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On the Occurrence of Squid (*Illex illecebrosus*) in NAFO
Subareas 2, 3 and 4, during Winter Season

by

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I - Introduction

Many aspects of the biology and distribution of short-finned squid (*Illex illecebrosus*) are still unknown and the scarcity of informations collected on this species during winter season is one of the major difficulties for a complete knowledge of the life-cycle of *Illex*.

Short-finned squid migrates in spring on continental shelves or in coastal waters of NAFO Subareas 2 to 6, and then disappears in autumn for reproduction. It is generally accepted that reproduction takes place mostly during winter in southern areas, probably in the vicinity of the Gulf-Stream (Report of NAFO Working Group on squid, 1981).

However, SQUIRES (1957) has noted the presence of adult *Illex* during winter off Newfoundland. But unfortunately this author provided few informations on these observations. In the course of French groundfish surveys in NAFO Subareas 2, 3 and 4 from 1979 to 1982, some specimens of *Illex illecebrosus* were caught incidentally and their biological characteristics were analysed (length frequencies, sex and maturity stages, gut fullness). Moreover, all the reports of French surveys carried out by R/V *Cryos* from 1972, between the end of november till the beginning of April, were examined for collecting informations on the distribution of this species in NAFO Subareas 2, 3 and 4 during winter.

II - Results

On a total of 20 surveys 1,476 tows were realized (table 1). All the tows were of 30 minutes duration and the trawl used was a Lofoten bottom trawl with 50 mm stretched mesh in the codend, except for the first survey where a high vertical opening bottom trawl was used. Squid *Illex* occurred in 51 tows, representing a total of 103 specimens.

1. Geographical distribution related to depth and bottom temperatures

The location of tows where squid were caught are represented on

figure 1. Illex occurred on a wide range of Latitude, from 43°N (NAFO Div. 4 V W) to 53°N (Div. 2 J). But most of individuals were located on southern and western slope of St. Pierre bank (Div. 3 P) and along the edge of the shelf of western Newfoundland (Div. 4 R).

Bottom temperatures during these surveys ranged from - 1°C to 9°C and depths were comprised between 50 to 500 m. However, 90 % of squid were caught in temperatures ranging from 4° to 8°5 and depth from 200 to 320 m (fig. 2). This pattern of distribution can be influenced by the number of tows made per Division, because a majority of them were located in Div. 3 P and 4 R, but this is not sufficient for explaining such differences in repartition of squid. For example only 3 squid were caught in Div. 2 J 3 K L against 43 in Div. 4 R although the number of tows in the later area is only twice the number in 2 J 3 K L. In the same way, in Subdiv. 3 Ps, no squid were found in central and eastern part of St. Pierre bank instead numerous tows made there, contrasting with the 33 squid caught in the western and southern edge of this bank.

In fact, the maximum of occurrence of Illex coincides with the northwards incursion of warm slope water by the Laurentian Channel (4° to 8°C) and by the Esquiman Channel (4 to 6°C) on depths ranging from 200 to 500 m. On the other hand, the continental shelf off East and South-East coast of Newfoundland is under influence of cold water of Labrador current ; temperatures rarely exceed 3°C and seem unsuitable for squid.

2. Biological characteristics

On the total of 103 squid reported, 39 were directly examined by the author, following the procedure described by AMARATUNGA and DURWARD (1979). These specimens were collected during the months of January to March, from 1979 to 1982 (table 2).

The proportion of males is very low (about one male for two females). The same observation (see table 2) was made by SQUIRES (1957).

The length ranged for males from 15 to 23 cm and for females from 16 to 29 cm. All these individuals (fig. 3) were maturing (stages I or II for males and stages III and IV for females) or yet matures (stage III for males). These stages of maturity are very similar to those observed in October at St. Pierre bank (DUPOUY, 1979 ; DUPOUY and POULARD, 1980) for squid ranging from 20 to 30 cm and assumed to spawn in winter. Therefore the specimen caught on January to March probably spawn at the end of spring or beginning of summer.

