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An Estimate of Redfish Year-Class Strength From Surveys to the Flemish Cap

by

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INTRODUCTION

This paper is to serve as an information document in response to a NAFO Scientific Council request to establish a consistent time series of abundance estimates for recruiting year-classes of redfish on the Flemish Cap (see NAFO Cir. Letter 85/77). Year-classes from the early 1980's appear to be the only prospect for this stock which should enter the fishery in the early 1990's.

MATERIALS AND RESULTS

Canadian data were collected during research surveys conducted by the M.V. GADUS ATLANTICA in January-February months from 1979-85. USSR data were extracted from a research report to NAFO (SCS Doc. 84/17) and a NAFO research document (SCR Doc. 85/53). The USSR surveys were conducted in spring-summer months.

Canadian and USSR length frequencies for 1979-85 are overlaid in Fig. 1. In some years, sets that appeared to be anomalously high were removed before analysis. This included 2 sets in 1979 and 1983, and 3 sets in 1981. No sets were removed from the 1980, 1982, 1984 or 1985 data. The removal of one of the sets in 1981 resulted in the disappearance of a mode at about 7 cm. It can be seen that the 1982 Canadian frequency shows moderate and strong year-classes. These correspond to the late 1970's and early 1980's year-classes respectively. These year-classes showed a decline in the 1983 and 1984 surveys, especially the early 1980's year-classes. The USSR surveys showed these two year-classes as well but not as abundantly as the Canadian surveys. The USSR data shows a decline in the late 1970's year-classes but not for the 1980's year-classes. The decline of the aforementioned year-classes appears real as it had been monitored in the surveys of 1983 and 1984. Other than these year-classes the prospect from recent years appears poor. There was no Canadian survey to Div. 3M in 1986 and thus further comment on the status of the late 1970's-early 1980's year-classes cannot be made. There still seems to be a good supply of the late 1960's-early 1970's year-classes available to the fishery, however, biomass estimates from Canadian research cruises have decreased from 1983 to 1985 (Atkinson MS 1985 (Table 6)).

Estimates of population numbers from the Canadian surveys are given at length (Table 1) and at age (Table 2). Estimated mean length at age in the population over the 1979-85 period is displayed in Table 3 and plotted in Fig. 2a and b. Age/length keys are supplied through Tables 4-10.

REFERENCE

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

Table 1. Population numbers at length estimated from Canadian stratified random trawl surveys to NAFO Division 3M from 1979 to 1985.

Length (cm)	1979	1980	1981	Year 1982	1983	1984	1985
1.0	0	0	0	0	0	0	0
2.0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0
5.0	0	0	0	0	109364	0	0
6.0	111433	6596	31551	718378	848696	0	0
7.0	1323605	31084	1203071	42223488	2637594	33539	12010
8.0	1102879	159680	659027	63441040	1839156	4015001	6205
9.0	143398	129326	54529	9179153	9423092	2000769	23996
10.0	273684	176533	34793	63966496	37162752	1565241	174296
11.0	1059230	66727	95112	158441920	41908800	2470388	567336
12.0	529203	81114	151611	115545888	16895648	2325243	489528
13.0	172860	286988	136891	25359776	23078800	4035433	907211
14.0	389746	232110	113658	1065796	45143792	7028397	1901491
15.0	685354	187438	74663	353128	69820528	8906371	2908734
16.0	1278529	191001	182978	321086	23401264	8130956	5828148
17.0	1914953	376564	177809	360070	6088158	13438491	10430875
18.0	1629659	1241232	361752	325306	1336342	15159260	16986624
19.0	1784371	1935869	200467	509732	1173821	13987261	25320672
20.0	2488400	3099995	320788	583935	1059253	6307438	27475680
21.0	4118914	5177441	811058	708677	1393060	3893137	20043152
22.0	8190446	15631398	1735059	1008596	1650908	3067391	8182296
23.0	13607007	40694576	3177320	1284960	2446035	3071009	1873753
24.0	14553983	87273472	8899640	2097248	2720846	3581963	820139
25.0	8174360	00674576	22221952	4180243	3391147	4071904	979370
26.0	3278522	78947296	45081376	6519101	4429376	6065553	1558186
27.0	882374	30071904	53109456	13885574	9660059	8742137	2765742
28.0	2002184	7462530	31001712	22404432	19360944	15467048	7502412
29.0	4793031	7035181	14373933	19526560	26191408	28989200	16887024
30.0	9915332	11480378	9281873	12581107	2480032	30685040	21749840
31.0	13635321	19080896	10987769	9111020	23496560	35720480	25131920
32.0	19132720	26239952	15079215	9563141	21255056	29280304	19892992
33.0	19991840	33797760	18860832	10828376	23609472	22260032	19160992
34.0	22883760	42205264	22513696	12708826	25975696	21771952	21554976
35.0	21054448	42083888	21496784	14715357	24069904	18553568	20830224
36.0	19388288	36350640	21739248	14250630	22765280	17724400	20012432
37.0	16246838	32356016	15632059	12726262	20789104	15176113	17851456
38.0	11643977	23150592	14157047	9185303	16294725	10364844	12887242
39.0	7991959	16054799	8857589	6858014	13188285	7404413	8091213
40.0	4737462	9069794	5305175	3302595	6825472	4467087	5485448
41.0	2740932	4919079	3544640	2208494	3201990	2666346	2768310
42.0	1239588	2573793	2068395	1979237	2183704	1772328	1683306
43.0	966970	946526	1301274	724813	962419	862701	738823
44.0	383608	585491	660474	457760	606331	366909	379650
45.0	169103	177348	331081	214097	315312	180716	178754
46.0	32136	313023	101483	88865	226564	90180	138191
47.0	40528	72754	93148	0	133721	43391	28085
48.0	4673	0	26318	18286	39141	23649	18323
49.0	0	0	21618	11000	34435	5949	0
50.0	11898	36377	0	5500	0	0	5949
51.0	0	0	0	0	5500	0	0
52.0	6205	0	0	0	0	0	0
53.0	0	0	0	0	0	0	0
54.0	0	0	0	0	10982	0	0
Total	246705616	682664704	356269568	675548416	583960064	385773312	352232704

