Northwest Atlantic Fisheries Organization

Serial No. N1240 NAFO SCR Doc. 86/113

SCIENTIFIC COUNCIL MEETING - SEPTEMBER 1986

Condition Factors of Cod on the Flemish Cap in 1978-85

by

R. Wells

Science Branch, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1

INTRODUCTION

As an indicator of cod condition, gutted weight was chosen so as to avoid the variation due to the amount of stomach contents at the time of sampling. Condition of fish may be of importance in determining spawning success.

MATERIALS AND METHODS

Samples of cod were measured at sea, tagged and frozen, and subsequently thawed and examined in the laboratory. Gutted weight was one of the routine observations made. Over the period 1977-86, some 12,500 specimens of length 31 cm and greater have been examined to date. Samples were stratified at sea so that equal numbers were taken, if available, for each 3 cm group. One hundred and thirteen samples of 30 cod or more totalling 12,172 specimens were considered. These samples were taken from all NAFO Divisions from Div. 2G to Div. 4S (Table 1). Samples were taken on research vessel cruises as feasible and thus certain areas and months are sampled more extensively than others (Table 2).

Length and weight relationships were adequately described by logarithmic transformations.

RESULTS

Length-gutted weight

The logarithmic length-weight relationships by quarter were based on unequal sample sizes (Table 3). The overall relationship using all observations was log gutted weight (kg) = 3.0944 log fork length (cm) -5.2868. To derive a representative overall relationship, the unweighted quarterly relationships were combined and resulted in:

log gutted weight (kg) = 3.101 log fork length (cm) -5.298

From the 113 samples of Table 1, the slope values ranged from 2.88 to 3.25 (Table 4). Intercepts were significantly (r^2 = .99) related to slopes by the relationship:

intercept = -1.782 slope + 0.225

If the exponent of the length-weight relationship is assigned the theoretical cubic value of exactly 3, then the appropriate intercept is -5.121, that is, log gutted weight (kg) = 3.000 log length (cm) -5.121.

For Div. 3M, the 16 samples available (Table 5) showed slopes ranging from 3.04 to 3.18 and intercepts of -5.423 to -5.104 (Table 6). These slopes and intercepts, although of limited range, show a decided negative relationship (Fig. 1).

Condition factors

The average gutted weights at length for each sample was divided by the standard weights implied by the logarithmic relationship:

log gutted weight = 3.101 log length -5.298

to arrive at condition factors. Condition factors after month 2 (February) tended to be lower than in January or February (Table 7). Overall variation was low with most values ranging from .95 to 1.05. For the January-February period only, highest condition factors are the smaller cod (31-52 cm) were found in 1979, 1982, 1983, and 1984. For intermediate size cod (55-76 cm) the highest condition factors were in 1981, 1982, and 1983 (Fig. 2, 3).

From the more theoretical relationship, log gutted weight = 3.000 log length -5.121, results are quite similar (Table 8 and Fig. 4, 5).

CONCLUSIONS

Condition of cod as measured by condition factors involving gutted weight did not vary greatly in the January-February period but appeared to be highest in 1979, 1981, 1982, and 1983 for cod in the 31-52 cm range. For cod in the 55-76 cm range, condition seemed best in 1981-83.

Table 1. Areas from which samples of length and gutted weight of cod were available for the period 1977-86.

Area number	NAFO divisions	Number of samples	Number of observations
1	4R, 4S, 3Pn	8	830
2	2G, 2H, 2J	19	2248
3	3N, 3O	18	2125
4	3K	16	1497
5	3L	26	2404
6	3M	16	1983
7	3Ps	10	1085
	Total	113	12172

Table 2. Time and place of length-gutted weight samples of cod available from the period 1977-86.

Month	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Number of samples
Jan.		1	1	1,6	1,5,6				5	5	9
Feb.		6,7	6,7			6	6	5,6	6	2,4,5	12
Mar.			4,6	4,7	1,2,4,7	2,3,5	4,5,6		3,4,5,7	7	19
Apr.			3,6	3,6	5	3	1,7	3,7	3,5	3	13
May		3,5	5,6	3,5,6	3,6	5,7	4	3	3,5	3	16
June		3	3			7					3
July							5	5			2
Aug.			2				5	5	5		4
Sept.		2	1						3		3
Oct.				1,2	2,3	2,5	2,5	2	2,5		11
Nov.	2	4,6	2,4	2,4	2,5	2,4,5	2,4,5	2,4	2,4		19
Dec.					4		4				2
Total samples	1	9	14	13	15	13	15	10	16	7	113

Table 3. Regession parameters for quarterly periods for cod in the Northwest Atlantic, 1977-86 relating log gutted weight and log length.

