.46	20.38	14.27	12.84	9.38	10.03
23	20.33	13.74	7.12	20.32	10.28	11.47	14.77	11.74
24	50.34	21.32	16.74	13.75	17.20	12.77	13.46	10.18
25	60.32	12.53	18.95	14.74	14.10	16.55	5.58	15.02
26	23.54	14.55	28.11	12.68	10.93	18.34	13.63	12.10
27	37.23	11.04	23.14	11.96	5.43	13.52	8.04	15.46
28	22.75	10.08	19.43	7.94	7.82	12.82	9.61	10.08
29	8.83	11.68	11.51	7.69	5.47	6.84	5.44	7.67
30.+	22.25	25.32	70.13	12.21	17.62	33.25	17.93	19.63
Total	719.89	382.41	861.62	678.56	1069.47	1207.82	486.81	444.57

$Z_{yc60-71}$	0.45	-0.91	0.26	0.69	-0.20	-0.12	0.30
$Average_{80-85}$					0.18		
$Z_{yc57-64}$	0.67	-0.23	0.12	0.54	-0.26	0.17	-0.01
$Average_{80-85}$					0.11		

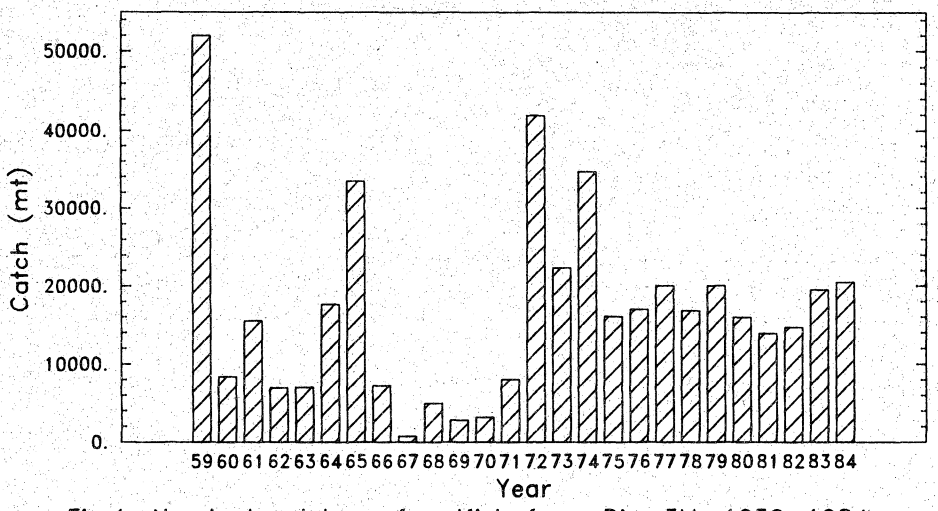

Fig.1: Nominal catches of redfish from Div. 3M, 1959–1984. (1983 and 1984 Provisional)

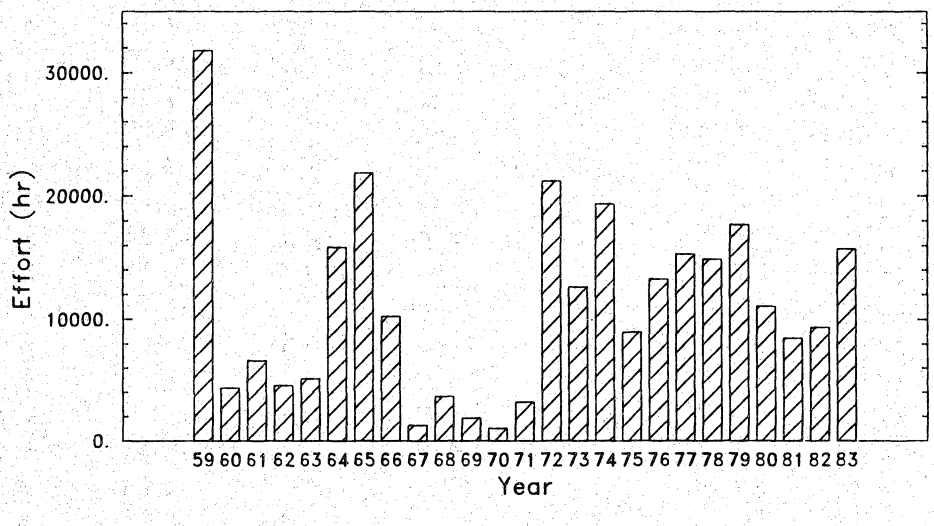

Fig.2: Standardized directed effort for redfish, Div. 3M, 1959–1983. (1983 Provisional)

