International Commission for the Northwest Atlantic Fisheries

Serial No. 3548
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ICNAF Res.Doc. 75/64
Corrigendum

ANNUAL MEETING - JUNE 1975

Squids, *Loligo pealei* and *Illex illecebrosus*, on Georges Bank, R/V *Cryos* cruise, September-October 1974

by

G. Paulmier and B. Mesnil
CRIP, ISTPM
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Page 5, line 1: Sentence "..... to rise, meaning that the Northeast ..... individuals." should read:

"to fall, meaning that the Northeast part of the Bank is occupied by bigger individuals."

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Introduction

A trawl survey for study and prospection of commercial Squids was carried out aboard R/V Cryos from 27 September to 12 October, on Georges Bank and adjacent areas down to 39°50 N and 74° W, ICNAF subareas 5 Ze, 5 Zw, 6 A and 6 B.

Our main objective was to improve the results obtained in 1973 in the same region and increase our knowledge on the ecology and the evolution of the squids populations inhabiting the surveyed area.

Materials and methods.

Some 50 hauls, 30 minute each, were realised during daytime using a semi-pelagic trawl 35/42 (50 mm stetched mesh in the codend), that allows sampling in an important layer above the bottom (7-8 m) ; each station was achieved by a BT cast. The distributions of the stations is given on map-fig.1, except for 3 hauls made in ICNAF subarea 6 along a transect following the 73°20 W.

At every station, all the squids or a representative sample were sexed and the dorsal mantle length measured to the half-centimeter below.

However, for working with sufficient numbers in each centimeter class, we have grouped the classes to the centimeter below, then added the samples collected within the different strata as described by GROSSLEIN (1969). For Loligo, the analysis was made using the graphical method of CASSIE (1954) ; for Illex, the simplicity of the size-distributions allowed to determine the parameters arithmetically. Finally, we have grouped the stations or strata presenting homogeneous compositions (fig. 4 & 6), and the discussion will start at this stage.

Maps 3 and 5 were established by interpolation between couples of station, after an extension of the catches to a fishing-time unit of one hour.

Results.

1) Hydrology.

Here, we will deal only with temperatures measured near the bottom. At first sight on map 2, isotherms run parallel to isobaths : the 12°C isotherm follows the edge of the shelf while the shallower central area is encircled by the 16°C line. This arrangement is disturbed in two places : the Northeast part of the Bank receives colder waters descending along the Nova Scotia shelf, and penetrating deeply to the South ; they cause warmer waters to be pushed eastward to the edge of the slope ; in the South, a column of cold water down to 10°C is trapped in warmer waters of the shelf and extends far to the southwest ; its presence can be detected from surface to the bottom. On the slope, we observe again the regular decrease of temperature with depth, both in the North and the South side ; the deeper waters have a temperature of 7° to 10-11°C ; their high salinity contrasts with the low values observed on the Bank.

2) Loligo pealei.

- Geographic distribution -

As indicated on map 3, Loligo pealei are absent from the North and Northeast parts of Georges Bank, and concentrated near the South-Southwest edges of this bank, then again on the Mid-Atlantic Bight, that is in the South of Cape Cod.

The highest yields were obtained in strata 2, 3, 11 and particularly 6 (530 kg/h), i.e. between 60 and 120 m (35-75 fms) ; in shallower and deeper waters as well, yields were much lower so that we cannot establish any direct yield to depth relation. If we superpose isotherms and concentrations maps, we can see that both patterns are independant ; temperature is similar if not superior in the central and Northeast parts where Loligo are absent from and in the Southwest part where they are plentiful ; nevertheless, the penetration of individuals into deeper waters of the slope is restricted by the low temperatures found there ; no individual was encountered in waters under 9°C. Temperature would then be only a limiting factor with action on the degree of extension of the populations in given season or region.

Within a same range of depth or temperature, the decrease of yields occurs along a main Northeast to Southwest axis, and since external factors are not sufficient to explain the observed distribution, we must think an internal, specific, factor is involved.

Either, although it seems too early in the season, the migration is already initiated, then the population tends to leave the area toward southern and deeper waters ; the primary North to South axis of the migration is deviated to the Southwest by the orientation of the shelf.

Or the bulk of the population is standing at its maximum extent and only a little part of it, the biggest animals as we will see, may reach the northern side of the Bank ; at the same season in 1973 however, Loligo were found more evenly distributed on the whole central and southern part of the Bank.

More regular surveys will be necessary for having a precise idea of the extent and the modalities of the migrations.

- Size-groups -

The analysis of samples collected on the whole surveyed area leads to the distinction of 3 main patterns of size-frequencies distribution illustrated by fig.4 ; since younger Loligo could not be sexed, both sexes are grouped on the diagrams.

