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Length-weight Relationships of Roundnose Grenadier (*Coryphaenoides rupestris* Gunn.) in Different Areas of the Northwest Atlantic

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Abstract

Length and weight information were obtained from roundnose grenadier (*Coryphaenoides rupestris* Gunn.) during research trawling in the areas off West Greenland and Baffin Island (Subareas 0 and 1), off northern Labrador (Div. 2G) and off Notre Dame Bay (Div. 3K) from 1968 to 1980. Comparisons by area and sex indicated some variability, possibly caused in part by differing habitat conditions. Relationships derived for grenadiers in Subarea 2 and Div. 3K indicated general consistency between studies, while results from Subareas 0 and 1 were more variable. The results suggest that it may not be appropriate to utilize growth differences as indicators of differing stocks.

Key words: Length, Northwest Atlantic, relationships, Roundnose grenadier, *Coryphaenoides rupestris*, weight

Introduction

The assessment of roundnose grenadier (*Coryphaenoides rupestris*) stocks in different areas of the Northwest Atlantic is difficult because of the relatively deep distribution of these fish as well as a general lack of knowledge concerning their biology, population dynamics and life history. Traditional assessment methodologies such as analysis of research and/or trawling survey results, production models and sequential population analyses can not be applied under current circumstances.

There is also relatively little known or understood concerning stock structure of these fish. At present, NAFO separates roundnose grenadier in Subareas 0 and 1 from those in Subareas 2 and 3 for assessment and quota management purposes. In the past, analyses of length-weight relationships have been used to make inferences concerning interrelationships between roundnose grenadier in different areas of the North Atlantic (Atkinson, 1989). This paper presents the results of analyses of length and weight data collected from various areas of the Northwest Atlantic during 1968–80 and makes comparisons with the findings of previous studies.

Materials and Methods

The data were collected from waters off West Greenland and Baffin Island (Subareas 0 and 1), off northern Labrador (Div. 2G) and off Notre Dame Bay (Div. 3K) between 1968 and 1980 from Union of Soviet Socialist Republics research and scouting vessels fishing with bottom trawls. The fish were sexed and total lengths (L to the nearest cm) and weights (W to the nearest g) were recorded for only those fish considered to have unbroken tails. Prior to analyses, the fish were grouped into 3 cm groups (e.g. 33–35, 36–38 cm etc.), and the mean weight for each group calculated (Tables 1 and 2).

Weighted (by the number of fish in each length group) regressions of the form:

$$W = a L^{b}$$

were done by sex and area (Subarea 0, Subarea 1, Div. 2G and 3K). In addition, the data for Subareas 0 and 1 were combined by sex as were the data for Div. 2G and 3K, and regression analyses carried out. Finally, regressions of the data for the above two areas were carried out with sexes combined. Analyses of covariance were not carried out because of the large sample sizes. It was anticipated that statistically significant differences would exist between all curves.

Fulton's condition factor (Fulton, 1911):

$$K_f = \frac{100W}{L^3}$$

TABLE 1. Mean weight (numerator) and number (denominator) of roundnose grenadier males of various lengths in Subareas 0, 1 and Div. 2G, 3K from 1968 to 1980.