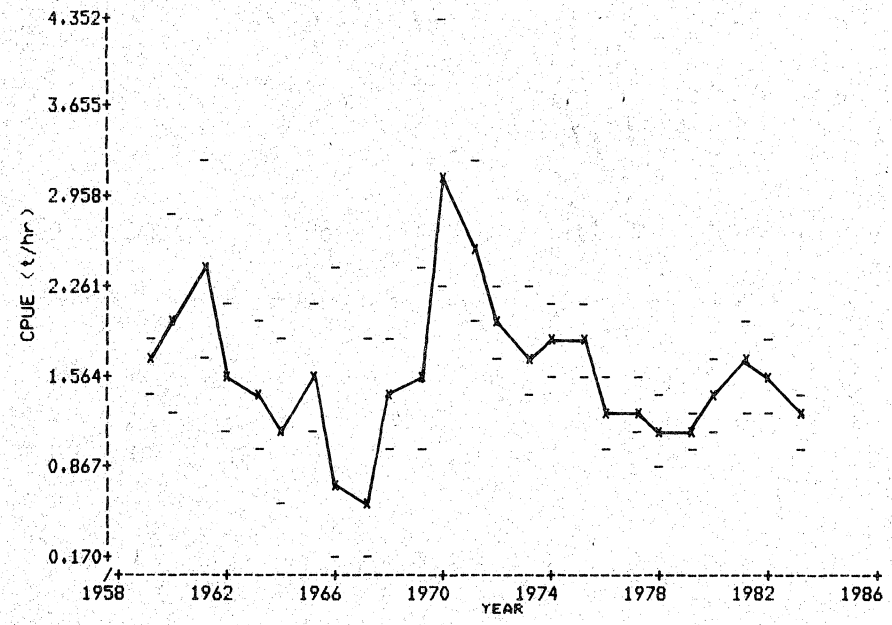

Fig 3: Standardized CPUE for 3M redfish (1959-1983)

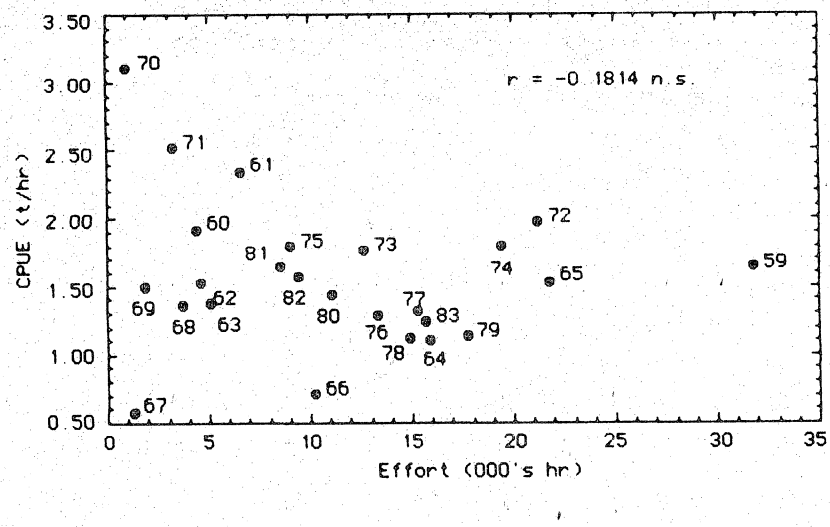

Fig.4: Regression of CPUE on effort for 3M redfish (1959-1983), using unlagged data.

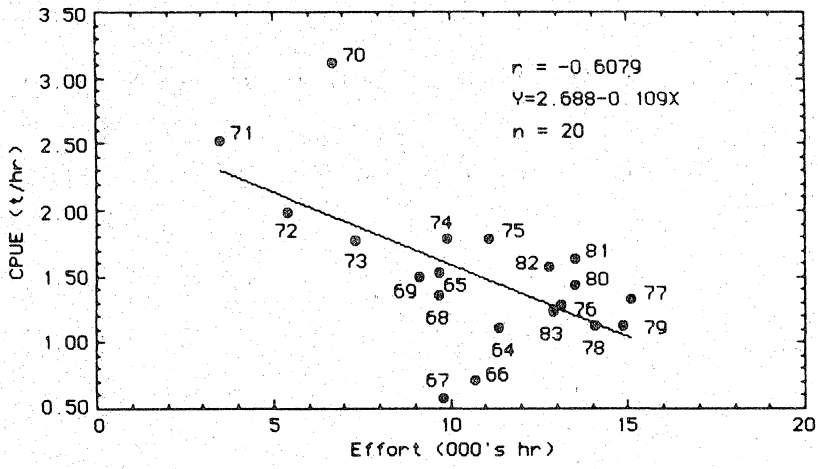

Fig. 5: Regression of CPUE on effort for redfish in 3M using effort data lagged 6 years.

