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The NAFO Division 3P Redfish

by

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Abstract

The catch of redfish in Division 3P remained low in 1985, with only about 3500 t being taken. Effort has shown a steady decline since about 1981. Catch rates peaked in 1983 but have declined since then back to the level of the late 1970's and early 1980's. General production analyses indicate that the present TAC, 18,000, t may be too high. There is evidence that recruitment to the fishery will be good in a few years but there may be by-catch problems with small, unmarketable fish in the interim.

Résumé

Les prises de sébaste dans la Division 3P sont demeurées faibles en 1985, totalisant seulement 3 500 t environ. L'effort de pêche enregistre une baisse constante depuis 1981. Les taux de prise ont atteint leur point culminant en 1983, mais ils ont baissé depuis au niveau enregistré vers la fin des années 1970 et au début des années 1980. Les analyses de la production générale montrent que le TPA actuel, soit 18,000 t, est peut-être trop élevé. Tout porte à croire que le recrutement sera bon dans quelques années, mais les petits poissons non commercialisables pourront, entre temps, causer des problèmes de prises accessoires.

Introduction

After peaking at about 37,000 t in 1970, catches of redfish in Division 3P have declined fairly steadily to a level of about 3500 t in 1985 (Table 1, Fig. 1). The greatest decline has occurred in Div. 3Ps. In recent years, the majority of the catch from Subdiv. 3Pn has been taken by Maritimes vessels, while those from Nfld. have accounted for the majority in Subdiv. 3Ps (Table 2). In 1985, the trend of catches predominating in the second half of the year was restored after being disrupted in 1984 due to labor problems (Table 3).

Methods and Results

Catch and effort data extracted from ICNAF/NAFO Statistical Bulletins for the period 1959 to 1983 were combined with preliminary data from NAFO for 1984 and preliminary data from Canada for 1985. These were analysed using a multiplicative model (Gavaris 1980) to derive a standardized catch rate series. Only those catches where redfish comprised >50% of the total were used. In addition, all country-gear-TC and months with <5 data points were deleted as were all catches and effort of <10 units.This was done in order to reduce potential biases. The parameter estimates and final combinations are shown in Table 4. Table 5 shows the regression results while Table 6 and Figures 2 and 3 show the standardized catch rates and effort. Effort has declined fairly steadily since the mid-1970's. After peaking in 1983, the catch rates have dropped gradually through 1985.

The available commercial frequencies (Fig. 4 and 5) were combined (Gavaris and Gavaris 1983) as shown in Figure 6 then converted to numbers at age with their associated average weight at age (Table 7). The weight at age has been calculated on an annual basis from 1981-1984 only. The relationships used in all years are:

$$WT(males)=0.01659FL^{2.9548}$$

$$WT(females)=0.01372FL^{3.0210}$$

Fish aged 6 predominated (16-17 cm) with another mode present at ages 17-18 (30-32 cm). The mode at age 6 is interesting. It was first thought to predominate because most of the frequencies were derived from samples taken at sea before culling but these smaller fish were also present in the samples taken in port. The smaller fish that were landed were processed as meal. From the data available it is not possible to determine the extent of discarding, but for those frequencies shown in Figure 4b, the majority of the small fish in the July sample were discarded but there was no discarding from the sampled August catch. These small fish predominated in the 1985 Canadian survey results (Atkinson MS 1985) and were also found in relatively high numbers during the 1986 survey (Fig. 7). These all indicate a potential for good recruitment to the fishery over the next few years.

SPA has not been attempted in recent years because of the low levels of effort and resultant low F's (Atkinson MS 1985). Since effort was again low in 1985, and only about 20% of the TAC taken, no analytical assessment was carried out again this year. The catch-at-age matrix and associated weights at age are shown in tables 8 and 9.

A general production analysis was carried out using unlagged data and data lagged 6, 8, 10 and 12 years (Gulland 1961). The residuals of the regressions of catch rate on effort were examined in order to determine if serial correlation existed in the data. The residuals from each run were correlated with these same residuals moved ahead 1 year. Significant correlation between these indicates serial correlation in the data (Draper and Smith 1982). It was hypothesized that serial correlation would exist for unlagged data but that this would be reduced or eliminated by lagging. The results were:

LAG	df	r	
nil	24	0.9081	reg. of cpue on f was N.S.
6	18	0.8901	
8	16	0.9084	
10	14	0.6501	
12	12	0.1051	

From the above it was considered that a lag of 12 years was most appropriate. This is a somewhat longer period than has normally been used for redfish in the past. The lag period should, in theory, approximate the number of years that a cohort contributes significantly to the fishery. In Division 3P, the very strong year classes of the late 1950's contributed significantly from the mid-1960's to the late 1970's, about 12-15 years. Since this period encompasses the time from which a major portion of the catch and effort data are available, it is not unreasonable to expect that the most appropriate lag period for the particular stock is in the vicinity of 12 years. The results of the regression using data lagged 12 years is shown in Figure 8. These results were analysed using an equilibrium production model (Fig. 9). All points since 1977 are below the equilibrium curve, with 1984 and 1985 being the two lowest points in the entire series.

In addition to the equilibrium production analysis, the catch rate and effort data were analysed using a non-equilibrium model. The analyses were done with an input q of 7.0×10^{-6} as determined from the equilibrium model and assuming that $F_{0.1}$ catch $\approx$ yield at 2/3MSY (ie. $q \times 2/3f_{MSY} \approx F_{0.1}$) and again allowing the model to estimate q. A fixed q gave an estimated virgin biomass of about 250,000 t while estimating q (4.55×10^{-6}) gave an estimate of virgin biomass of about 870,000 t. Since a level of 870,000 t was considered unrealistic, the run with a fixed q of 7.0×10^{-6} was taken as being more appropriate.

The two general production analyses indicated the following:

		MSY	$2/3f_{MSY}$
Equilibrium (12 year lag)	EFFORT	32,048 hr	21,365 hr
	CPUE	0.533 t/hr	0.710 t/hr
	YIELD	17,077 t	15,179 t
Non-equilibrium	EFFORT	21,624 hr	14,416 hr
	CPUE	0.905 t/hr	1.206 t/hr
	YIELD	19,562 t	17,388 t

Current levels of effort are well below the MSY and 2/3 f_{MSY} levels

suggested by these two models. Catch rates are also well below the levels suggested by the non-equilibrium model, and have been above the MSY level in only three years. Catch rates at MSY and 2/3 f_{MSY} from the equilibrium model are closer to those noted over the period of this fishey. The non-equilibrium model predicts catches of 4106 t and 5210 t in 1986 and 1987 respectively but this should be viewed with some caution as the model indicates that q has decreased in recent years.

