Northwest Atlantic Fisheries Organization

Serial No. N2244 NAFO SCR Doc. 93/61

SCIENTIFIC COUNCIL MEETING - JUNE 1993

Abundance Indices of Greenland halibut in Deepwater Fishing Zones of NAFO Divisions 3LMN

by

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INTRODUCTION

Since 1990 a deepwater fishery of Greenland halibut has been developed in the boundary of Divisions 3L and 3M, extended to the North of Division 3N in 1992. The main participants in this fishery are Spain and Portugal. A description of this fishery is found in *Junquera et al.* (1992).

The Spanish fleet is composed by bottom trawlers that fish from depths of 800 m onwards. Catch rates are of the same level as in other areas where Greenland halibut were traditionally exploited (Brodie, 1991).

The fishing activity has been monitored by observers on board since the onset of this fishery. Eight observers stayed on board these commercial vessels in 1990, 23 in 1990 and 30 in 1992. They provided a great amount of information on fishing areas, length distributions, catches and effort which would allow us to get a quite clear picture about the trends of this species in the area. The fleet in 1990 was mainly large trawlers, but smaller vessels were incorporated with time. This heterogeneity of the fleet and the differences in the survey intensity at different seasons and years hampered a direct interpretation of the raw information on catch and effort to calculate indices accounting for seasonality or long-trends in catch rates (Junquera et al., 1992).

Following a recommendation of the NAFO Scientific Council in 1992 (Anon., 1992), the standardization of the catch rates in the whole available time series of data from the commercial fishery is undertaken in this paper. It allowed us to obtain comparable time series of catch rates, which can be considered as fishery related abundance indices because this is a directed fishery for Greenland halibut.

MATERIAL AND METHODS

Catch rates were adjusted to a multiplicative model for CPUE. The method used (Vazquez, 1980) gives a solution assuming a variance:

$$V(CPUE) = (CPUE)^k \; Vb \; / \; t$$

The power k has commonly a value between 1.5 and 2.0. The Vb s are constants for each vessel or fleet component. A minimum square solution is calculated by iteration.

Input data were monthly Greenland halibut catches and effort of each vessel by Division and depth zone, and they comprised 1400 records. Catches of other species were also included in each record, and they were used to exclude those records with catches of other species larger than for Greenland halibut. Although catches of species other than Greenland halibut were probably incidental by-catches, we decided to exclude the above mentioned records to reduce doubts regarding target species.

A total of 1236 records were used. The best fit to the multiplicative model was obtained with an exponent k=2.146 and 58 % of the variance was explained. A power greater than 2.0 indicates a dispersion of highest values a little higher than the theoretical maximum, but the value obtained is within the expected range for a calculated parameter.

RESULTS

Results of the analysis are presented in Table 1. Significant differences among values obtained for each factor were explored. Cross comparison squares are presented in figure 1. In this figure, the values for each factor were previously arranged in increasing order to make easier interpretation of differences. No significant differences at a 5 % level are indicated with an asterisk. A diagonal of asterics is always present for this reason. On this figure, a certain grouping can be observed among vessels but they are not independent and there is a continuous variation of values.

DISCUSSION

The relationships between the vessel factor value and vessel characteristics: gross tonnage and horse power, are presented in Figure 2 and 3, respectively. Correlation coefficients between them were also calculated. Horse power has a greater correlation with the vessel factor, indicating a greater influence on it.

There are no significant differences in year factor for 1991 and 1993, although data in 1993 are quite scarce. The year factor has its maximum value in 1990, when the fishery began, and a clear tendency is not observed, in spite of their annual variation (Figure 4).

Month factor value decreases along the year, from January to November, and increases to December and next January (Figure 5). This pattern seems to indicate a main concentration of Greenland halibut in January.

Division factor is significantly different between zones. The highest value corresponds to Division 3N (Figure 6), but the fleet does not concentrate there because catches contain smaller fish than in Divisions 3L and 3M, where the bulk of the catch was taken (Junquera et al., 1992). Similarly, the depth zone factor has its maximum value in 600-800 m depth zone and decrease with depth (Figure 7), but catches were mainly made in deepest zones, where large fish is more abundant (Junquera et al., 1992).

REFERENCES

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Brodie, W.B.- 1991. An assessment of Greenland halibut in SA 2+Div. 3KL. NAFO SCR Doc.91/88.

