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Contrast Between Day and Night Greenland Halibut Yields from Catches by Spanish Commercial Fleet, During the Period 1991-94 in NAFO Divisions 3LMN

by

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Abstract

Greenland halibut (Reinhardtius hippoglossoides) day and night yields were estimated for 1991-1994 from 8 361 hauls made by Spanish commercial fleet fishing in the NAFO Area. These hauls were selected taking into account total presence or absence of light. Contrast between day and night Greenland halibut yields by NAFO Division, by depth and by total were obtained. Non-significant Student's t test differences were found.

Introduction

From 1991 to January 1995 a continuous study was made of the fishery developed in the NAFO Regulatory Area (Divisions 3LMNO) through data from scientific observers on board at least a third of the commercial fleet. The target species of the fishery is Greenland halibut (Reinhardtius hippoglossoides) caught at depths of between 800 and 1 500 metres. This species makes up more than 60% of the total catch and so the CPUE of the fleet may be considered as being directed at this species (Gil *et al.*, 1997).

The aim of this paper is to compare day and night yields of this species in Divisions 3LMN at three different depth strata in the period 1991-1994.

Materials and Methods

Data come from a total of 8 361 hauls carried out by the Spanish fishing fleet in Flemish Pass and to the southeast of Newfoundland Grand Bank between 1991 and 1994. Hauls in which there were incidents of importance, such as serious breakages or other anomalies preventing the normal working of the gear have not been taken into account.

Daytime hauls (1 345) are considered to be those in which trawling takes place between 12.00 and 17.30 hours GMT; therefore the gear reaches the bottom after 12.00 hours and the lifting of the gear always begins before 17.30 hours. Night-time hauls (7 016) are those which take place between 00.30 and 06.00 hours GMT. Thus, we ensure that daytime hauls are made when it is completely light, whereas night-time hauls are carried out in complete darkness, throughout trawling time, independent of the season of the year.

Daytime and night-time hauls were analyzed, accumulating the Greenland halibut catch and trawling time by several categories: month, division (3L, 3M and 3N) and depth (800-999, 1 000-1 199 and 1 200-1 399 m). For calculation of yields in each category, only the catches accumulated in more than one haul were taken into consideration. The number of daytime and night-time hauls by categories used in the calculation of yields appears in Table 1.

Yields by month, division and depth strata were estimated as the result of dividing the Greenland halibut catch, in Kilogrammes, by effective trawling time, in hours, calculating this latter as the sum of the differences between the time when the lifting manouevre begins and the time when the trawling gear reaches the bottom. To normalize the values and stabilize their variances, a logarithmic transformation was applied to the yields.

With the aim of observing the relationship between day and night values, linear regressions were performed, situating the values corresponding to day yields on the x-axis, and those of the night on the y-axis. The value of the intersection of the line with the y-axis was previously assumed to be zero, making the lines pass through the origin of coordinates, and calculating the value of the slope of each line by the minimum squares method. Different regressions were made by category and total.

The slopes of each of the regression lines were contrasted with the value of the slope corresponding to the theoretical line which represents the equality of day and night yields (slope=1), through the Student's t statistic, with a level of significance of 95%:

$$t = (b - b') / SE \quad \text{with n-2 degrees of freedom}$$

where b= parameter estimate, b'= parameter value hypothesized and SE= standard error parameter estimate.

Results

As can be observed in Figures 1, 2 and 3, day and night yields present the same variations, the same trends remaining except in certain cases, possibly due to sampling errors. This similarity between day and night yields seems to be present in the three divisions and in each depth strata.

The results of the statistical analysis of pairs of values, Table 2, confirm what is observed in the figures, in which non-significant differences appear between the day and night yields, except in the depth stratum 1 000-1 199 m of Division 3N and thus, in the total of this division. The slopes obtained in the remaining cases give values of t which do not permit the rejection of the null hypothesis. In Figure 4 the two regression lines, observed and theoretical, are shown for the total of day/night yields.

Discussion

From the results we deduce that fishing yields do not present differences with daylight in the three divisions and depth strata analyzed throughout the period studied, 1991-1994. This result may be due to the great depths at which the fishery takes place, far from the limit of the photic layer.

Therefore, it would seem evident that the factor analyzed in this study is not determinant in the behaviour of the resource, which is a fact of some interest when designing scientific surveys, since the results of night-time hauls will be directly comparable with those made during day.light.