Table 2. Population numbers at age estimated from Canadian stratified random trawl surveys to NAFO Division 3M from 1979 to 1985.

Age	Year						
	1979	1980	1981	1982	1983	1984	1985
1.0	452462	0	21034	4222349	60621	0	0
2.0	2193002	143296	1908965	97054720	6179975	4948881	12010
3.0	983475	335738	23005	206523600	51736128	2198819	324732
4.0	864540	247147	235890	169496864	57624960	5538377	589571
5.0	760358	465054	336719	22603584	88549504	11455292	3173066
6.0	2860623	801369	466841	2976336	63483904	26098496	22252240
7.0	7148032	6659265	1129605	987306	10368949	32694000	57321088
8.0	20177920	60029536	9660605	1866948	3441840	12071962	36673744
9.0	25135600	141198640	31379872	2050485	3880868	5483413	3778566
10.0	5588619	96154960	62643072	5863178	3832719	5924263	1377459
11.0	1961371	43718688	52109136	11956633	5809867	3363489	2263458
12.0	1511810	17876720	15023168	21294816	7171004	6371860	4021892
13.0	2430366	13788548	13790019	17436944	11332102	12748188	3990788
14.0	3564377	5748383	8592807	13054856	24325712	22777648	12452133
15.0	10874786	5861021	9531987	8763225	34965680	28517344	19877664
16.0	7123998	13181651	13970698	15649833	24280912	30707936	22583632
17.0	19079616	27454400	13166173	8481172	27113312	25382384	20159136
18.0	22209936	23655136	11498976	5247223	13417697	28638080	18833040
19.0	9984658	26508608	9454015	7916241	14614975	15610322	8759762
20.0	4615071	21384480	12095740	5276129	9538158	14814804	12463678
21.0	7115650	16820576	13650457	3921237	12263600	12909270	12644167
22.0	8461016	5912654	11999165	9011033	10186693	7429109	7947625
23.0	9113312	5644904	11519255	6490758	9093837	11699199	9298304
24.0	14248444	13265927	9009777	10864424	10127664	10666856	8065889
25.0	8452285	15014068	9540140	8908266	13128139	4421892	11901959
26.0	9799967	22275040	8116788	6902692	14549970	10797663	9587167
27.0	7626314	18335168	7850925	3432484	10727258	6371632	12248878
28.0	6905935	15393064	4928275	4939134	10169392	7616418	7990157
29.0	7954066	9118528	4861932	3457570	5422920	4312456	6078409
30.0	17489648	55562704	7755068	11127447	26401536	14203096	15556257
Unknown	18103	109132	0	723878	160281	0	6205
Total	246704848	682662656	356268544	698500864	583958784	385771776	352231680

Table 3. Mean length at age in the population, as determined from Canadian survey results, calculated from the population age/length table which was derived by applying the age length key to the population numbers at length (Table 1).