Junquera, S., S. Iglesias and E. Cardenas - 1992. Spanish fishery of Greenland halibut (Reinhardtius hippoglossoides) in 1990-91. NAFO SCR Doc. 92/28.

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TABLE 1 - Values obtained for each factor from a multiplicative model. Catches in Kg and effort in hours.

order	code	n.	value	s.error	Catch	effort	Y/f
	total	1236			29091201	5656052	5.14

FACTOR 1 : vessel

order	code	n.	value	s.error	Catch	effort	Y/f	Vb
1	JAH	75	1.000	0.027	2451405	354607	6.91	1.00
2	RSE	16	0.413	0.010	124600	47073	2.65	0.13
3	ZXG	13	0.924	0.062	439174	58004	7.57	0.97
4	CKH	68	1.301	0.059	3823551	358283	10.67	2.61
5	EIF	19	0.752	0.062	513380	113880	4.51	3.09
6	GEH	25	1.638	0.048	711342	64512	11.03	0.20
7	NKD	20	0.909	0.059	257651	47785	5.39	0.78
8	OSF	32	0.752	0.021	1095205	234888	4.66	0.76
9	DSD	72	0.874	0.025	1832787	316269	5.80	0.99
10	RTH	51	0.649	0.011	1176926	290290	4.05	0.31
11	XRH	17	0.629	0.020	430732	136152	3.16	0.57
12	ZRH	29	0.844	0.040	1098282	206242	5.33	1.80
13	WXD	20	0.639	0.033	141156	40075	3.52	0.43
14	HDE	13	0.608	0.043	79174	27200	2.91	0.59
15	SJF	25	0.796	0.044	544567	124711	4.37	1.53
16	IXE	15	0.769	0.034	266983	60138	4.44	0.48
17	FOD	39	0.541	0.015	856622	239771	3.57	0.77
18	VZG	18	0.436	0.021	143972	71410	2.02	0.74
19	NWH	40	0.633	0.017	965866	203969	4.74	0.57
20	BOE	52	1.001	0.034	1638500	250418	6.54	1.08
21	JVD	31	0.628	0.022	741966	164948	4.50	0.84
22	MAA	38	0.656	0.022	763632	172017	4.44	0.81
23	BXH	27	0.955	0.053	671304	93433	7.18	1.09
24	LJF	11	0.556	0.050	240816	78520	3.07	2.71
25	ACH	11	0.396	0.032	87211	40294	2.16	1.21
26	XME	27	0.551	0.020	598216	130079	4.60	0.66
27	CXG	36	0.485	0.013	752053	184235	4.08	0.58
28	UUA	39	0.590	0.013	738486	165365	4.47	0.33
29	LAE	37	0.919	0.027	1409726	174058	8.10	0.54
30	XXH	27	0.648	0.023	892570	164840	5.41	0.80
31	ATH	30	0.363	0.013	479409	166820	2.87	0.95
32	YWD	59	0.461	0.012	673775	189726	3.55	0.57
33	NMF	17	0.503	0.019	318209	86651	3.67	0.49
34	KMF	37	0.648	0.022	485185	90214	5.38	0.42
35	UUG	26	0.421	0.016	213263	70160	3.04	0.43
36	NKE	32	0.486	0.011	467389	127355	3.67	0.28
37	RQD	19	0.382	0.014	226022	76245	2.96	0.43
38	WCH	20	0.352	0.024	120786	43457	2.78	0.90
39	KYF	21	0.459	0.023	329320	88176	3.73	0.95
40	FCH	32	0.358	0.011	289988	103782	2.79	0.43

FACTOR 2 : year

order	code	n.	value	s.error	Catch	effort	Y/f
4	90	141	1.088	0.018	4571688	579232	7.89
2	91	289	0.853	0.009	5544523	1467297	3.78
1	92	795	1.000	0.007	18851445	3570353	5.28
3	93	11	0.874	0.045	123545	39170	3.15