Examination of stomachs revealed that 59 % were empty, 24 % $\frac{1}{4}$ full and 17 % $\frac{1}{2}$ full. Most of food content when presents, was constituted of crustacean remains.

Discussion

From 1972 to 1982, Illex illecebrosus was encountered incidentally in groundfish survey with some regularity, particularly in the warm slope water in Div. 3 P and 4 R. These observation presents same abnormality if compared with the general southwards migration of Illex in autumn and the occurrence of spawning during winter.

The squid collected in Subareas 2, 3 and 4 during January to March were adults mostly in maturation although their length was relatively small compare to squid leaving the shelf in autumn. During a cruise from la Have bank to Cape Hatteras (NAFO Subareas 4, 5 and 6), during March-April 1967, MERCER (1969) noted the presence of Illex illecebrosus along the slope of the continental shelf. The lengths observed for males (13 to 20 cm) and for females (13 to 27 cm) are close to those noted by SQUIRES (1957) and during the French winter survey. MERCER (1969) supposed that there squid probably spawn in summer, at a smaller size than the winter spawner.

LANGE and SISSENVINE (1981) after compilation of bottom trawl surveys along the shelf of Northeastern United States concludes to a protracted period of spawning for Illex illecebrosus because the presence of maturing or yet mature squid (Length > 14 cm) in that area in early spring (March-April).

SQUIRES (1967) for Southern Newfoundland and MESNIL (1977) for Scotian shelf and Georges bank noted the presence of small immature squid in November of some years and concluded both to the existence of summer spawning.

During the course of French surveys on Scotian shelf in September 1980 and 1981 a group of small immature Illex ranging from 6 to 12 cm length was caught (DUPOUY, 1981 and 1982). They were probably aged of 3 to 4 month, assuming a growth rate of 2 to 3 cm per month in summer.

All these observations are in good agreement and the existence of at least two breeding period (one during winter, the other during summer) for Illex in the Northwest Atlantic seems well established.

But noticeable divergences appeared on the signification of these two spawning period. For SQUIRES (1967) the slow growing and late spawning squid probably spawn when $1 \frac{1}{2}$ year, instead of 1 year old for the winter spawners. This author as MERCER (1969) concluded to the existence of two separate stocks of Illex illecebrosus for the Northwest Atlantic. On the other hand, MESNIL (1977) stated that these two groups of spawners are issued of crossed generations of a single stock, based on life cycle of $1 \frac{1}{2}$ year.

LANGE and SISSENVINE (1981) observed that years of high autumn abundance of prerecruited squid (< 10 cm) issued of summer hatching have been followed by great abundance of recruited squid in autumn of next year, most of them being

then mature or maturing, indicating that they will spawn during winter. This observation is very consistent with MESNIL hypothesis of crossed generations.

In this case the squid observed during French winter surveys are issued of a winter hatching of previous year and were about 10 to 14 months old. They pertain to the same group than the medium squid observed by the author on Scotian shelf in September 1980 (DUPOUY, 1981) and by MESNIL in November-December 1975 (MESNIL, 1977). Their low abundance in NAFO Subareas 2, 3 and 4 between mid-November to beginning of April can be explained because they are in their northern range of distribution, limited by the extension of warm slope water under the cold layer prevailing in this area during winter. In spring when surface temperatures are rising they reappear on the shelf mixed with small squid of a new brood and then migrate for reproduction, at the end of spring.

Références

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Table 1. Listing of French surveys carried-out on R/V CRYOS during winter season from 1972 to 1982 and number of illex caught per survey.