Age	1979	1980	1981	Year 1982	1983	1984	1985
0	-	-	-	-	-	-	-
1	6.84	-	6.00	7.00	6.00	-	-
2	7.58	7.79	7.38	7.63	7.51	8.18	7.00
3	10.80	9.28	9.60	10.74	10.22	9.77	10.66
4	11.59	11.98	11.53	11.66	11.48	11.65	11.78
5	13.86	13.76	13.40	11.57	14.13	13.82	13.63
6	16.41	17.13	16.97	13.65	15.04	16.41	17.01
7	19.81	20.85	20.01	18.20	16.40	18.21	19.20
8	22.43	23.82	24.22	21.38	18.76	20.15	20.60
9	23.72	24.46	25.45	23.27	22.05	22.96	22.15
10	24.45	25.13	26.49	24.98	23.66	24.98	25.82
11	26.95	25.71	27.25	27.37	25.82	25.50	27.18
12	28.77	26.30	28.25	27.79	26.45	27.14	28.34
13	28.99	27.48	28.48	28.20	28.48	28.34	28.13
14	29.80	31.27	31.56	29.16	29.08	29.13	29.48
15	31.02	30.42	32.09	30.62	29.83	29.89	30.40
16	31.43	31.90	32.83	31.06	30.24	30.83	30.76
17	32.49	32.77	32.99	32.27	31.75	31.35	31.80
18	32.71	33.46	33.94	31.84	33.15	31.94	32.28
19	33.48	33.92	34.98	34.34	33.37	32.83	32.77
20	33.84	34.06	34.49	33.43	33.73	33.58	34.15
21	34.42	34.30	34.89	34.58	34.66	34.36	34.19
22	34.40	35.41	34.91	35.33	34.95	34.87	34.38
23	35.45	33.85	36.32	36.00	35.56	34.63	34.90
24	35.60	34.63	37.25	35.81	34.96	34.99	35.98
25	36.54	35.87	37.26	36.49	35.98	36.31	36.22
26	36.76	35.67	38.58	37.33	37.56	36.38	36.49
27	37.19	36.29	37.56	36.98	37.15	37.37	37.32
28	37.09	36.36	39.33	37.88	37.14	37.76	37.10
29	37.40	37.65	37.81	37.81	38.08	38.07	37.36
30+	38.51	38.17	39.51	39.88	39.15	39.00	39.77
Grand mean	31.00	29.30	30.52	16.66	23.31	28.27	28.46

Table 6. Age/length key constructed from Canadian research vessel survey data for 1981 (sexes combined).

LENGTH	AGES																														TOTAL				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		30			
6.0		2																																	3
7.0			12																																12
8.0			12																																12
9.0				1																															1
10.0				2																															3
11.0					7																														7
12.0					7																														7
13.0					3																														3
14.0						9																													9
15.0						4																													4
16.0						1																													1
17.0							3																												3
18.0							6																												6
19.0							8																												8
20.0							1																												1
21.0							11																												11
22.0							6																												6
23.0							1																												1
24.0							15																												15
25.0							2																												2
26.0							1																												1
27.0							1																												1
28.0							1																												1
29.0							1																												1
30.0							1																												1
31.0							1																												1
32.0							1																												1
33.0							1																												1
34.0							1																												1
35.0							1																												1
36.0							1																												1
37.0							1																												1
38.0							1																												1
39.0							1																												1
40.0							1																												1
41.0							1																												1
42.0							1																												1
43.0							1																												1
44.0							1																												1
45.0							1																												1
46.0							1																												1
47.0							1																												1
48.0							1																												1
49.0							1																												1
0	2	29	3	21	28	31	46	49	47	41	29	16	15	17	13	16	15	13	11	13	16	13	16	15	19	20	16	22	18	54	664				

Table 7. Age/length key constructed from Canadian research vessel survey data for 1982 (sexes combined).