FACTOR 3 : month

order	code	n.	value	s.error	Catch	effort	Y/f
6	1	51	1.596	0.043	1169485	197881	5.91
10	2	82	1.440	0.030	2268143	393136	5.77
11	3	88	1.257	0.026	2213217	424240	5.22
12	4	93	1.339	0.027	2893720	471348	6.14
7	5	90	1.411	0.025	3669169	564078	6.50
8	6	73	1.170	0.024	2360980	390681	6.04
9	7	78	1.210	0.026	1710232	314929	5.43
2	8	124	1.046	0.016	2715503	622193	4.36
1	9	173	1.000	0.014	3274427	728912	4.49
3	10	166	0.916	0.014	2913744	690925	4.22
4	11	136	0.894	0.015	2333593	567769	4.11
5	12	82	1.219	0.029	1568988	289960	5.41

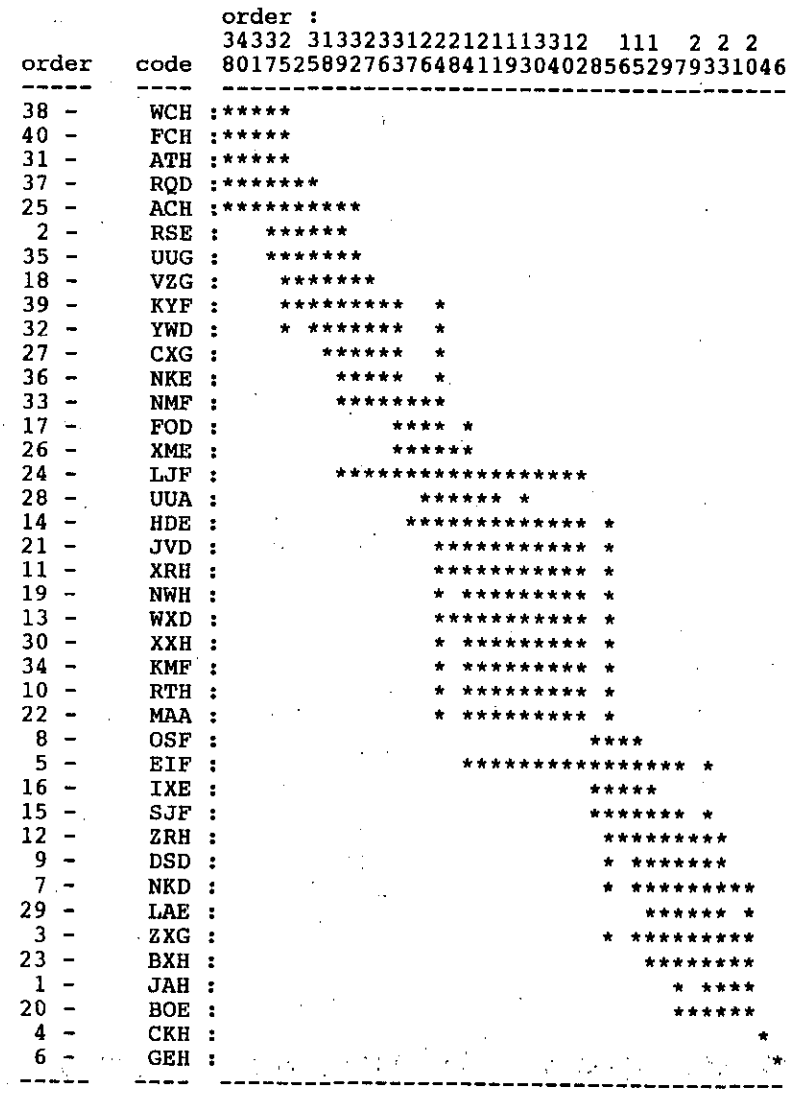
FACTOR 4 : Division

order	code	n.	value	s.error	Catch	effort	Y/f
1	3L	651	1.000	0.008	18739920	3148355	5.95
2	3M	489	0.860	0.007	8794536	2177085	4.04
3	3N	96	1.318	0.026	1556745	330612	4.71

FACTOR 5 : depth zone

order	code	n.	value	s.error	Catch	effort	Y/f
4	600-800	102	7.335	0.185	1724790	291384	5.92
2	800-1000	389	6.812	0.070	8696097	1528638	5.69
1	1000-1200	490	6.328	0.045	14722492	3100217	4.75
3	1200-1400	226	6.339	0.100	3734948	705973	5.29
5	1400-1600	29	5.182	0.390	212874	29840	7.13

