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An Evaluation of the Status of Roundnose Grenadier in Subarea 0+1 and 2+3

by

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Introduction

Annual catches of roundnose grenadier in SA 0+1 have been less than 100 t from 1982 to the present. Preliminary data indicate that only 31 t were taken in 1986 (Table 1, Fig. 1a). These catches are taken in small quantities primarily by Greenland vessels as by-catch (Table 2a) throughout most of the year (Table 3a). Because there are no recent directed catch and effort data, surplus production analyses have not been possible in recent years. In 1986, Canada mounted a research survey to the area. Biological information regarding the abundance and distribution of roundnose grenadier in SA 0+1 were collected.

In 1986, it was reported that almost 7,500 t of roundnose grenadier were taken in SA 2+3 (Table 1, Fig. 1b). This represents an increase of about 25% over the reported catch for 1985 (5,000 t). The increased landings are a result of increases by both the USSR and the German Democratic Republic (Table 2b). As has been noted previously, catches are taken in the second half of the year (Table 3b). Prior to 1979, nominal catches from this stock averaged about 22,500 t (excluding the catch of 75,445 t in 1971) but from 1979 to the present, landings have remained below 10,000 t. There are insufficient data to carry out an analytical assessment of this stock. In recent years, surplus production models have not been employed in the assessments because the relationships between CPUE and effort have had positive slopes.

Methods and Results

a) Commercial Data

Commercial catch and effort data obtained from ICNAF/NAFO Statistical Bulletins for the period 1968 to 1985 were combined with preliminary NAFO statistics for 1985 and analysed using a multiplicative model (Gavaris 1981). In addition, commercial catch and effort data collected by Canadian observers for the period 1978 to 1986 were combined and analysed using the same multiplicative model. Data were selected based on the criterion that the catch of roundnose grenadier made up at least 50% of the total reported. The Observer data were examined on a set by set basis. Any data points that represented <10 units of either catch or effort were deleted because of possible biases due to rounding errors. In addition, the data were examined for outliers as detected through an examination of residuals. Points so identified were also eliminated. The groupings used previously (Atkinson and Power MS 1986) were used again this year (Tables 4a and 4b). Because of the question of possible pro-rating of effort data, the regressions were not weighted.

The results (Tables 5a and 5b) indicate that the regressions are significant. Effort peaked in 1971 (Table 6a, Fig. 2a) then gradually declined to an all time low in 1980. Effort has been fairly steady in the 1981-1986 period. Catch rates (Table 6a, Fig. 3a) declined from the early 1970's to about 1981 but have been fairly steady since then.

The results from the observer data (Table 6b, Fig. 2b) indicate a drop in effort between 1978 and 1979. Effort has gradually increased from 1984 to 1986. Catch rates (Table 6b, Fig. 3b) have fluctuated between years but show no real trend with time.

When compared, the two catch rate series show similar overall trends with time but there are considerable differences in the 1978 and 1979 values (Fig.4).

It has been noted in the past (Atkinson and Power MS 1986) that surplus production analyses could not be carried out on the SA 2+3 data because the slopes of the regressions of CPUE on effort (lagged 4 and 6 years (Gulland 1961)) were positive. Ordinary least squares regressions were again carried out, this time using both data series. The relationships using ICNAF/NAFO statistics were either not significant (unlagged effort) or had positive slopes (lagged 2, 4 and 6 years). The relationship using Canadian observer data (unlagged effort) was not significant. No lagging was performed with this latter series because of the shortness of the time series. Because of these, surplus production analysis is inappropriate.

b) Research Data

In 1986, Canada conducted a research cruise in Subareas 0+1. The area from 61° north to about 70° north was surveyed using a stratified random design in depths of 200-1250 m. The stratification scheme used and the distribution of sets within the area is described by Bowering (MS 1987a, MS 1987 b). The distribution of catches of roundnose grenadier in the survey area is shown in Figure 5. It is interesting to note that they were not found north of about 66°50' N latitude. There is a gradual increase in size with depth (Figure 6) with the most pronounced change between 1000-1099 m and 1100+m. The fish were most abundant in the 900-999 m depth range (Figures 7a and 7b). The minimum trawlable biomass was estimated to be 110,806 t (444,839,424 fish). Of this, only about 9% was in Subarea 0. Only a few mature or maturing fish were caught, and these were all male.