Quarter	n	Slope	Intercept	r^2
January-March	4385	3.1055	-5.3063	.99
April -June	3347	3.1364	-5.3665	.99
July -September	1149	3.0585	-5.2285	.99
October-December	3670	3.0523	-5.2069	.99
All months	12551	3.0944	-5.2868	.99

Table 4. The range of slope values by area from the relationship between log gutted weight and log length.

Area	Slope values		Associated intercept values	
	Minimum	Maximum		
1	3.007	3.170	-5.140	-5.431
2	2.876	3.103	-4.902	-5.292
3	3.041	3.247	-5.187	-5.564
4	2.890	3.157	-4.928	-5.389
5	2.953	3.173	-5.029	-5.448
6	3.032	3.180	-5.194	-5.423
7	2.981	3.127	-5.101	-5.355

Table 5. Average gutted weight of cod on the Flemish Cap at length for various months in the period 1978-86.

Length group	Month and year 1978 2	1978 11	1979 2	1979 3	1979 4	1979 5	1980 1	1980 4	1980 5	1981 1	1981 5	1982 2	1983 2	1983 3	1984 2	1985 2
31	.21	.23	.22	.19	.18	.20	.22	.17	.24	.24	.23	.24	.21	.22	.20	.22
34	.29	.30	.30	.30	.27	.28	.29	.25	.29	.31	.30	.29	.30	.29	.31	.28
37	.37	.36	.42	.37	.37	.35	.35	.34	.36	.39	.37	.39	.37	.38	.37	.35
40	.47	.49	.49	.43	.46	.50	.48	.45	.43	.46	.50	.52	.49	.43	.47	.49
43	.61	.58	.62	.57	.59	.60	.56	.54	.52	.65	.63	.58	.60	.63	.59	.58
46	.73	.68	.78	.69	.71	.72	.69	.73	.68	.76	.77	.74	.76	.75	.72	.71
49	.86	.90	.96	.82	.84	.83	.85	.86	.86	.91	.92	.93	.89	.89	.85	.85
52	1.07	1.02	1.05	1.02	.99	1.02	1.10	1.08	1.09	1.08	1.09	1.10	1.16	1.04	1.10	1.04
55	1.22	1.25	1.32	1.20	1.13	1.22	1.28	1.26	1.27	1.33	1.27	1.30	1.23	1.21	1.23	1.22
58	1.43	1.41	1.53	1.34	1.46	1.40	1.47	1.36	1.53	1.62	1.43	1.53	1.59	1.62	1.52	1.40
61	1.68	1.69	1.63	1.53	1.72	1.75	1.66	1.68	1.68	1.92	1.85	1.76	1.94	1.82	1.73	1.66
64	1.93	1.97	1.94	1.89	1.80	1.82	1.98	-	1.82	2.20	2.08	2.13	2.06	2.10	2.03	2.01
67	2.37	2.33	2.25	2.24	2.33	2.18	2.46	1.89	2.11	2.55	2.33	2.35	2.42	2.33	2.32	2.47
70	2.46	2.50	2.61	2.17	2.54	2.53	2.84	2.50	2.57	2.63	2.77	2.59	2.80	2.77	2.77	2.76
73	3.04	2.64	2.97	2.95	-	2.75	3.01	-	2.91	2.95	3.01	3.15	3.12	2.83	3.33	3.06
76	3.50	-	3.44	2.90	-	3.06	3.47	3.21	3.44	3.48	3.47	3.56	3.46	3.49	3.30	3.31
79	4.01	3.97	3.83	3.69	-	3.63	3.79	-	4.03	3.95	3.91	4.02	4.07	-	3.95	4.06
82	4.35	4.34	4.41	-	-	4.24	4.62	4.20	4.07	4.59	4.32	4.32	4.53	4.37	4.74	4.17
85	4.87	-	4.91	-	-	4.59	4.80	4.48	4.57	5.05	4.68	5.00	4.86	5.57	5.29	5.35
88	5.66	4.94	5.21	-	-	-	5.42	-	-	5.86	5.46	5.33	6.05	-	5.83	5.55
91	6.08	6.22	6.10	6.36	-	-	6.47	-	5.50	6.27	6.47	6.48	6.33	6.51	6.47	6.25
94	6.97	-	6.26	-	-	-	6.69	-	-	6.83	6.74	7.07	6.87	-	7.28	6.87
97	7.28	6.95	7.44	-	-	-	7.43	-	6.92	8.02	8.23	7.98	7.59	7.46	7.97	6.83
100	8.68	8.71	7.78	8.17	-	-	-	-	-	8.46	8.63	8.56	9.69	-	8.77	8.20
103	9.32	8.54	10.14	-	-	-	8.65	-	-	10.25	10.87	9.89	9.00	9.58	9.22	-
106	10.48	10.81	9.35	9.90	-	-	9.93	-	-	10.44	16.60	10.04	10.71	-	12.08	9.62
109	-	11.52	11.55	10.72	-	-	12.34	9.65	-	10.64	-	12.09	11.51	-	12.42	12.23
112	12.68	-	11.75	-	-	-	11.83	-	-	-	-	13.48	12.88	12.38	12.62	13.38
115	-	-	15.52	-	-	-	-	-	-	12.94	-	12.88	16.21	-	13.42	13.57
118	-	-	16.91	-	-	-	16.11	-	-	-	-	-	16.57	-	17.16	-
121	15.10	-	14.72	-	-	-	15.66	-	-	-	-	-	-	-	-	17.46
124	-	-	16.76	-	-	-	-	-	-	-	-	-	-	-	-	-
127	-	-	-	-	-	-	-	-	-	-	-	-	-	16.80	-	-
130	-	21.74	16.71	-	-	-	-	-	-	-	-	-	-	-	18.50	-
133	-	-	-	-	-	-	-	-	-	-	-	-	24.06	-	-	-
Number	159	86	117	127	88	127	123	47	97	133	137	114	175	88	174	191