FACTOR 1 : vessel



FACTOR 2 : year

order	code	order: 2314
2 -	91	:**
3 -	93	:**
1 -	92	: *
4 -	90	: *

FACTOR 3 : month

order	code	order: 11 1 431289512706
4 -	11	:**
3 -	10	:**
1 -	9	: *
2 -	8	: *
8 -	6	: ***
9 -	7	: ****
5 -	12	: ****
11 -	3	: ***
12 -	4	: **
7 -	5	: ***
10 -	2	: **
6 -	1	: *

FACTOR 4 : Division

order	code	213
2 -	3M	:*
1 -	3L	: *
3 -	3N	: *

FACTOR 5 : depth zone

order	code	order: 51324
5 -	1400-1600	:*
1 -	1000-1200	: **
3 -	1200-1400	: **
2 -	800-1000	: *
4 -	600-800	: *

FIGURE 1 - Cross comparison of values for each factor. No significant differences at 5 % level are indicated with a asterisk.

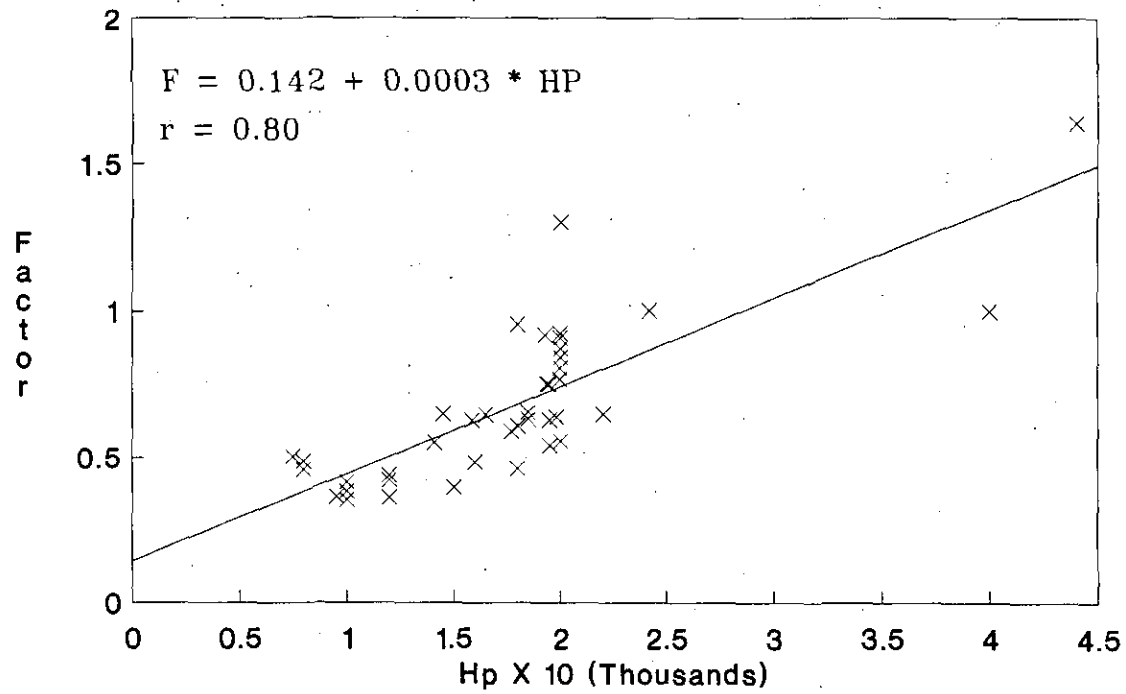


Fig. 2.- Relationship between the ship factor and the Horse power.