Discussion

Because the fishery for roundnose grenadier in SA 0+1 has only been by-catch since about 1980, it is not possible to update the general production analysis presented previously (Atkinson MS 1985) which indicated an equilibrium yield of about 8,000 t at ⅔ effort MSY. Based on the research survey biomass estimate, this would represent a fishing mortality rate of less than 10% (F=C/N).

The database available for roundnose grenadier in SA 2+3 is inappropriate for surplus production analyses because the relationships between CPUE and effort have positive slopes. Catch rates appear to have stabilized in the 1980's although the Canadian observer data may suggest a slight decline over this period. By-catch limitations of Greenland halibut may be restricting this fishery and thus catch rates in the most recent period may not be reflective of stock status. There are insufficient data available to suggest any change in the TAC for roundnose grenadier in SA 2+3 for 1988 from the present level of 11,000 t.

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Table 1: Summary of nominal catches (t) of roundnose grenadier by Subarea and Division.

Year	0	1	Total	TAC	2G	2H	2J	3K	Other	2+3	TAC
1967	1,129	6	1,135		-	868	217	16,009	210	17,304	
1968	5,996	284	6,280		2,536	4,089	479	23,553	606	31,263	
1969	2,642	68	2,710		387	-	264	11,682	-	12,333	
1970	545	5,980	6,525		-	-	468	22,267	129	22,864	
1971	4,172	4,132	8,304		54,179	2,738	81	18,392	55	75,445	
1973	5,783	2,311	8,094		2,161	655	293	21,122	155	24,386	
1972	1,054	3,830	4,884		5,880	232	632	10,655	165	17,564	
1974	2,661	9,657	12,318		3,220	2,007	333	22,816	40	28,416	32,000
1975	204	4,749	4,953	10,000	6,489	3,536	1,754	15,388	258	27,425	32,000
1976	2,610	5,893	8,503	14,000	3,841	1,460	1,381	13,636	275	20,593	32,000
1977	721	2,214	2,935	8,000	2,597	525	206	11,935	123	15,386	35,000
1978	-	5,839	5,839	8,000	3,112	1,412	913	15,250	12	20,699	35,000
1979	106	6,815	6,921	8,000	1,035	3,090	438	3,200	19	7,782	35,000
1980	32	1,721	1,753	8,000	279	493	726	451	104	2,053	30,000
1981	-	392	392	8,000	967	1,593	463	3,920	42	7,085	27,000
1982	43	48	91	8,000	719	734	182	2,709	-	4,344	27,000
1983	46	22	68	8,000	140	1,390	36	1,916	87	3,569	11,000
1984	25	25	50	8,000	107	289	3	3,362	112	3,873	11,000
1985*			51	8,000	-	80	13	4,642	213	4,948	11,000
1986*			31	8,000						7,439	11,000
1987				8,000							11,000

* Provisional.

Table 2a: Nominal catches (t) of roundnose grenadier in Subarea 0+1 by country and year.

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985*	1986*
Denmark (G)	6	1	10	32	21	-	39	37	22	25	49	30
GDR	186	181	61	-	-	-	-	-	-	-	-	-
FRG	33	147	519	5,807	6,794	1,721	353	11	-	-	-	-
USSR	4,728	8,174	2,345	-	106	32	-	43	46	25	2	1
TOTAL	4,953	8,503	2,935	5,839	6,921	1,753	392	91	68	50	51	31

* Provisional.

Table 2b: Nominal catches (t) of roundnose grenadier in Subarea 2+3 by country and year.

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985*	1986*
Canada (M)+	-	-	-	2	-	-	-	-	-	-	-	-
Canada (N)	-	16	15	7	4	-	-	-	-	-	-	-
FRG	-	1	174	973	-	32	-	-	-	23	178	12
GDR	2,705	497	613	1,801	480	898	1,407	1,640	2,586	3,650	3,740	4,570
Poland	1,499	101	-	51	95	36	18	15	50	51	12	52
Romania	-	-	7	108	-	-	-	-	-	-	-	-
USSR	23,221	19,978	14,577	17,760	7,201	1,087	5,660	2,689	933	147	1,018	2,801
Japan	-	-	-	-	-	-	-	-	-	2	-	4
TOTAL	27,425	20,593	15,386	20,702	7,781	2,053	7,085	4,344	3,569	3,873	4,948	7,439

