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Preliminary biological data on the shrimp stocks of Davis Strait

by

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From September 27 to October 20, a survey was undertaken aboard the French research vessel "La Thalassa" with the main objective of estimating the abundance of the shrimp stocks in Davis Strait. The results of these estimations are presented in NAFO/SCR Doc. 79/XI/6 (Dupouy *et al.*, 1979).

In addition to the biomass estimation, we measured several physical and biological parameters in order to examine the structure of the shrimp population, i.e. the size structure, the reproductive cycle and spatial distribution. Because of the time limitation (the survey was finished on October 20,1979), only data on size and sex of the shrimp catch (which were largely calculated during the cruise) will be presented.

Material and methods

Dupouy *et al.* (1979) describe the fishing procedure, gears utilised, mesh sizes used on the trawl, and the stratification schemes used to select the stations. Figure 1 summarizes the work made on the two sides of Davis Strait. The catch rate in the OB area, near the Cumberland coast, was very low, thus most of the effort was concentrated on the West Greenland stock. The boundary line drawn on the map comes from Canadian chart no 7010 and indicates that a part of this stock is in Canadian waters.

For each station, the species were separated, then a random sample was taken of the shrimp and of each principal species of fishes collected. For the shrimp samples, the sample was sorted into five reproductive stages: male, transitional, female without eggs, head roe females and berried females. The shrimps were then measured to the nearest o,1 mm and weighed by category. Principal species of fishes were also measured by sex.

The data were thereafter recorded and analysed on board using a standard office computer immediately after each stratum was completed. For each stratum the size distribution of shrimps were cumulated for all the stations, and the resulting size distribution (0,1 mm) was converted into 0,3 mm size distribution on which a moving average of three classes was made. Figure 2 is an example of this type of analysis. We have previously used this technique in studies of shrimp of population in Gulf of St. Lawrence and found it to be suitable for separating age classes and estimating their abundance.

Results

1- Selectivity of the trawls used

In the middle of the survey, the sputnik trawl used was badly torn and the decision was taken to use another type, the Lofoten trawl. Dupouy et al. (1979, NAFO/SCR Doc. 79/XI/6) describes this type of trawl, its mesh size, vertical opening and fishing efficiency. If we compare it to the sputnik trawl, we should suspect that, in addition to its lower efficiency to catch shrimps, the difference in the mesh sizes between the two trawls would produce difference in the length frequency distribution.

Figure 3 presents cumulated size distributions in stratum 6 for stations made for a part with the sputnik trawl and for the other part the Lofoten trawl. Three principal modes are clearly visible in the two length frequency distributions: these distributions look very similar except that the smaller shrimps are more numerous for the Lofoten trawl. The reason is the very small mesh size of the cod-end liner of the lofoten (30 mm stretched mesh) compared to the cod-end mesh size of the sputnik (36 mm).

It is possible in fact that the lower efficiency of the Lofoten trawl to catch shrimps is more due to basic differences in horizontal and vertical openings of the trawls than a large difference in selectivity.

Lack of difference between the size compositions for the two types of trawl permitted us to cumulate within each stratum all the length frequency distributions independantly of the type of trawl.

2. Population structure in relation to depth in area 1B

For each depth, a cumulative size distribution of shrimps was produced. The cumulative distribution of shrimps for different depth intervals is shown for the northest part of the study area in Figure 4 and for the southest part in Figure 2. In both regions, there are three well-defined modes. In this species, there is an annual reproduction cycle and a short hatching period, (Haynes and Wigley, 1969). Thus the first two modes probably corresponds age classes 1 and 2 respectively. In some distributions, for example Figure 5, two groups are evident in the position of the third mode (age class 3^+), and thus this third mode probably represents an accumulation of, at least, the age classes 3 and 4.

Young males of age class 1 are most abundant at 200-300 m depth and decrease in abundance with increasing depth, whereas older males of age class 2 and females, age class 3 and older, increase in abundance with increasing depth to a peak at depths up to 300 m. A similar pattern was observed by Horsted (1978) for inshore stock of the southern Greenland.

Table 1 gives the estimated mean length for each age class (our estimate presented here were made by eye) and the mean bottom temperature for some strata were samples were collected. Temperature increases with increasing depth and could be the principal factor accounting for the more advanced position of the year classes at greater depths. Thus the enhancement of growth by increased temperatures probably results in the advancement of the position of the year classes at greater depths.

3- <u>Sex and reproductive stages in the 1B area</u>

Figure 6 shows size distribution calculated by sex and reproductive stages for the 1B shrimp stock. Different length distributions were chosen from different depths and from stations made in a small interval of time (5-6 of October) to produce a cumulative length frequency distribution. In that figure, the outer curve of females represents size distribution for all females, the second, third and fourth representing berried females, head roe female and not spawning females.