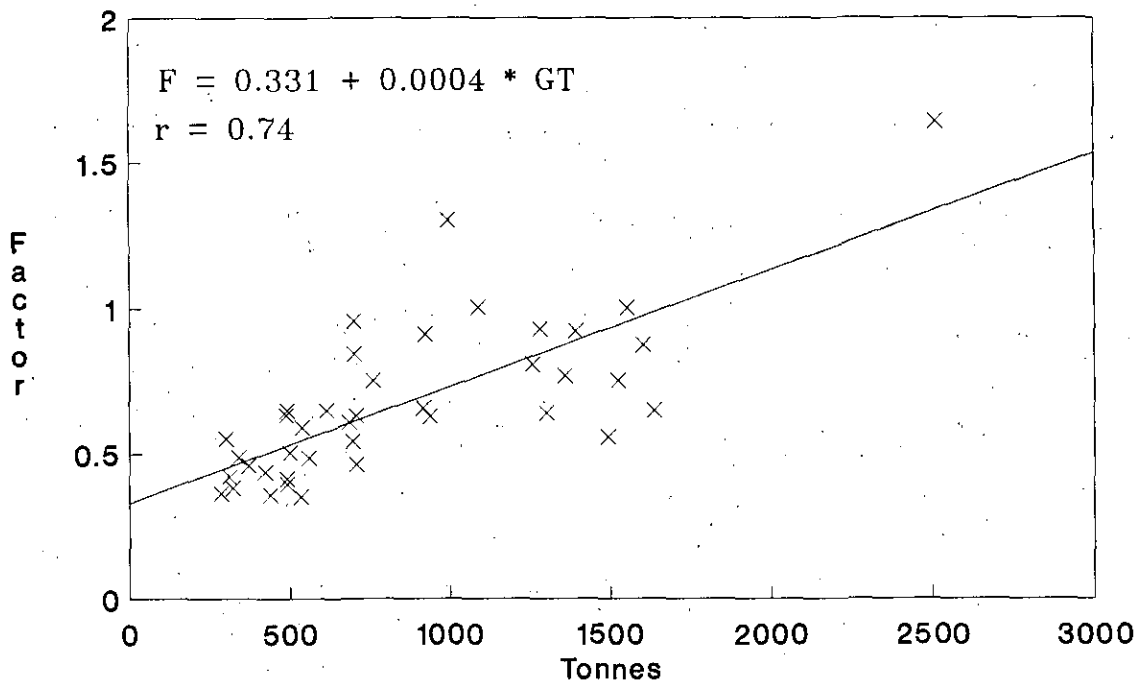


Fig. 3.- Relationship between the ship factor and gross tonnage.

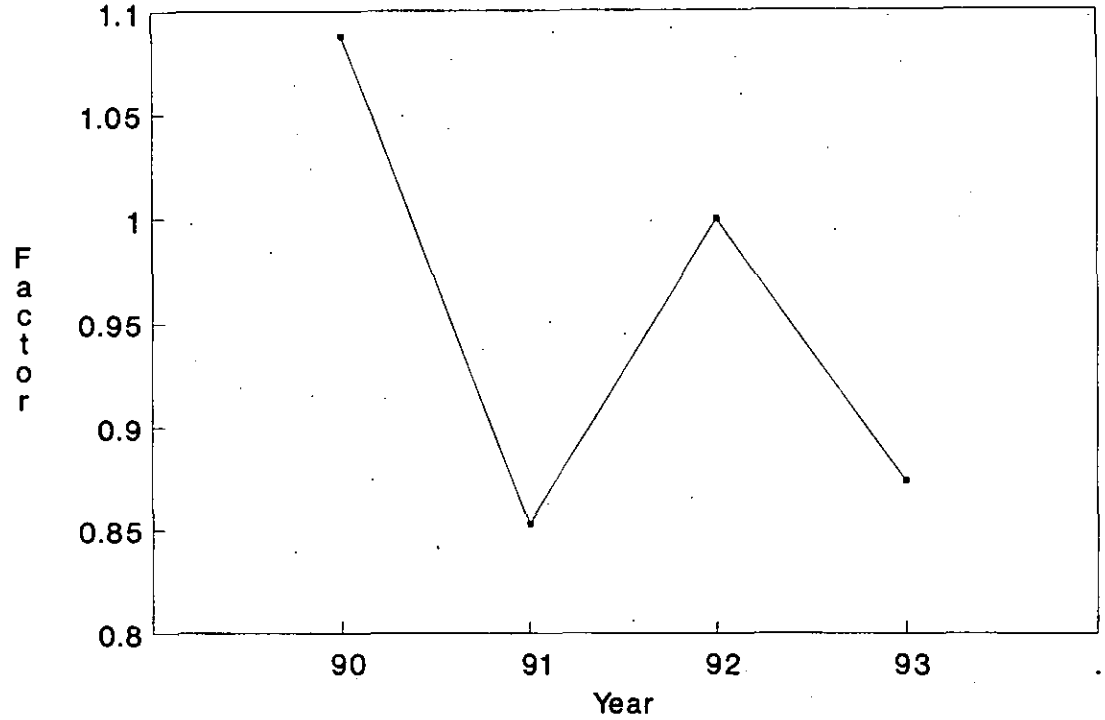


Fig. 4.- Year factor variation.