Conclusions

Based on the results from the general production analyses, there is some evidence to suggest that the present TAC of 18,000 t is too high but a lower, more appropriate level cannot be determined at this time. Both research and commercial frequencies indicate that there should be good recruitment to the fishery in the future, but there may be a by-catch problem of small, unmarketable fish for the next few years.

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Table 1: Summary of nominal catches (t) of redfish in Division 3P.

Year	3Pn	3Ps	Total	TAC
1959	9	3,774	3,783	
1960	14	9,211	9,225	
1961	1,060	8,340	9,400	
1962	2,132	11,306	13,438	
1963	2,597	11,150	13,747	
1964	4,688	9,119	13,807	
1965	8,802	9,931	18,733	
1966	4,325	16,543	20,868	
1967	4,526	28,465	32,991	
1968	2,642	11,242	13,884	
1969	3,324	28,727	32,051	
1970	3,689	33,581	37,270	
1971	966	26,534	27,500	
1972	639	25,398	26,037	
1973	3,654	14,714	18,368	
1974	4,264	17,894	22,158	25,000
1975	8,100	20,150	28,250	25,000
1976	5,932	13,235	19,167	18,000
1977	2,485	14,678	17,163	18,000
1978	3,042	12,203	15,245	18,000
1979	3,160	6,459	9,619	16,000
1980	2,372	5,192	7,564	18,000
1981	4,256	4,685	8,941	18,000
1982	3,820	2,090	5,910	18,000
1983	2,929	2,996	5,925	18,000
1984*	1,239	2,006	3,245	18,000
1985*	1,857	1,801	3,658	18,000
1986				18,000

* Provisional.

Table 2a: Nominal catches (t) of redfish in Division 3Pn by country and year.

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
Canada (M)+	1,520	3,941	2,735	932	743	37	30	108	311	540	860	1,467
Canada (N)	2,559	3,505	2,925	1,283	2,266	2,676	2,154	3,749	3,508	2,385	379	390
Canada (Q)	-	-	-	-	-	384	165	387	-	-	-	-
France (M)	53	27	8	-	1	1	-	11	-	-	-	-
France (SP)	24	571	236	270	32	62	23	1	1	-	-	-
France	-	-	-	-	-	-	-	-	-	4	-	-
Japan	-	6	-	-	-	-	-	-	-	-	-	-
Portugal	105	50	-	-	-	-	-	-	-	-	-	-
UK	3	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	28	-	-	-	-	-	-	-	-	-
TOTAL	4,264	8,100	5,932	2,485	3,042	3,160	2,372	4,256	3,820	2,929	1,239	1,857

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

Table 2b: Nominal catches (t) of redfish in Division 3Ps by country and year.

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
Canada (M)+	513	2,549	3,242	3,730	2,592	970	360	391	515	670	396	314
Canada (N)	4,999	8,744	7,948	9,489	9,282	5,119	4,609	4,123	1,553	2,316	1,609	1,487
Canada (Q)	-	-	-	-	-	248	-	-	-	-	-	-
France (M)	147	60	6	8	14	21	112	124	5	-	-	-
France (SP)	200	571	1,071	1,437	315	101	111	47	17	-	-	-
France	-	-	-	-	-	-	-	-	-	10	1	-
Japan	601	-	8	-	-	-	-	-	-	-	-	-
Portugal	90	101	10	-	-	-	-	-	-	-	-	-
Spain	-	10	13	-	-	-	-	-	-	-	-	-
UK	-	3	-	-	-	-	-	-	-	-	-	-
USSR	11,344	8,112	911	14	-	-	-	-	-	-	-	-
Ireland	-	-	26	-	-	-	-	-	-	-	-	-
TOTAL	17,894	20,150	13,235	14,678	12,203	6,459	5,192	4,685	2,090	2,996	2,006	1,801

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

Table 3a: Nominal catches (t) of redfish in Division 3Pn by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1974	660	643	149	21	32	142	133	55	108	203	1,508	610	4,264
1975	1,944	445	224	744	21	61	273	1,146	2,764	340	104	34	8,100
1976	281	511	1,370	1,892	469	281	509	371	130	91	19	8	5,932
1977	146	108	373	74	71	291	102	459	613	89	71	88	2,485
1978	6	339	674	38	10	77	160	549	392	55	491	251	3,042
1979	17	142	598	354	74	92	210	168	167	372	570	396	3,160
1980	5	38	279	193	12	155	388	196	173	192	360	381	2,372
1981	9	432	100	315	117	160	969	540	498	753	272	91	4,256
1982	-	1	39	13	10	153	502	288	923	652	959	280	3,820
1983	21	63	30	207	1	217	294	622	791	144	356	183	2,929
1984*	-	533	211	115	11	37	65	9	-	205	-	53	1,239
1985*	83	7	13	171	3	141	278	527	206	135	122	171	1,857

* Provisional.

Table 3b: Nominal catches (t) of redfish in Division 3Ps by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1974	1,077	1,317	3,378	3,328	487	2,463	2,162	1,029	689	838	667	459	17,894
1975	911	357	657	847	2,546	1,846	3,072	3,527	2,589	1,731	1,104	963	20,150
1976	363	371	1,729	1,272	714	2,414	2,970	2,282	822	211	66	21	13,235
1977	80	388	1,348	694	506	2,408	1,848	1,782	1,846	2,010	1,307	461	14,678
1978	31	301	899	396	148	903	1,625	2,029	1,892	2,178	1,066	735	12,203
1979	30	53	459	881	140	886	951	1,005	690	587	618	159	6,459
1980	6	72	347	469	174	257	978	1,130	706	335	339	379	5,192
1981	21	537	763	157	217	897	465	937	134	150	224	183	4,685
1982	4	5	27	127	154	133	220	580	193	398	205	44	2,090
1983	8	11	25	28	82	61	133	462	667	957	168	394	2,996
1984*	9	126	179	39	114	471	804	141	40	37	22	24	2,006
1985*	31	27	101	32	105	122	360	412	382	141	63	25	1,801

* Provisional.

Table 4: Parameter estimates from the analysis of catch/effort for redfish in Division 3P using a multiplicative model.

Country-Gear-TC	Estimate	Month	Estimate
USSR OTB 4	-0.552	Apr.	
		May	
POR OTB 6	-0.628	Oct.	-0.128
		Nov.	
FR(SP) OTB 4	-0.478	Dec.	
CAN(N) OTB 4	0.000	Jan.	
		Feb.	
CAN(M) OTB 4		Mar.	0.000
CAN(MQ) OTB 4		Jul.	
CAN(N) OTB 5	0.161	Aug.	
FR(SP) OTB 5		Sep.	
GDR OTB 5			
		Jun.	0.110
CAN(MQ) OTM 4			
CAN(N) OTM 4			
CAN(M) OTB 5	0.390		
CAN(MQ) OTB 5			
POL OTB 7			

CAN(MQ) OTM 4	0.550	Div.	