Table 6. Slope and intercept values for the log gutted weight (kg)/log length (cm) relationship of cod on the Flemish Cap.

Year	Month	Number	Slope	Intercept	r^2
1978	2	159	3.106	-5.286	.994
1978	11	86	3.089	-5.279	.995
1979	2	117	3.083	-5.258	.996
1979	3	127	3.104	-5.325	.991
1979	4	88	3.124	-5.347	.990
1979	5	127	3.032	-5.194	.980
1980	1	123	3.138	-5.360	.995
1980	4	47	3.075	-5.277	.993
1980	5	97	3.038	-5.202	.992
1981	1	133	3.101	-5.274	.997
1981	5	137	3.061	-5.219	.997
1982	2	114	3.110	-5.294	.996
1983	2	175	3.145	-5.354	.996
1983	3	88	3.130	-5.335	.997
1984	2	174	3.180	-5.423	.996
1985	2	191	3.172	-5.421	.995

Table 7. Condition factors for cod on the Flemish Cap where observed gutted weight is compared to the standard weight with exponent = 3.101.

Year/month		Length group (cm) 31-40	43-52	55-64	67-76	79-88	91-100	>100	Average	Number observed
1978	2	1.0267	1.0171	.9695	.9966	1.0260	1.0381	1.0774	1.0216	159
	11	1.0503	.9879	.9790	.9415	.9825	1.0265	1.0999	1.0097	86
1979	2	1.0874	1.0593	1.0006	.9879	.9980	.9893	1.0883	1.0301	117
	3	.9785	.9599	.9217	.9029	.9578	1.0410	1.0272	.9699	127
	4	.9596	.9786	.9455	.9830	-	-	-	.9667	88
	5	.9920	.9863	.9609	.9262	.9556	-	-	.9642	127
1980	1	1.0292	.9842	.9908	1.0374	1.0118	1.0375	1.0866	1.0254	123
	4	.9043	.9862	.9642	.8988	.9472	-	.9214	.9370	47
	5	1.0282	.9664	.9822	.9633	.9757	.9343	-	.9750	97
1981	1	1.0873	1.0628	1.0905	1.0233	1.0539	1.0594	1.0792	1.0652	133
	5	1.0614	1.0595	1.0245	1.0161	.9981	.9773	1.0589	1.0280	137
1982	2	1.0907	1.0334	1.0383	1.0204	1.0156	1.0785	1.1103	1.0553	114
1983	2	1.0388	1.0752	1.0525	1.0371	1.0573	1.0867	1.1653	1.0733	175
	3	1.0197	1.0360	1.0407	1.0028	1.0806	1.0553	1.0585	1.0419	88
1984	2	1.0259	1.0129	1.0069	1.0294	1.0740	1.0927	1.1416	1.0548	174
1985	2	1.0211	.9860	.9719	1.0228	1.0378	1.0109	1.1115	1.0231	191

Table 8. Condition factors for cod on the Flemish Cap where observed gutted weight is compared to the standard weight with exponent = 3.000.