N°	Code of survey	Dates	N° of tows	N° of <u>Illex</u>	NAFO Divisions
1	HARENG 72	March 1 - March 9	19	2	4 V W
2	POISSONS FOND 72	Feb. 3 - Feb. 20	34	2	3Ps
3	MORUE 731	Jan. 23 - March 6	105	12	3 P 4 R 4 V W
4	MORUE 732	Nov. 5 - Nov. 17	35	16	4 R
5	MORUE 741	Jan. 14 - March 14	122	11	3 P 4 R 4 V W
6	MORUE 742	Nov. 6 - Nov. 18	48	11	3 P 4 R 4 V W
7	MORUE 75	Jan. 17 - Feb. 24	98	0	3 P 4 R 4 V W
8	MORUTENE 76	Jan. 8 - March 10	129	0	2J - 3KL - 3P - 4R
9	MORUTENE 77	Jan. 13 - Feb. 16	60	3	2J - 3KL - 3P - 4R
10	ERHAPS 771	March 13 - April 3	43	0	3Ps
11	MORUTENE 78	Jan. 12 - Feb. 27	83	0 V	2J - 3KL - 3P - 4R
12	ERHAPS 781	March 7 - March 25	58	0	3Ps
13	MORUTENE 79	Jan. 11 - Feb. 27	92	1	2J - 3KL - 3P - 4R
14	ERHAPS 791	March 3 - March 19	50	5	3Ps
15	MORUTENE 80	Jan. 10 - Feb. 26	93	2	2J - 3KL - 3P - 4R
16	ERHAPS 801	March 4 - March 11	39	0	3Ps
17	MORUTENE 81	Jan. 9 - March 4	153	16	2J - 3KL - 3P - 4R
18	ERHAPS 811	March 8 - April 1	69	16	3Ps
19	MORUTENE 82	Jan. 11 - March 7	67	5	2JJ- 3KL - 3P - 4R
20	ERHAPS 821	March 10 - April 3	79	1	3Ps
TOTAL			1 476	103	

Table 2. Length distributions of Illex illecebrosus reported by SQUIRES (1957) on the left and examined for this paper, on the right.

Jan. + Feb.	Mantle length	Jan.	Feb.	March	Total
M F		M F	M F	M F	
	15			1	1
	16			1 2	3
	17			1 3	4
	18			2 1	3
1	19				3
3	20		1		3
	21	1		3 3	7
	22			3 2	5
	23	1	2		6
	24				
	25				
	26		1	1	2
	27			1	1
	28			1	1
	29				
	30				
4 8	Total	1 4	0 4	11 19	39
20 23	Mean length	23 23		25 19 17	21