Length	Subareas			Divisions			
(cm)	0	1	0+1	2G	3K	2G+3K	Total
15–17	–	50.0 1	50.0 1	9.0 1	17.0 1	13.0 2	25.3 3
18–20	–	13.0 1	13.0 1	15.0 1	19.4 5	18.7 6	17.8 7
21–23	–	52.0 5	52.0 5	22.0 2	31.2 35	30.7 37	33.3 42
24–26	–	70.5 16	70.5 16	28.5 6	44.4 49	42.6 55	48.9 71
27–29	72.7 3	81.7 39	81.1 42	39.4 5	59.1 56	57.5 61	67.1 103
30–32	80.0 4	101.3 64	100.0 68	89.2 17	83.8 62	85.0 79	91.9 147
33–35	115.0 5	114.9 102	114.9 107	110.8 39	105.0 92	106.7 131	110.4 238
36–38	152.2 9	142.9 82	143.9 91	136.7 62	132.8 143	133.9 205	137.0 296
39–41	197.5 20	179.6 128	182.0 148	163.1 96	160.2 189	161.2 285	168.3 433
42–44	250.3 49	219.6 165	226.6 214	204.2 129	197.9 231	200.2 360	210.1 574
45–47	264.1 75	261.1 226	261.8 301	250.0 140	245.8 333	247.0 473	252.8 774
48–50	329.9 139	307.8 342	314.2 481	297.9 202	288.0 454	291.0 656	300.8 1 137
51–53	374.9 181	355.3 331	362.2 512	353.5 301	334.4 497	341.6 798	349.7 1 310
54–56	424.8 252	408.8 404	414.9 656	397.6 382	385.6 538	390.6 920	400.8 1 576
57–59	477.1 319	456.4 500	464.5 819	451.4 432	433.6 631	440.8 1 063	451.1 1 882
60–62	540.1 365	496.6 492	515.2 857	517.7 456	496.2 600	505.5 1 056	509.8 1 913
63–65	602.4 359	570.2 403	585.4 762	574.9 530	565.0 571	569.8 1 101	576.1 1 863
66–68	658.5 342	642.0 302	650.7 644	639.2 465	634.4 519	636.7 984	642.2 1 628
69–71	734.3 310	712.7 230	725.1 540	718.3 453	703.4 380	711.5 833	716.9 1 373
72–74	811.7 244	789.5 152	803.2 396	793.2 372	774.0 310	784.5 682	791.3 1 078
75–77	882.4 185	874.5 102	879.6 287	845.4 253	848.4 178	846.6 431	859.8 718
78–80	943.5 143	951.9 60	945.9 203	936.2 184	949.2 123	941.4 307	943.2 510
81–83	1 035.7 58	1 081.4 21	1 047.8 79	998.2 98	1 056.0 39	1 014.6 137	1 026.8 216
84–86	1 100.0 33	1 088.3 6	1 098.2 39	1 093.3 44	1 049.3 26	1 076.9 70	1 084.6 109
87–89	1 152.5 12	1 250.0 3	1 172.0 15	1 232.3 22	1 258.6 7	1 238.6 29	1 215.9 44
90–92	1 470.0 1	–	1 470.0 1	1 216.7 3	1 175.0 2	1 200.0 5	1 245.0 6
93–95	–	–	–	–	1 565.0 2	1 565.0 2	1 565.0 2
96–98	–	–	–	–	1 740.0 2	1 740.0 2	1 740.0 2
15–98	606.7 3 108	454.9 4 177	519.7 7 285	559.4 4 695	458.8 6 075	502.7 10 770	509.5 18 055

TABLE 2. Mean weight (numerator) and number (denominator) of roundnose grenadier females of various lengths in Subareas 0, 1 and Div. 2G, 3K from 1968 to 1980.