Year/month		Length group (cm) 31-40	43-52	55-64	67-76	79-88	91-100	>100	Average	Number observed
1978	2	.9791	.9990	.9743	1.0204	1.0671	1.0945	1.1525	1.0410	159
	11	1.0014	.9704	.9839	.9618	1.0210	1.0828	1.1787	1.0286	86
1979	2	1.0371	1.0405	1.0054	1.0115	1.0608	1.0430	1.1690	1.0525	117
	3	.9333	.9429	.9263	.9244	.9907	1.0973	1.0960	.9873	127
	4	.9155	.9611	.9503	1.0021	-	-	-	.9573	88
	5	.9464	.9686	.9657	.9482	.9921	-	-	.9642	127
1980	1	.9813	.9670	.9956	1.0621	1.0523	1.0920	1.1638	1.0449	123
	4	.8628	.9689	.9665	.9198	.9852	-	.9846	.9479	47
	5	.9798	.9496	.9868	.9865	1.0129	.9835	-	.9832	97
1981	1	1.0364	1.0437	1.0960	1.0475	1.0962	1.1169	1.1521	1.0841	133
	5	1.0121	1.0406	1.0297	1.0403	1.0381	1.0304	1.1333	1.0464	137
1982	2	1.0401	1.0153	1.0435	1.0448	1.0562	1.1371	1.1862	1.0747	114
1983	2	.9905	1.0343	1.0579	1.0618	1.0997	1.1459	1.2507	1.0915	175
	3	.9721	1.0174	1.0461	1.0267	1.1241	1.1107	1.1355	1.0618	88
1984	2	.9783	.9950	1.0120	1.0540	1.1171	1.1520	1.2241	1.0761	174
1985	2	.9738	.9685	.9768	1.0470	1.0794	1.0657	1.2110	1.0460	191