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

Table 3a: Nominal catches (t) of roundnose grenadier in Subarea 0+1 by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1975	46	158	35	43	-	111	307	672	439	109	1,171	1,862	4,953	
1976	475	7	1	197	-	-	-	206	631	1,793	3,276	1,917	8,503	
1977	464	94	20	14	2	5	58	1,094	1,089	38	18	39	2,935	
1978	139	130	723	2,554	1,942	343	4	2	1	-	-	-	5,838	
1979	605	759	348	626	1,658	1,122	123	118	1	185	545	831	6,921	
1980	686	385	-	-	-	-	-	418	117	118	23	6	1,753	
1981	1	4	13	12	1	2	-	-	170	183	-	-	386	
1982	1	3	9	6	4	11	1	3	-	14	25	7	91	a
1983	-	3	6	5	1	-	-	-	7	5	21	14	68	b
1984	-	2	6	8	1	1	-	14	14	2	-	2	50	
1985*	1	5	9	7	1	-	22	-	4	-	2	-	51	
1986*	3	2	4	9	-	-	-	1	2	2	-	-	31	c

* Provisional.
a includes catch of 7t from month 'unknown'.
b includes catch of 6t from month 'unknown'.
c includes catch of 8t from month 'unknown'

Table 3b: Nominal catches (t) of roundnose grenadier in Subarea 2+3 by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1975	784	1,388	400	807	47	1,596	812	6,516	7,498	3,301	2,332	1,944	27,425	
1976	843	1,225	1	605	290	106	257	1,856	1,170	3,961	4,530	5,749	20,593	
1977	44	8	12	45	13	6	1,776	5,698	3,411	1,973	1,681	719	15,386	
1978	264	467	13	45	7	405	6,416	3,963	1,814	3,964	1,487	1,866	20,711	
1979	103	32	44	6	136	683	1,169	1,612	1,691	611	745	949	7,781	
1980	3	4	48	13	2	-	-	130	376	794	577	106	2,053	
1981	40	14	1	2	4	1	168	1,636	1,391	759	1,751	1,318	7,085	
1982	4	-	3	5	3	4	559	563	410	698	1,465	630	4,344	
1983	3	18	4	-	3	1	1	74	1,292	851	866	446	3,559	
1984	31	13	6	19	-	5	-	45	460	3,018	123	153	3,873	
1985*	44	7	1	96	73	-	54	873	1,869	1,361	537	33	4,948	
1986*	29	-	-	-	-	-	128	2,804	2,072	1,529	523	342	7,439	a

a includes catch of 12t from month 'unknown'
* Provisional.

Table 4a: Parameter estimates from the analysis of catch/effort for grenadier in SA 2 + 3 using a multiplicative model and ICNAF/ NAFO statistics.

Country-Gear-TC	Estimate	Month	Estimate
GDR OTB 5	-0.286	Jun.	
GDR OTB 6		Jul.	combined
		Aug.	since no
USSR OTB 6	0.000	Sep.	significant
USSR OTB 7		Oct.	differances
		Nov.	
GDR OTB 7	0.251	Dec.	
USSR OTM 7			
		Div.	
		2J	-0.166
		2G	0.000
		3K	
		2H	0.157

Table 4b: Parameter estimates from the analysis of catch/effort for roundnose grenadier in SA 2 + 3 using a multiplicative model and Canadian Observer Program statistics.

Country-Gear-TC	Estimate	Month	Estimate
GDR OTB 5		Jul.	
GDR OTB 7	0.000	Aug.	combined
USSR OTB 7		Sep.	since no
		Oct.	significant
		Nov.	differances
		Dec.	
		Div.	
		2G	
		2J	0.000
		3K	
		2H	0.206

Table 5a: Regression of multiplicative model for roundnose grenadier in SA 2+3 using ICNAF/NAFO statistics.

multiple r..... 0.662
multiple r squared..... 0.438

analysis of variance

source of variation	df	sums of squares	mean squares	f-value
intercept	1	8.267e0	8.267e0	
regression	22	3.364e1	1.529e0	7.371
type 1	2	4.867e0	2.433e0	11.730
type 2	2	1.680e0	8.401e-1	4.049
type 3	18	2.079e1	1.155e0	5.569
residuals	208	4.315e1	2.075e-1	
total	231	8.586e1		

Table 5b: Regression of multiplicative model for roundnose grenadier in SA 2+3 using Canadian Observer Program statistics.

multiple r..... 0.602
multiple r squared..... 0.362

analysis of variance

source of variation	df	sums of squares	mean squares	f-value
intercept	1	1.918e-1	1.918e-1	
regression	9	3.637e0	4.041e-1	4.107
type 1	1	4.664e-1	4.664e-1	4.740
type 2	8	3.249e0	4.061e-1	4.127
residuals	65	6.396e0	9.839e-2	
total	75	1.022e1		