Practically all the shrimps of age class 2 are males, while the age classe 3^+ is composed of females. Very few females are not spawning females. Head roe and berried females represent 95% of the total females number of females.

The presence of an important proportion of head roe stage (23% of the total number of females) in October seems to be different of that we should expect. In Sukkertoppen Deep offshore grounds and in Disko Bay, this stage disappears completely during September (Horsted, 1978). Klimenkov and al. (1978) observed that females with developed ovocytes in gonads predominate in September 1975 and 1976 on the western slope of Store Hellefiske Bank. From these papers, it is possible that the spawning period is to a small extent delete in 1979. According to Allen (1959) there is a relation between the time the egg-laying takes place and the bottom temperature. Relatively higher temperatures were observed this year in the 200-300 m depth interval (Table 1) compared to the 1976 data (Klimenkov et al., 1978).

4- Population structure and maturity in OB area, east of Cumberland

Figure 7 shows length frequency distributions for different depths in that area. As reported for the West Greenland coast, large sizes females occur in abundance in deeper waters, while smaller male shrimps are more abundant in shallower waters. Even if high overlapping occurs between age groups, the distribution seems trimodal, with a mode at 22 mm, the second at 24-25, and the third at 29-30.

Figure 8 shows length frequency distributions by sex and reproductive stages. Most of the females are berried and no head roe stage were observed, indicating that egg-laying period is completed. Contrary to the 1B area, an important proportion of not spawning females were observed. It is thus clear that at least a part of females do not spawn each year. Couture (1971) observed the same in the fjord of Saguenay in Quebec where about 50% are not spawning females.

5- Discussion

Size of shrimps and maturity are different for the east and west part of Davis Strait. Table 2 summarizes these differences for females. The virgin condition of the OB stock could explain the fact that females are considerably larger in that area. Differences in the proportion of head roe stages in the two regions indicates that in OB the egg-laying period is earlier; very low temperatures in that area (- 1.7°C at 211 m to 1.7 at 465 m)could be the reason for that (Allen, 1959).

Temperature factor could explain too the important proportion of non-spawning females in OB. Lower temperatures have the effect to lengthen the breeding period (Allen, 1959); it is possible that in such condition some females do not succeed in spawning yearly. In the Saguenay fjord in Quebec, large proportion of non-spawning females are associated with temperature of 0.4°C to 1.7 (Drainville, 1968).

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Table 1. Estimated mean carapace length for age classes 1, 2 and 3^+ and mean temperature by stratum in 1B area.

Stratum	Depth interval (m)	Mean length (mm) 1	2	3^+	Temperature (°C)
2	300-400	14	21	24.5	3.5
3	400 +	-	22.2	26.1	3.85
4	300-400	15	22	26	3.45
6	200-300	15.9	21.3	26.1	2.9
9	200-300	16.8	21.3	26.3	3.8
11	300-400	17.1	22.2	27.3	4.05
12	400-600	17.3	22.5	27.6	4.4
13	200-300	17.3	21	26.5	3.7
15	200-300	16.5	21	25.3	2.1

TABLE 2. Characteristics of length and maturity of females in OB and 1B areas.

Area	Mean length (mm)	Maturity stages (%) not spawning females	head roe	berried
1B	24-26	4.4	23.0	72.7
OB	29-30	24.3	0.3	75.4

