

Northwest Atlantic



Fisheries Organization

Serial No. N043

NAFO SCR Doc. 80/II/11

SPECIAL MEETING OF SCIENTIFIC COUNCIL - FEBRUARY 1980

Biomass Estimate and Biological Characteristics of the Squid (*Illex illecebrosus*)  
on St. Pierre and Burgeo Banks (Subdivision 3Ps) in the autumn of 1979

by

H. Dupouy and J. C. Poulard  
Institut Scientifique et Technique des Peches Maritimes  
St. Pierre et Miquelon

I - Introduction.

During the course of the autumnal groundfish survey in Subdivision 3Ps carried out on board the R/V Cryos from 12 to 31 October 1979, data on squid, *Illex illecebrosus*, were collected for biomass estimate. Furthermore, biological characteristics of squid are presented here as : length frequencies by sex and maturity stages versus depth of trawling, distribution of catches in relation to hydrological situation.

II - Material and methods.

The gear used was the standard Lofoten trawl with specifications : 31.20 m headrope, 17.70 m footrope and 50 mm stretched mesh in the codend. A total of 60 hauls were made during the trip, on which 3 were not used to estimate the biomass, because the trawl was damaged. After each tow, an hydrographic station was occupied, using XBT.

On the surveyed area (St-Pierre bank, Burgeo bank and Halibut channel), the stations were distributed randomly using the ICNAF stratification scheme recommended for groundfish survey in Subdiv. 3Ps. A total of 22 strata for depth ranging from 20 fathoms (37 m) to 200 fathoms (366 m) were covered during the survey.

Tows were of 30 minutes duration. The total area swept by the trawl is calculated on the basis of an horizontal opening of 13.5 m at the wings, in the 3.5-4 knots speed range. So, the mean area swept per tow,  $b$ , is estimated at 0.015 square nautical miles ( $0.05 \text{ km}^2$ ).

After each tow, the catch was sorted by species. Squid were weighed and measurements to the half-centimeter below were made on a representative sample. Sex and maturity stages were recorded using the scales defined by MERCER (1973) for the males and by AMARATUNGA and DURWARD (1978) for the females.

### III - Results.

A total catch of 25,000 individuals representing 6 776 kg was made during the whole cruise.

#### A. Geographical distribution in relation to hydrographic situation.

48 tows on 57 were productive in squid but the yield per tow (Fig. 1) was very unequal depending on the area. All the best yields were obtained on the Western and Southwestern slope of the St-Pierre bank. Largest concentrations were noted in strata 319, 318, 312 and 313 with respectively 830, 703, 537 and 490 kg per 30 minutes' set. On the other hand, squid were scarce or absent in the Eastern part of the St-Pierre bank and in the Halibut channel.

This pattern of distribution was also observed in November 1977 (CHEVALIER, 1978) and in October 1978 (DUPOUY, 1979). The probable explanation can be found in the thermic situation (Fig. 1 and Fig. 2). Hydrographic section of 3Ps (Fig. 2) reveals the presence of three levels of water masses :

- in surface (0 to 10 fath) relatively warm temperatures ranging from 8° to 12° C ;
- in the intermediate level, cold waters (-1° C to +3° C) unsuitable for squid ;
- and along the slope of the bank, from Burgeo to the Southwestern edge of St-Pierre bank, warmer waters (6° C to 8° C) ranging from 70 to 200 fath. Almost 90 p.cent of the squid catches were made in the slope waters. For the other 10 p.cent of the catches, the bottom temperature of trawling stations was unsuitable for squid and the yield per tow (Fig. 1) was relatively low (1 to 100 kg). Thus, the catch occurred in the upper level (8° to 12° C) when hauling the trawl on board.

#### B. Biological characteristics of catches.

##### 1. Length frequency distributions.

In Fig. 3, the length frequency distributions, each sex apart, are expressed by depth strata of trawling.

For males, the distributions are comprised between 18 cm and 27 cm mantle length. All the distributions are unimodal and leptokurtic. The mean size presents no marked differences with depth (22.52 cm to 22.63 cm) and the standard deviation is ranging from 0.97 to 1.22 (Table 1).