Table 6a: The predicted catch rate for roundnose grenadier in SA 2+3 using ICNAF/NAFO statistics.

	ln transform		retransformed			
year	mean	s.e.	mean	s.e.	catch	effort
1967	0.2950	0.0754	1.435	0.388	17304	12056
1968	0.0673	0.0171	1.177	0.154	31263	26563
1969	0.2314	0.1037	1.328	0.418	12333	9288
1970	0.7248	0.0214	2.267	0.331	22864	10087
1971	0.4638	0.0118	1.754	0.191	75445	43005
1972	0.2488	0.0260	1.484	0.226	24386	17372
1973	0.7512	0.0347	2.312	0.428	17567	7599
1974	0.3934	0.0211	1.628	0.236	28146	17294
1975	0.4989	0.0157	1.799	0.225	27425	15245
1976	0.2057	0.0200	1.351	0.191	20953	15508
1977	0.2189	0.0139	1.372	0.162	15387	11217
1978	0.2613	0.0080	1.436	0.128	20699	14419
1979	-0.1695	0.0091	0.933	0.089	7782	8345
1980	0.0320	0.0188	1.135	0.155	2053	1809
1981	-0.3109	0.0139	0.888	0.095	7085	8772
1982	-0.2699	0.0195	0.839	0.117	4344	5177
1983	-0.2703	0.0417	0.829	0.168	3569	4303
1984	0.0145	0.0818	1.081	0.304	3873	3584
1985	-0.3992	0.0285	0.734	0.123	4948	6741

Table 6b: The predicted catch rate for roundnose grenadier in SA 2+3 using Canadian Observer Program statistics.

	ln transform		retransformed			
year	mean	s.e.	mean	s.e.	catch	effort
1978	-0.1459	0.0252	0.897	0.142	20699	23075
1979	0.4778	0.0492	1.653	0.365	7782	4707
1980	-0.0258	0.0129	1.018	0.116	2053	2017
1981	-0.0809	0.0073	0.966	0.083	7085	7335
1982	-0.0899	0.0074	1.037	0.090	4344	4189
1983	-0.5435	0.0185	0.685	0.083	3569	5902
1984	0.3271	0.0200	1.443	0.205	3873	2683
1985	-0.2698	0.0123	0.798	0.089	4948	6203
1986	-0.1959	0.0089	0.860	0.082	7439	8647

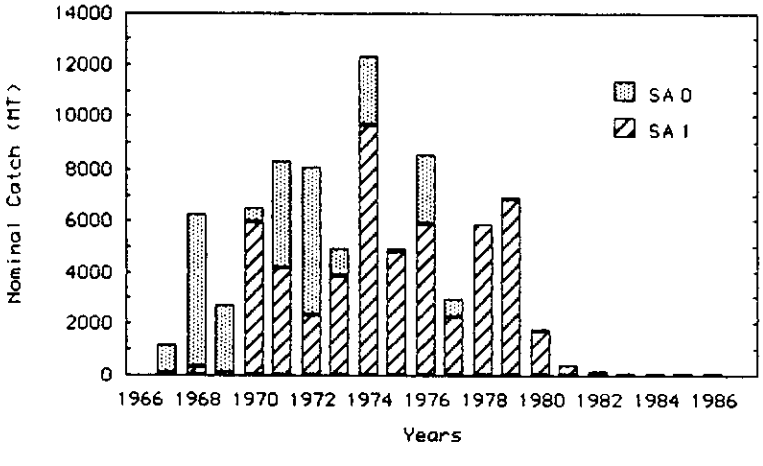

Fig. 1a: Nominal catches of roundnose grenadier in SA 0+1, 1967-1986 (1985 and 1986 are provisional)

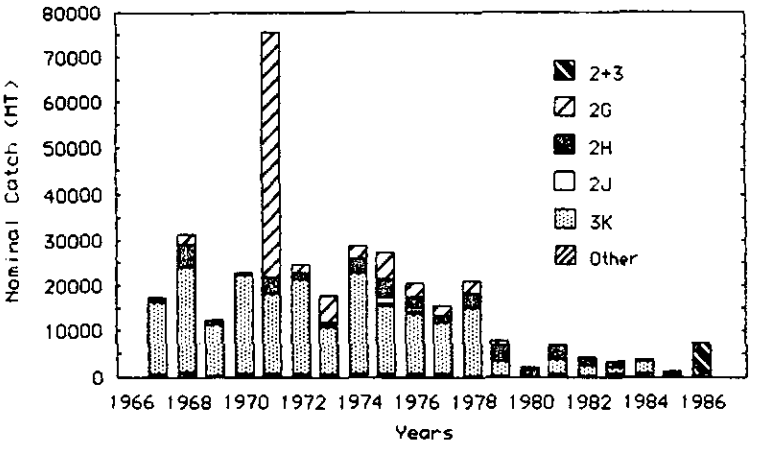

Fig. 1b Nominal catches of roundnose grenadier in SA 2+3, 1967-1986 (1985 and 1986 are provisional)