Length (cm)	Subareas			Divisions			Total
	0	1	0+1	2G	3K	2G+3K	
18–20	–	15.5 3	15.5 3	30.0 1	22.9 8	23.7 9	21.6 12
21–23	–	33.9 5	33.9 5	16.0 1	32.1 25	31.5 26	31.9 31
24–26	–	98.0 5	98.0 5	31.8 5	50.2 28	47.4 33	54.1 38
27–29	70.0 1	96.4 10	93.9 11	–	60.8 50	60.8 50	66.8 61
30–32	75.0 1	97.9 31	97.2 32	66.2 16	85.4 48	83.3 54	88.5 86
33–35	130.0 1	114.4 44	114.8 45	105.4 15	109.0 70	108.4 85	110.6 130
36–38	190.0 2	150.8 55	152.2 57	140.7 39	138.2 122	138.8 161	142.3 218
39–41	222.0 5	197.1 63	198.9 68	162.6 51	168.9 116	166.9 167	176.2 235
42–44	262.0 17	227.3 80	233.6 97	207.6 57	206.0 146	206.5 203	215.2 300
45–47	301.7 24	270.9 114	276.3 138	244.8 83	248.9 232	247.8 315	256.5 453
48–50	334.2 46	318.4 162	321.9 208	310.2 121	295.3 290	299.7 411	307.1 619
51–53	403.1 60	367.8 145	378.1 205	342.8 149	349.4 318	347.3 467	356.7 672
54–56	446.4 76	417.7 207	425.4 283	425.4 190	407.0 356	413.4 546	417.5 829
57–59	491.7 133	476.3 227	482.0 360	476.9 229	460.2 383	466.5 612	472.2 972
60–62	574.2 127	530.7 209	547.2 336	536.9 265	530.0 388	532.8 653	537.7 989
63–65	640.6 131	599.2 212	615.0 343	591.9 280	607.4 422	601.2 702	605.8 1045
66–68	708.1 130	678.6 200	690.2 330	679.7 268	683.7 332	681.9 600	684.9 930
69–71	800.6 124	748.2 140	772.8 264	760.2 238	771.9 256	766.3 494	768.6 758
72–74	861.2 121	849.6 98	856.0 219	871.7 200	852.0 204	861.8 404	859.7 623
75–77	974.5 108	920.1 91	949.7 199	928.1 184	926.1 141	927.2 325	935.8 524
78–80	1 063.0 78	1 026.3 65	1 046.3 143	1 022.6 141	1 054.3 113	1 036.7 254	1 040.2 397
81–83	1 112.9 41	1 137.9 44	1 125.8 85	1 190.0 81	1 149.9 47	1 130.4 128	1 128.6 213
84–86	1 199.5 42	1 175.2 20	1 191.7 62	1 199.3 71	1 302.3 31	1 230.6 102	1 215.9 164
87–89	1 316.3 19	1 249.2 6	1 300.2 25	1 237.8 39	1 298.9 19	1 257.8 58	1 270.6 83
90–92	1 510.0 2	1 190.0 3	1 318.0 5	1 430.0 10	1 481.4 7	1 451.2 17	1 420.9 22
93–95	1 430.0 1	–	1 430.0 1	1 366.7 3	1 950.0 2	1 600.0 5	1 571.7 6
96–98	–	–	–	1 300.0 1	1 850.0 1	1 575.0 2	1 575.0 2
99–101	1 560.0 1	1 640.0 1	1 600.0 2	1 450.0 1	1 673.3 3	1 617.5 4	1 611.7 6
18–101	712.6 1 291	525.6 2 240	594.0 3 531	634.8 2 729	507.4 4 158	557.9 6 887	570.1 10 418

was also calculated to compare males and females in Subareas 0 and 1 and Div. 2G and 3K as well as make comparisons by sex between the two areas. Although this factor is most appropriately applied when growth is isometric, it may be used to compare fish of approximately the same length regardless of the value of b (Ricker, 1975).

Results and Discussion

Results of the regression analyses are summarized in Table 3. There were no large scale differences in the length-weight relationships between Subareas 0 and 1 or Div. 2G and 3K when examined by sex (Fig. 1). Similarly, there were no large differences observed when comparing relationships by sex for the two management areas (Fig. 2). There were differences between sexes in the two areas however (Fig. 3). With sexed data combined, very little difference was observed between the two management areas (Fig. 4).

These results are somewhat different to those described by other authors (Savvatimsky, 1971; Borrmann, 1976; Atkinson, MS 1980, 1989). Although most studies yielded quite similar results for Subareas 2+3 (Fig. 5), differing results have been obtained for the more northern area. The reasons for this are unknown.

Comparisons of Fulton's condition factors indicated differences between males and females in both areas, but no large differences between areas for either sex (Fig. 6). The condition factor decreased with size in all cases.