For females, the length measurements are distributed from 19 to 31 cm. All the distributions are also unimodal, but with meso or platykurtic profiles. Moreover, the skewness is increasing with depth, from slightly negative for the 20-50 fath level to important positive asymmetry for 150-200 fath level. In the same time, the mean size also increases with depth (from 24.47 cm to 25.34 cm). On the other hand, the standard deviation is stable (1.50 to 1.55).

## 2. Maturity stages.

Examination of maturity stages (Fig. 3) shows that 39 to 44 p.cent of males are maturing (stage 2) while the others are already mature (56 to 69 p.cent). No special tendency is noted with depth levels.

For the females all the individuals are at the beginning of maturation (stage 2 or 3) some (less than 1 p.cent) entering in stage 4 (i.e. vitellogenesis) but no mature animals were observed. At the contrary of males, a slight increase in maturation with depth is noted.

## 3. Sex ratio.

One can observe in Table 2 important variability in sex ratio by tow. Though in each stratum, the number of females exceed the number of males (ratio 1.74 to 4.23) some tows present a majority of males. So, the ratio F/M is ranging from 78.00 to 0.38. The sex ratio for the total catch is 16,067 females and 9,243 males i.e. 1.74.

## 4. Mean weight by sex.

A total of 2,059 kg of males was caught during the cruise and the individual mean weight was 223 g. For the females the catch was 4,654 kg and the mean weight 290 g.

## C. Biomass estimate.

The minimum biomass B is given by :  $B = \bar{Y}_h A_h / b$  where  $\bar{Y}_h$  is the mean yield in the stratum h,  $A_h$  is the surface of stratum h and

b is the area swept per tow (0.015 square nautical miles). The variance of this estimate is given by :  $\frac{A^2 \cdot s^2_h}{b \cdot nh}$  where  $s^2_h$  is the variance of yields in the stratum h and nh the number of tows in the stratum.

The results in number and weight of squid are expressed in Table 3. The total estimation for the area surveyed is 206,748 thousands of individuals and 57,828 tons. The standard deviation is 43,685 individuals and 12,360 tons, i.e. 21 p.cent.

D. Sex ratio corrective factor for biomass.

One of the bias underestimating this biomass estimate is the disproportion of sex ratio, consecutive to the earlier migration of males to deep waters, compare to females.

If we assume that the normal sex ratio of the stock is 1, we can determine the number of lacking males,  $M_1$  on the surveyed area, by subtracting to the number of females, the number of males present on the surveyed area :

$$M_1 = N_1 \cdot \frac{R}{R+1} - N_1 \frac{1}{R+1} = N_1 \frac{(R-1)}{(R+1)} ;$$

where R is the ratio females/males in the surveyed area (i.e. 1.74) and  $N_1$  is the total number of squid in the biomass estimate (i.e. 206,748 thousands).

Thus, the adjusted biomass estimate in number of squid,  $N_2$ , is :

$$N_2 = N_1 + M_1 = 2 N_1 R / (R+1)$$

the adjusted biomass estimate in weight,  $B_2$ , can be calculated by assuming that the mean weight  $\bar{w}_m$  of the migrated males is the same that the one of the squid still remaining in October in the surveyed area :

$$B_2 = B_1 + M_1 \bar{w}_m .$$

In these conditions, with our figures ( $B_1 = 57,828$  tons and  $\bar{w}_m = 223$  grams) the adjusted biomass was :

$$N_2 = 262,585 \cdot 10^3 \text{ squids and}$$

$$B_2 = 70,280 \text{ tons.}$$

IV - Discussion and conclusion.

This biomass estimate of over 70,000 tons for the Subdiv. 3Ps in October 1979 is a minimum biomass because :

1. The trawl efficiency was assumed to reach 100 p.cent.

2. The low vertical opening of the Lofoten bottom trawl (3 m to 3.50 m) do not take in account the proportion of squid above the gear.
3. In October, a part of squid were still remaining in inshore waters.
4. The southwards migration to deep waters has already started. If a part of females were in strata deeper than 200 fathoms (strata not surveyed), the corrective factor for sex ratio is underestimated.