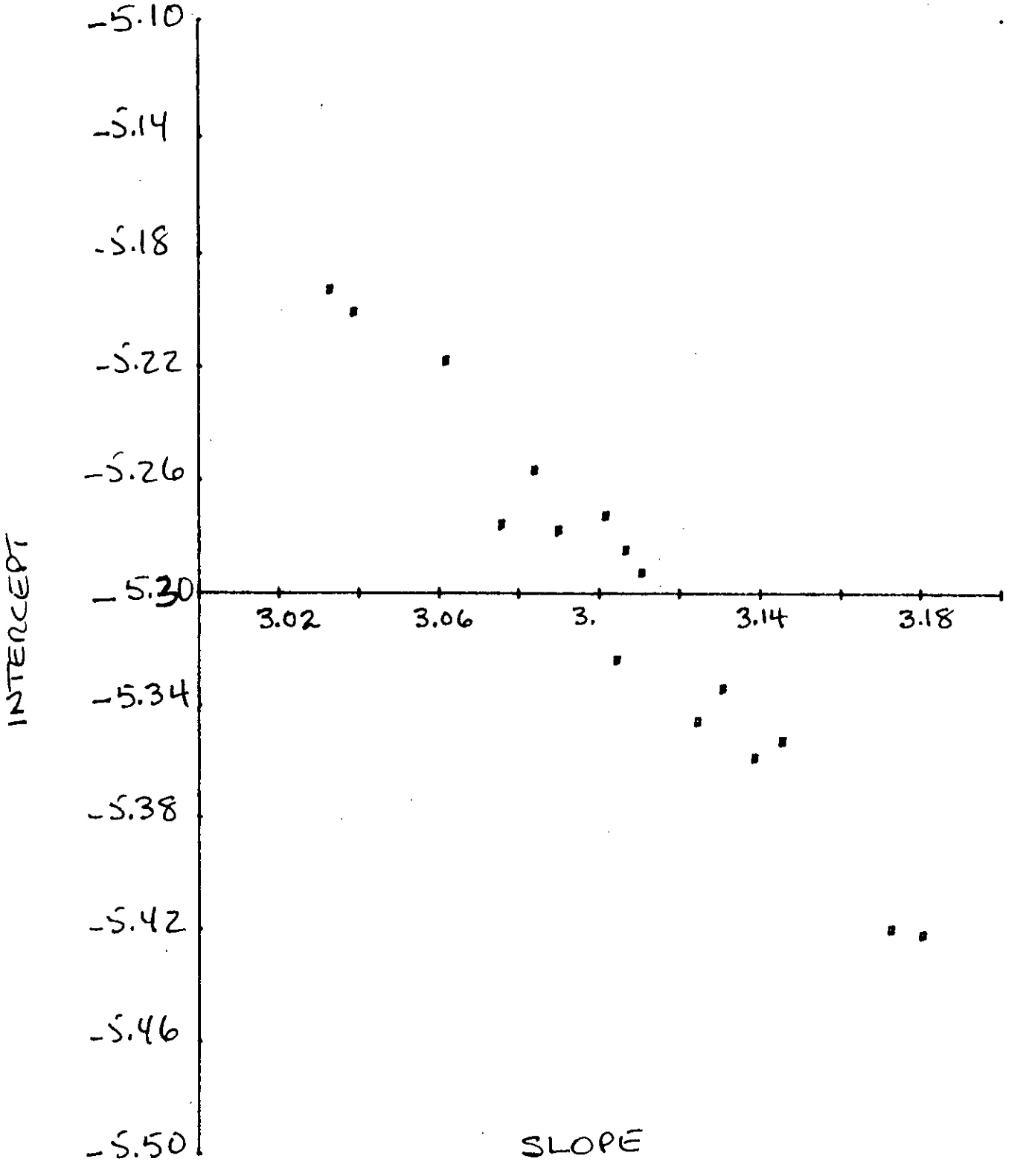

Fig. 1. The relationship between slope and intercept values derived from gutted weight samples of cod from the Flemish Cap.