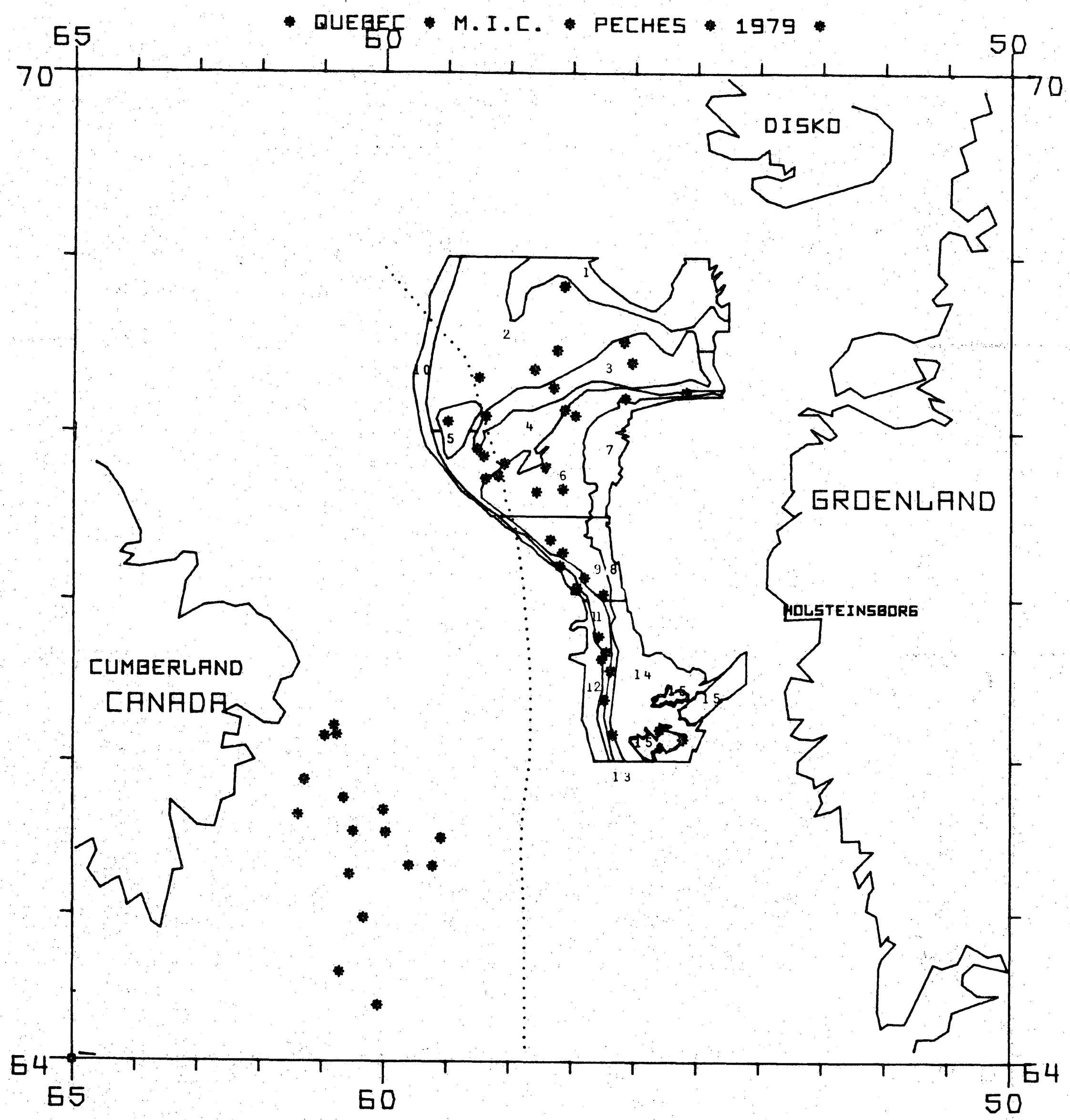


Figure 1. Map showing the stratification used, stations completed and boundary line between canadian and greenland waters (ref. canadian chart no.: 7010)