References

- AMARATUNGA (T.) and DURWARD (R.D.), 1978.- A guide for data collection in the field for the squid, Illex illecebrosus. ICNAF Res.Doc. 78/II/5
- CHEVALIER (R.), 1978.- Biomass estimates of squid Illex illecebrosus in Subdivision 3Ps. ICNAF Res.Doc. 78/II/12
- DUPOUY (H.), 1979.- Distribution and biological characteristics of the short-finned squid, Illex illecebrosus, off southern Newfoundland (ICNAF Subdiv. 3Ps) in the autumn of 1978. ICNAF Res.Doc. 79/II/5
- MERCER (M.C.), 1973.- Sexual maturity and sex ratio of the ommastrephid squid, Illex illecebrosus (LESUEUR), at Newfoundland (Subarea 3). ICNAF Res.Doc. 73/71, Ser. No. 3023.

Table 1. Mean lengths and standard deviations by sex and depth for squid, Illex illecebrosus, in NAFO Subdiv. 3Ps (R/V Cryos cruise, 12 to 31 October 1979).

Depth strata	:	20-50 fath	:	50-100 fath	:	100-150 fath	:	150-200 fath	:	overall
males	$\bar{x}$	22.62	:	22.63	:	22.52	:	22.57	:	22.59
	s.d.	0.97	:	1.06	:	1.07	:	1.22	:	1.07
females	$\bar{x}$	24.47	:	24.67	:	24.98	:	25.34	:	24.86
	s.d.	1.50	:	1.54	:	1.55	:	1.50	:	1.54
			:		:		:		:	

Table 2. Variation of sex ratio (F/M) by tow and strata for squid, *Illex illecebrosus*, in NAFO Subdiv. 3Ps (R/V Cryos cruise, 12 to 31 October 1979).

Depth strata		Number of squid and sex ratio per tow (R = F/M)									overall
20-50 fath	n	80	12	99	97	113	15	82			498
	R	2.3	3.0	1.0	2.5	1.5	6.5	3.6			2.09
50-100 fath	n	101	99	98	37	42	58	36	51	31	
	R	1.2	4.2	3.7	8.2	2.8	2.6	3.5	2.2	1.8	
	n	97	132	108	101	100	100	110			1301
	R	1.0	0.9	1.7	1.5	1.0	1.0	4.0			1.74
100-150 fath	n	82	88	98	98	99	79	96	100	99	
	R	4.5	3.4	8.8	2.6	2.5	78.0	7.7	2.8	1.1	
	n	102	100	98	196						1335
	R	0.9	0.9	1.9	1.8						2.39
150-200 fath	n	128	56	73	101	92	83	99	98		730
	R	20.2	8.3	0.4	11.6	17.4	3.6	4.0	3.4		4.23
Genral sex ratio											1.74

Table 3. Biomass estimate of squid, *Illex illecebrosus*, for strata surveyed by the R/V Cryos, in NAFO Subdiv. 3Ps (12 to 31 October 1979).

Depth range	Stratum No.	Area of Stratum miles	Number of sets	Biomass of squid	
				No. thousands	W-tons
20-50 fath (37-92 m)	312	272	2	18 284	5 457
	314	974	3	9 064	2 472
	315	827	2	227	113
	320	1320	3	0	0
	321	1189	4	2 630	673
	308	112	1	1 790	502
51-100 fath (93-183 m)	307	395	2	9 009	2 520
	311	317	2	12 035	3 338
	317	198	3	1 368	344
	319	984	5	62 959	16 847
	322	1567	3	5 517	1 451
	323	696	4	1 647	394
101-150 fath (184-274 m)	306	419	2	10 476	3 190
	309	296	1	5 570	1 651
	310	170	3	2 946	859
	313	165	3	13 876	3 682
	316	189	3	13 025	3 470
	318	123	2	17 245	4 412
151-200 fath (275-366 m)	705	195	3	3 538	2 051
	706	476	3	8 761	2 405
	715	132	1	4 600	1 349
	716	539	2	2 181	647
TOTAL		11648	57	206 748	57 828