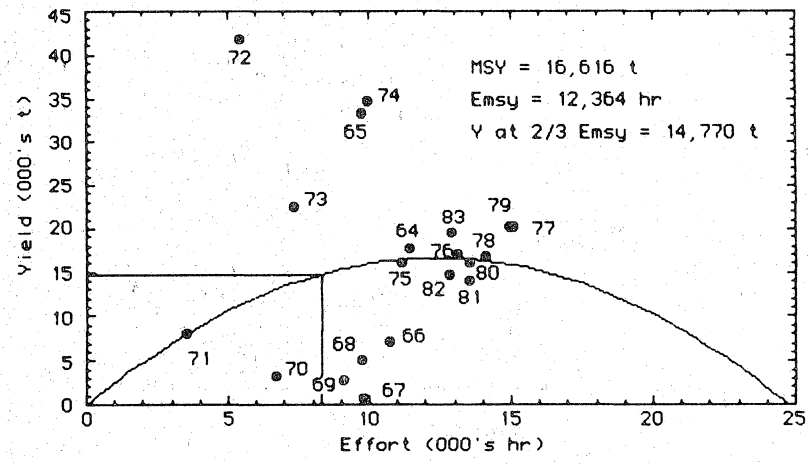

Fig. 6: Equilibrium general production model for redfish in 3M derived from regression in Fig. 5.

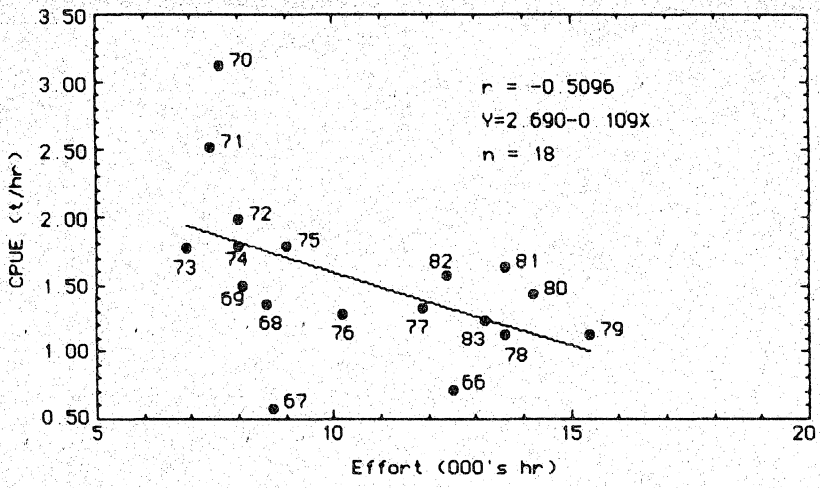

Fig. 7 Regression of CPUE on effort for redfish in 3M using effort data lagged 8 years.

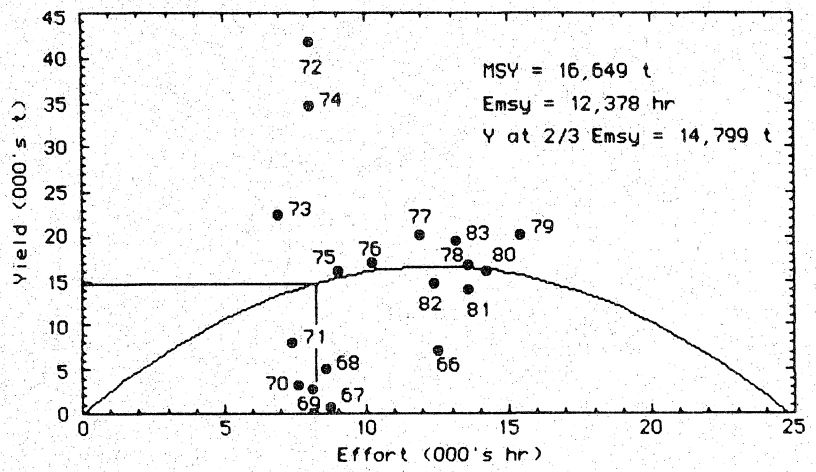

Fig. 8 Equilibrium general production model for redfish in 3M derived from regression in Fig. 7.