GDR OTB 6	0.602		
		3Pn	-0.051
CAN(MQ) OTM 5			
CAN(N) OTM 5	0.861	3Ps	0.000
JPN OTB 7			
USSR OTB 7	1.327		
USSR OTM 7	1.648		

Table 5: Regression of multiplicative model for redfish in Division 3P.

multiple r.....0.742
multiple r squared.....0.551

analysis of variance

source of variation	df	sums of squares	mean squares	f-value
intercept	1	3.686e2	3.686e2	
regression	38	2.261e2	5.951e0	43.475
type 1	9	1.431e2	1.590e1	116.124
type 2	2	7.698e0	3.849e0	28.120
type 3	1	7.136e-1	7.136e-1	5.213
type 4	26	8.453e1	3.251e0	23.751
residuals	1345	1.841e2	1.369e-1	
total	1384	7.789e2		

Table 6: The predicted catch rate for redfish in Division 3P.

year	total catch	catch rate mean	s.e.	effort
1959	3783	0.679	0.085	5574
1960	9225	0.584	0.050	15800
1961	9400	0.582	0.043	16143
1962	13438	0.599	0.039	22422
1963	13747	0.771	0.042	17824
1964	13807	0.789	0.055	17507
1965	18733	0.969	0.063	19337
1966	20868	1.026	0.061	20334
1967	32991	0.941	0.053	35048
1968	13884	0.910	0.058	15253
1969	32051	0.835	0.045	38384
1970	37270	0.778	0.039	47900
1971	27500	0.671	0.035	40969
1972	26037	0.632	0.033	41179
1973	18368	0.607	0.031	30258
1974	22158	0.525	0.027	42228
1975	28250	0.538	0.024	52483
1976	19167	0.441	0.020	43488
1977	17163	0.451	0.021	38017
1978	15245	0.444	0.020	34357
1979	9619	0.409	0.020	23529
1980	7564	0.493	0.027	15351
1981	8941	0.435	0.025	20554
1982	5910	0.536	0.037	11021
1983	5925	0.636	0.044	9320
1984	3245	0.567	0.049	5728
1985	3658	0.481	0.030	7602

average c.v. for the mean:0.061

Table 7: Estimated numbers of redfish caught at age (000's) (including their average weight and length) in the commercial fishery in Division 3P in 1985.

	average		catch		
age	weight	length	mean	std. err.	c. v.
5	0.051	15.164	69	26.52	0.38
6	0.066	16.522	1152	66.25	0.06
7	0.088	18.178	504	61.22	0.12
8	0.145	21.378	277	37.24	0.13
9	0.183	23.172	269	35.76	0.13
10	0.231	25.131	39	15.13	0.39
11	0.232	25.162	68	20.67	0.30
12	0.243	25.626	102	23.33	0.23
13	0.273	26.582	119	26.42	0.22
14	0.287	27.032	144	32.15	0.22
15	0.376	29.627	414	77.61	0.19
16	0.420	30.674	737	115.25	0.16
17	0.476	31.966	787	122.60	0.16
18	0.472	31.898	699	122.48	0.18
19	0.513	32.715	336	87.25	0.26
20	0.553	33.510	350	84.41	0.24
21	0.574	33.877	149	58.29	0.39
22	0.602	34.411	164	54.34	0.33
23	0.534	33.261	95	43.93	0.46
24	0.632	35.164	171	49.08	0.29
25	0.648	35.466	140	41.26	0.29
26	0.657	35.758	134	36.43	0.27
27	0.686	36.100	258	51.69	0.20
28	0.713	36.512	270	52.34	0.19
29	0.764	37.279	245	46.85	0.19
*30	0.925	39.650	506	45.86	0.09

* for the ages flagged by * there was an age length key with only one age determination for some length. Since the variance formula has n-1 in the denominator it cannot be evaluated for this length. Consequently this variance component is not included in the variance for the flagged ages. This is generally not a serious problem since it occurs when few fish are caught at that length.

Table 8. Estimated numbers of redfish caught at age (000's) in Division 3P, 1973-1985.

age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
6	13	105	401	41	257	1339	440	191	8	3
7	11	895	694	56	491	4146	1510	976	204	11
8	16	1876	1868	263	499	7359	2703	1776	1550	76
9	8	1647	883	581	790	7382	2859	2377	1923	234
10	20	1528	486	386	835	5203	1606	1929	1686	250
11	536	1830	1112	434	777	2358	896	1532	1344	606
12	1004	1399	623	506	971	2049	1020	1219	1236	856
13	3076	3602	1016	990	849	857	714	629	1327	943
14	6099	3058	1123	1119	1022	1085	710	802	635	1315
15	9314	3173	2206	1072	1438	1162	496	579	518	1042
16	5866	7661	3613	1796	793	927	449	313	384	940
17	7300	2597	8428	1124	1298	791	603	366	348	458
18	1842	3930	6040	4154	1005	1067	548	308	304	322
19	878	1063	12060	1897	2659	852	531	315	399	233
20	1149	1326	3015	6345	1490	1883	655	319	374	151
21	589	701	2323	1463	4659	520	1021	428	286	188
22	385	1555	2080	2387	2281	1534	676	809	510	207
23	404	2821	1758	1957	2398	1040	1263	484	876	194
24	484	1410	790	1310	2031	1080	731	796	521	302
25	168	2147	1205	2269	1083	1053	1053	482	1021	393
26	2	1887	995	1613	619	674	691	490	688	575
27	2	2	687	868	396	532	454	239	649	386
28	2	2	2	575	307	339	345	287	450	411
29	2	2	2	2	289	187	207	171	371	342

age	1983	1984	1985
6	8	71	1152
7	10	365	504
8	8	395	277
9	58	461	269
10	188	1266	39
11	232	2321	68
12	404	1519	102
13	602	1292	119
14	956	1041	144
15	1064	815	414
16	1130	856	737
17	939	709	787
18	1178	743	699
19	612	419	336
20	567	264	350
21	483	192	149
22	342	149	164
23	270	136	95
24	271	150	171
25	270	165	140
26	218	335	134
27	430	122	258
28	251	153	270
29	266	60	245

Table 9: Estimated weight at age (kg) of redfish caught in Division 3P, 1973-1985.