+ Histograms c), d) and e) represent the distribution observed at most sets, then parted according to the 3 main depth levels. The squids have mantle lengths of 2 to 35 cm and 3 size groups may be separated :

- The youngest squids belong to the classes 2 to 10-11 cm ; by CASSIE analysis, 2 components can be extracted with modal sizes 5.8 cm (SD = 1.0) and 8.1 cm (SD = 1.2), but they may have no signification since they appear in the group most affected by selectivity ; more over, the difference between the two modal sizes would correspond to an age difference of 2-3 months only according to the observations by SUMMERS (1968) giving a monthly growth-rate 1.8 cm for the first 4 months; this delay is not visible in older groups and must be related to the range of the breeding and hatching periods. We can observe however that the proportion of the smaller group slightly increases with depth.

According to SUMMERS, these young squids hatched from summer brood (june) and are 3 to 6 month old.

- The first group of adults is the main component of the distribution : it ranges over the classes 11 to 22-23 cm for males, 11 to 19-20 cm for females ; depending on the stations, the modal sizes are comprised between 17.0 and 18.1 cm (males), 15.5 and 16.6 cm (females), and there is no relation between modal values and external factors. These length are inferior to those observed by SUMMERS (1971) : 21 and 18 cm for both sexes respectively in september, but these adults undoubtly belong to the 1 year old group, hatched in summer of the previous year.

- Loligo more than 20 cm are very poorly and irregularly represented ; most of them are males some of which ranging to 35 cm, females reaching 24 cm. According to SUMMERS, they would be the 2 years old members of the southern population ; we must better consider them as remainders of the 1 and 2 groups ; some of them may have never reached maturity before, while others could survive the breeding season ; as in other species of Loligo, the latter are more often males.

So, the population most frequently sampled on Georges Bank at this season is composed of 3 generations of successive years.

+ In the South of Cape Cod, two particular distributions could be noticed :

- In samples collected in stratum 6, we find again the three components described above, but another group, widely dominant, is added between the young and the first adult group, and broadly overlaps the latter. It is composed of individuals measuring 10 to 16-17 cm ; the males have modal sizes of 13.6 to 13.9 cm (SD = 1.4), the females 12.9 to 13.5 cm (SD = 1.2). According to data by SUMMERS, this group proceeds from later brood occuring in the South, hatched in autumn, and would be 8 to 10 month old ; it appears on the Bank at the 0-30 fms level where it causes a slight alteration of the modal size value.

- The population sampled on the shelf in the South of Hudson Canyon (fig. 4 a) is composed of squid 8 to 28 cm long, so that the younger group is absent ; 3 deeply fused components can be extracted : the first one includes males with mantle length 9 to 14-15 cm, mode at 12.2 cm (SD = 1.1) and females 8 to 13 cm, modal length 11.1 cm (SD = 0.8); it is the same group we just described in stratum 6,, but with lower mean size for both sexes. Then we find the two groups of adults occuring

in the whole area : one with males 12 to 20 cm (mode = 16.2 cm ; SD = 1.9) and females 12 to 17 cm (mode = 14.0 cm ; SD = 1.2) ; here again the modal lengths are lower than in the North ; the second with individuals longer than 17-20 cm, most of them being males.

Finally, 4 groups were encountered :

- The current year class includes juvenile squids, 2 to 11 cm long, 3 to 6 month old ; they are present only in stations North to 39°30 N, but in every depth level.

- Squid with mantle length 8-9 to 16-17 cm are nearly one year old, hatched from autumn brood on the Mid-Atlantic Bight ; they occur mainly on the shelf to the South of Hudson Canyon, but reach stratum 6 where they are still strongly mixed to other adults, and the inshore strata 5 and 9.

- The adults 13 to 22 cm long are, besides the young-of-the-year, the most important component of the population found on Georges Bank ; they were present on the whole surveyed area ; hatched in summer of the previous year, they are 15 to 18 month old.

We can notice that within these two groups, the modal sizes are lower in the South than in the North, so that the biggest individuals may have a wider distribution to the North than the other members of the groups.

- The last group includes large squid longer than 18-20 cm and nearly 2 years old ; they are survivors of previous generations and most of them are males.

+ Sex-ratio - Maturity.

Among the measured animals, 1694 were males, 1683 were females. Sex-ratio never was very different of 1:1, neither in the different strata, nor within the size-groups, with the exception of the 2 years group where males are dominant.

Maturity stages were observed and quoted to the scale established by VOVK (1972). Generally, the individuals longer than 18 cm have reached stage III at least, that is testis developped and first spermatophores, nidamental and accessory glands enlarged and eggs medium to big ; among smaller animals, only a few males are at stage III, a few individuals of both sexes are at stage II, but on the whole the squid have poorly developped gonads ; this is consistent with observations by SUMMERS and VOVK : mature animals will no be numerous before springtime. According to data by these two authors, the species appears to have a two-years long cycle, so that the southern population should proceed from the big two years animals ' the only one to attain maturity, unless, like european Loligo vulgaris, 12-15 month old animals could mature very quickly in autumn while 8-10 month old individuals of the South would mature during winter and breed in spring or summer ; then both groups would be able to reproduce at an age of 16-18 months.

3) Illex illecebrosus.