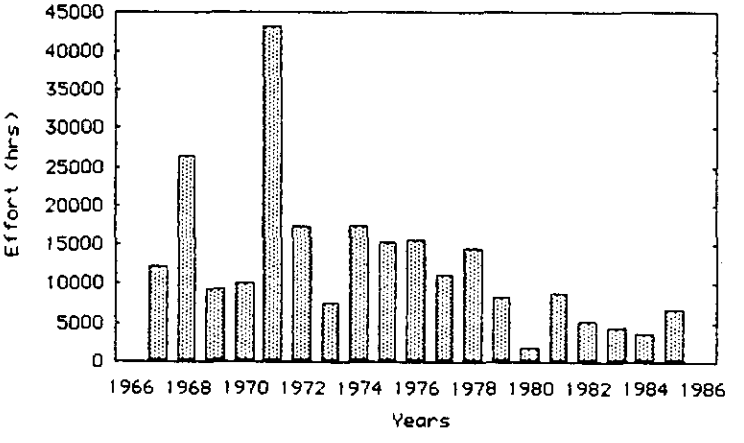

Fig. 2a:Standardized effort for roundnose grenadier in SA 2+3 derived from ICNAF/NAFO statistics (1985 is provisional).

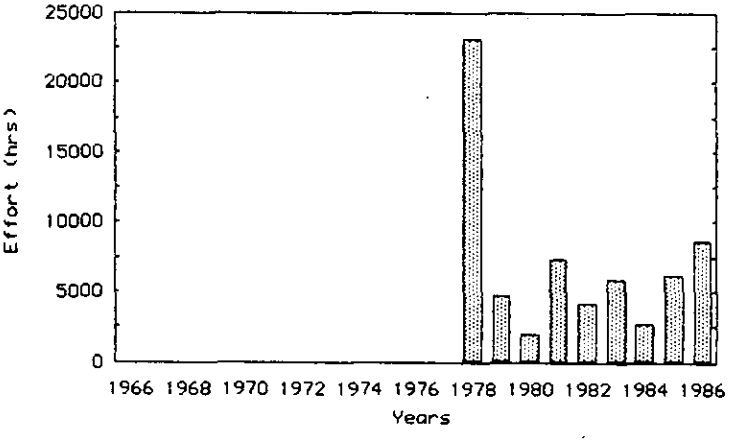

Fig. 2b: Standardized effort for roundnose grenadier in SA 2+3 derived from Canadian Observer Program statistics.