REDFISH 3M 1982		AGES																																	
AGE/LENGTH KEY		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL		
7.0	1																																		10
8.0			1																																10
9.0		2	1																																10
10.0			7	1																															10
11.0			7	3																															10
12.0			2	7	1																														10
13.0				2	7	1																													10
14.0				2	7	1																													10
15.0					1	4	2																												10
16.0					2	10	4																												10
17.0						6	6																												10
18.0					3	11	9	3																											10
19.0						7	15	7	8	1																									10
20.0						2	7	8	4	1																									10
21.0							2	7	4	1	1																								10
22.0									4	1	4																								10
23.0									4	7	4																								10
24.0									2	6	7	4																							10
25.0									1	4	6	7	4																						10
26.0									1	1	12	6	4																						10
27.0											1	6	6	11	4																				10
28.0												6	6	6	8	2																			10
29.0												3	3	6	3	2																			10
30.0												1	1	1	1	3																			10
31.0																																			10
32.0																																			10
33.0																																			10
34.0																																			10
35.0																																			10
36.0																																			10
37.0																																			10
38.0																																			10
39.0																																			10
40.0																																			10
41.0																																			10
42.0																																			10
43.0																																			10
44.0																																			10
45.0																																			10
46.0																																			10
47.0																																			10
48.0																																			10
49.0																																			10
0	1	20	24	23	13	24	37	41	28	34	29	34	22	17	14	23	14	10	13	10	7	14	10	18	14	15	5	11	7	49	582				

Table 3. Age/length key constructed from Canadian research vessel data for 1983 (sexes combined).

REDFISH 34 1983 AGE/LENGTH KEY		AGES																																
LENGTH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL		
6.0		1																															14	
7.0			13																															11
8.0			11																															17
9.0			6	1																														8
10.0			6	3																														9
11.0			4	5	1																													10
12.0			1	7	2																													10
13.0				4	4	2																												14
14.0				1	11	2																												15
15.0					7	10																												19
16.0					3	10	4																											17
17.0						8	6	3																										18
18.0							9	1																										18
19.0							2	10	1																									18
20.0								2	8	1																								20
21.0								4	4	11	4																							19
22.0										6	6	2																						20
23.0										3	6	2																						20
24.0										5	7	2																						22
25.0										1	2	10																						21
26.0										3	6	2																						20
27.0										1	2	1																						20
28.0											2	1																						20
29.0																																		20
30.0																																		19
31.0																																		21
32.0																																		20
33.0																																		22
34.0																																		20
35.0																																		20
36.0																																		20
37.0																																		20
38.0																																		23
39.0																																		20
40.0																																		18
41.0																																		16
42.0																																		17
43.0																																		13
44.0																																		13
45.0																																		10
46.0																																		4
47.0																																		2
48.0																																		2
	0	1	31	10	20	28	30	24	38	44	30	26	26	16	27	32	22	24	12	13	9	11	9	9	9	14	20	16	13	9103	683			

Table 9. Age/length key constructed from Canadian research vessel survey data for 1984 (sexes combined).

LENGTH	AGES																														TOTAL		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		30	
7.0			3																														3
8.0			20																														20
9.0			9	10	1																												20
10.0			4	15	1																												20
11.0				10	1																												20
12.0				6	13	1																											20
13.0				1	15	1																											20
14.0					4	13	3																										20
15.0					3	30	7	2																									40
16.0					19	19	7	2																									40
17.0					12	25	3																										40
18.0					4	27	9																										40
19.0					1	23	12	4																									40
20.0						7	28	5																									40
21.0						2	15	13	6																								36
22.0						2	12	8	4																								39
23.0						3	14	12	5	6																							39
24.0						2	18	10	8	1																							40
25.0						1	12	15	9	1																							40
26.0						1	1	12	10	1																							40
27.0						1	1	4	12	1																							40
28.0						1	1	4	12	1																							40
29.0						1	1	4	12	1																							40
30.0						1	1	4	12	1																							40
31.0						1	1	4	12	1																							39
32.0						1	1	4	12	1																							40
33.0						1	1	4	12	1																							40
34.0						1	1	4	12	1																							41
35.0						1	1	4	12	1																							40
36.0						1	1	4	12	1																							40
37.0						1	1	4	12	1																							40
38.0						1	1	4	12	1																							40
39.0						1	1	4	12	1																							38
40.0						1	1	4	12	1																							29
41.0						1	1	4	12	1																							24
42.0						1	1	4	12	1																							18
43.0						1	1	4	12	1																							17
44.0						1	1	4	12	1																							4
45.0						1	1	4	12	1																							4
46.0						1	1	4	12	1																							4
47.0						1	1	4	12	1																							3
48.0						1	1	4	12	1																							3
49.0						1	1	4	12	1																							1
	0	0	32	23	44	45	85	115	84	57	52	27	29	38	49	51	44	39	42	26	27	18	26	27	14	36	27	34	23118	1259			

Table 10. Age/length key constructed from Canadian research vessel survey data for 1985 (sexes combined).