References

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Junquera, S., S. Iglesias and E. de Cárdenas, 1992. Spanish Fishery of Greenland Halibut (Reinhardtius hippoglossoides) in 1990-91. *NAFO SCR Doc.* 92/28, Serial No. N2075, 14p.

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Table 1. Nº of valid hauls (day/night) by month, nafo division and depth strata.

DIVISION	3L			3M			3N		
DEPTH (M)	800 - 999	1000 - 1199	1200 - 1399	800 - 999	1000 - 1199	1200 - 1399	800 - 999	1000 - 1199	1200 - 1399
Jun. 91									
Jul. 91	/ 3	3 / 15		/ 6	9 / 54	2 / 7			
Aug. 91	7 / 60	7 / 56		2 / 11	11 / 125	2 / 24			
Sep. 91	5 / 40	10 / 55	/ 12	4 / 9	11 / 88	2 / 21			
Oct. 91	4 / 10	7 / 83	/ 3	/ 3	19 / 98	13 / 54			
Nov. 91	2 / 9	8 / 57	/ 10	2 / 9	12 / 71	20 / 89			
Dec. 91	/ 10	7 / 25	/ 17	/ 2	3 / 15	5 / 18			
Jan. 92	13 / 25	3 / 20	/ 3	/ 5	9 / 49	/ 4			
Feb. 92	15 / 46	11 / 69	/ 10	2 / 23	18 / 120	2 / 28			
Mar. 92	12 / 41	7 / 69	/ 11	11 / 21	38 / 136	13 / 54			
Apr. 92	27 / 93	8 / 102	5 / 30	2 / 13	22 / 52	15 / 28			
May. 92	21 / 111	15 / 146	6 / 62	2 / 12	14 / 50	9 / 21			
Jun. 92	17 / 70	12 / 84	7 / 35	/ 7	4 / 37	8 / 26			
Jul. 92	6 / 61	2 / 27	/ 2	/ 3	4 / 16	/ 3	/ 2		
Aug. 92	13 / 46	3 / 47	2 /	/ 5	5 / 30		9 / 25	3 / 8	
Sep. 92	10 / 48	4 / 29	3 / 4	/ 2	/ 5	3 / 2	15 / 57	9 / 26	/ 3
Oct. 92	2 / 22	4 / 21		/ 2			9 / 33	12 / 34	5 / 13
Nov. 92	3 / 19	7 / 24			/ 2		10 / 22	10 / 33	/ 4
Dec. 92	11 / 30	/ 11		5 / 8	2 / 5				
Jan. 93	8 / 35	9 / 52	/ 10	/ 10	/ 2				
Feb. 93	16 / 91	11 / 60	/ 19	5 / 14	3 / 26				
Mar. 93	5 / 88	11 / 70	4 / 12	4 / 26	7 / 71	2 / 3	5 / 16	/ 8	
Apr. 93	7 / 40	8 / 66	3 / 15	3 / 16	9 / 45		8 / 36	9 / 49	
May. 93	9 / 53	10 / 75	4 / 15	/ 3	/ 9	/ 6	9 / 26	9 / 42	2 / 2
Jun. 93	2 / 43	/ 23	/ 2	/ 2	3 / 13	/ 7	9 / 37	4 / 19	
Jul. 93	2 / 9	3 / 22		2 / 2	/ 4		15 / 67	13 / 47	3 / 7
Aug. 93	6 / 29	7 / 30		/ 2	/ 2		19 / 67	25 / 50	3 / 23
Sep. 93	5 / 41	7 / 28		2 /	/ 2		9 / 25	5 / 49	2 / 11
Oct. 93	2 / 20	2 / 17			/ 6	/ 5	14 / 46	12 / 49	7 / 29
Nov. 93		3 / 14	3 / 8				9 / 33	10 / 41	17 / 52
Dec. 93	2 / 16	/ 10		/ 6			/ 2	2 / 14	2 / 23
Jan. 94	/ 24	/ 11		/ 11	3 / 14	/ 2			
Feb. 94	2 / 9	/ 20	2 / 14	2 / 9	10 / 44	/ 10		5 / 12	5 / 11
Mar. 94	/ 10	2 / 5		/ 8	3 / 52	2 / 17	9 / 25	6 / 23	6 / 23
Apr. 94	/ 9	/ 15	3 / 4	/ 9	8 / 22	2 / 7	7 / 20	4 / 27	8 / 31
May. 94	2 / 19	5 / 16	/ 8	/ 5	2 / 21	2 / 15	5 / 18	5 / 23	6 / 47
Jun. 94	/ 10	2 / 10	/ 3		/ 5		2 / 26	7 / 12	/ 8
Jul. 94	3 / 14			/ 2	/ 5		/ 8	/ 5	2 / 3
Aug. 94	5 / 28	2 / 5		/ 3	/ 2		6 / 21	6 / 18	/ 9
Sep. 94	3 / 26	3 / 9		/ 2	/ 5		13 / 23	4 / 10	/ 5
Oct. 94	4 / 18	7 / 13	/ 10	/ 4	/ 2	/ 6	9 / 27	8 / 13	2 / 11
Nov. 94	6 / 27	9 / 30	/ 4	/ 2	2 / 6	/ 2	2 / 11	/ 8	/ 17
Dec. 94	7 / 45	4 / 8	/ 4				2 / 11	2 / 4	/ 5
Total	264 / 1448	223 / 1549	42 / 327	48 / 277	231 / 1311	102 / 459	195 / 684	170 / 624	70 / 337