- Geographic distribution

On map 5, the largest concentrations of Illex can be situated near the edges of the shelf, particularly on the Southern side. Generally speaking, this species relays the previous in the areas where it is absent from, especially in deep waters. Catches decrease from the Southwest to the Northeast, while number of squid per kilogram tends

to rise, meaning that the Northeast part of the Bank is occupied by bigger individuals.

The largest yields were obtained in strata 3, 4 and particularly 12 (620 kg/h), that is deeper than 150 m (80 fms). The distribution is strongly influenced by temperature and depth, although we cannot establish any direct relation, these external factor having in fact a limiting action. Illex are nearly absent from the shallow areas of the Bank, and their abondance significantly decreases as soon as the temperature gets higher than 11°C. We can even notice that the discontinuity observed at the edge of the shelf between 66° and 67° W is caused by the presence of a lobe of warmer waters from the shelf.

- Size-groups -

The analysis of the population of Illex is simple since young and adults are clearly separated and, in each group, the distribution is very compact around the mode. We could observe 3 patterns :

- The typical distribution was observed in a majority of sample and is illustrated by fig. 6 a.

The younger squid are very few. They only represent 8 p.cent of the population, with the exception of strata 2 and 14 where they are more important, and are absent from waters deeper than 100 fathoms. The males range from 6 to 11 cm, mean-size = 7.9 cm (SD = 1.1), the females from 7 to 10 cm, mean-size = 8.3 cm (SD = 0.7) ; since there are few individuals these value may have no signification.

The adult males range from 15 to 26 cm, their mean-length is 21.4 cm (SD = 1.2), the females from 16 to 30 cm, with a mean-length at 22.8 cm (SD = 1.5). These length are slightly inferior to those observed by Squires (1967) near the coasts of Newfoundland at the same period. According to data by this author, these adults would be 6 to 7 month old and would have hatched during winter ; the young squid would be about 2 month old only, then they would have hatched during summer.

- The samples collected in the South of Cape Cod, in strata 2, 4 and 6, show quite a different profile. The young squid are hardly present, but above all the modal size of the adults are clearly inferior ; the ranges and mean-sizes are 15 - 18 - 23 cm, SD = 1.3 for males and 16 - 18.5 - 24 cm, SD = 1.3 for females. According to data by SQUIRES, these animals would be about one month younger than the previously described, unless they suffered a slower growth. We had already noticed that the squid should be smaller in the Southwest than in the Northeast.

- The last diagram on fig. 6 represents the sample obtained at the head of Hydrographer Canyon, at a depth of 120 m (station A 883 - stratum 11). This sample is obviously a mixture of size-groups, but so irregularly present that we could not resolve it using the graphical method of CASSIE. The mean-lengths calculated on the whole sample, 14.4 cm for males and 16.0 cm for females, account for the presence of a group with a modal size still inferior to those previously noted, and this does not seem to be explained simply by a bias in sampling.

- Sex-ratio - Maturity -

Among the observed Illex, 965 were males, 875 were females, giving a sex-ratio of 1.1 with males dominant, females being in a majority at station 861, stratum 4, only.

At this season, most males longer than 18 cm are at stage II at least, according to MERCER's scale (1973), stage III being noticeable only in males beyond 21 cm ; females have much a slower development since they reach stage II when they are longer than 25 cm, and none of

them is at stage III ; this is consistent with all the previous observations. Animals of both sexes will fully mature during winter and breed at an age of 12 to 18 months.

Conclusion

After this second autumn cruise on Georges Bank, our knowledge still remains at a preliminary stage, particularly when Loligo pealei is concerned. Stocks assessments and advice for fisheries may have no biological signification as long as a more precise idea on the ecology of this species is not obtained ; for each population involved, migrations, breeding seasons, growth and life cycle must be clearly known, in spite of the difficulties due to important year-to-year variations ; anyway, the facts to be taken into account are a very high growth rate, a short life cycle, probably two years maximum, death of most individualsafter breeding. Loligo are present nearly all the year long on the shelf in subareas 5 and 6, but the migrations must be studied since there is an apparent discrepancy between the scientific litterature and the Statistical Bulletins, the latter indicating two major fishing periods, one of them being in winter from December to March, the second, more oftencited, in summer.

The biology of Illex illecebrosus in these area is quite consistent with the observations made off Newfoundland.

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Table 1.