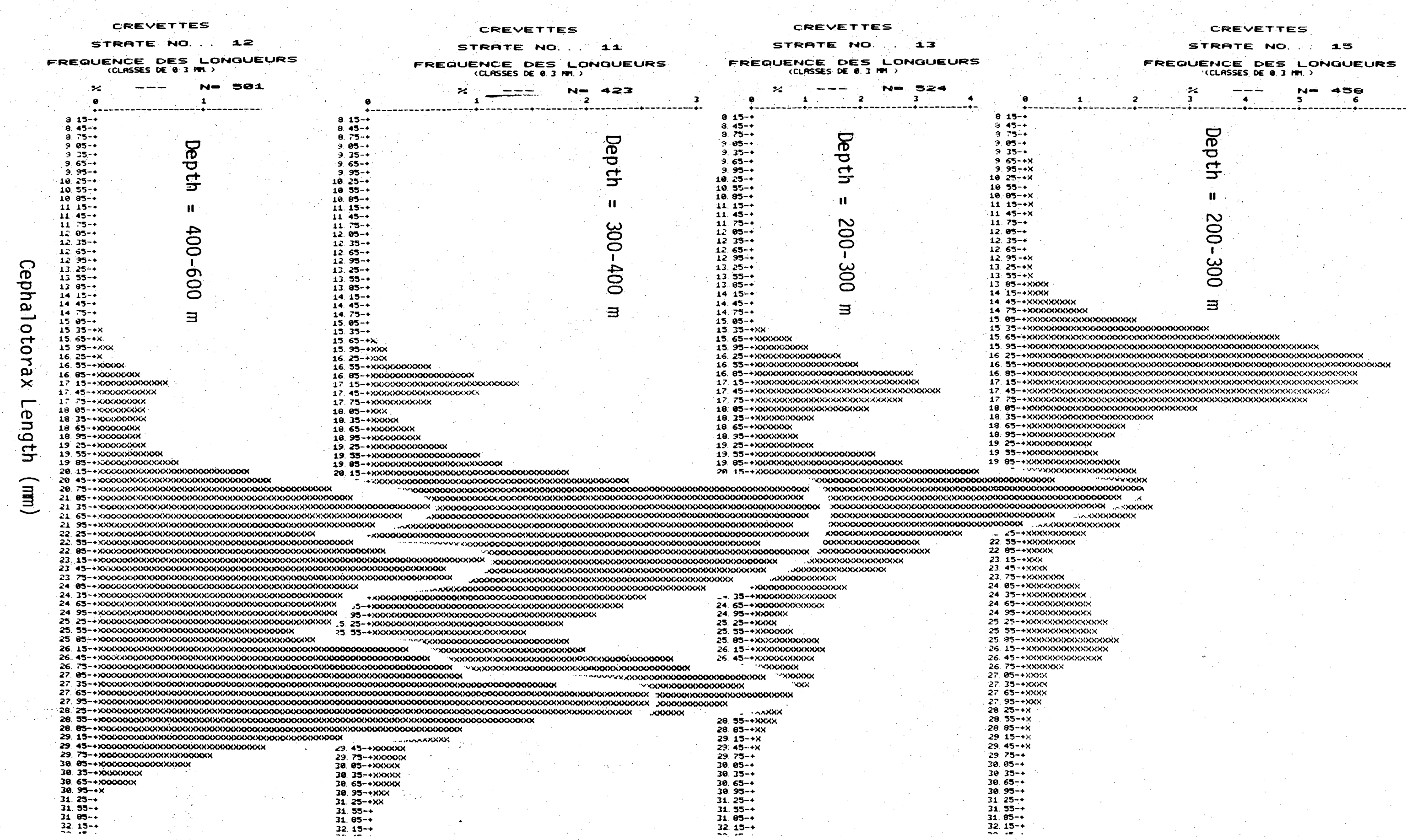
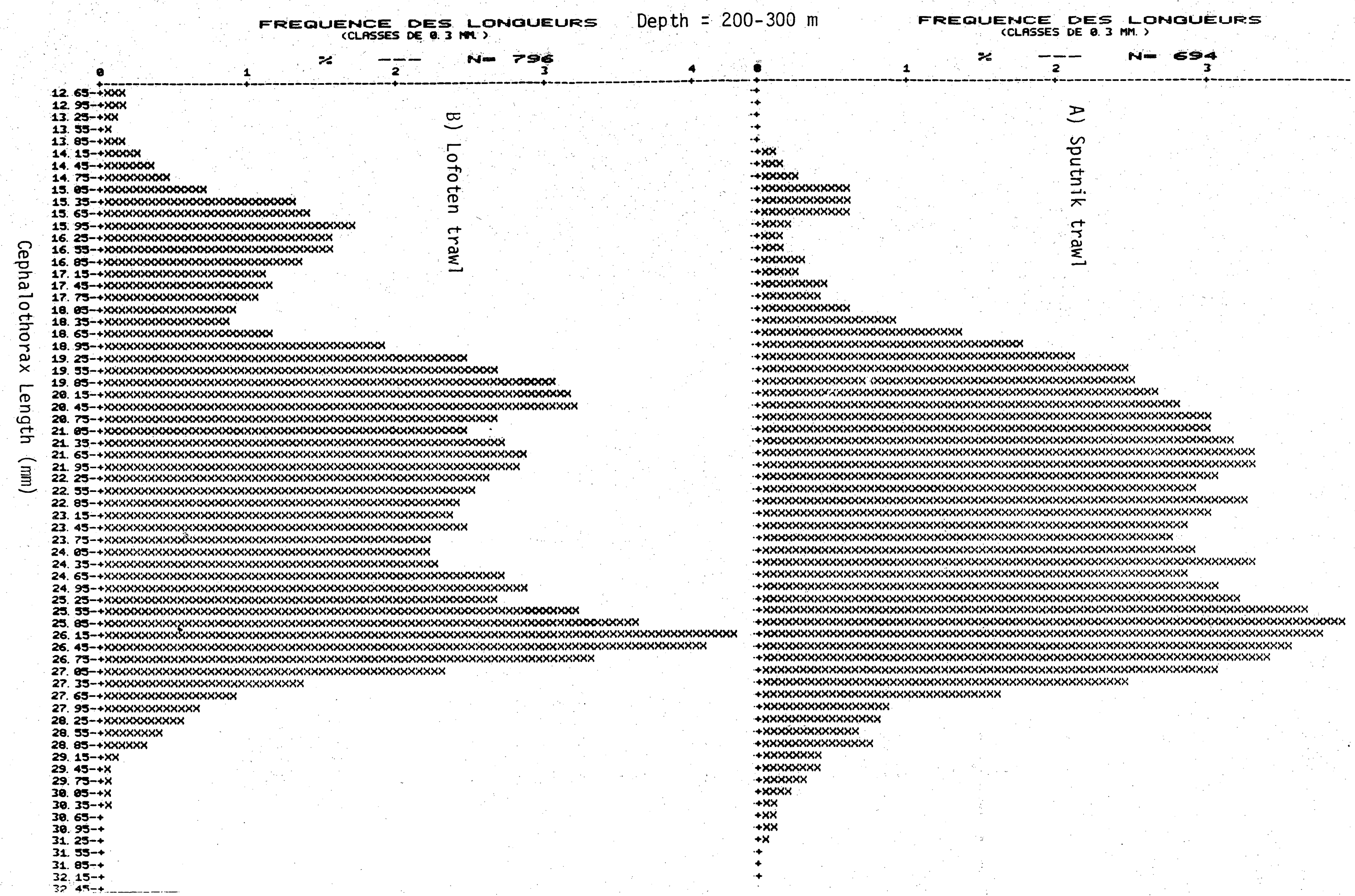


