

Effects of Light on Nephrops Catches

by

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Introduction

The dramatic effect of light on Nephrops catches has been studied by Simpson (1965), O'Riordan (1965), Höglund and Dybern (1965) and Hillis (1971). All these authors have demonstrated dawn and dusk peaks in the catch, with however some suggestion of variation on this pattern with depth and possibly season. In view of this variation a more detailed study of the phenomenon was undertaken.

Method

Sets of repetitive parallel hauls of standard length were made close together over the period under study, and interspersed with readings of the amount of illumination by blue-green light at intervals from the surface to the bottom (35 fm, maximum depth) made on a lightmeter developed and described by Craig and Lawrie (1962) and kindly loaned by the Marine Laboratory, Aberdeen. After an initial cruise of repetitive hauls without this lightmeter in November 1969, sets of hauls with readings were made a feature of routine distribution surveys and readings were also made on plankton cruises.

Results

The background of the work involves variations in illumination with time of day and depth. Regarding the former, examples of day and night illumination are given in Table 1 showing daytime illumination to be roughly a million times brighter than night time but this is obviously very approximate being subject to influence of cloud cover and phases of the moon. A similar value is indicated by Craig and Craig (1965).

Regarding depth, Table 2 gives examples of the depth at which brightness is 1% of its surface value for the Irish Sea and Cork coast; similar values given by Craig and Craig (op.cit) are also shown for comparison.

It will be noted that in the Irish Sea light penetration is greater in deep areas measured than in shallow (which are more inshore) and greater in June than in April while poorest in November. Off Co. Cork it is comparable to or greater than that at the deeper Irish Sea stations.

In Table 3 and Figure 1 the results of dawn cruises in November 1969 are given (results at dusk were less conclusive owing to bad weather). Increasing lateness of the peak catch with increasing depth, as well as the gradual emergence of broad daylight catches were strong indicators of the correlation of maximum catch at each station with an overall optimum level of light intensity, with however some influence of tidal currents on the small catches at 45 fm.

In Table 4 and Figure 2 catches of Nephrops in more recent experiments are correlated with the prevailing degree of illumination and the results show very strongly an optimum illumination value in the region of 0.01 lux. It will be noticed however that with hauls C1, C3, I5 and I6 very large catches occur at brightness of 1 lux or more. With the Cork ("C" hauls) this may be due to lessened occurrence of predators in inner Bantry Bay: subaqua observations have shown Nephrops

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visible at their burrow entrances by day in Killary Harbour (also a long narrow bay), though not in the Irish Sea (Browne, personal communication). In the Irish Sea ("I" hauls ) however high catches at high degrees of illumination may be due to increased turbidity reducing effective visibility for a given degree of illumination; these hauls were made in a period interspersed with much bad weather.

### Discussion

The chief difficulty is possibly that of obtaining several successive hauls at light intensity levels illumination near to the optimum in the Irish Sea. In shallow areas this occurs during the periods of swift change at dawn and dusk, whilst deeper areas are considerably affected by tidal currents which exert their own influence on the catches.

Work is continuing along the lines described, one of the main objects being that of evolving correction factors for different illumination levels to apply to catches in distribution surveys.

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Table 1. Examples of difference between day and night time levels of surface illumination.

Date	Level of illumination Day (lux)	Time	Date	Level of illumination Night (lux)	Time	Factor day/night ( $\div 10^6$ )
21-4-70	6 600	14.35	24-4-70	0.0012	00.50	5.13
11-6-70	22 000	15.20	12-6-70	0.032	00.10	0.68
14-4-71	74 000	16.30	14-4-71	0.0030	23.05	24.6

Table 2. Examples of depth at which level of illumination is 1% of its surface value.

Date or Source	Area	Sea depth		Depth of 1% illumination	
		fm	m	fm	m
21-4-70	Irish Sea	55	101	16	29
22-4-70	" "	12	22	8	15
4-6-70	" "	18	33	9	17
10-6-70	" "	55	101	19	35
5-11-70	" "	15	27	6	11
28-7-70	Cork: Celtic Sea	26	66	16	29
29-7-70	" " "	60	110	21	38
5-8-70	Cork: Bantry Bay	20	37	14	26
6-8-70	" " "	34	62	18	33
From Craig & Craig	E. of Shetland	-	-	33-38	60-70
" " "	S. Moray Firth	-	-	16-22	30-40
" " "	Clyde (Bute Area)	-	-	20	20

Table 3. Catches at different depths related to time-interval haul - sunrise, Irish Sea, November 1969.

Date (Nov.)	Sunrise time (BST)	Depth fm	Interval mid-point of haul - sunrise (h. m.)	Catch (N)
20	09.01	11 - 14	- 1h56	28
			- 1h01	1 447
			- 11	673
			+ 41	1
			+ 1h24	0
			+ 2h 3	0
19	08.59	17 - 18	- 1h14	173
			- 29	1 247
			+ 51	9
			+ 1h43	2
			+ 2h33	0
			+ 3h28	0
21	09.02	22	- 2h16	1
			- 1h18	3
			- 32	129
			+ 17	1 408
			+ 1h 8	354
			+ 2h15	197
13	08.43	29 - 32	- 1h20	15
			- 17	748
			+ 42	1 186
			+ 1h42	576
			+ 2h35	660
			+ 3h30	420
18	08.57	45 - 48	- 1h12	13
			- 17	17
			+ 49	13
			+ 1h53	90

Table 4. Catches at different depths and time-intervals from sun - rise/set related to levels of sea bed illumination.