Depth level		0 to 30 fms			30 to 60 fms							60 to 100 fms						100 fms				
Strata		5	9	20	2	6	10	13	16	21	23	3	11	14	17	22	24	4	12	15	18	29
Temperature ° C		14°	13°9	14°6	10°1 15°8	11°5 13°1	11°8 13°4	12°4-14°8 + 10°7	11°1-13°9 8°8	11° 12°5	12°5	13°	10°2 13°	9°6 11°8	9° 10°	6°6 9°2	5°7 6°2	11°3	8°5 9°3	6°6 11°2	9°	8°5
Total fishing time (mn)		30	30	15	60	50	90	150	137	35	30	30	90	48	60	145	150	30	60	60	30	30
Loligo pealei	Catch kg	12.	39.	0.35	282.5	442	123	42.3	0.35	0.	7	87	231.5	12	0.09	0.	0.	29	2	2	0.	0.
	Number	103	583	1	2880	6610	1567	527	2		39	1640	2960	289	1			547	27	48		
	Yield kg/h	24	58	1.05	282.5	530	82	16.9	0.15		14	174	154	15	0.09			58	2	2		
	Number per kg	8.5	20	2.8	10.2	15.	12.7	12.4	5.7		5.5	18.8	12.8	24	11.1			18.8	13.5	24		
	Positive Stations	1/1	1/1	1/1	2/2	2/2	3/3	3/5	1/5	0/1	1/1	1/1	3/3	1/2	1/2	0/5	0/5	1/1	1/2	1/2	0/1	0/1
Illex illecebrosus	Catch kg	0.	0.	0.	1.2	4	4.2	8.5	7.6	0.5	7.5	78	100	17.2	1.5	4.6	11	46	620	15.6	30	0.95
	Number	.	.	.	23	25	15	44	41	2	22	685	778	168	8	19	37	404	2860	81	122	2
	Yield kg/h	.	.	.	1.2	4.8	2.8	3.4	3.3	0.8	15	156	66.6	21.5	1.5	1.9	4.4	92	620	15.6	60	1.9
	Number per kg	.	.	.	19.1	6.2	3.5	5.1	5.4	4	2.9	8.8	7.8	9.7	5.3	4.1	3.3	8.8	4.61	5.1	4.0	2
	Positive Stations	0/1	0/1	0/1	2/2	2/2	2/3	4/5	5/5	1/1	1/1	1/1	3/3	2/2	1/2	4/5	5/5	1/1	2/2	2/2	1/1	1/1

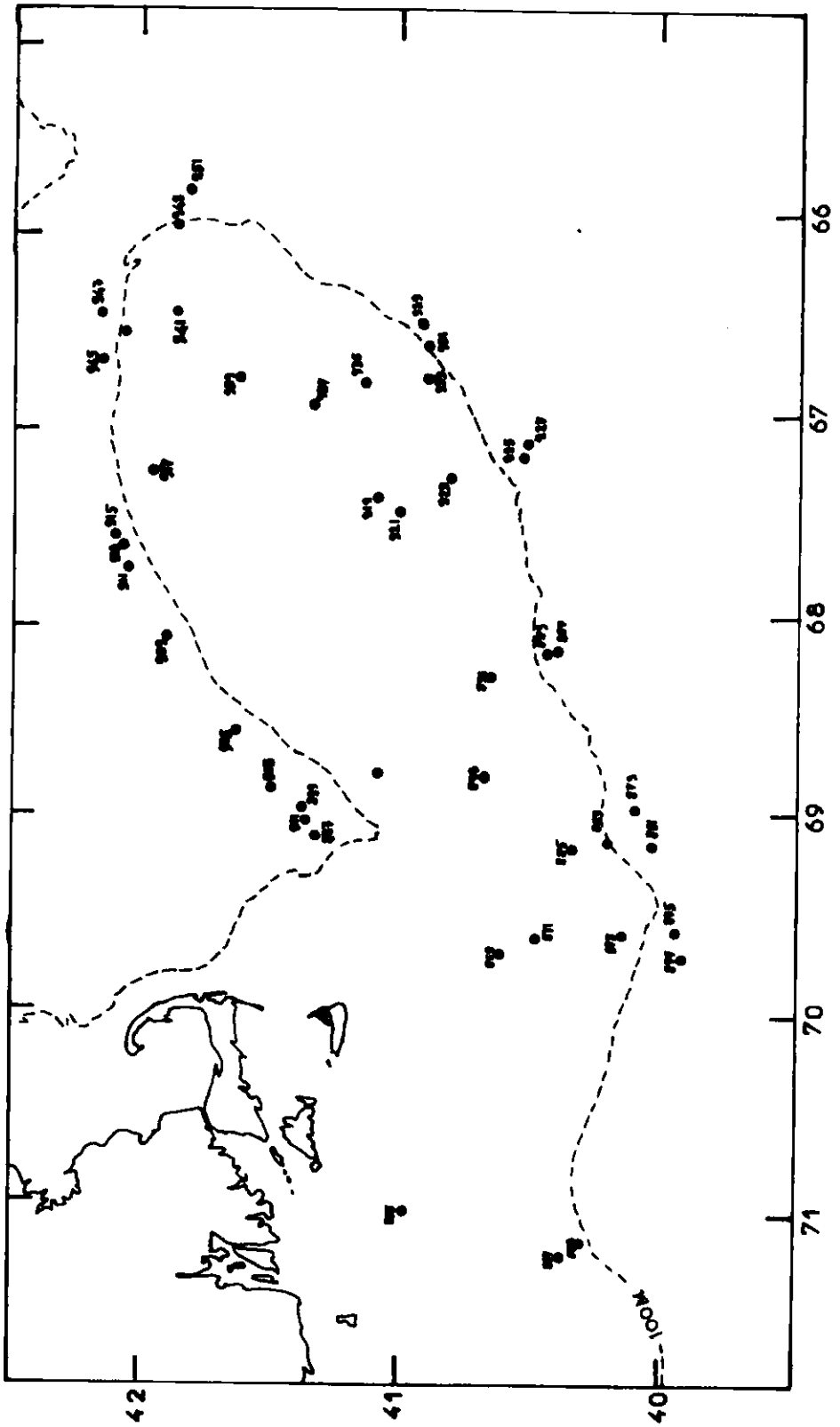

Fig. 1 - R/V Cyros - September-October 1974 - Position of the hauls.