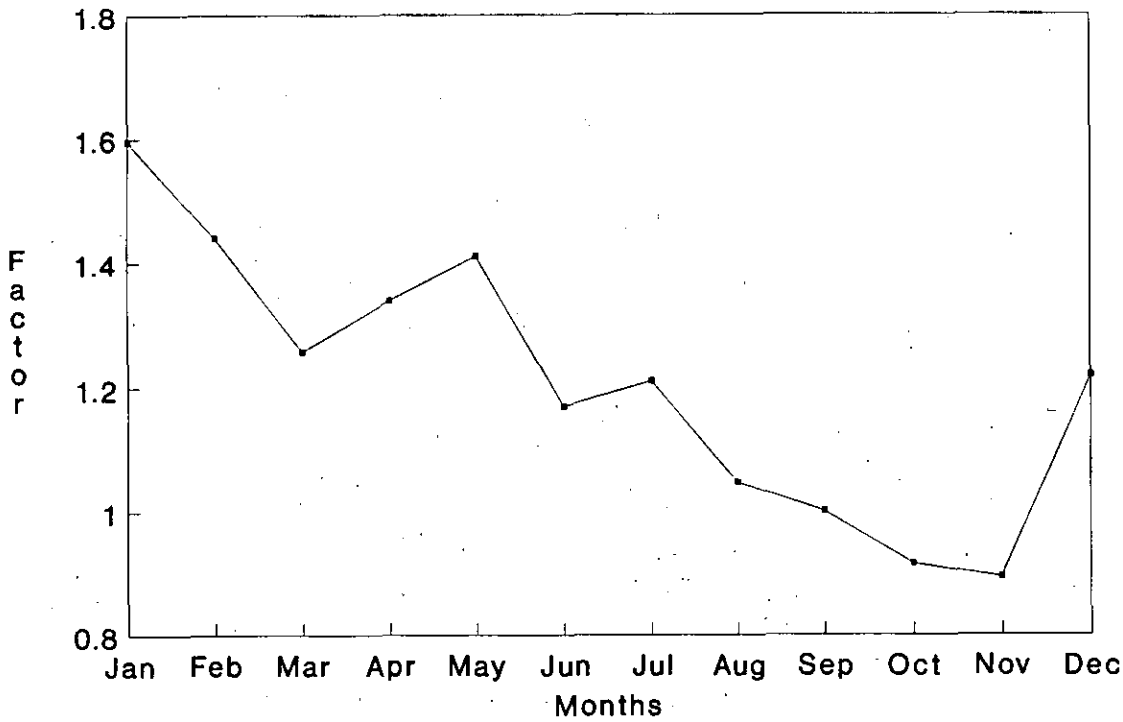


Fig. 5.- Month factor variation.