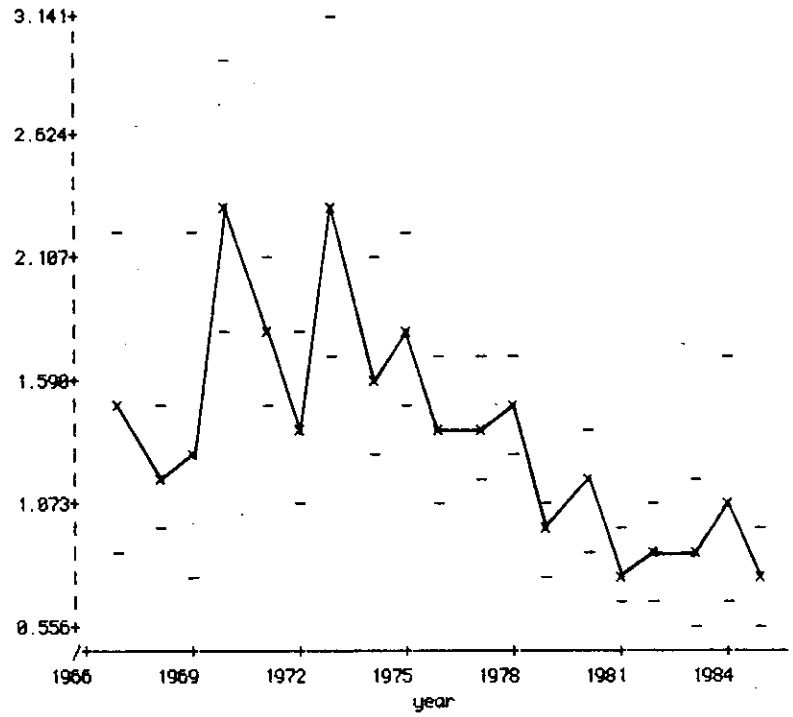

Figure 3a: Standardized catch rates for Roundnose grenadier in SA 2+3 derived using a multiplicative model and ICNAF/NAFO statistics.

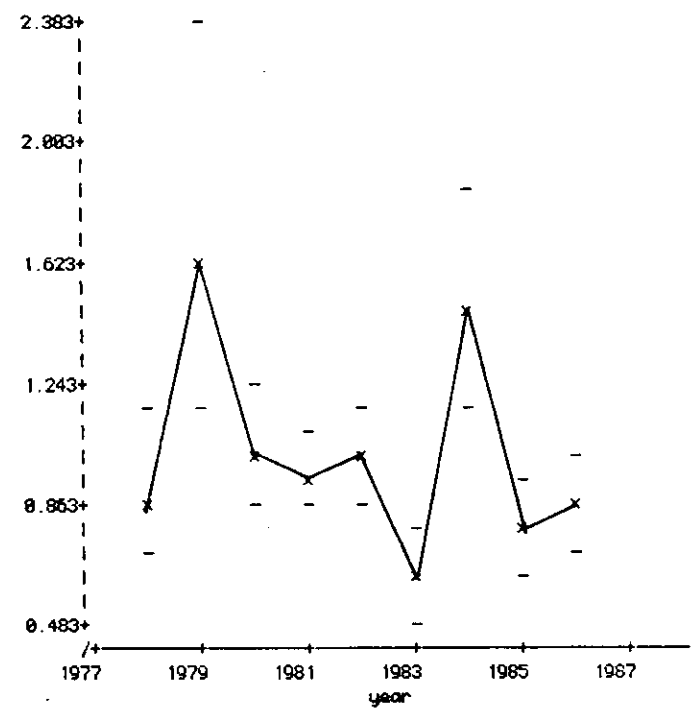

Figure 3b: Standardized catch rates for Roundnose grenadier in SA 2+3 derived using a multiplicative model statistics from the Canadian Observer Program.

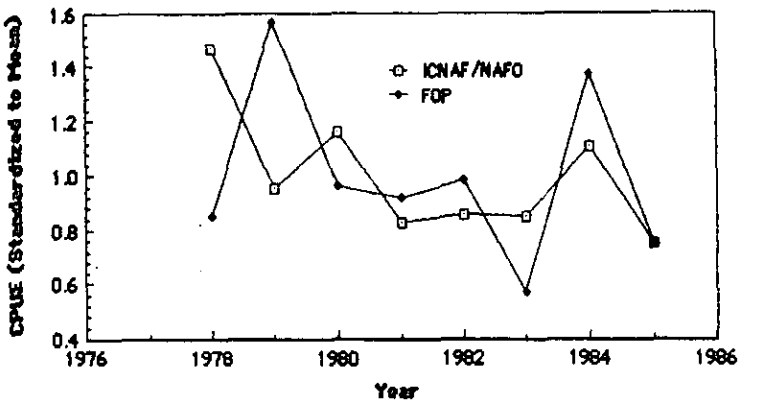

Fig. 4: Comparison of catch rates for grenadier in SA 2+3 derived from ICNAF/NAFO statistics and Canadian Observer Program data (standardized to respective 1978-1985 means).