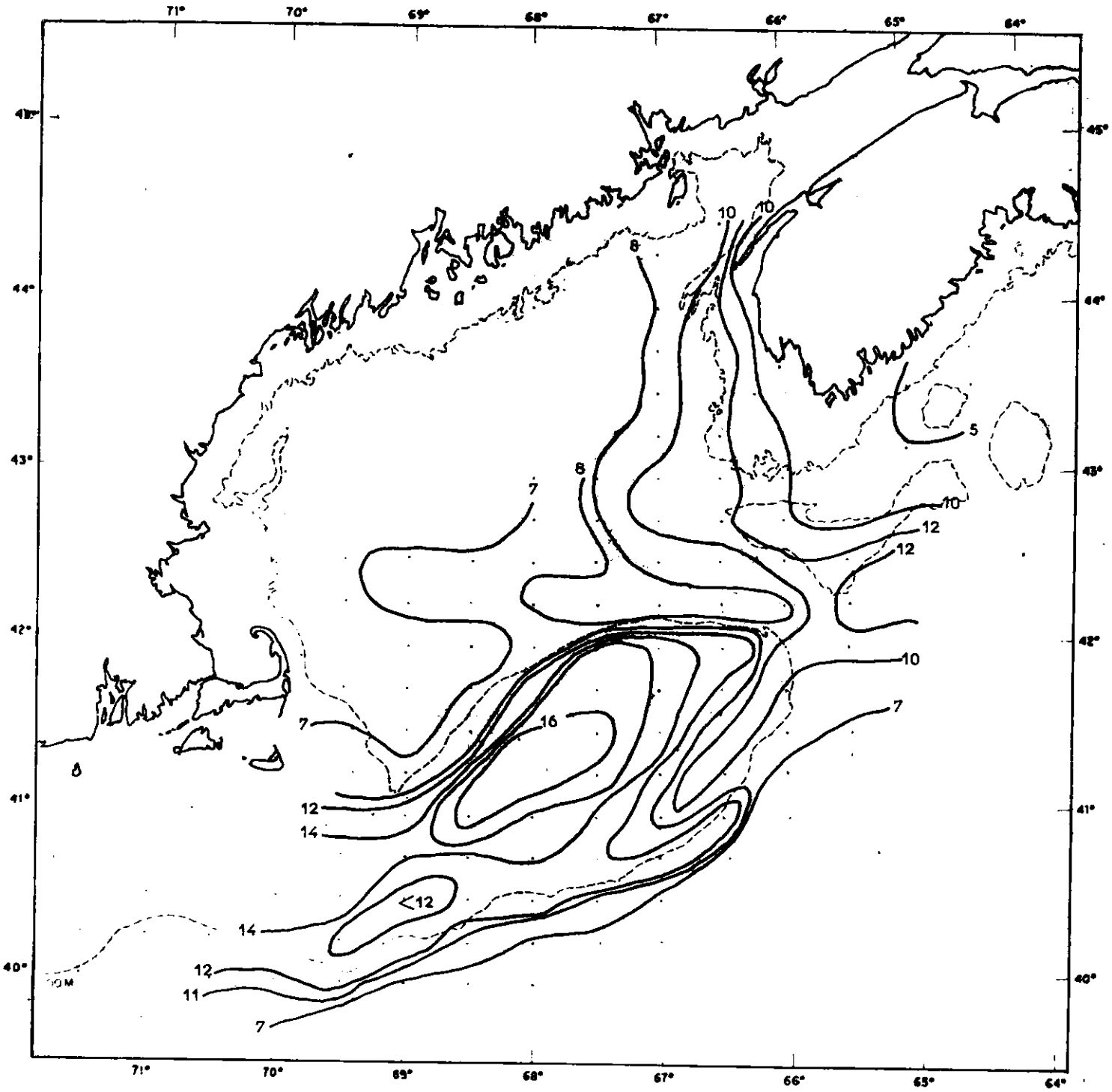

Fig. 2 - Temperature near the bottom. September 1974.