Figure 2. Cumulated size composition for selected strata in the south part of the IB area.

Figure 3. Cumulated size composition in stratum 6
a) for sets made with the sputnik trawl
b) for sets made with the lofoten trawl



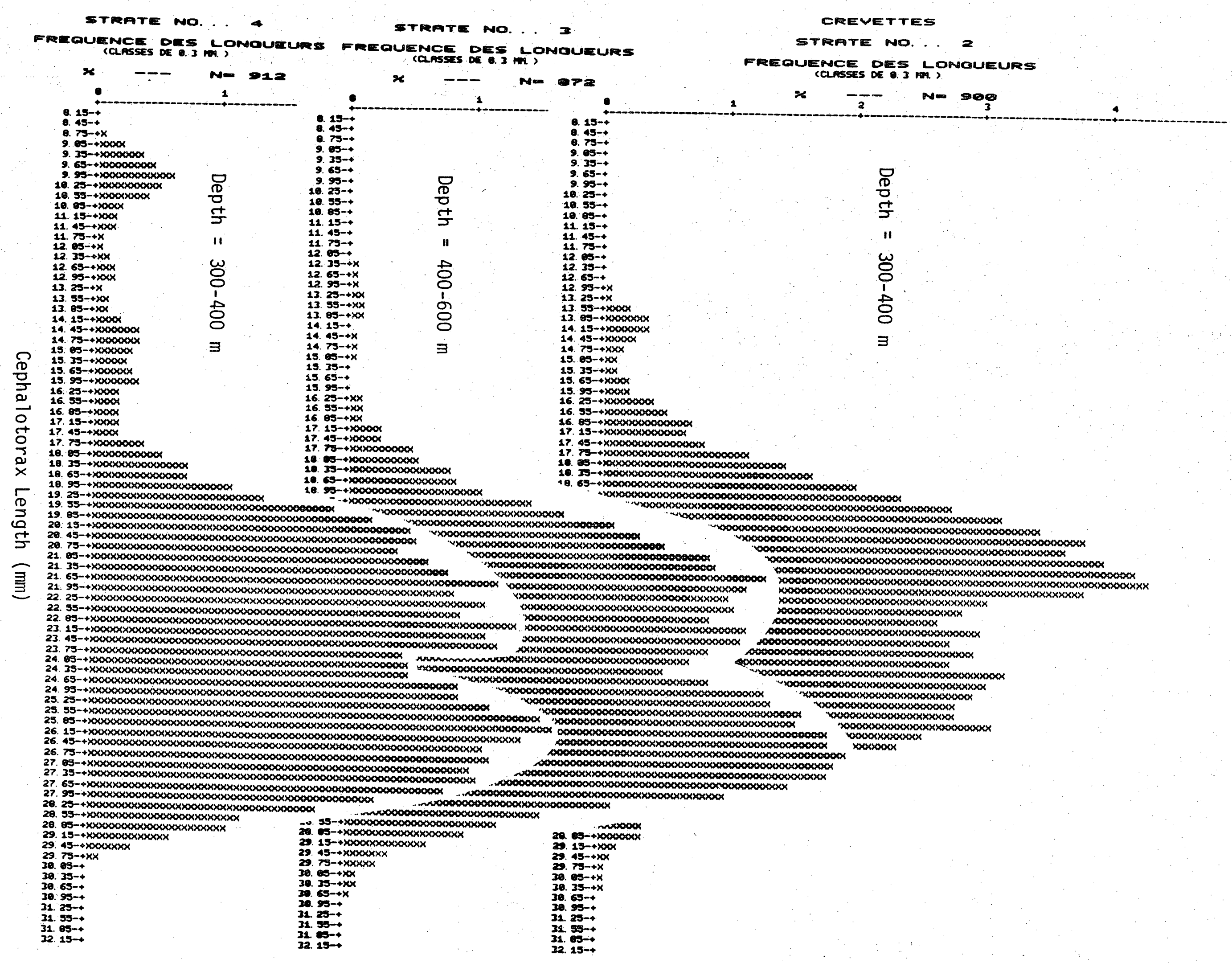


Figure 4. Cumulated size composition for selected strata in the north part of the IB area.