age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
6	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.06	0.08	0.08	0.07
7	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.10	0.11	0.11	0.09
8	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.16	0.15	0.15
9	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.21	0.18	0.18
10	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27	0.27	0.26	0.20	0.23
11	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.33	0.27	0.23	0.23
12	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.36	0.32	0.28	0.24
13	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.37	0.35	0.31	0.27
14	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.40	0.38	0.35	0.29
15	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.42	0.39	0.35	0.38
16	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.44	0.41	0.40	0.42
17	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.45	0.42	0.48
18	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.54	0.52	0.46	0.46	0.47
19	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.62	0.57	0.49	0.52	0.51
20	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.63	0.60	0.50	0.54	0.55
21	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.60	0.66	0.53	0.58	0.57
22	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.65	0.67	0.58	0.54	0.60
23	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.65	0.70	0.61	0.63	0.53
24	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.71	0.68	0.67	0.60	0.63
25	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.73	0.71	0.68	0.64	0.65
26	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.78	0.75	0.74	0.67	0.66
27	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.81	0.85	0.71	0.80	0.69
28	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.87	0.82	0.82	0.78	0.71
29	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.88	0.93	0.85	0.85	0.76

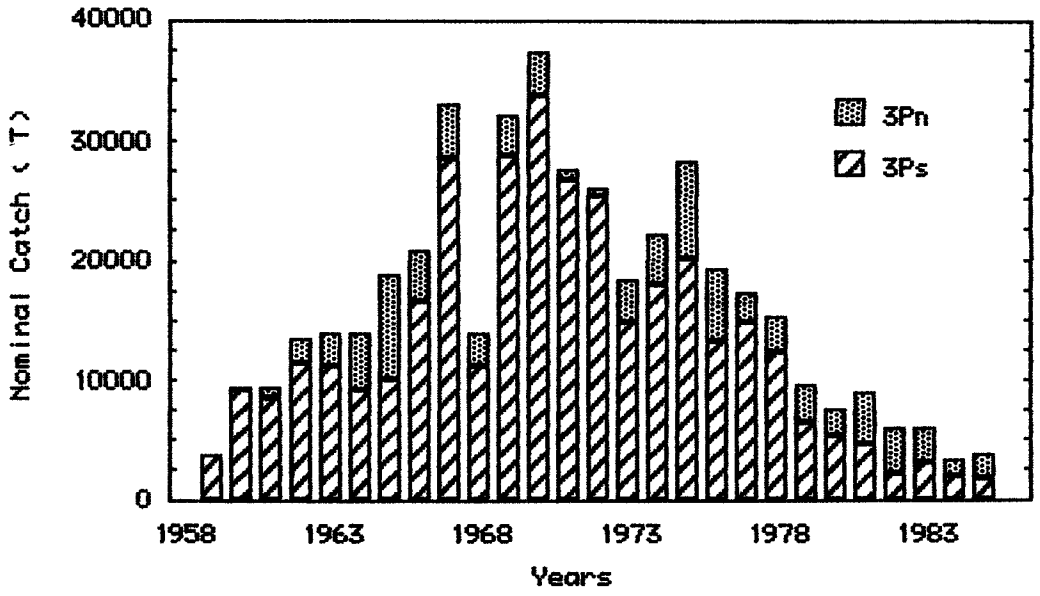

Fig. 1: Nominal catches of redfish from Division 3P, 1958-1985. (1984 and 1985 are provisional)

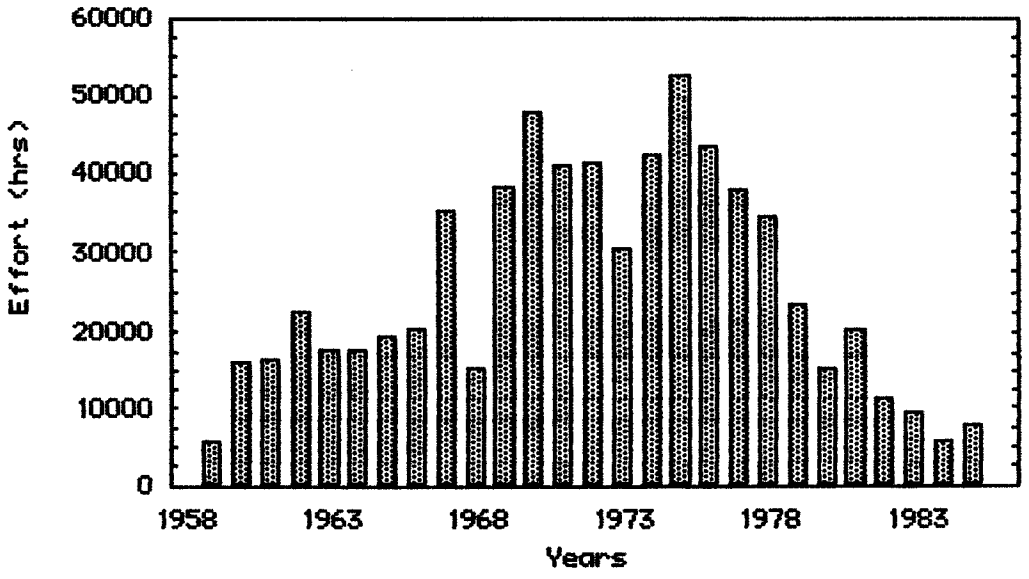

Fig. 2: Standardized effort for redfish in Division 3P, 1959-1985. (1984 and 1985 are provisional)