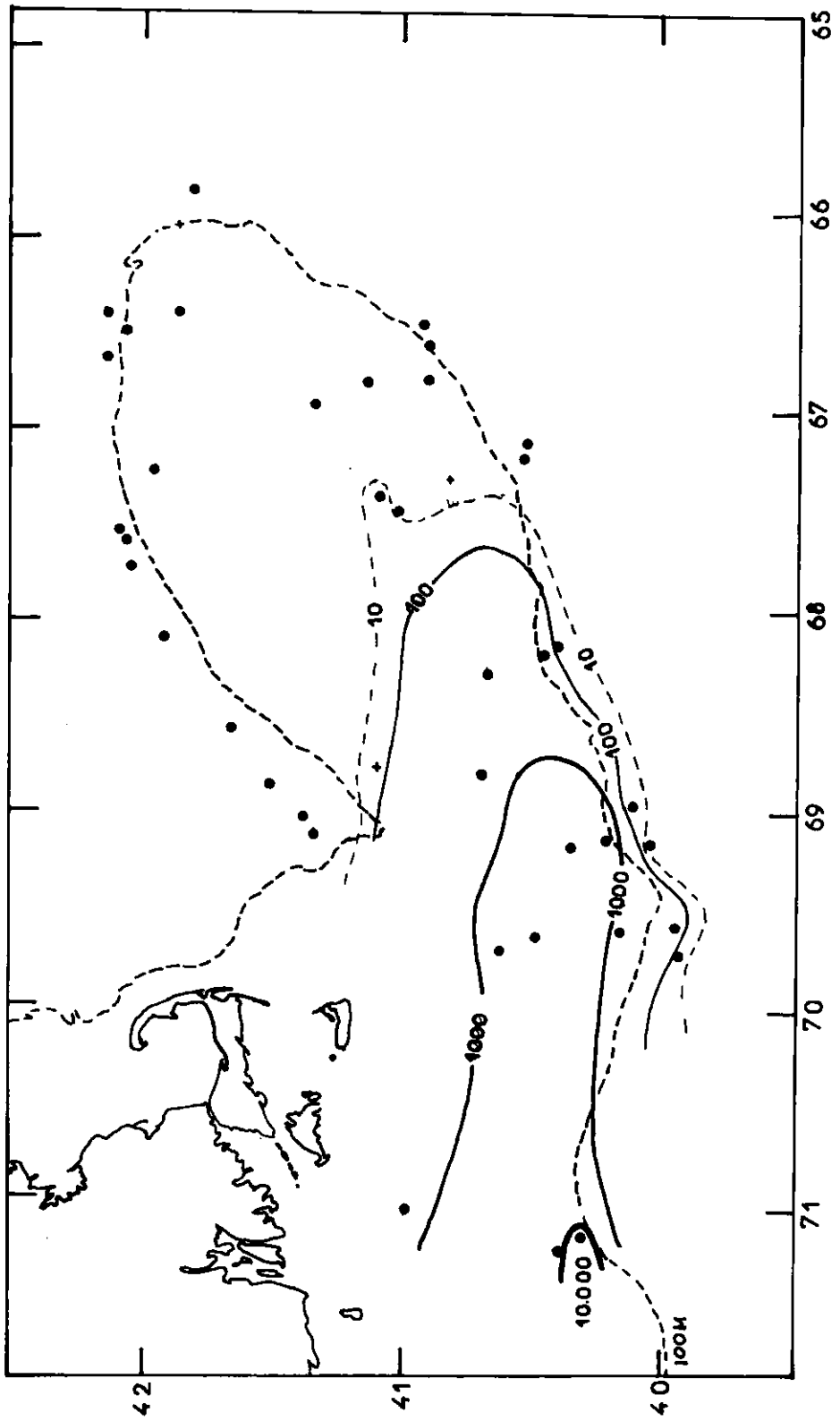

Fig. 3 - Distribution of Loligo pealei. Catches in number per hour.