It is most likely that the length-weight relationships for grenadier vary between seasons and years

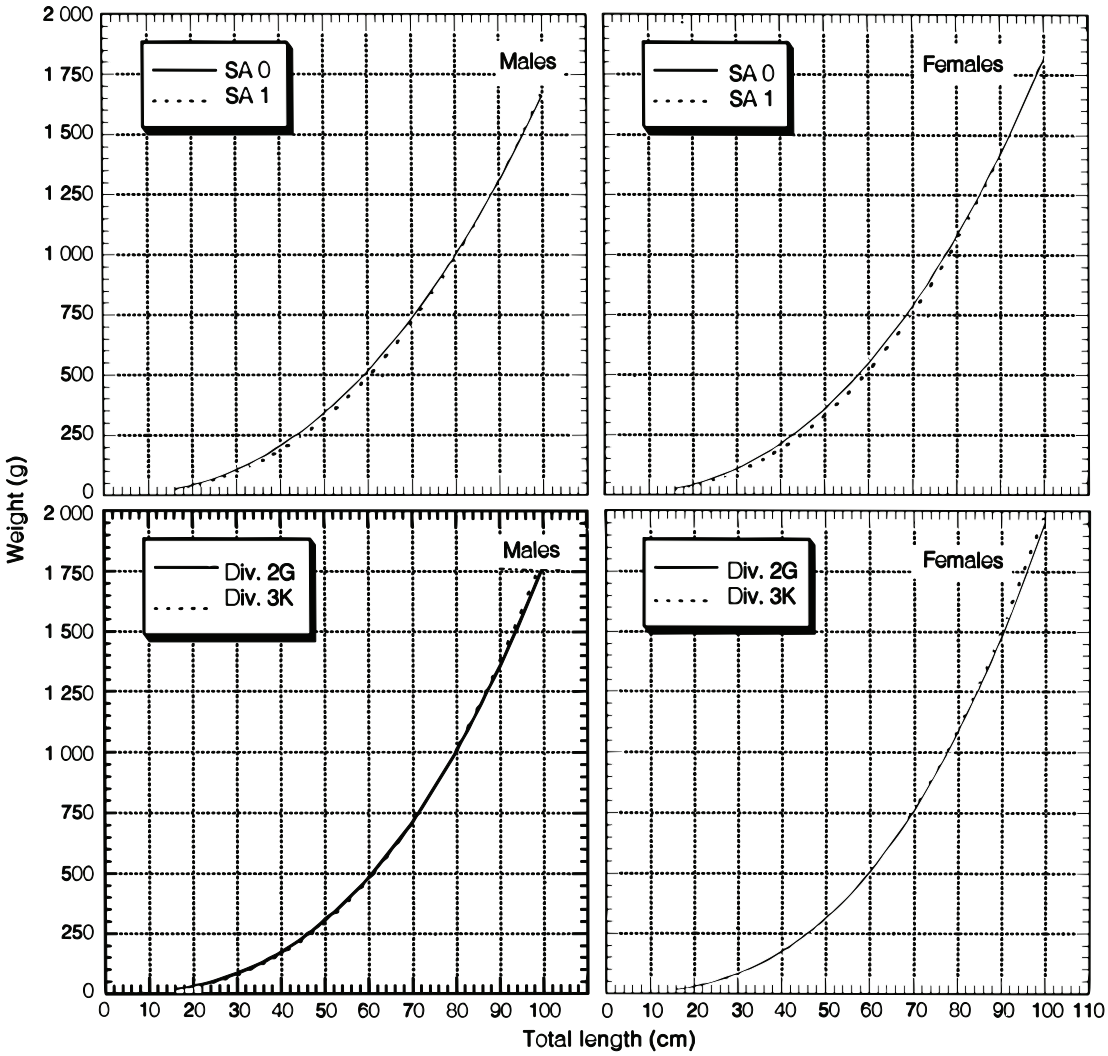

Fig. 1. Comparison of length-weight relationships by sex for roundnose grenadier in the two NAFO management areas.

TABLE 3. Summary of regression analyses of length–weight relationships for roundnose grenadier.