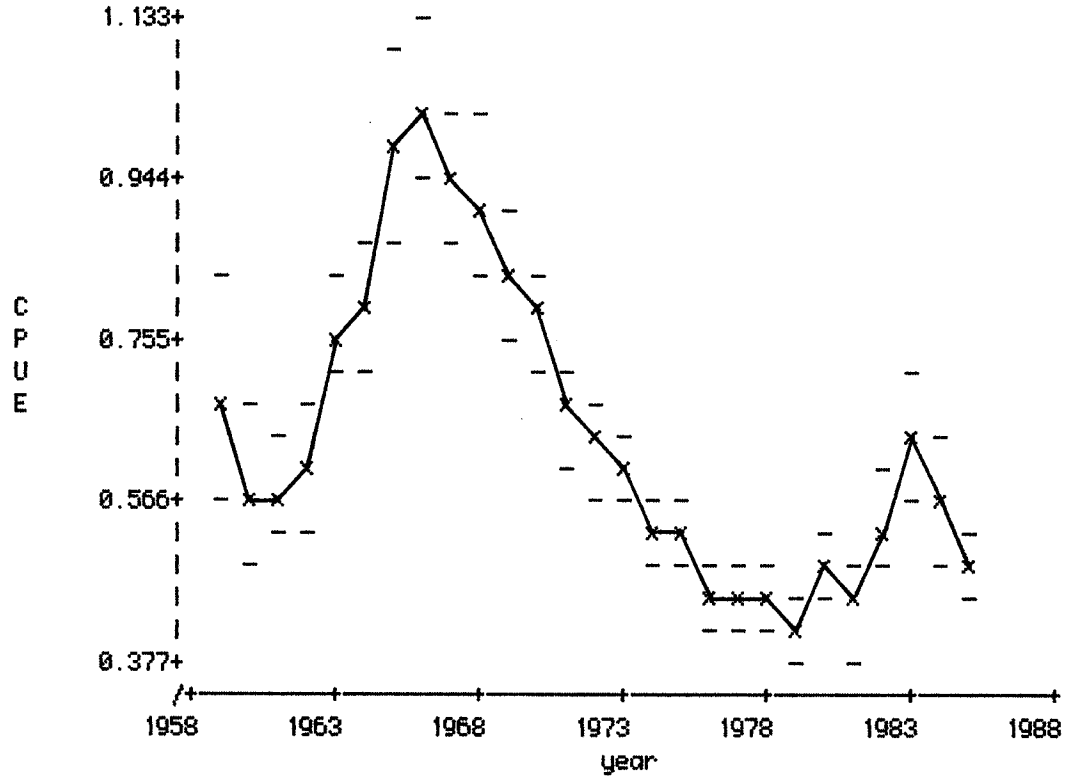

Fig. 3: Standardized CPUE (t/hr) for redfish in Division 3P, 1959-1985.
(1984 and 1985 Provisional)

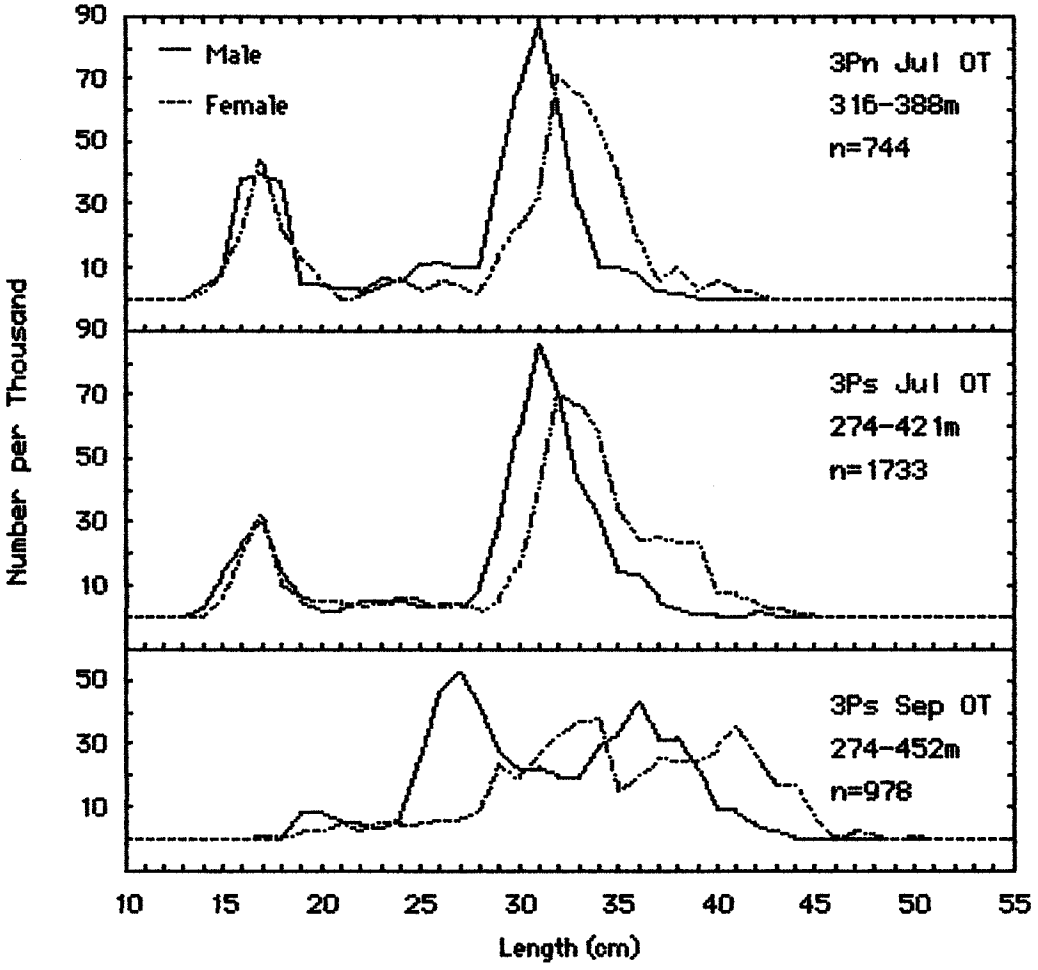

Fig. 4a: Commercial frequencies from the Canadian (Nfld.) otter trawl fishery for redfish in Division 3P, 1985 (port sampling).

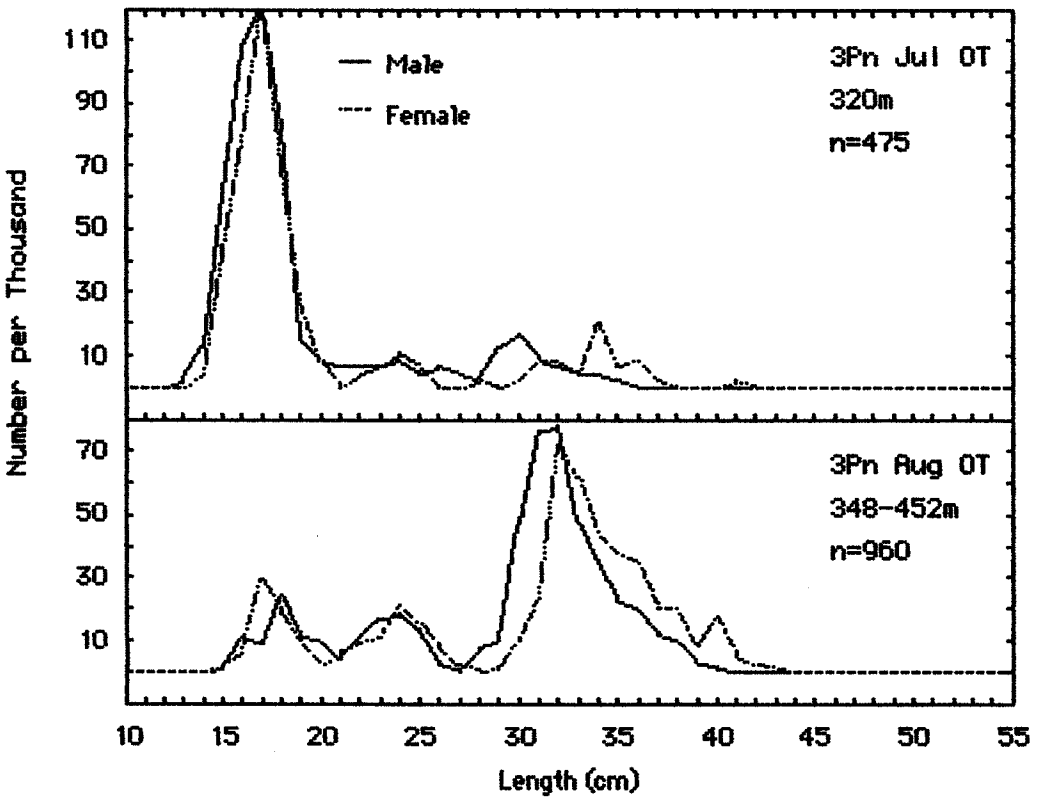

Fig. 4b: Commercial frequencies from the Canadian (Nfld.) otter trawl fishery for redfish in Division 3P, 1985 (sea sampling).