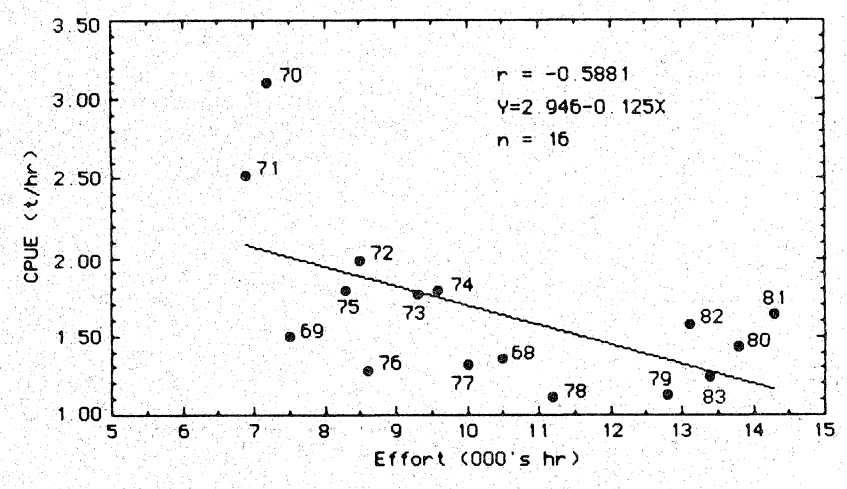

Fig. 9 Regression of CPUE on effort for redfish in 3M using effort data lagged 10 years.

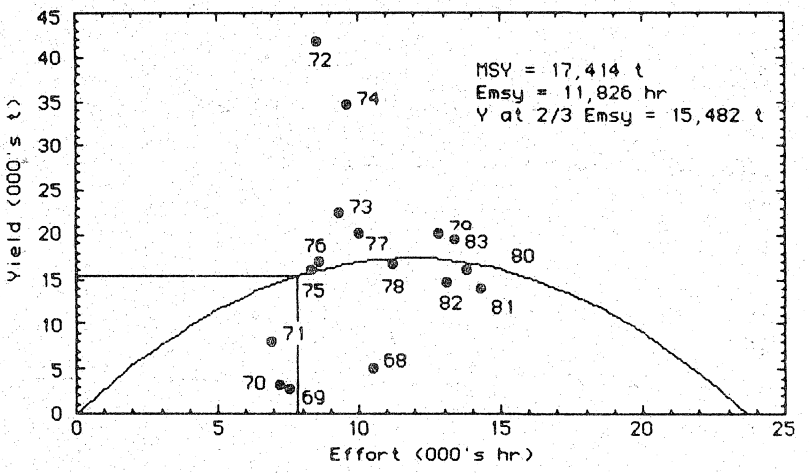

Fig.10: Equilibrium general production model for redfish in 3M derived from regression in Fig. 9.

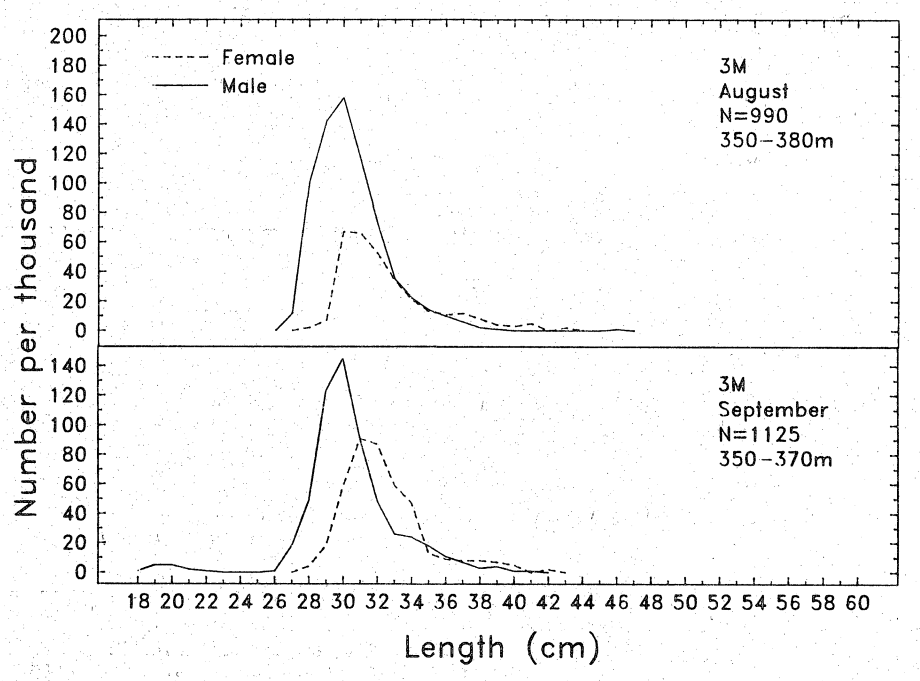

Fig.11: Commercial frequencies from Cuban otter trawl redfish fishery in 3M in 1984 (sea sampling).