REDFISH, 3M, 1985
AGE/LENGTH KEY

LENGTH	AGES																														TOTAL				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		30			
7.0			2																															2	
9.0			3																															3	
10.0			7	6	1																													14	
11.0			7	6	1																													21	
12.0			1	7	11	1																												20	
13.0				4	15	1																												20	
14.0					14	1																												21	
15.0					5	13	2																											20	
16.0						33	4																											40	
17.0						23	16																											39	
18.0						12	25	3																										40	
19.0						15		1																										40	
20.0						26	14																											40	
21.0						11	25	2																										38	
22.0						17	11	2																										40	
23.0							19	14	3	1																								37	
24.0							6	14	5	5	1																							31	
25.0							1	12	6	9	4	1																						33	
26.0							1	16	11	6	5	6	3																					38	
27.0									3	6	12	9																						40	
28.0									7	4	7	7	5	3																				40	
29.0									10	4	10	14	4	2	1																			40	
30.0									17	10	14	4	2	1	1																			40	
31.0									3	9	11	7	6	2	2																			41	
32.0									1	4	6	10	7	5	4	1																		40	
33.0										1	3	9	10	7	5	4	3	1	2															41	
34.0										2	2	3	4	2	2	4	3	1	2	4														40	
35.0												2	2	2	2	5	5	2	1	2	1	2	1	2	4									39	
36.0													2	2	2	3	3	2	6	3	5	2	6	3	5	4								40	
37.0																																			40
38.0																																			40
39.0																																			40
40.0																																			34
41.0																																			34
42.0																																			23
43.0																																			23
44.0																																			19
45.0																																			9
46.0																																			3
47.0																																			4
48.0																																			3
50.0																																			1
0	0	2	18	27	54	78	117	108	51	30	30	25	30	41	46	47	41	37	17	25	25	16	20	19	29	26	36	27	20	135	1193				

Table 4. Age/length key constructed from Canadian research vessel survey data for 1979 (sexes combined).

REDFISH 3M 1979		AGES																											TOTAL						
LENGTH	AGE/LENGTH KEY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL		
6.0	2																																		2
7.0	5																																		5
8.0	9																																		9
9.0	3				1																														4
10.0				10																															10
11.0			6	5	1																														12
12.0			9	7	1																														11
13.0				4	4																														8
14.0				3	3																														6
15.0				5	5																														10
16.0						13																													13
17.0						10																													10
18.0						4																													4
19.0						1																													1
20.0																																			0
21.0																																			0
22.0																																			0
23.0																																			0
24.0																																			0
25.0																																			0
26.0																																			0
27.0																																			0
28.0																																			0
29.0																																			0
30.0																																			0
31.0																																			0
32.0																																			0
33.0																																			0
34.0																																			0
35.0																																			0
36.0																																			0
37.0																																			0
38.0																																			0
39.0																																			0
40.0																																			0
41.0																																			0
42.0																																			0
43.0																																			0
44.0																																			0
45.0																																			0
46.0																																			0
47.0																																			0
48.0																																			0
		0	4	18	20	16	14	36	51	64	63	19	9	10	12	10	24	13	24	25	10	5	7	8	10	16	13	14	14	12	17	71	631		

Table 5. Age/length key constructed from Canadian research vessel survey data for 1980 (sexes combined).