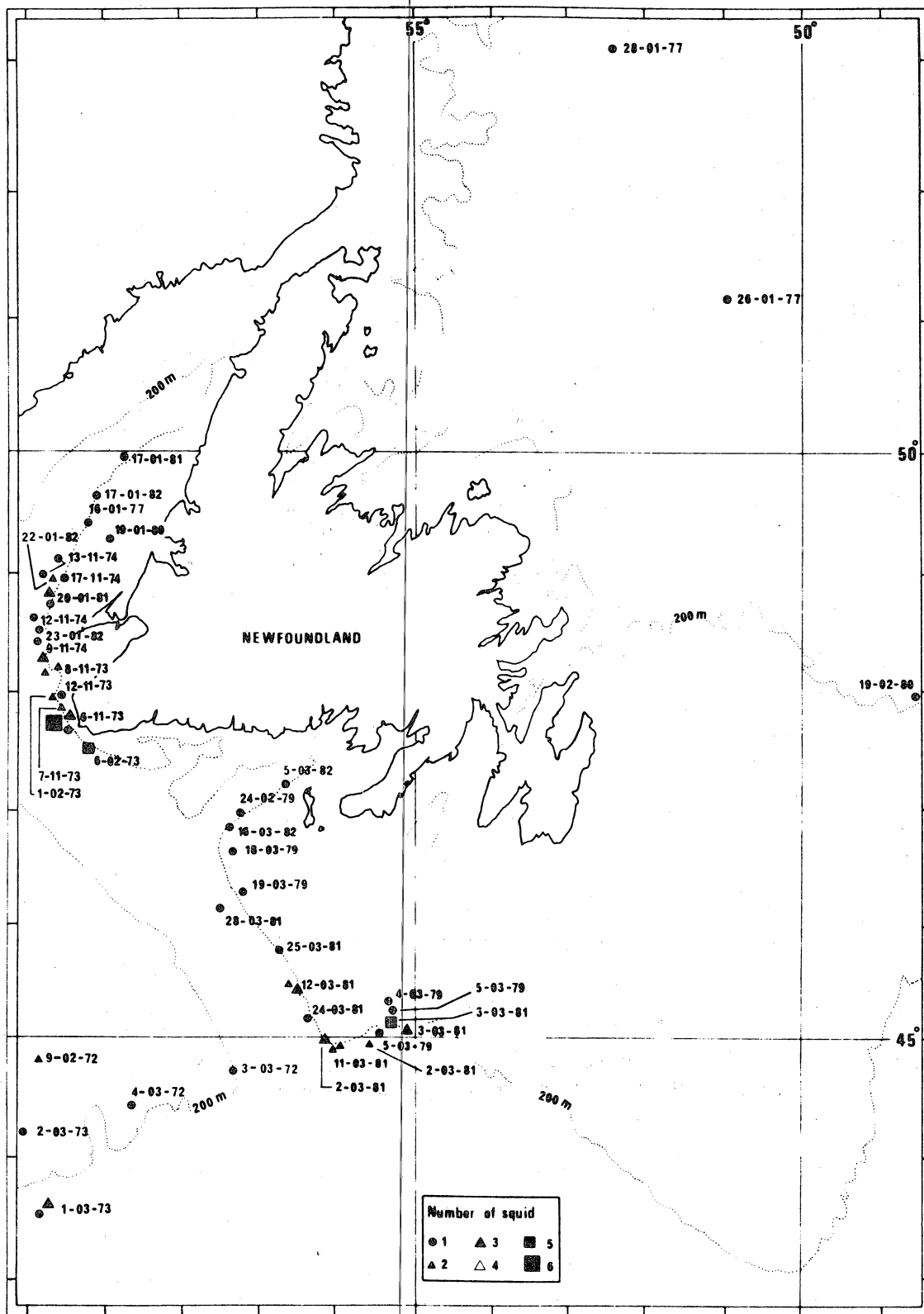


Figure 1 - Location of tows where *Illex illecebrosus* were caught during winter surveys of R/V CRYOS from 1972 to 1982 (NAFO Subareas 2, 3 and 4).