NAFO Area	No. of fish	Ln-Ln Regression			
		Slope (ß)	S.E. (ß)	Intercept (ln)	r^2
SA 0 – males	3 107	2.2965	.0026	–3.1591	0.996
SA 1 – males	4 177	2.4118	.0023	–3.6769	0.996
SA 0 – females	1 291	2.3454	.0041	–3.2957	0.996
SA 1 – females	2 240	2.4783	.0040	–3.9010	0.994
SA 0+1 – males	7 285	2.4102	.0015	–3.6529	0.997
SA 0+1 – females	3 531	2.4808	.0028	–3.8922	0.996
SA 0+1 – sexes combined	10 186	2.4411	.0012	–3.7623	0.997
Div. 2G – males	4 695	2.5398	.0032	–4.2156	0.993
Div. 3K – males	6 705	2.6214	.0014	–4.5691	0.998
Div. 2G – females	2 729	2.6445	.0041	–4.6005	0.993
Div. 3K – females	4 158	2.6913	.0010	–4.7913	0.999
Div. 2G+3K – males	10 770	2.6001	.0013	–4.4749	0.997
Div. 2G+3K – females	6 887	2.6706	.0011	–4.7087	0.999
Div. 2G+3K – sexes combined	17 657	2.6328	.0007	–4.5865	0.999

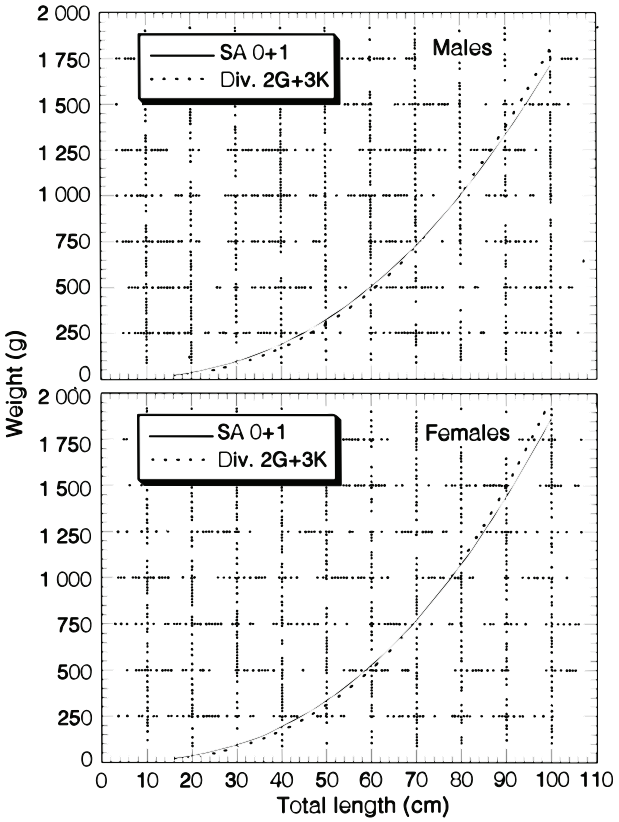

Fig. 2. Comparison of length-weight relationships by sex for roundnose grenadier for the two NAFO management areas.

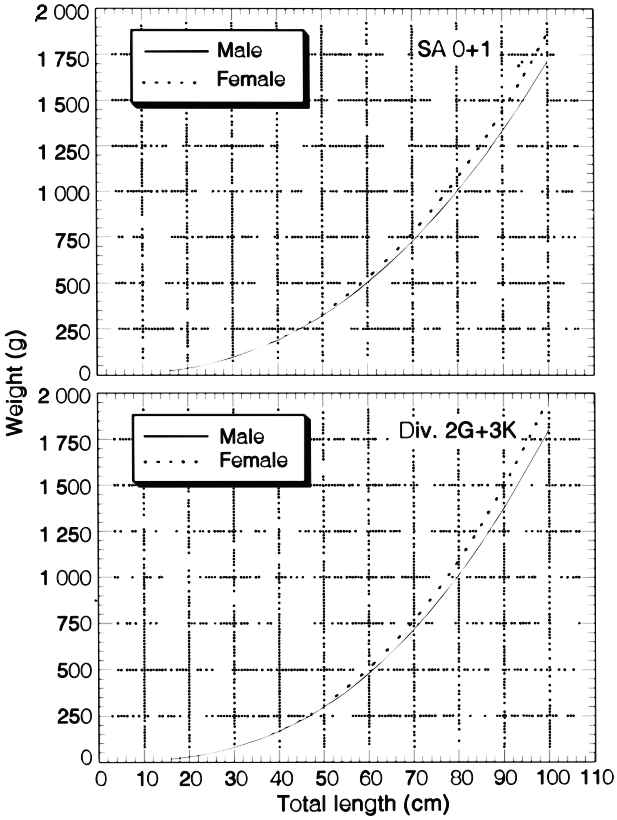

Fig. 3. Comparison of sexed length-weight relationships for roundnose grenadier for the two NAFO management areas.