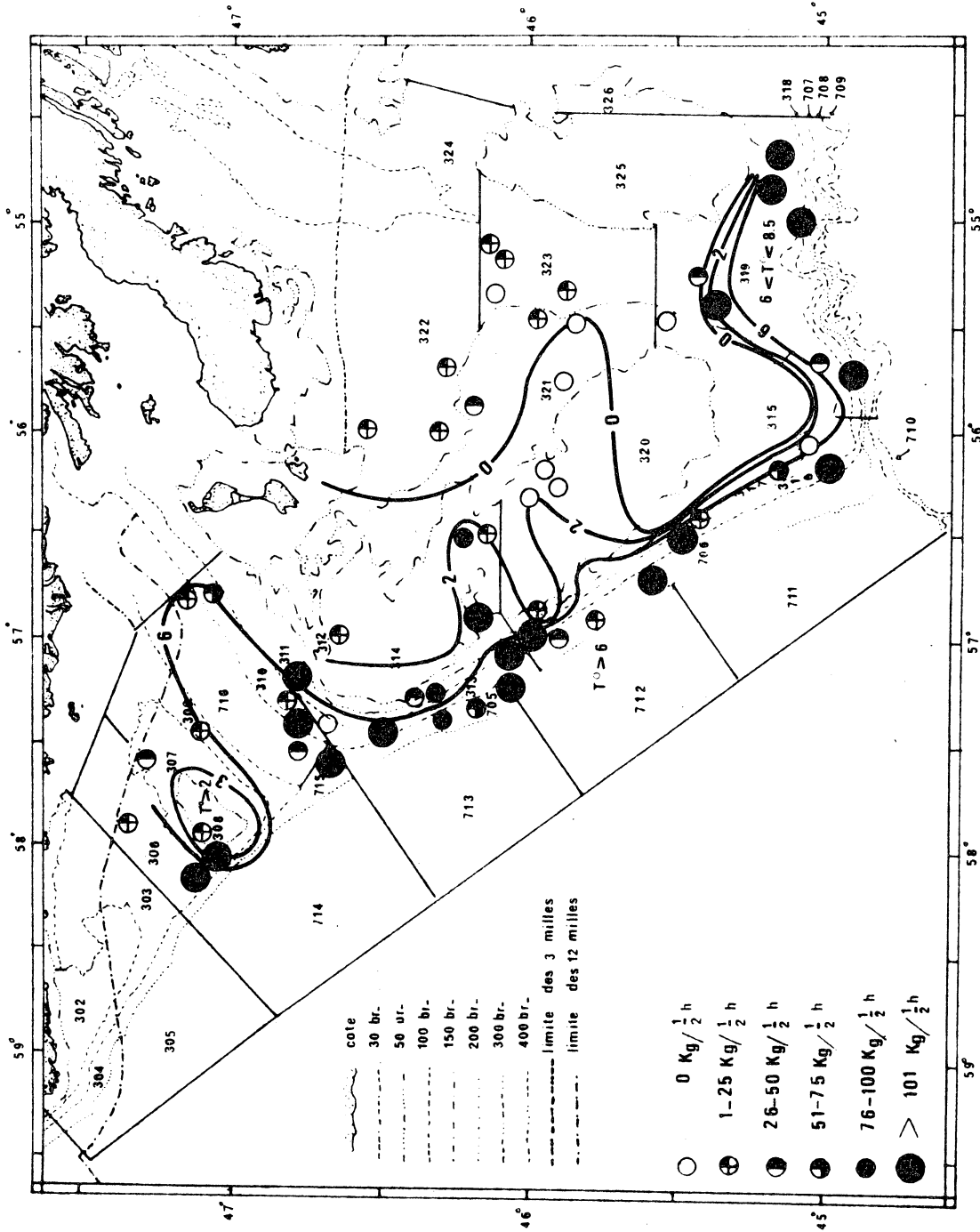


Fig.1 - Distribution and yield of squid, *Illex illecebrosus*, and bottom temperature isotherms in NAFO Subdiv. 3Ps (R/V Cryos cruise, 12 to 31 October 1979).