REDFISH 3M 1980		AGES																														TOTAL		
AGE/LENGTH KEY		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL	
6.0	1																																	1
7.0	2																																	2
8.0	4																																	4
9.0	1																																	1
10.0	1																																	1
11.0	1																																	1
12.0	1																																	1
13.0	1																																	1
14.0	1																																	1
15.0	1																																	1
16.0	1																																	1
17.0	1																																	1
18.0	1																																	1
19.0	1																																	1
20.0	1																																	1
21.0	1																																	1
22.0	1																																	1
23.0	1																																	1
24.0	1																																	1
25.0	1																																	1
26.0	1																																	1
27.0	1																																	1
28.0	1																																	1
29.0	1																																	1
30.0	1																																	1
31.0	1																																	1
32.0	1																																	1
33.0	1																																	1
34.0	1																																	1
35.0	1																																	1
36.0	1																																	1
37.0	1																																	1
38.0	1																																	1
39.0	1																																	1
40.0	1																																	1
41.0	1																																	1
42.0	1																																	1
43.0	1																																	1
44.0	1																																	1
45.0	1																																	1
46.0	1																																	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		7	10	13	16	19	26	44	57	61	44	20	13	15	7	9	13	23	16	17	13	11	4	4	7	10	16	15	11	14	95	615		

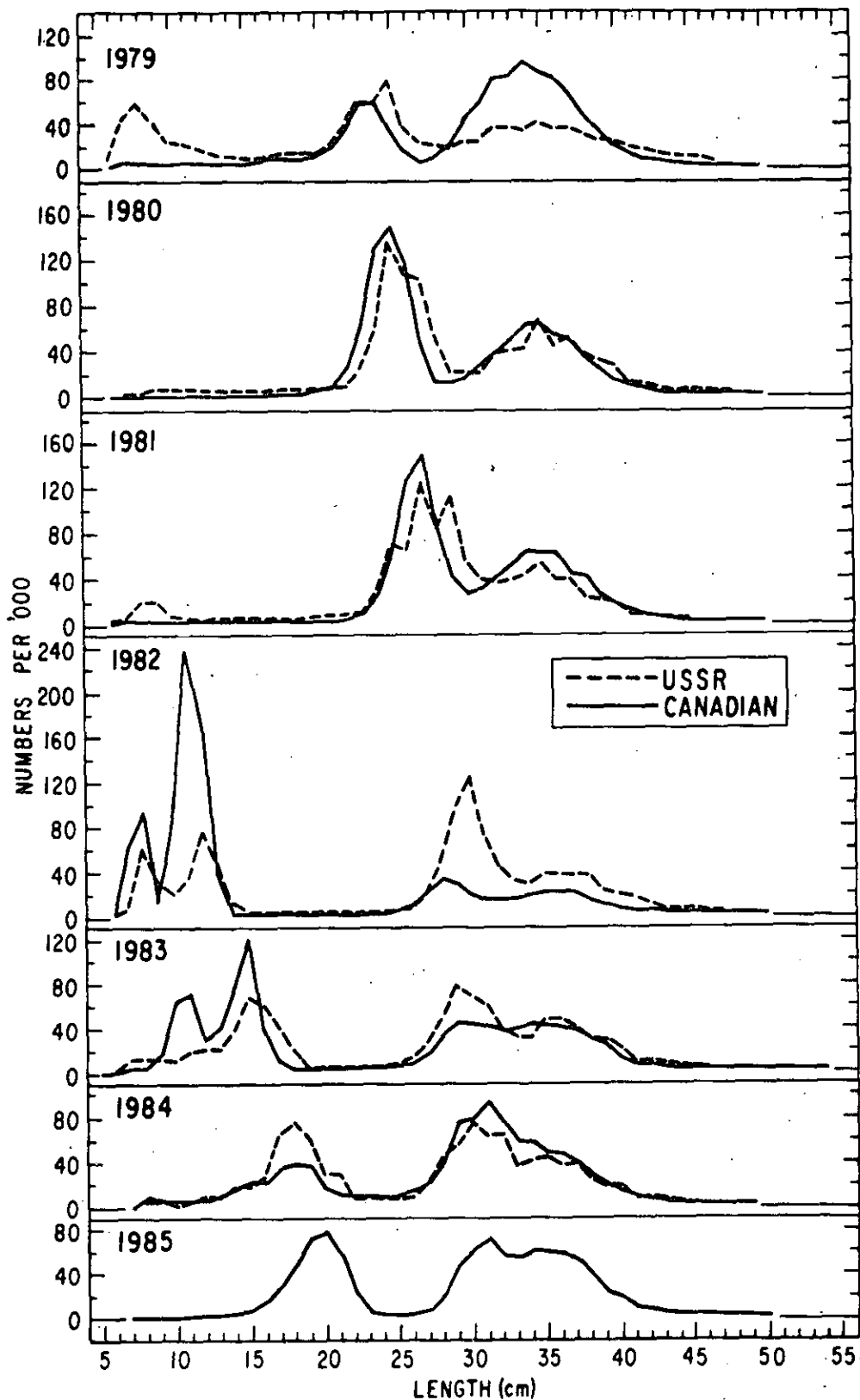


Fig. 1. Length composition of Div. 3M redfish from research vessel surveys with bottom otter trawl lined with small mesh in codend. Canadian data were collected in January-February, 1979-85. USSR data were collected in spring-summer months 1979-84.