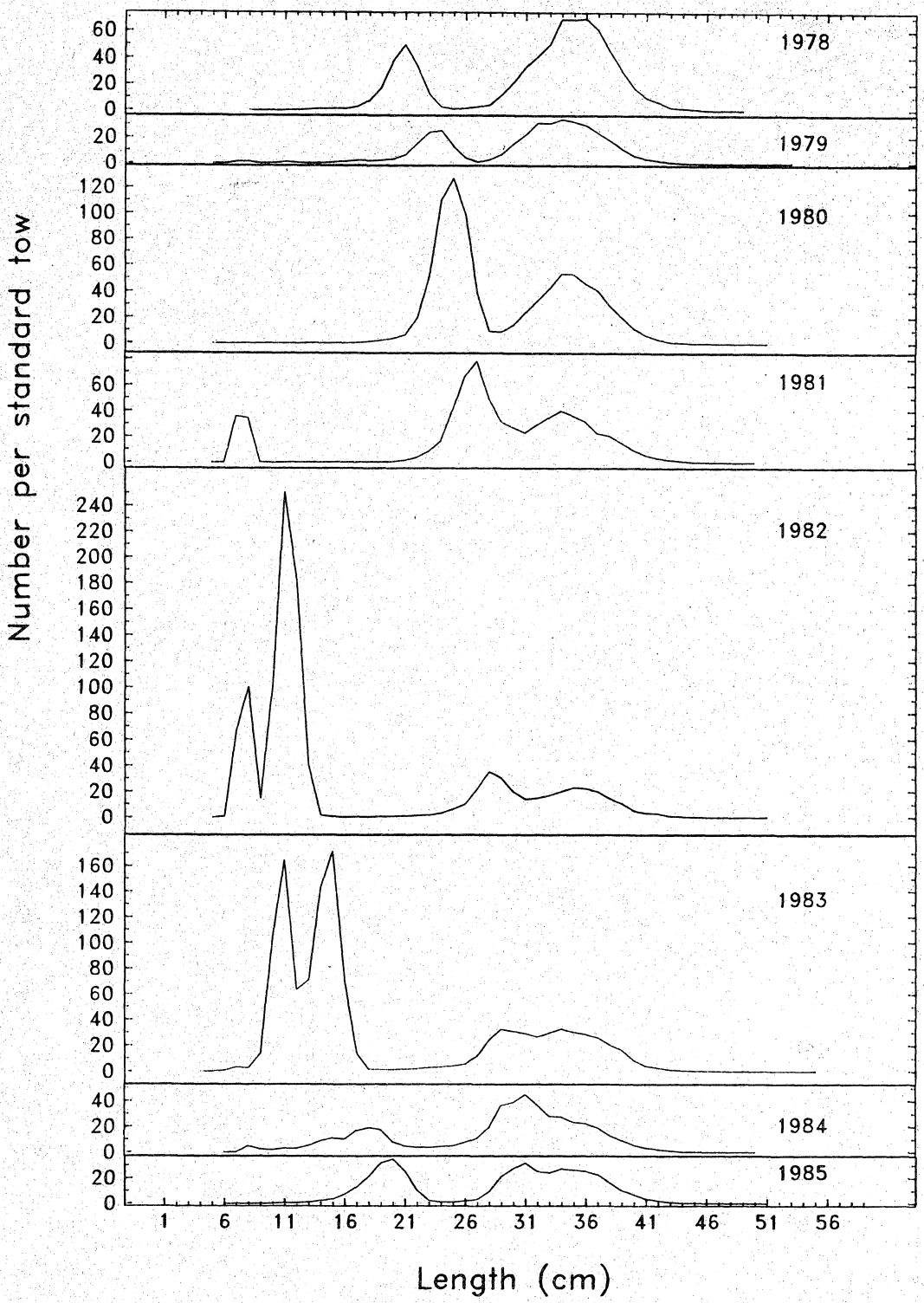

Fig.12: Research frequencies from Canadian surveys in 3M, 1978–1985 (sexes combined)