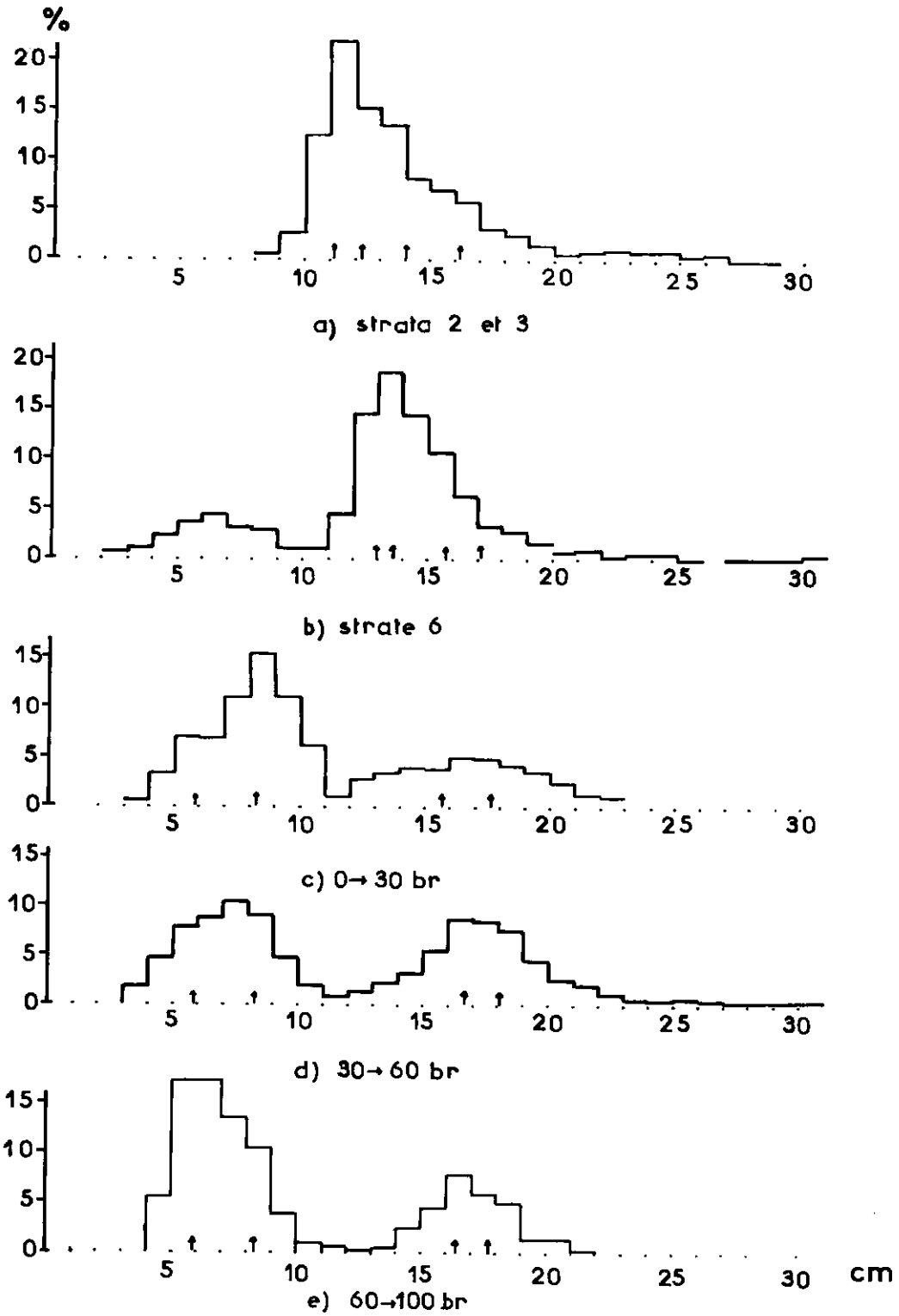

Fig. 4 - Loligo pealei. Size-frequency distributions, in percent.