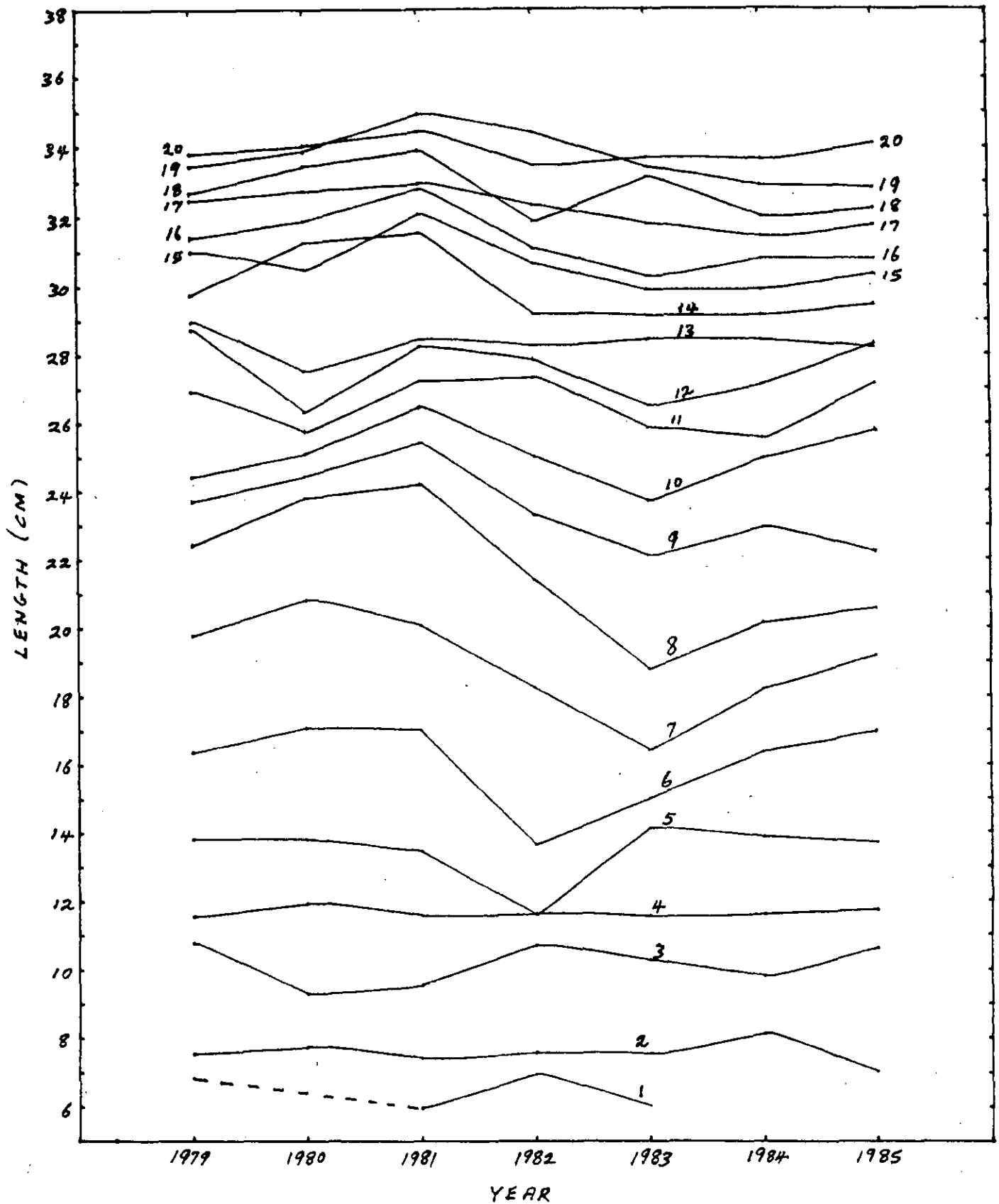


Fig. 2a. Mean length of age of redfish in the population (age 1-20) as determined from Canadian research surveys (1979-85).