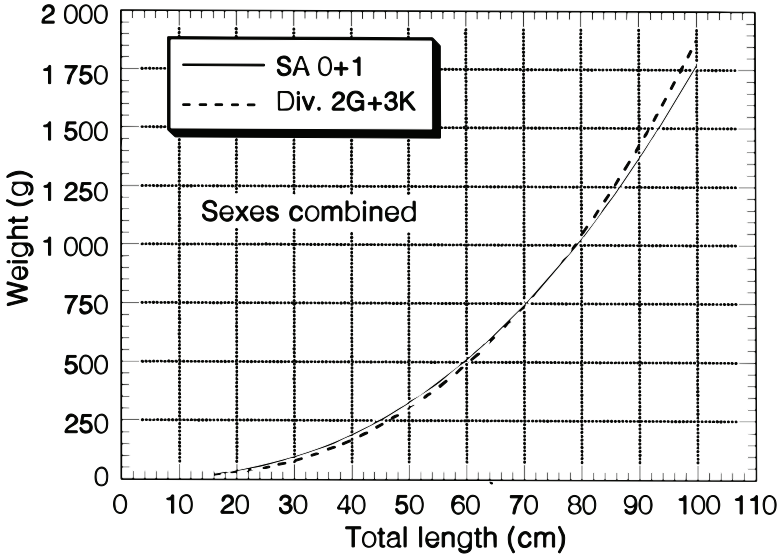

Fig. 4. Comparison of length-weight relationships for roundnose grenadier in the two NAFO management areas (sexes combined).

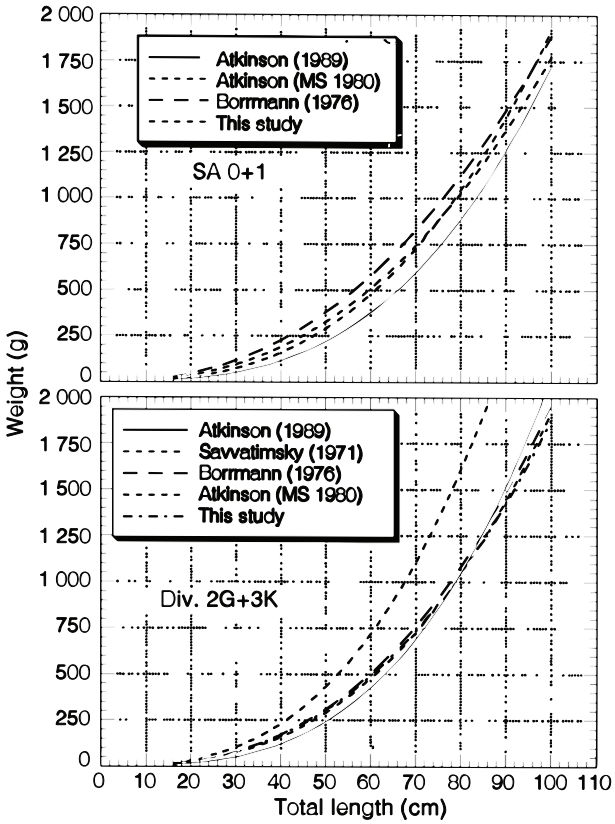

Fig. 5. Comparison of length-weight relationships for roundnose grenadier in the two NAFO management areas (sexes combined) from this and previous studies.