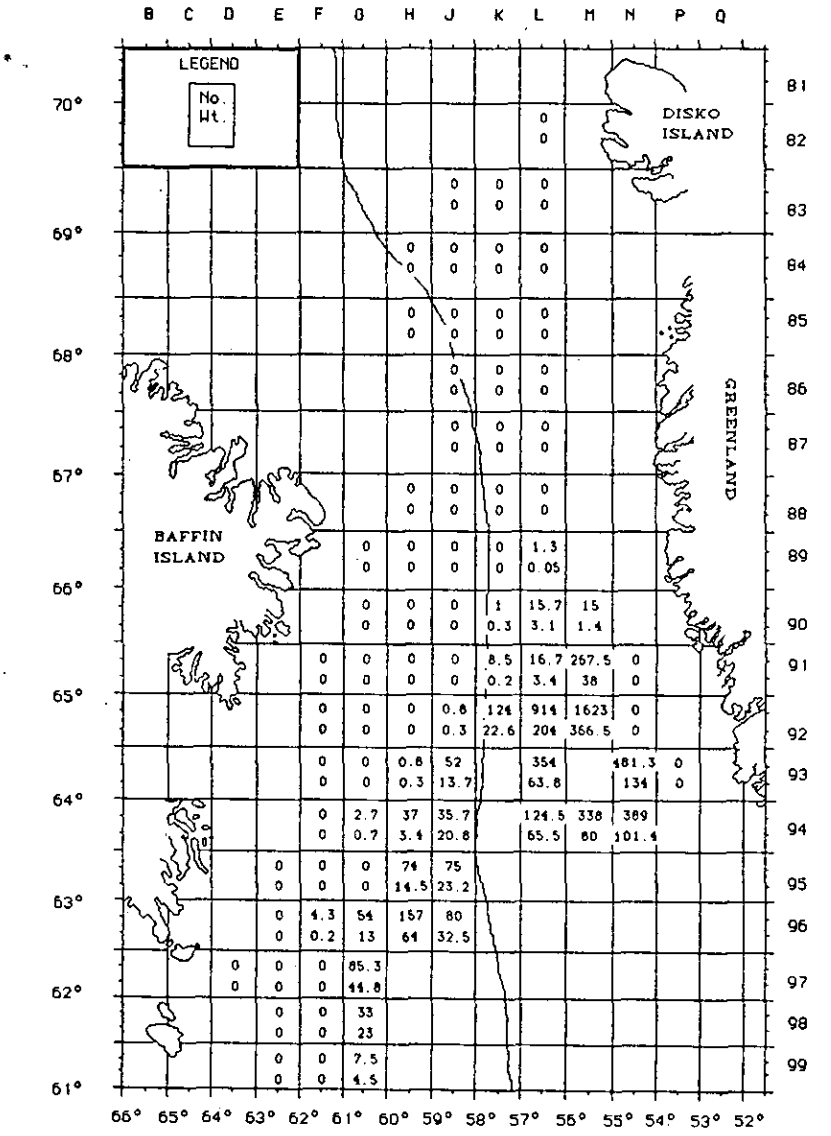

Figure 5: Distribution of roundnose grenadier by Unit Area in NAFO Subareas 0+1 during Canadian bottom trawl survey in 1986.