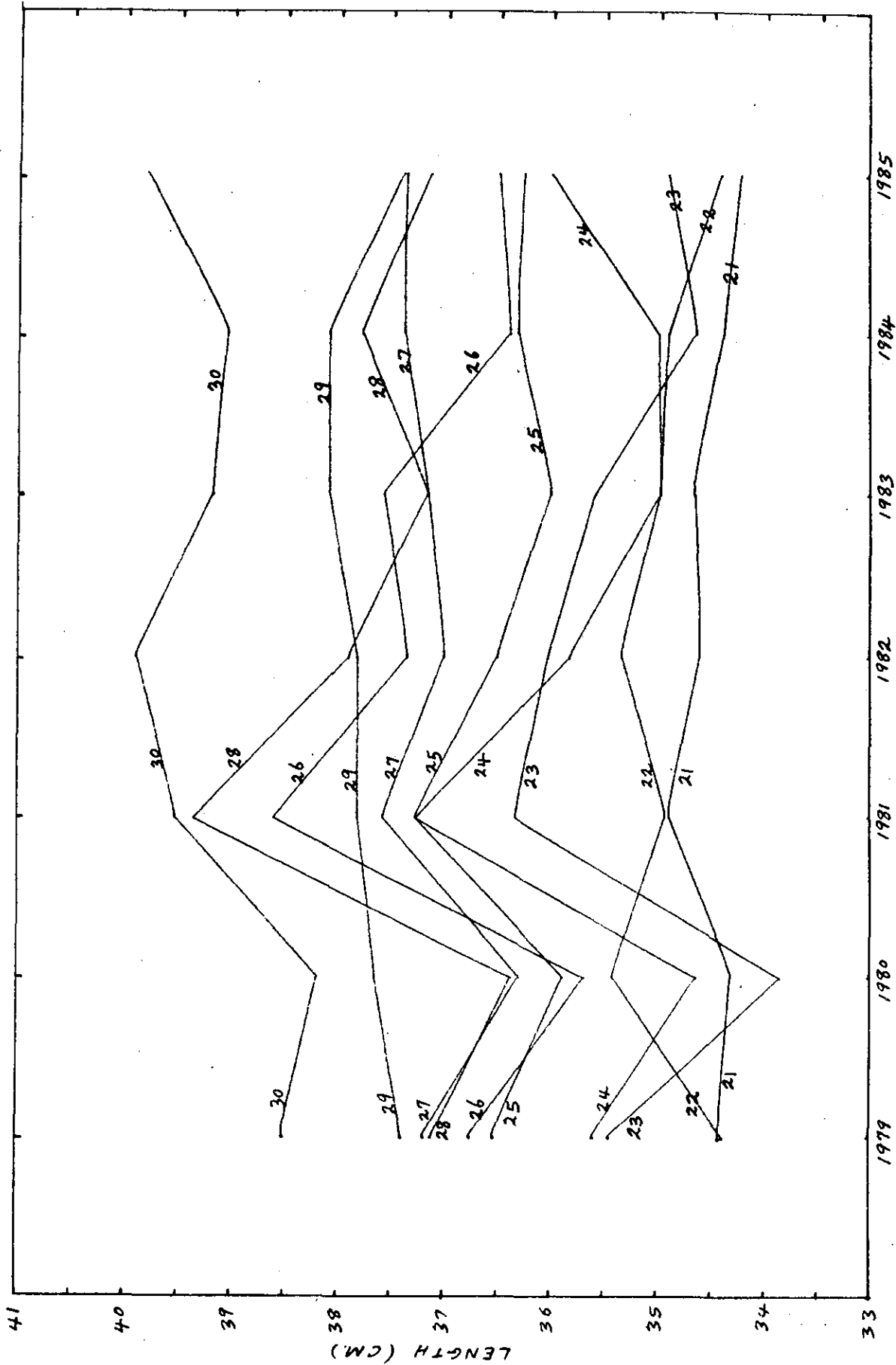


Fig. 2b. Mean length at age of redfish in the population (age 21-30+) as determined from Canadian research surveys (1979-85).