Table 2. Parameters estimated, values of t, degrees of freedom and significance of each regression line.

| Regression	Slope	Standard error	T value	Df	Significance
3L (800-999m.)	0.96746	0.02766	1.17656	33	No
3L (1000-1199m.)	0.99267	0.04586	0.15975	33	No
3L (1200-1399m.)	1.06477	0.03203	2.02229	8	No
Nafo Div. 3L	0.98804	0.02333	0.51289	78	No
3M (800-999m.)	1.06706	0.08247	0.81312	11	No
3M (1000-1199m.)	1.01738	0.03318	0.5239	23	No
3M (1200-1399m.)	0.9882	0.0308	0.38323	14	No
Nafo Div. 3M	1.02051	0.02596	0.7898	52	No
3N (800-999m.)	0.94866	0.0315	1.62989	20	No
3N (1000-1199m.)	0.91428	0.02868	2.98845	20	Yes
3N (1200-1399m.)	0.98212	0.03806	0.46985	12	No
Nafo Div. 3N	0.9437	0.01858	3.03042	56	Yes
800-999 m.	0.9787	0.02262	0.94166	68	No
1000-1199 m.	0.98216	0.02314	0.77069	80	No
1200-1399 m.	1.00488	0.02016	0.24182	38	No
Total (day/nigth)	0.98517	0.01358	1.09233	190	No
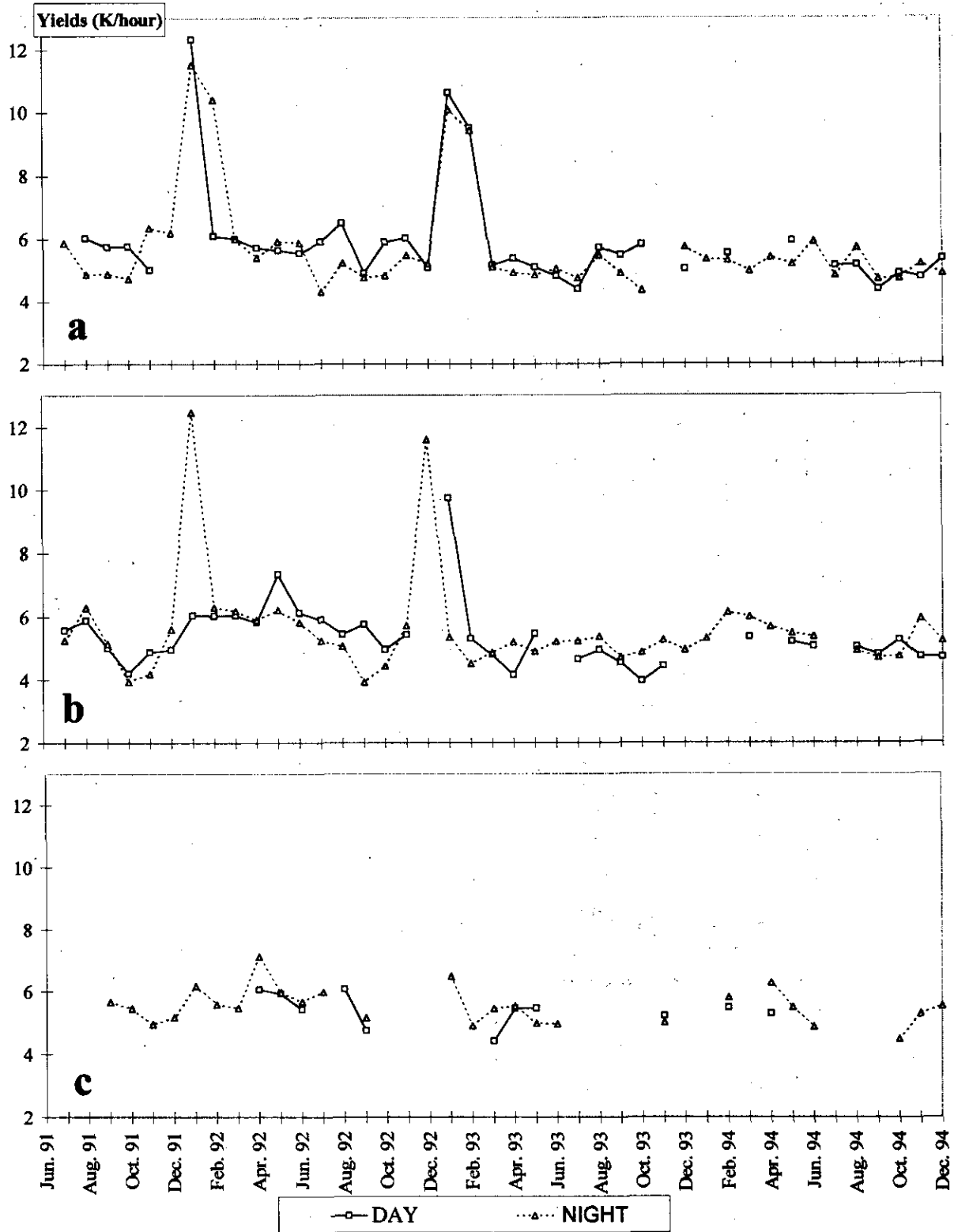
Fig. 1: 3L NAFO Division Day and Night Yields by Months and Depth strata
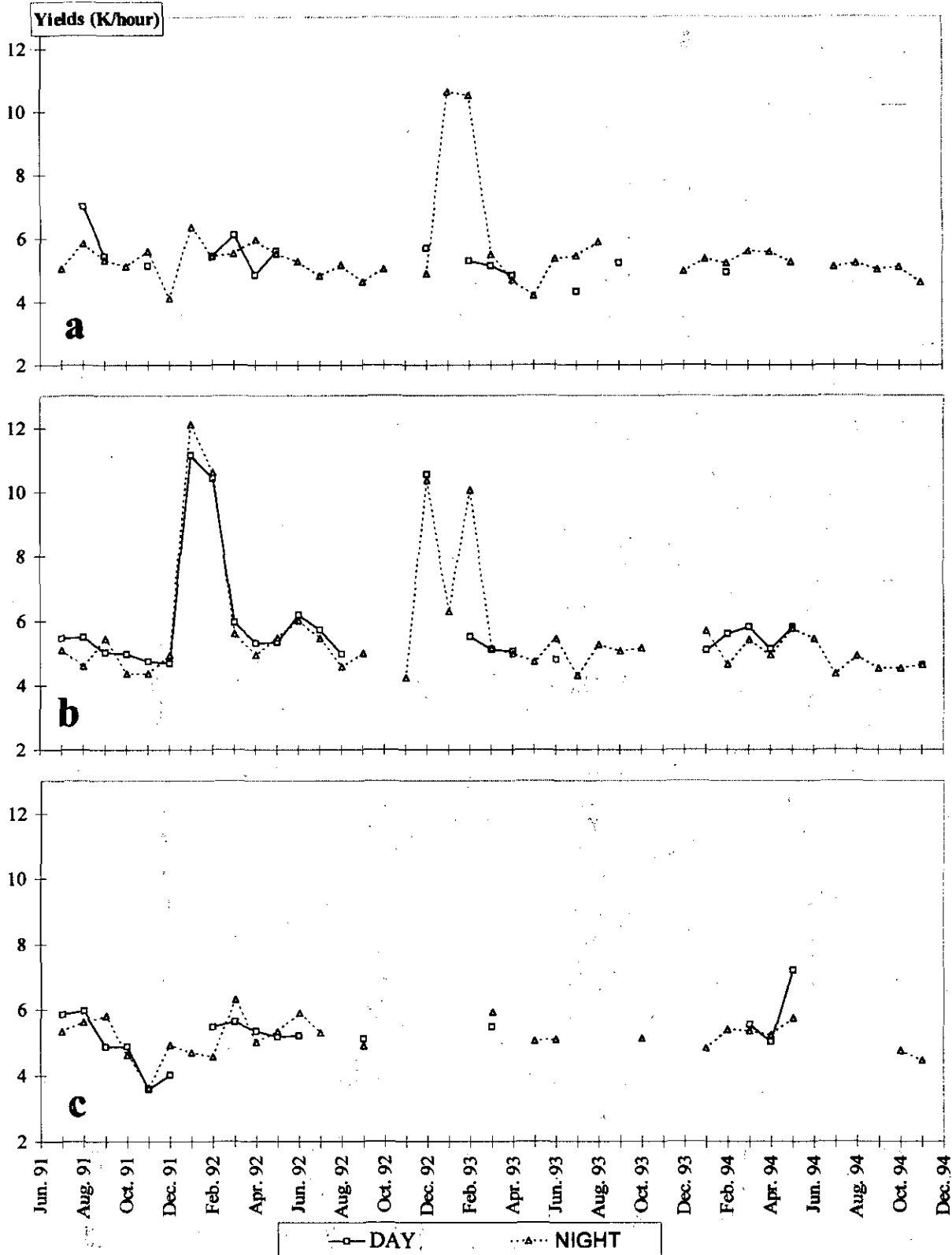a:800-999 m.   b:1000-1199 m.   c:1200-1399 m.