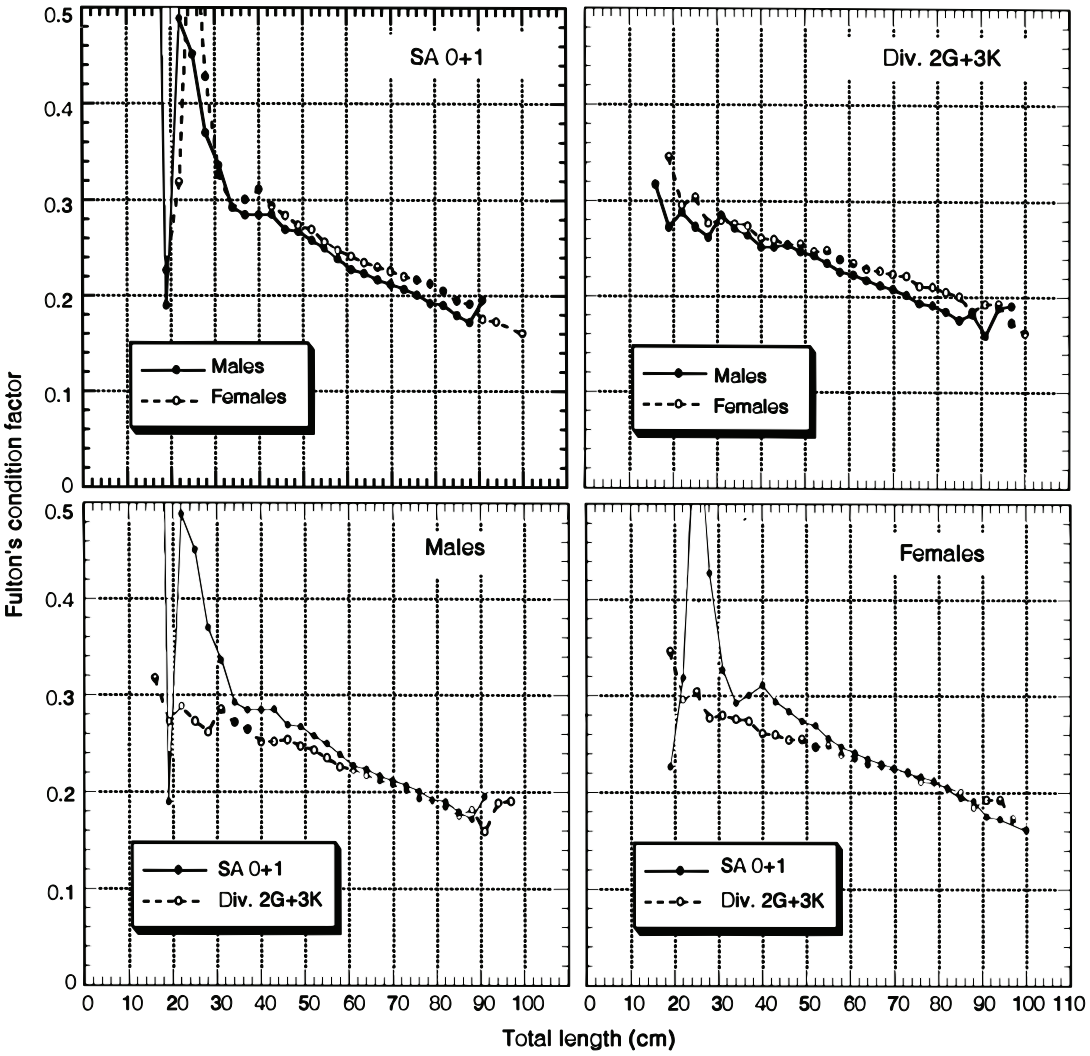

Fig. 6. Comparison of Fulton's condition index for roundnose grenadier for the two NAFO management areas by sex.

as is characteristic of other gadoids (Postolaky, 1978). The relationships will depend on the feeding activity of the fish as well as the relative weight of the liver and gonads. Savvatimsky (1982) has shown that the liver may constitute from 1 to 10% of the body weight during different months of the year and this translates to weights between 5 and 50 g depending on the size of fish. These changes may account, to a large degree, for the differences noted in the length-weight relationships derived from different areas and different studies. Prior to using this type of information to make inferences concerning population structure, it is necessary to consider when samples were collected, as well as fish condition at the time of collection.

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