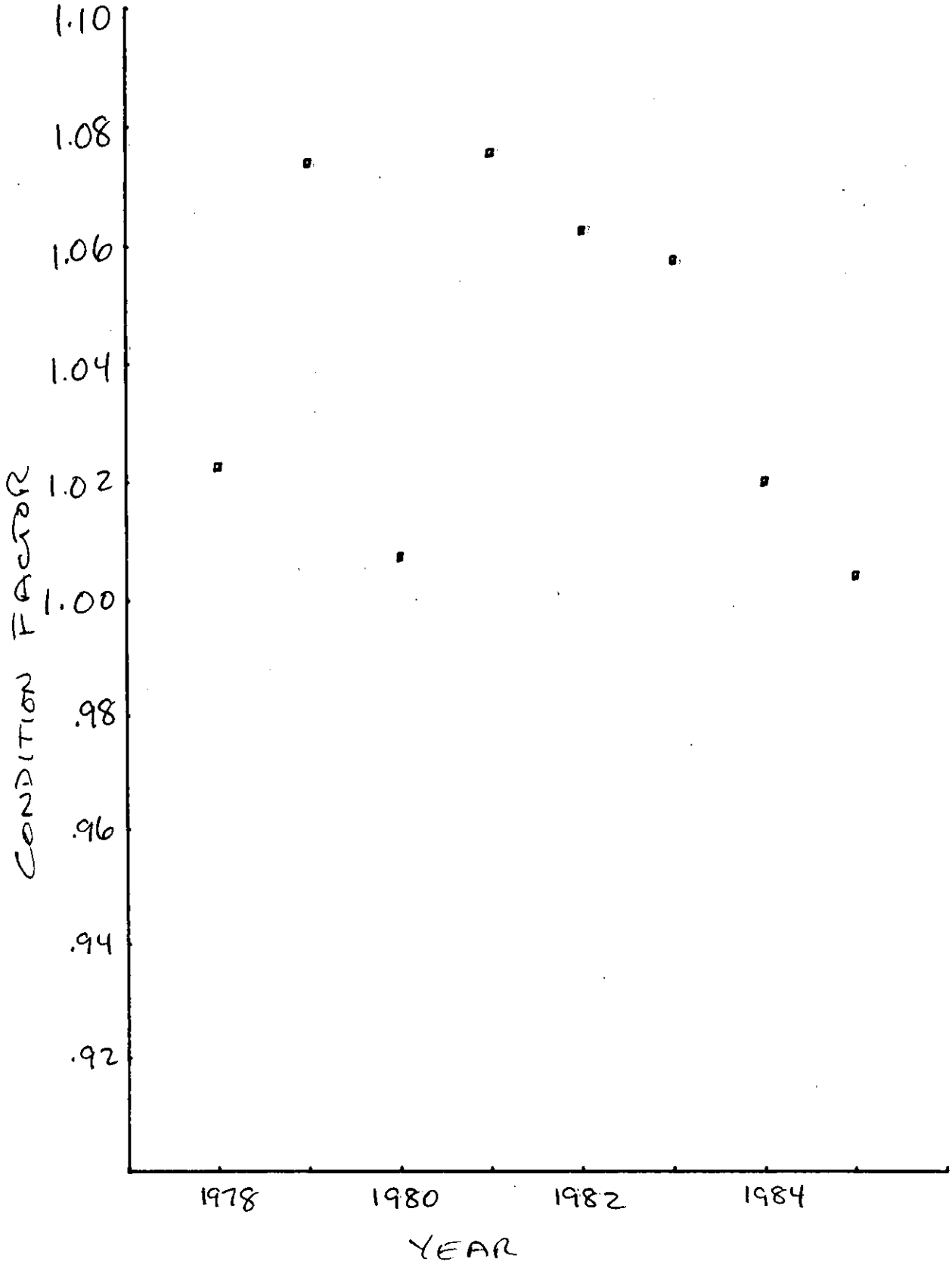

Fig. 2. Condition factors of cod in the length range 31-52 cm using the relationship with exponent 3.101.