Fig. 2: 3M NAFO Division Day and Night Yields by Months and Depth strata
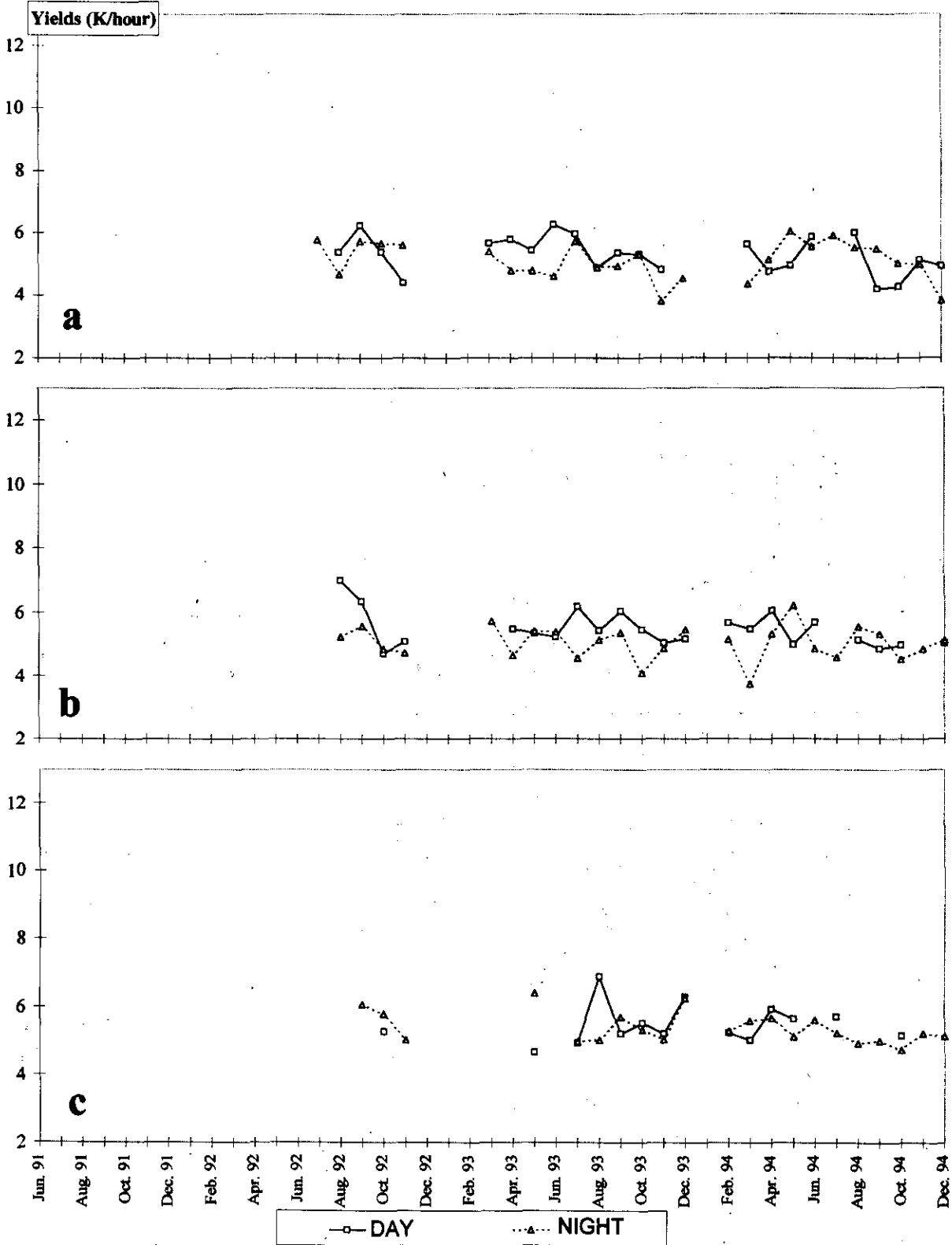a:800-999 m.   b:1000-1199 m.   c:1200-1399 m.