Expt. no. Date & time of sun- rise/set (BST)	Depth fm	Interval, haul midpoint - sun- rise/set (h.m.)		Light intensity (lux)	Catch
		Sun Below horizon	Sun Above horizon		
I 1 15-6-70 (21.57)	20	-	1h31	15	31
		-	24	2.4	120
		36	-	.02	2 600
		1h37	-	.0005	1 300
I 2 30-10-70 (08.20)	11	34	-	.058	930
		-	40	2.9	32
I 3 5-11-70 (17.43)	15	-	39	.0027	5 900
		23	-	.000017	1 400
I 4 14-4-71 (20.23)	15	-	47	1 000.	2
		11	-	12	100
		1h16	-	.0023	2 570
		2h20	-	.000027	240
I 5 20-4-71 (06.13)	37	-	17	.10	5 200
		-	1h17	1.0	3 400
		-	2h40	8.6	360
I 6 22-4-71 (06.08)	15	-	7	.13	8 400
		-	1h12	2.7	3 300
		-	2h22	9.0	5 000
C 1 5-8-70 (21.22)	21	-	1h49	3.7	2 050
		-	59	1.1	870
		28	-	.0050	2 100
		1h28	-	.00011	320
C 2 6-8-70 (21.20)	34	-	3h35	1.6	120
		-	2h05	1.0	300
		-	1h10	.65	400
		-	20	.024	1 800
		40	-	.00020	83
C 3 11-8-70	21	-	3h47	14	900
		-	2h53	10	2 900
		-	2h 1	5.5	2 200
		-	1h 6	2.3	5 200
		4	-	.046	5 800