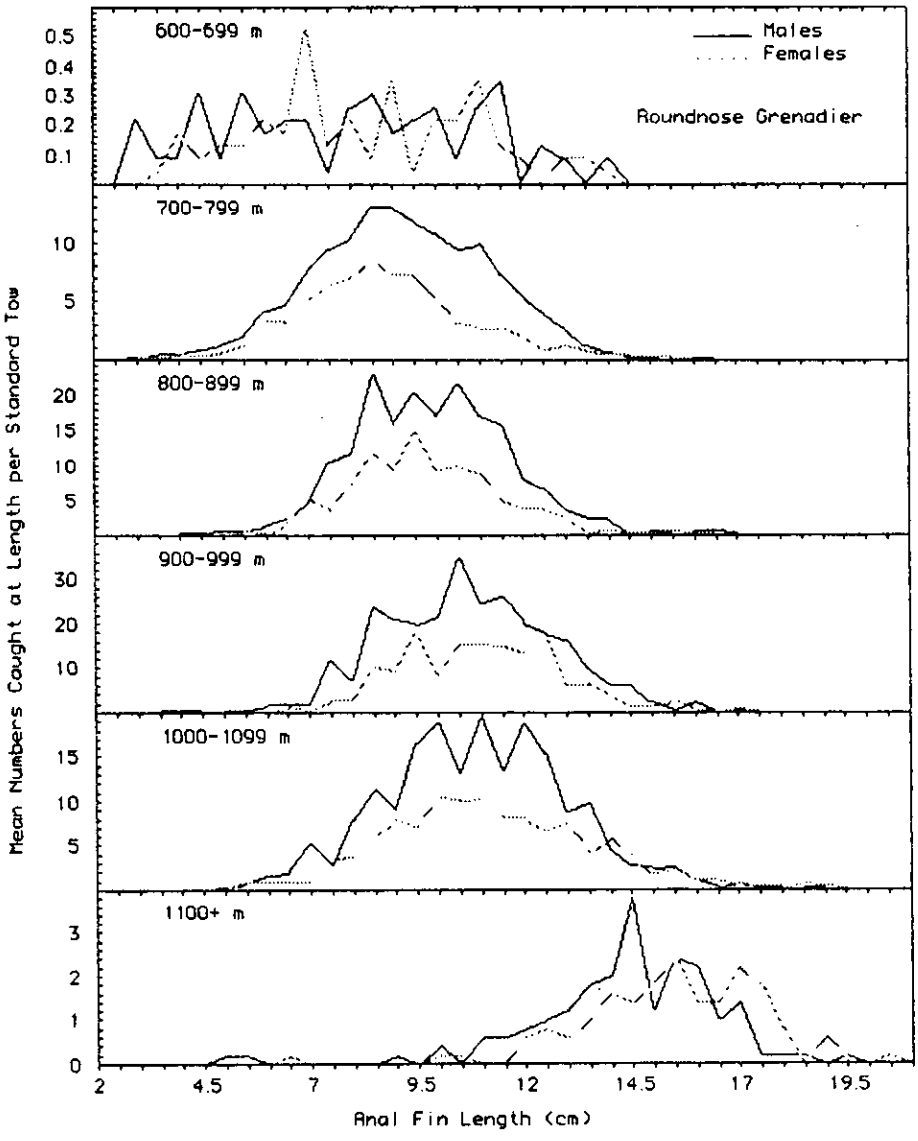

Figure 6: Frequency distribution of roundnose grenadier in SA 0+1 by depth as determined from a Canadian research survey in 1986 (the frequencies for depths <600 m are not shown because only a few grenadier were caught in this range).

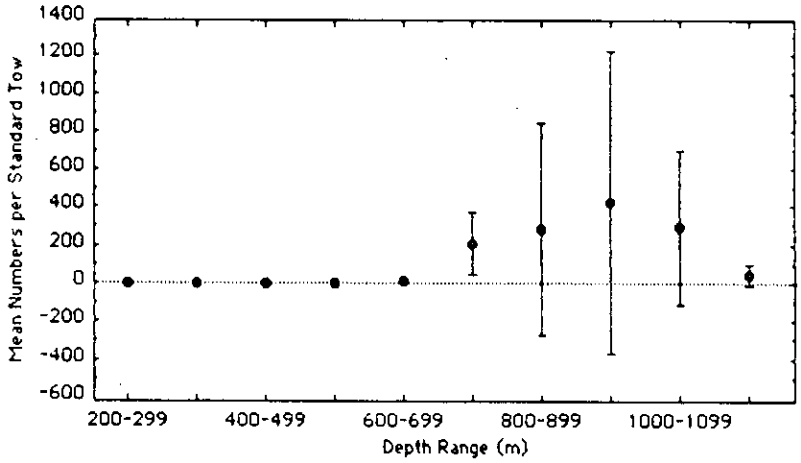

Figure 7a: Mean numbers of Roundnose grenadier caught per 30 min. tow in each depth range during Canadian research cruise to SA 0+1 in 1986.

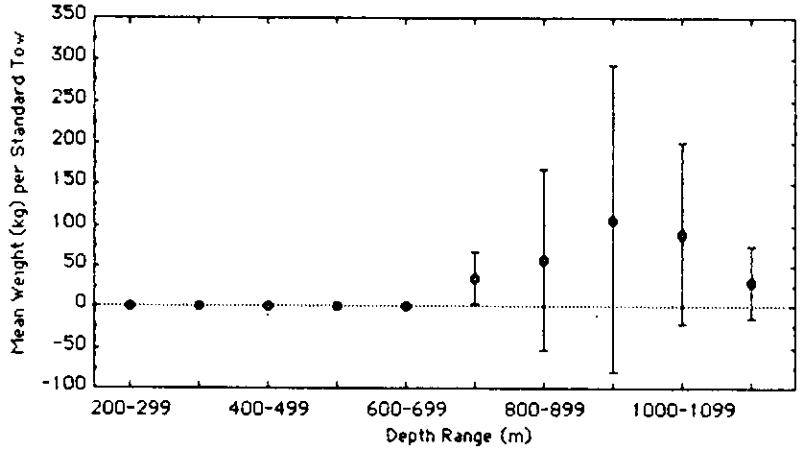

Figure 7b: Mean weights of Roundnose grenadier caught per 30 min. tow in each depth range during Canadian research cruise to SA 0+1 in 1986.