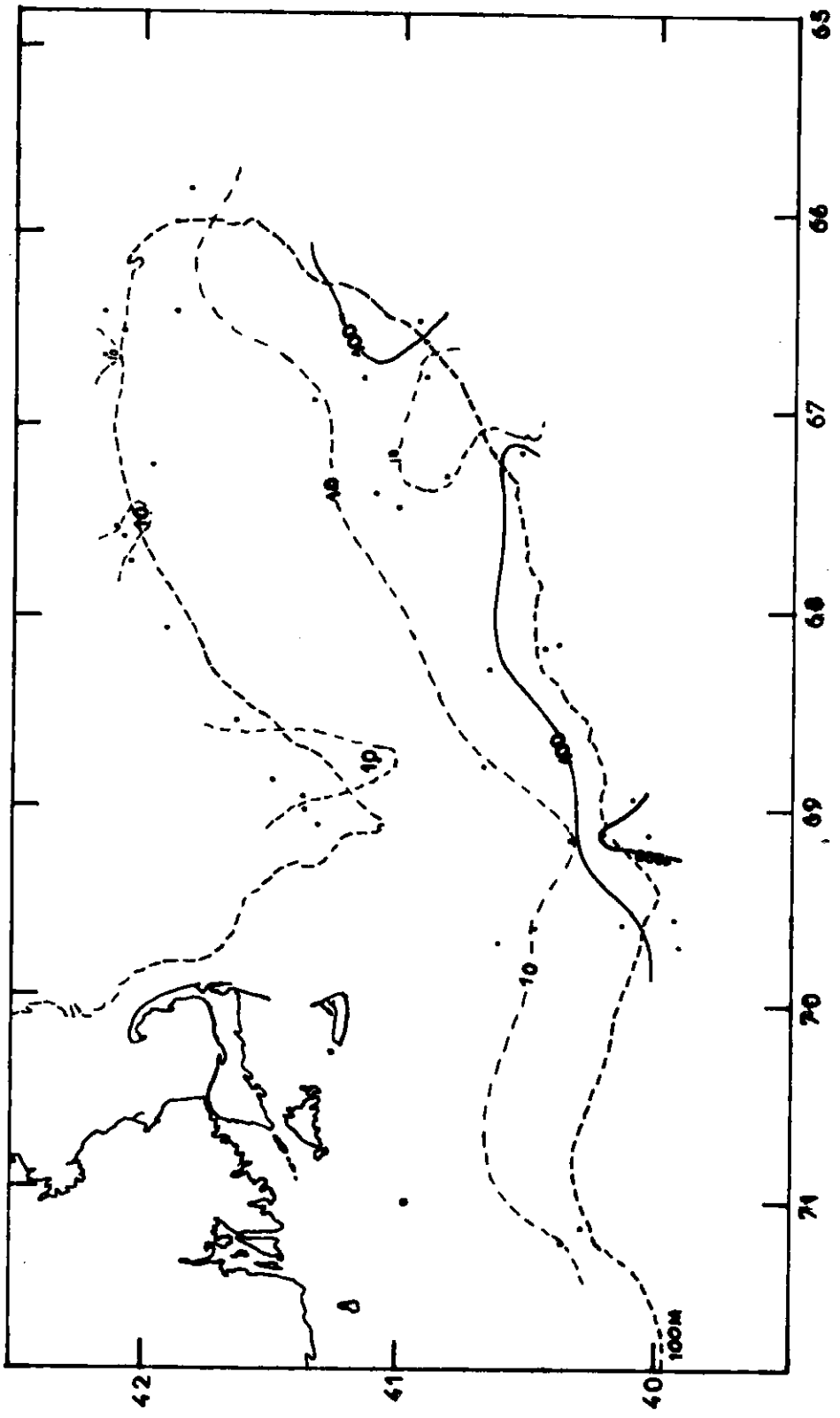

Fig. 5 - Distribution of Illex illecebrosus - Catches in Number per Hour.

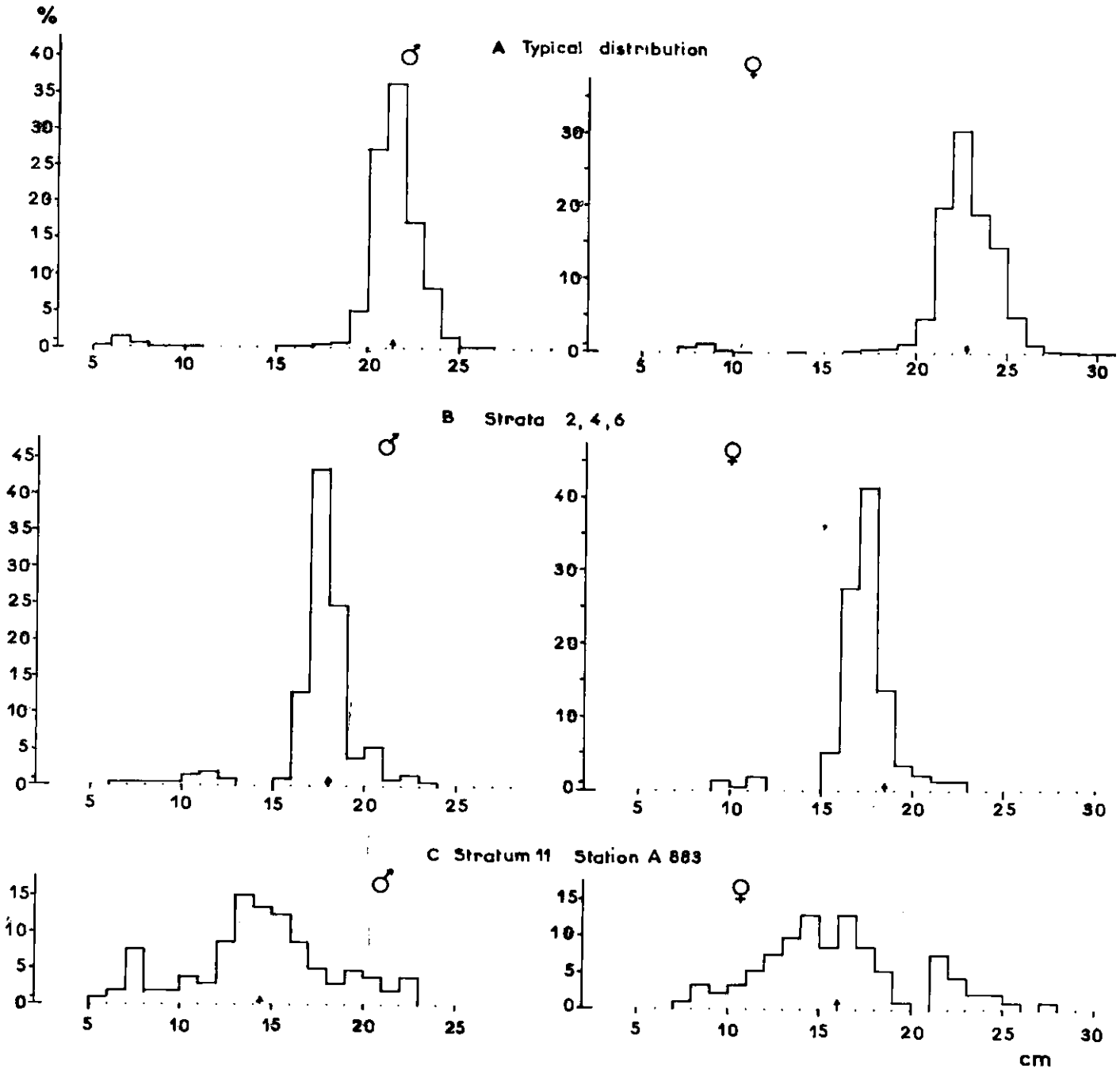

Fig. 6 - Illex illecebrosus - Size-frequency distributions, in percent.