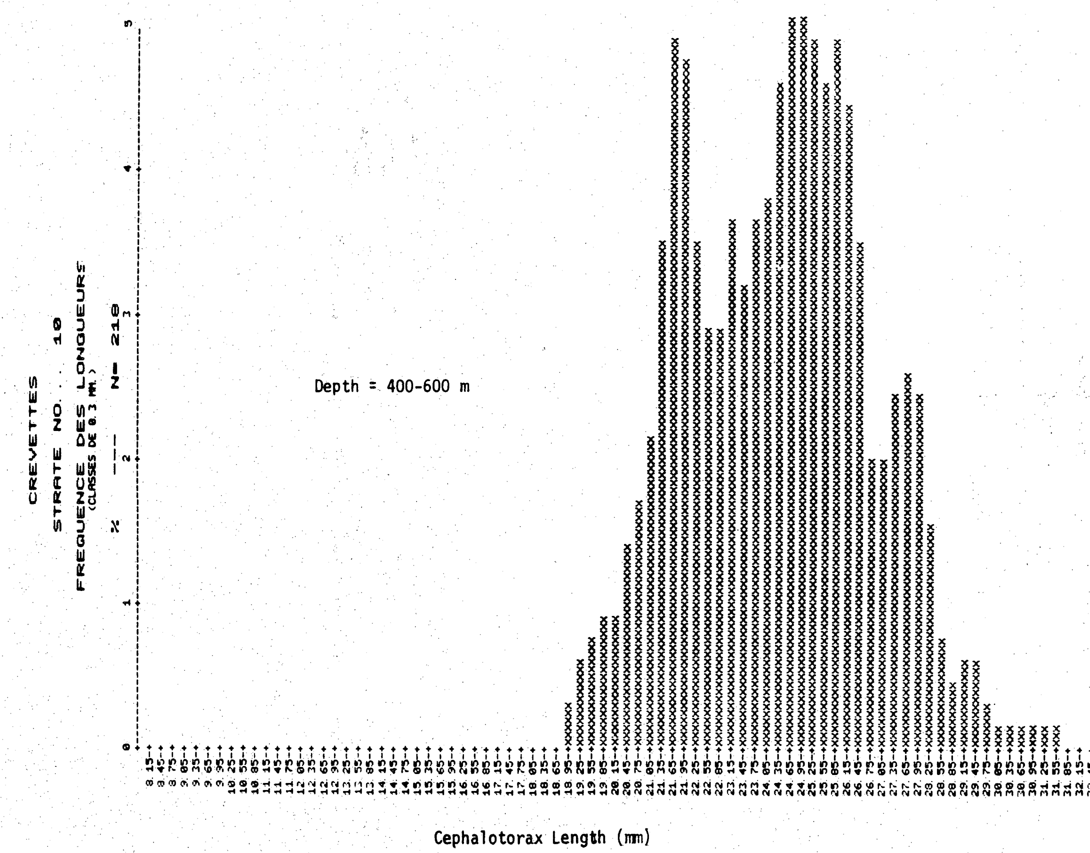


Figure 5. Length frequency distribution for stratum 10.