Fig. 3: 3N NAFO Division Day and Night Yields by Months and Depth strata
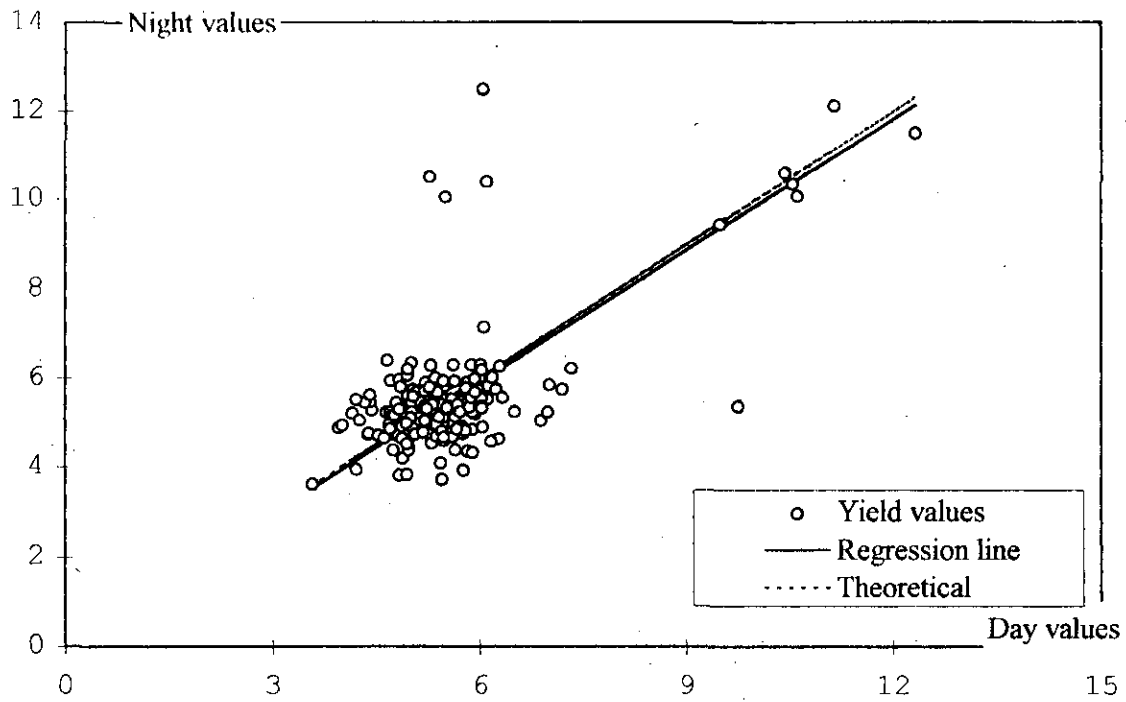a:800-999 m.   b:1000-1199 m.   c:1200-1399 m.

Fig. 4 . Comparison between the Regression line obtained with all pairs of yield values (day/night)
and *theoretical line* (day yields = night yields).