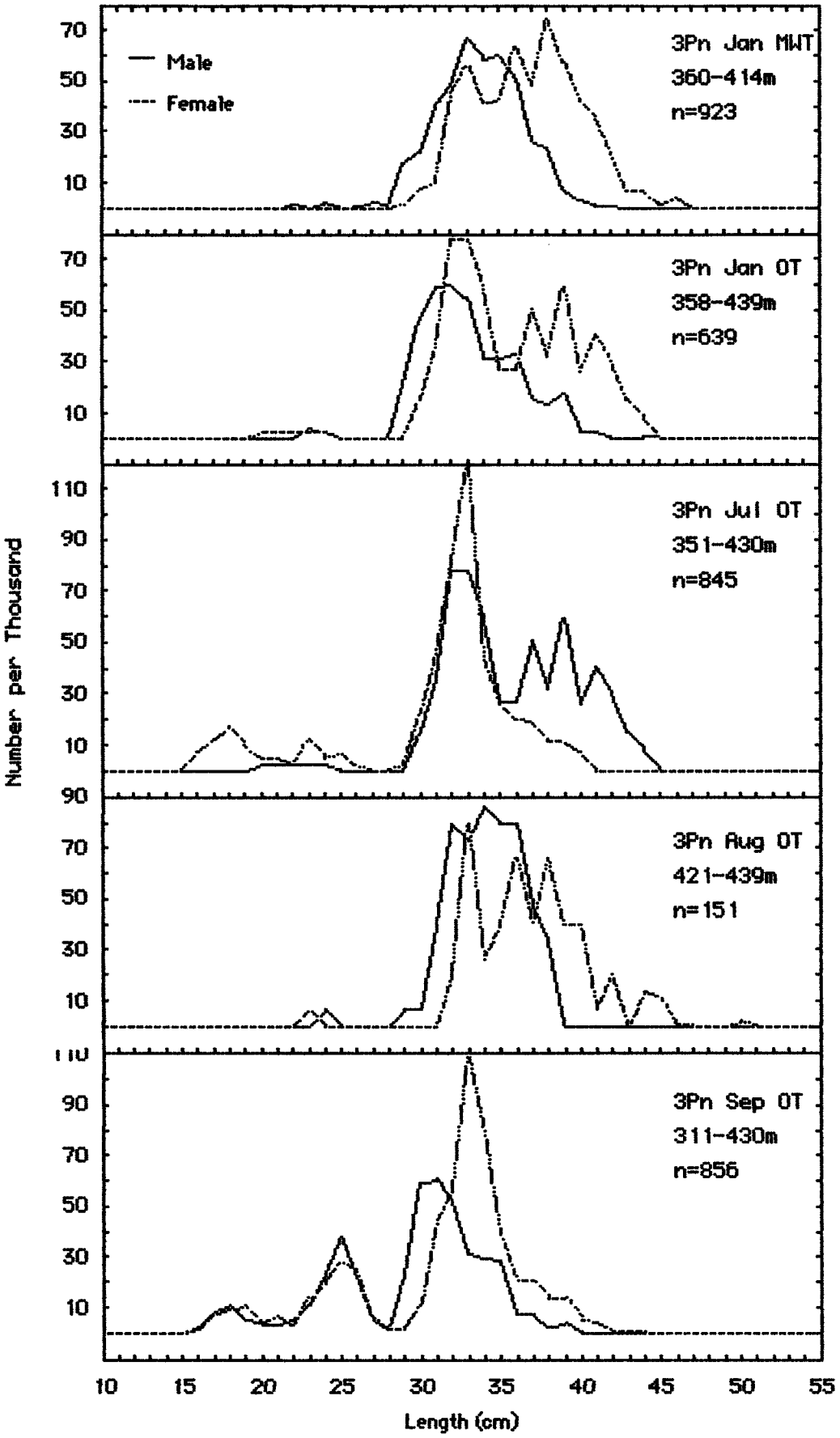

Fig. 5a: Commercial frequencies from the Canadian (Maritimes) trawl fishery for redfish in Division 3P, 1985 (sea sampling).