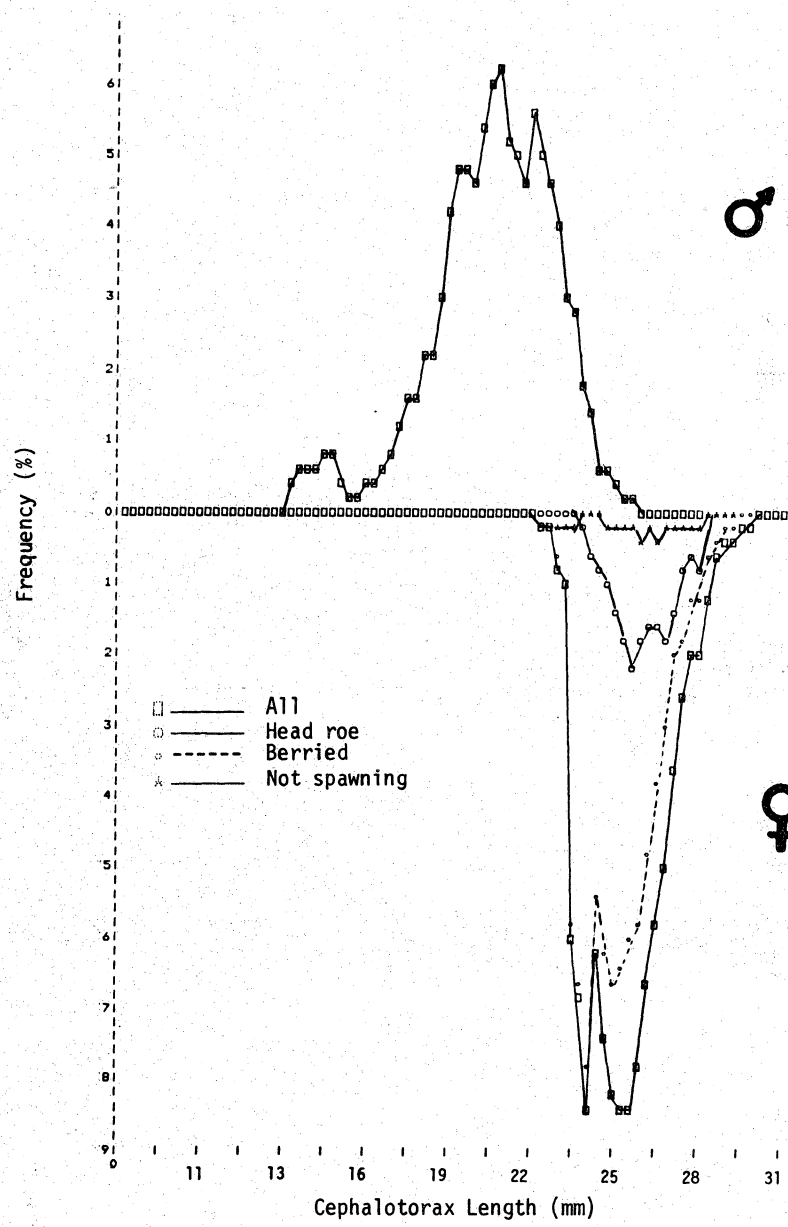


Figure 6. Size composition by sex and by female reproductive stages for selected samples of various depths in IB area.