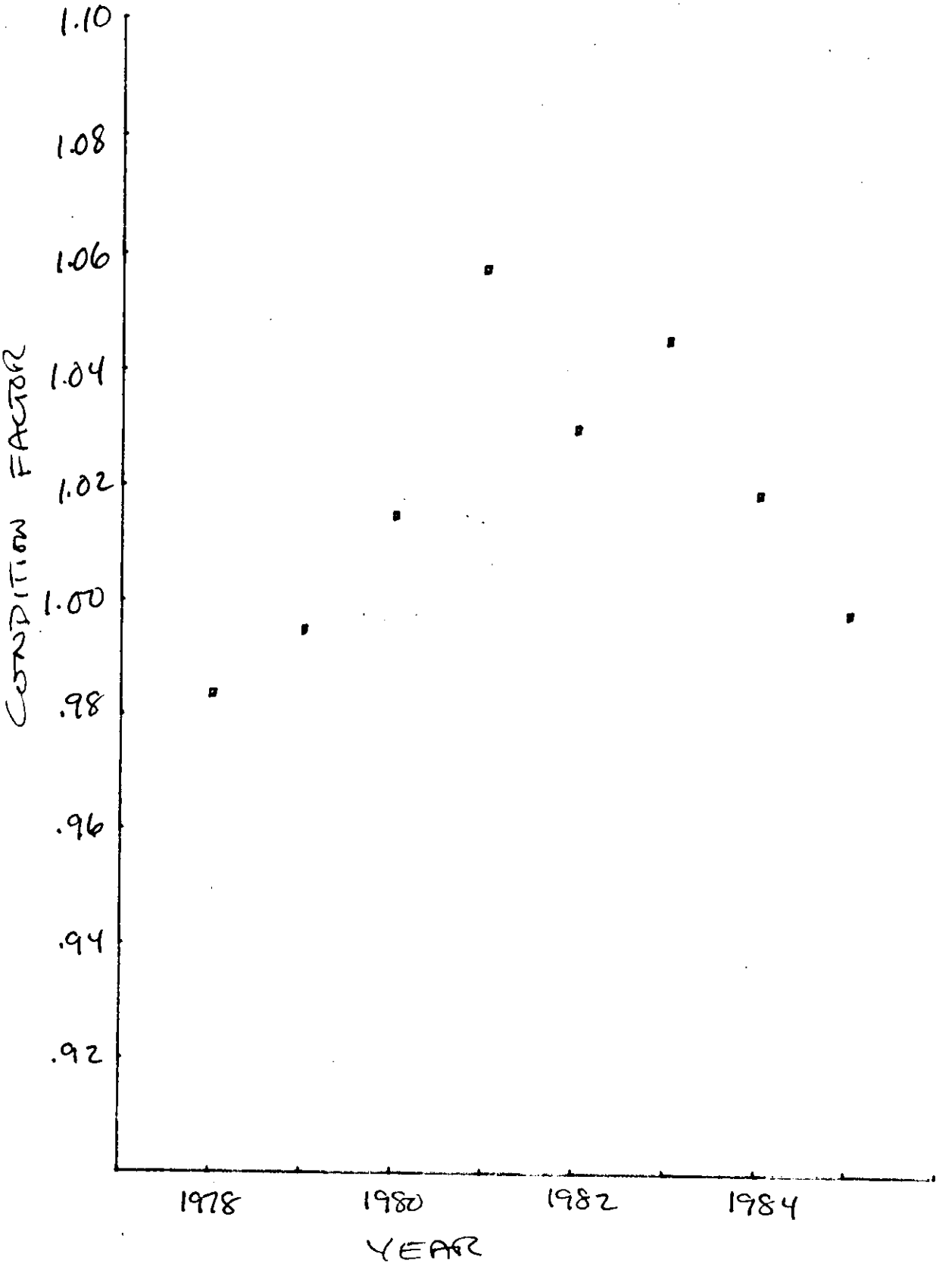

Fig. 3. Condition factors of cod in the length range 55-76 cm using the relationship with exponent 3.101.

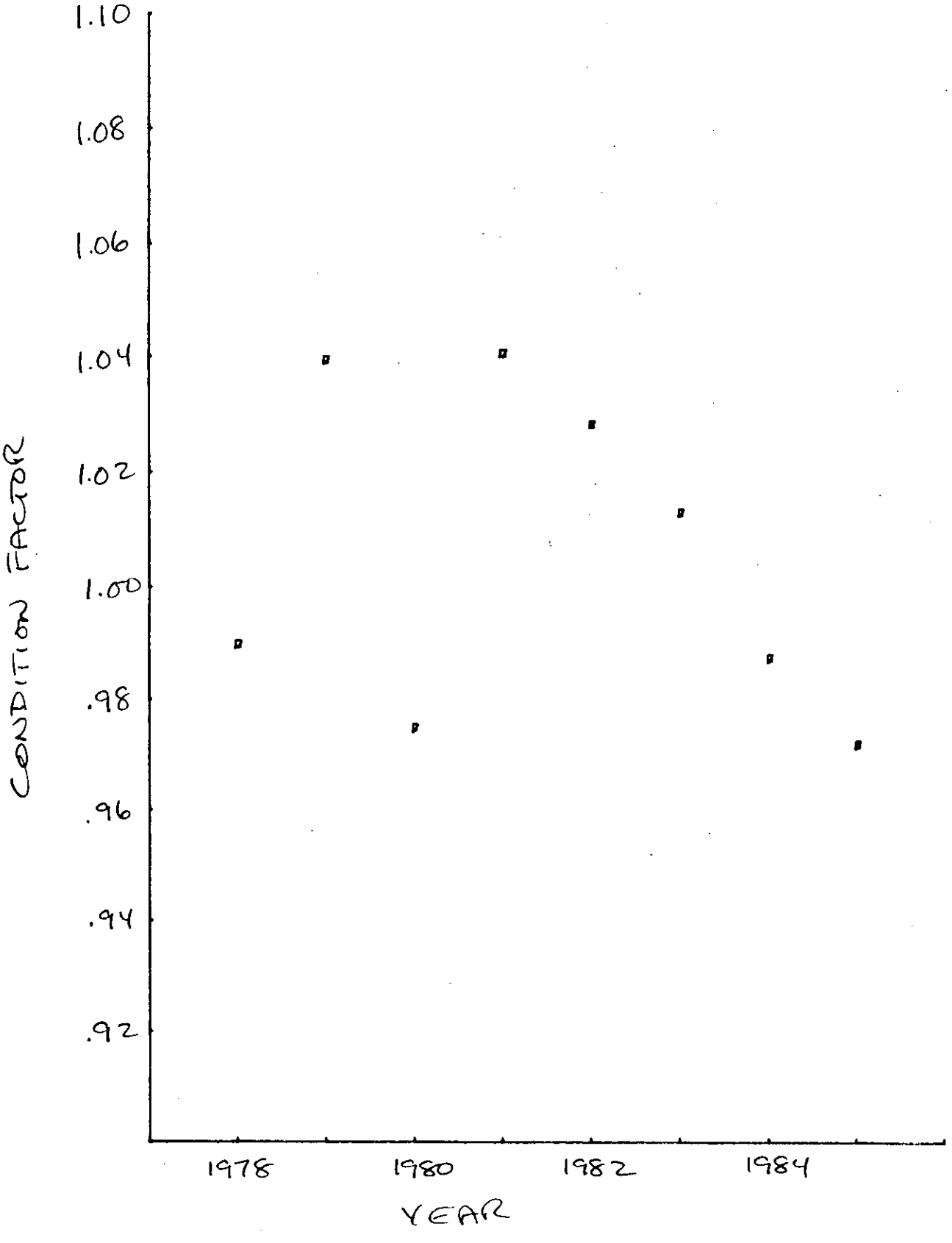

Fig. 4. Condition factors of cod in the length range 31-52 cm using the relationship with exponent 3.000.