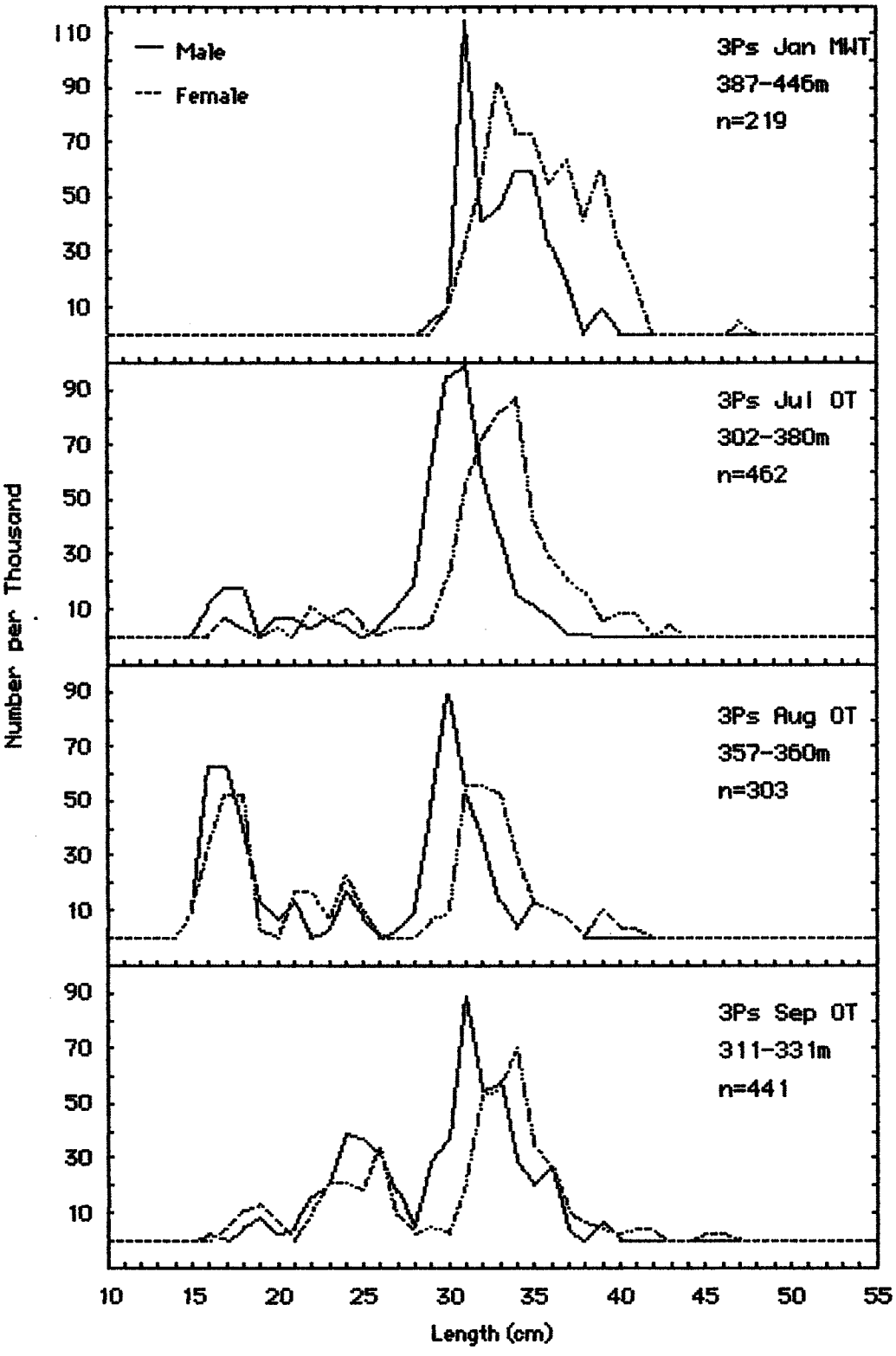

Fig. 5b: Commercial frequencies from the Canadian (Maritimes) trawl fishery for redfish in Division 3P, 1985 (sea sampling).

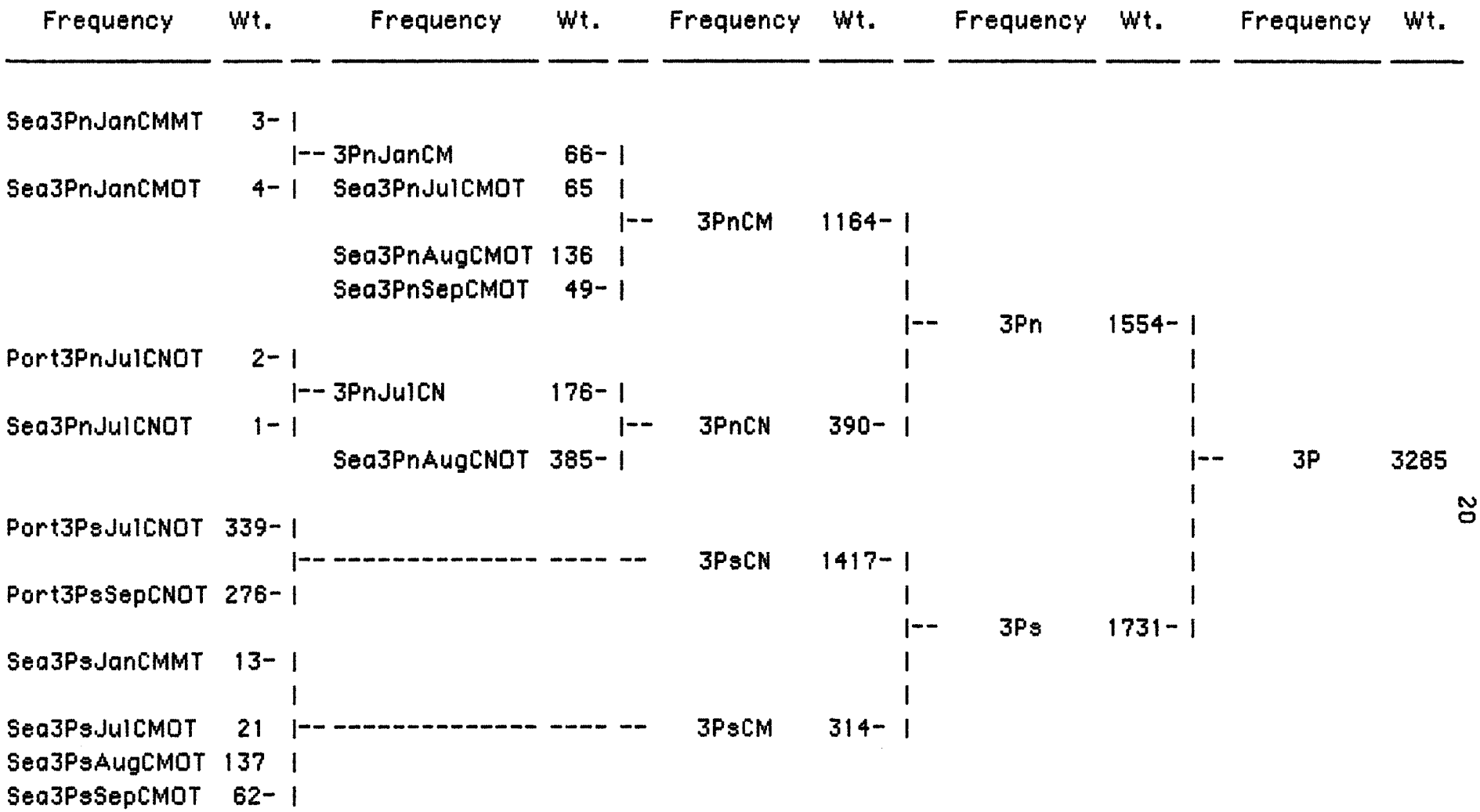

Fig. 6: Commercial Frequencies used and the combination process followed to derive the estimate of number of redfish caught at age in Division 3P in 1985.