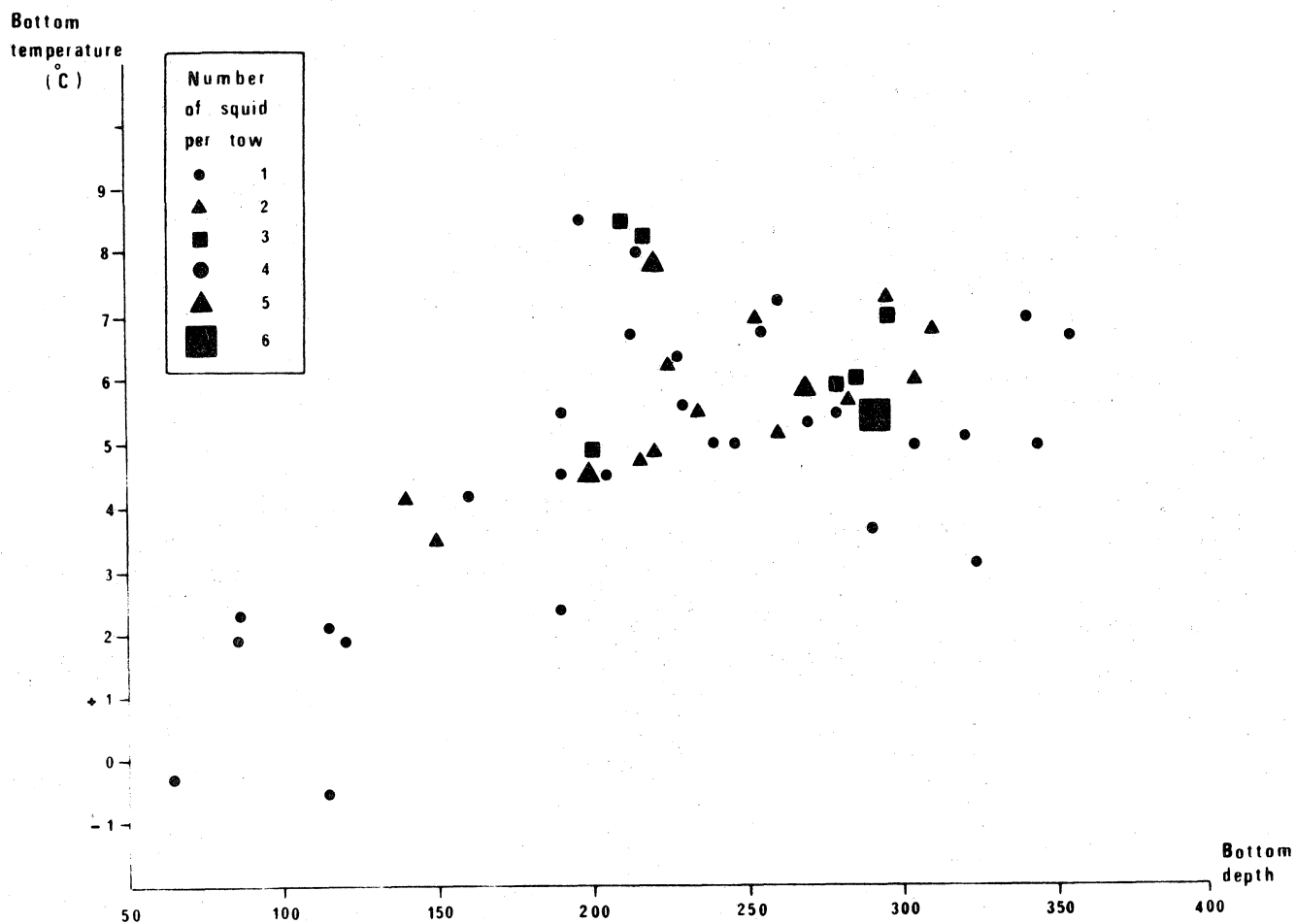


Figure 2 - Pattern of distribution of Illex illecebrosus related to depths of trawling and to bottom temperatures (R/V CRYOS winter surveys from 1972 to 1982).