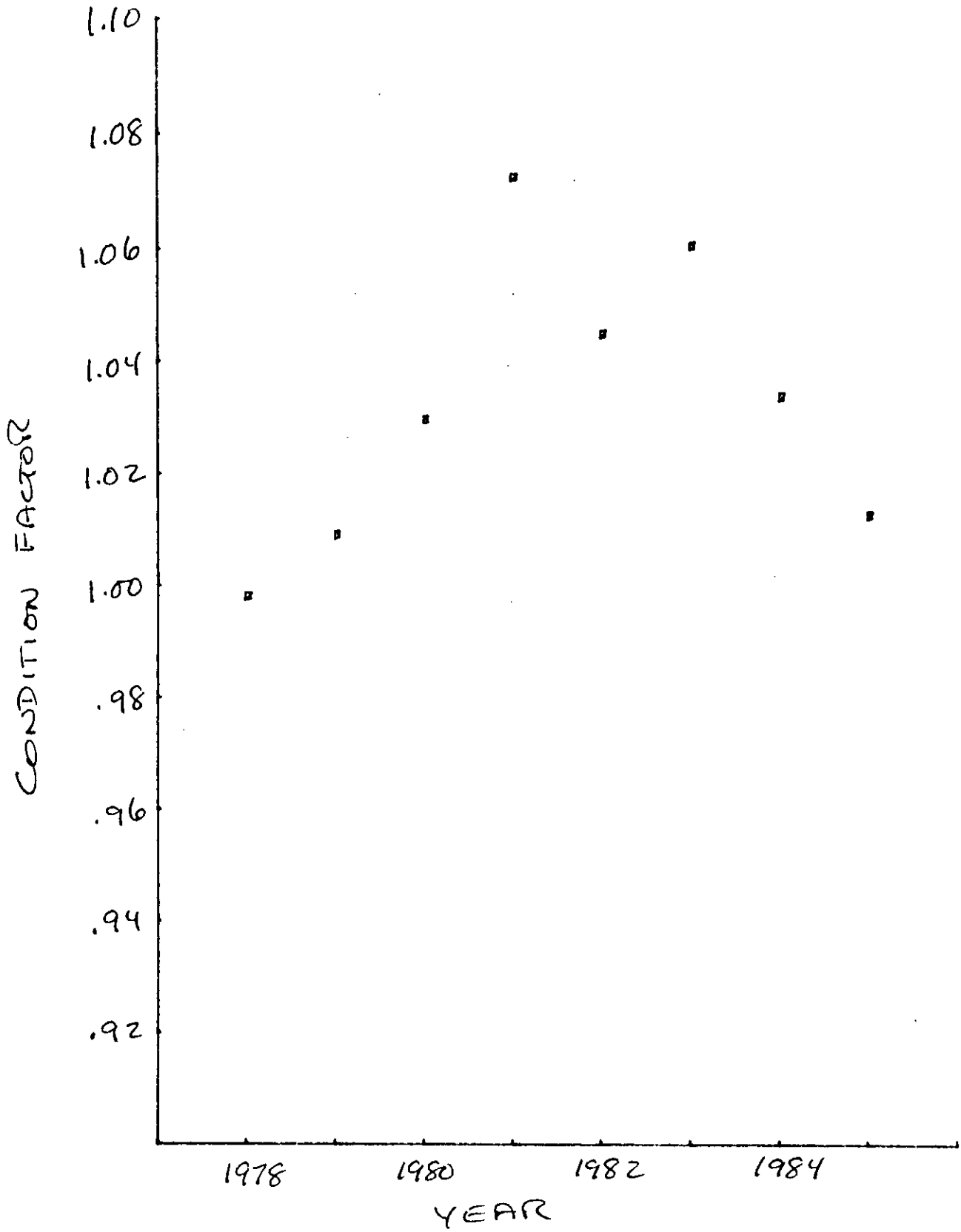

Fig. 5. Condition factors of cod in the length range 55-76 cm using the relationship with exponent 3.000.