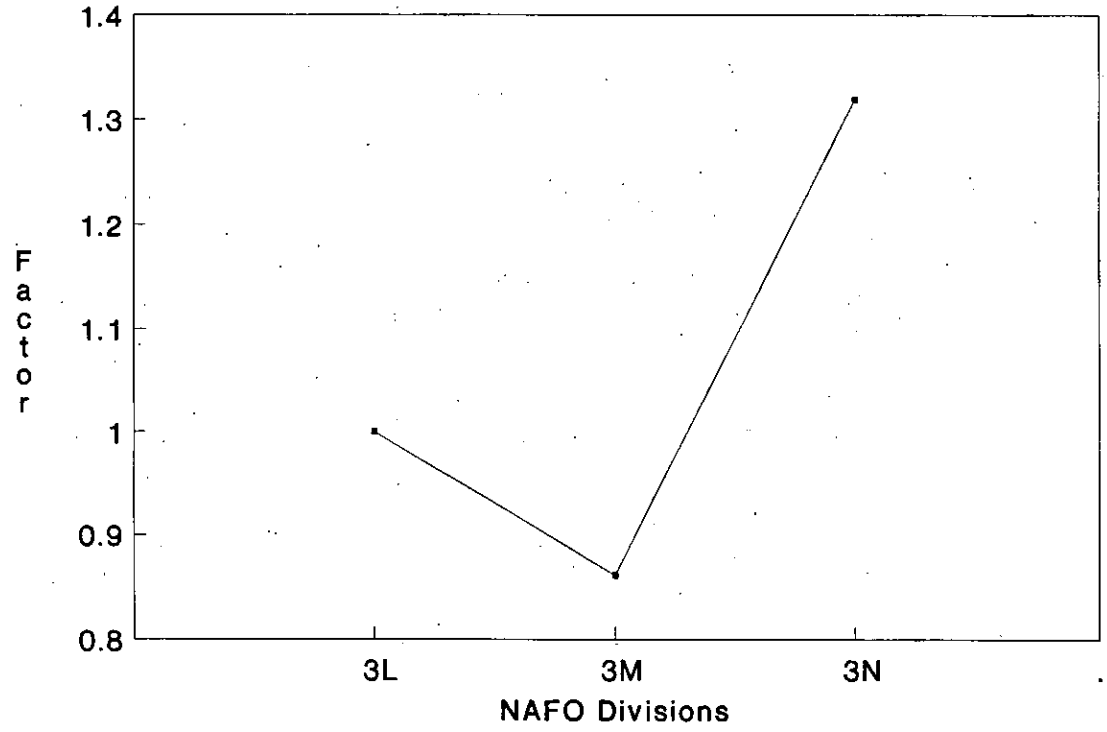


Fig. 6.- Division factor variation.

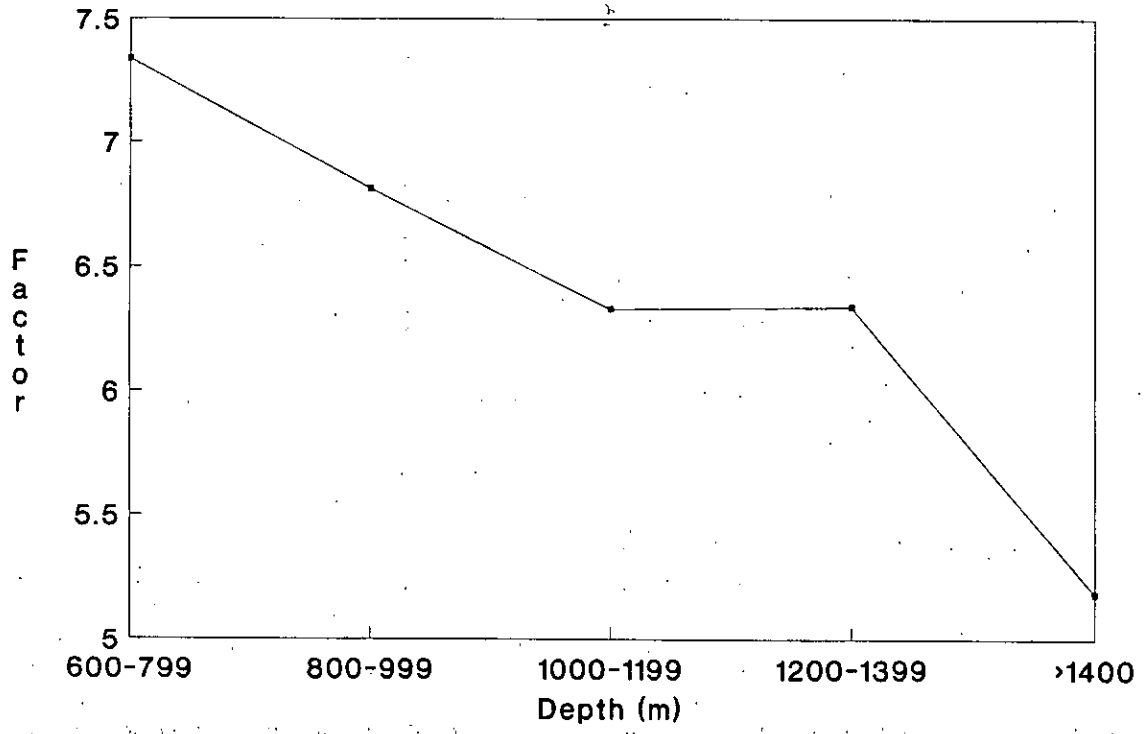


Fig. 7.- Depth factor variation.