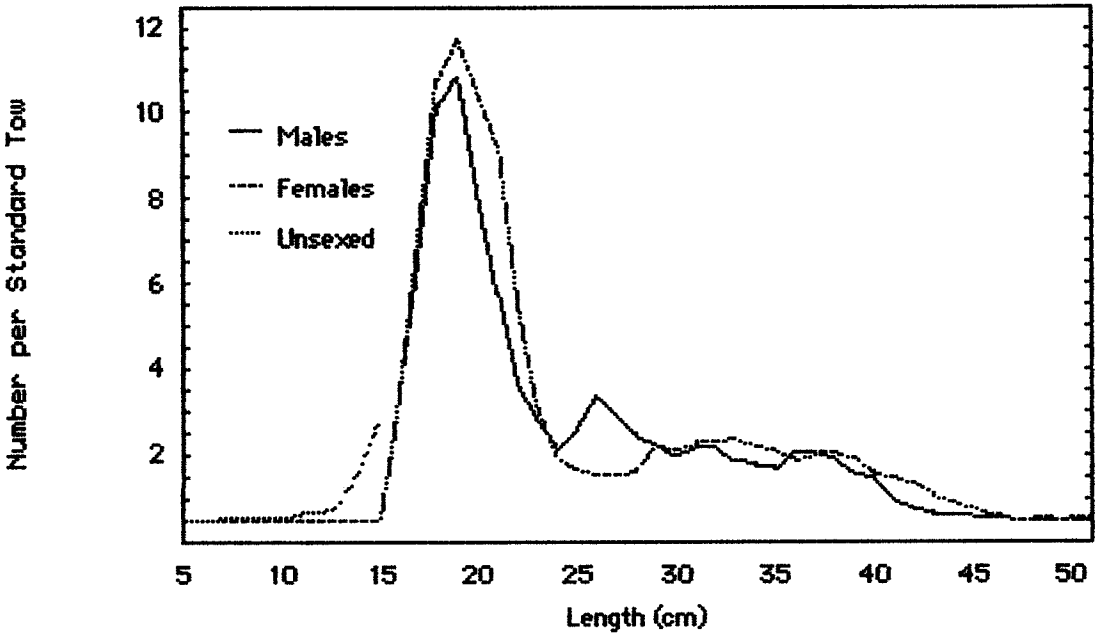

Fig. 7: Numbers of redfish caught at length per standard tow during a Canadian research survey in Division 3P, spring 1986.

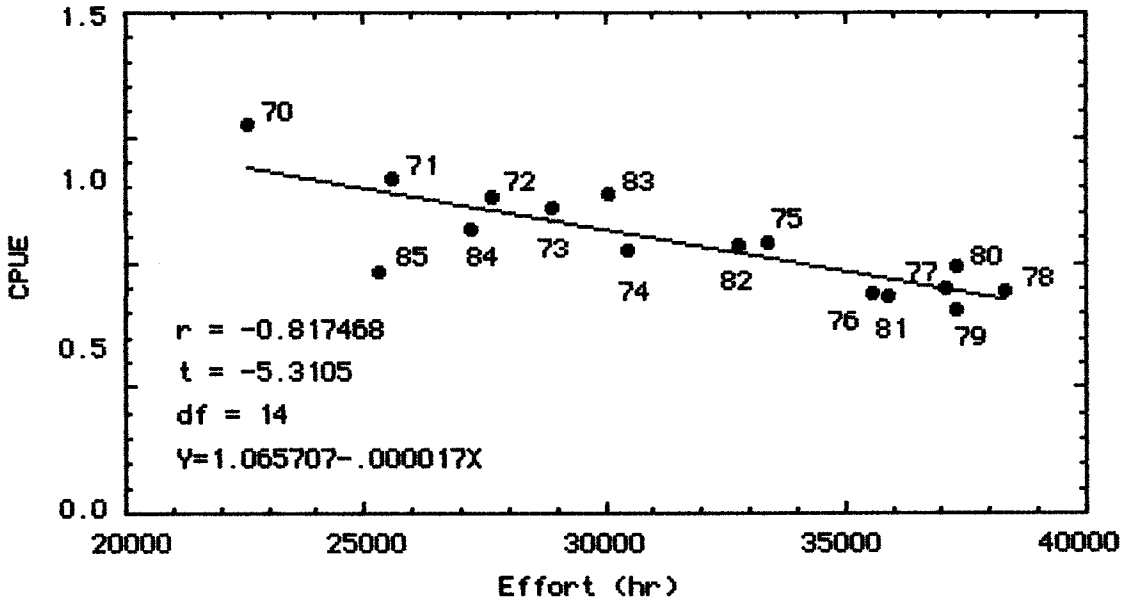

Fig. 8: Regression of standardized CPUE on standardized effort for redfish in Division 3P using data lagged 12 years.

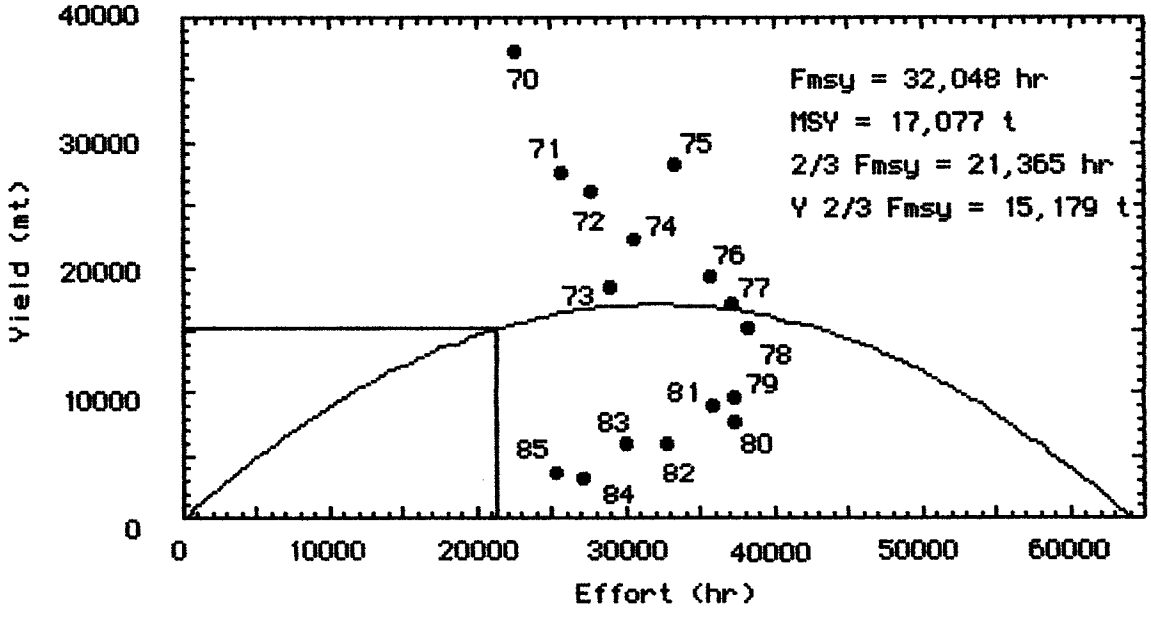

Fig. 9: General production curve derived from regression above.