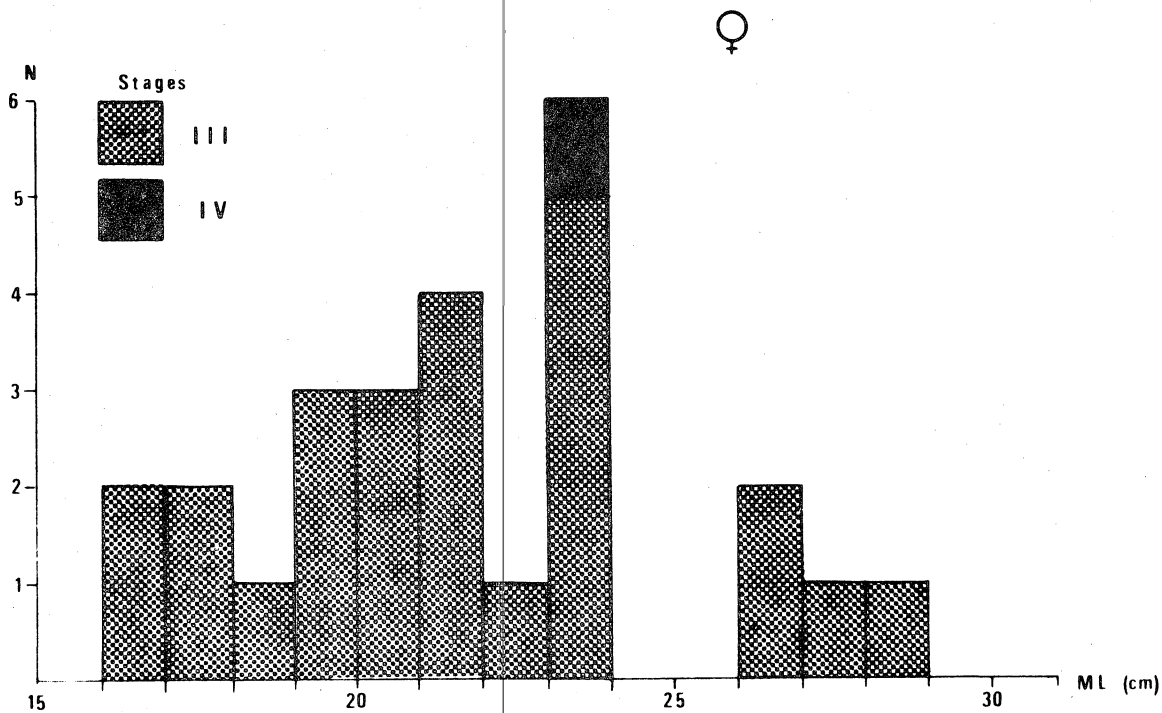
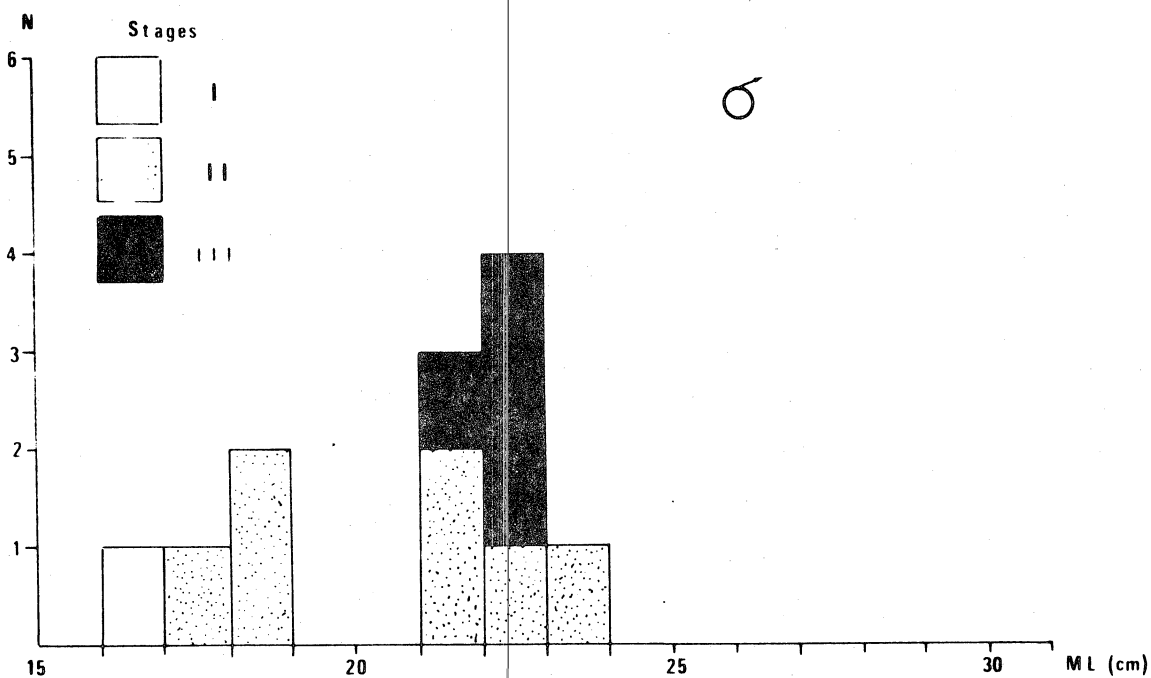


Figure 3 - Length distribution and maturity stages by sex of Illex illecebrosus during January to March (R/V CRYOS winter surveys from 1979 to 1982).