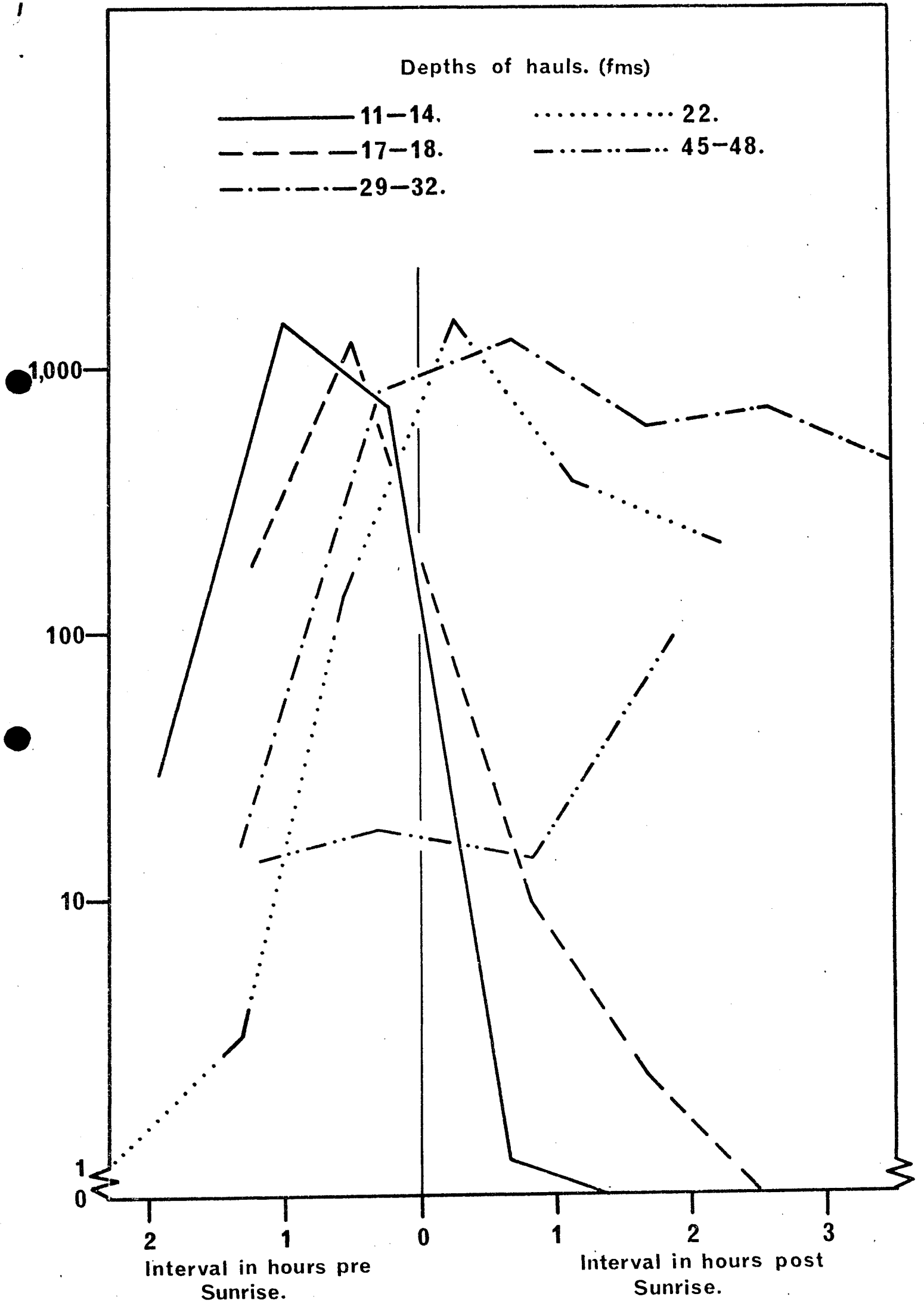


Figure 1. Variations in catch related to time interval between haul and dawn, November 1969.

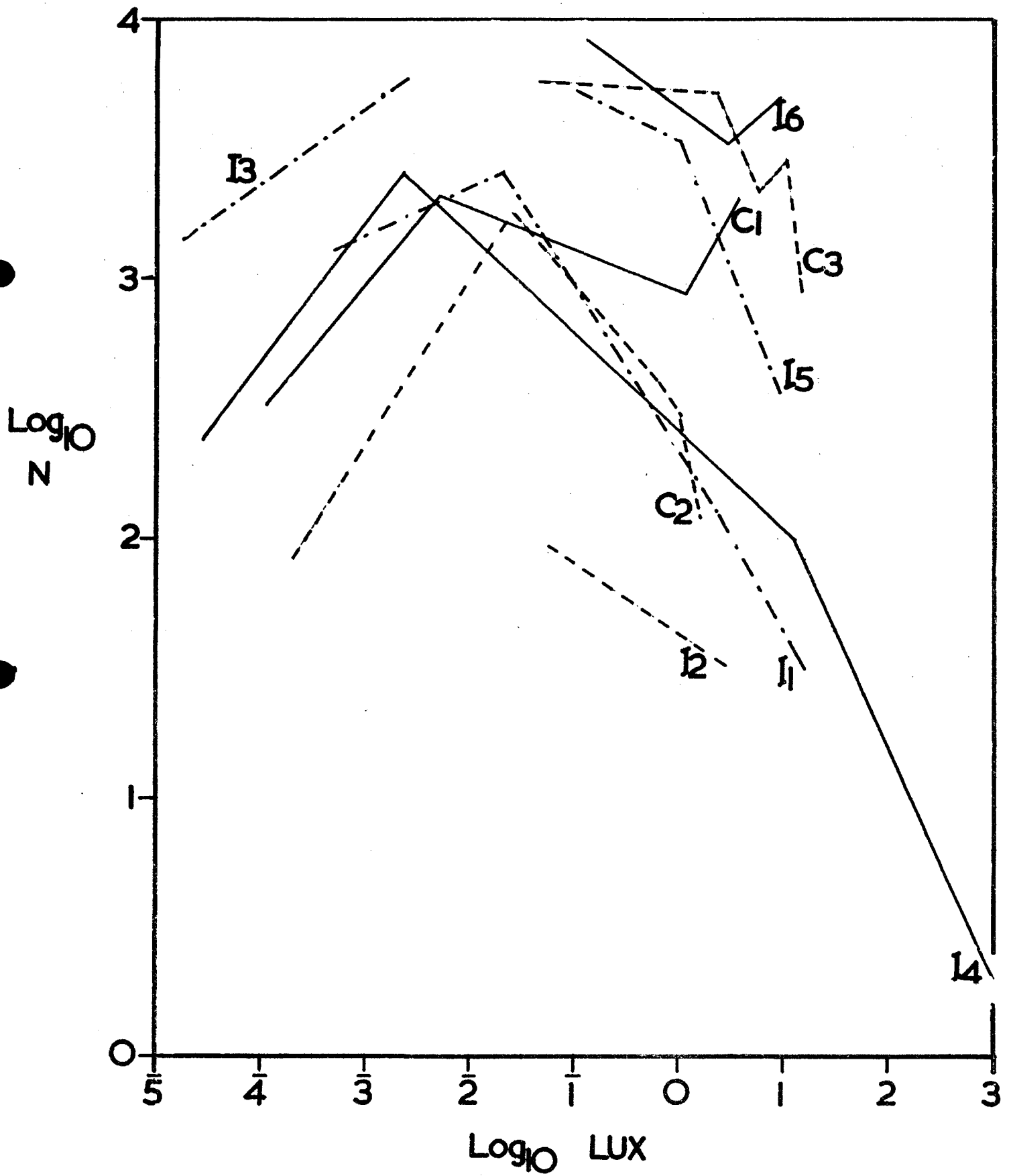


Figure 2. Variations in catch related to sea-bed illumination level. Numbering of hauls as in Table 4.