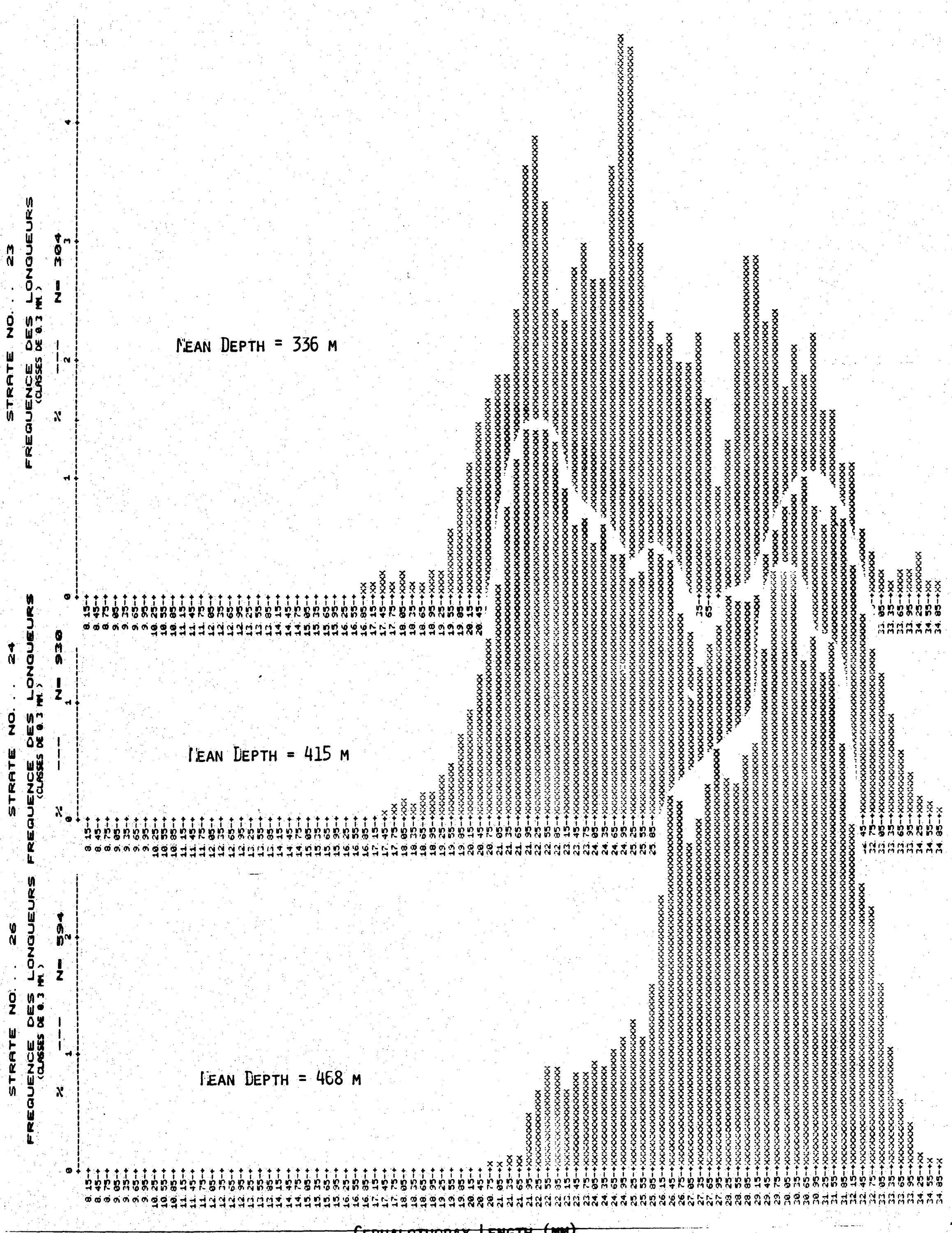


FIGURE 7. CUMULATED SIZE COMPOSITION FOR STRATA OF DIFFERENT DEPTHS IN THE OB AREA.

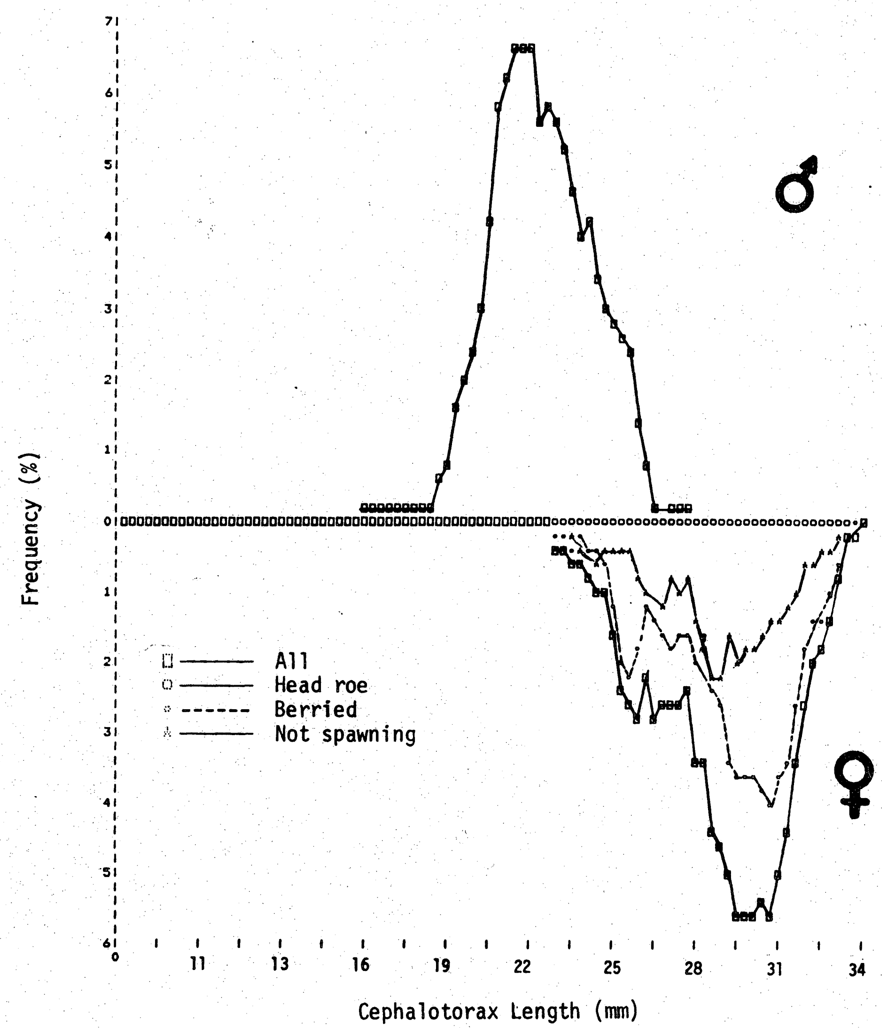


Figure 8. Size composition by sex and by female reproductive stages for selected samples of various depths in OB area.