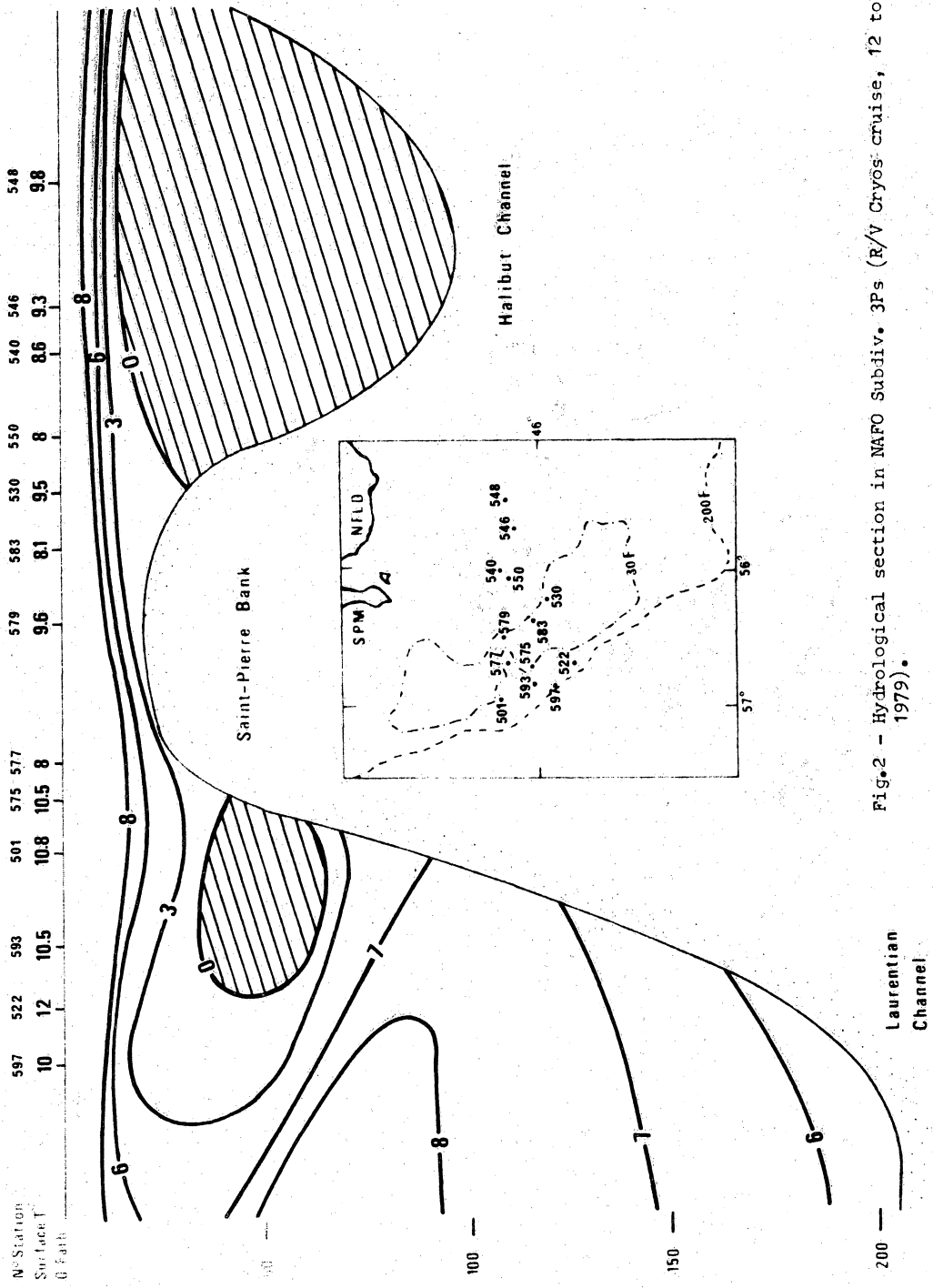


Fig.2 - Hydrological section in NAFO Subdiv. 3Ps (R/V Cryos cruise, 12 to 31 October 1979).

Laurentian Channel

Halibut Channel

Saint-Pierre Bank



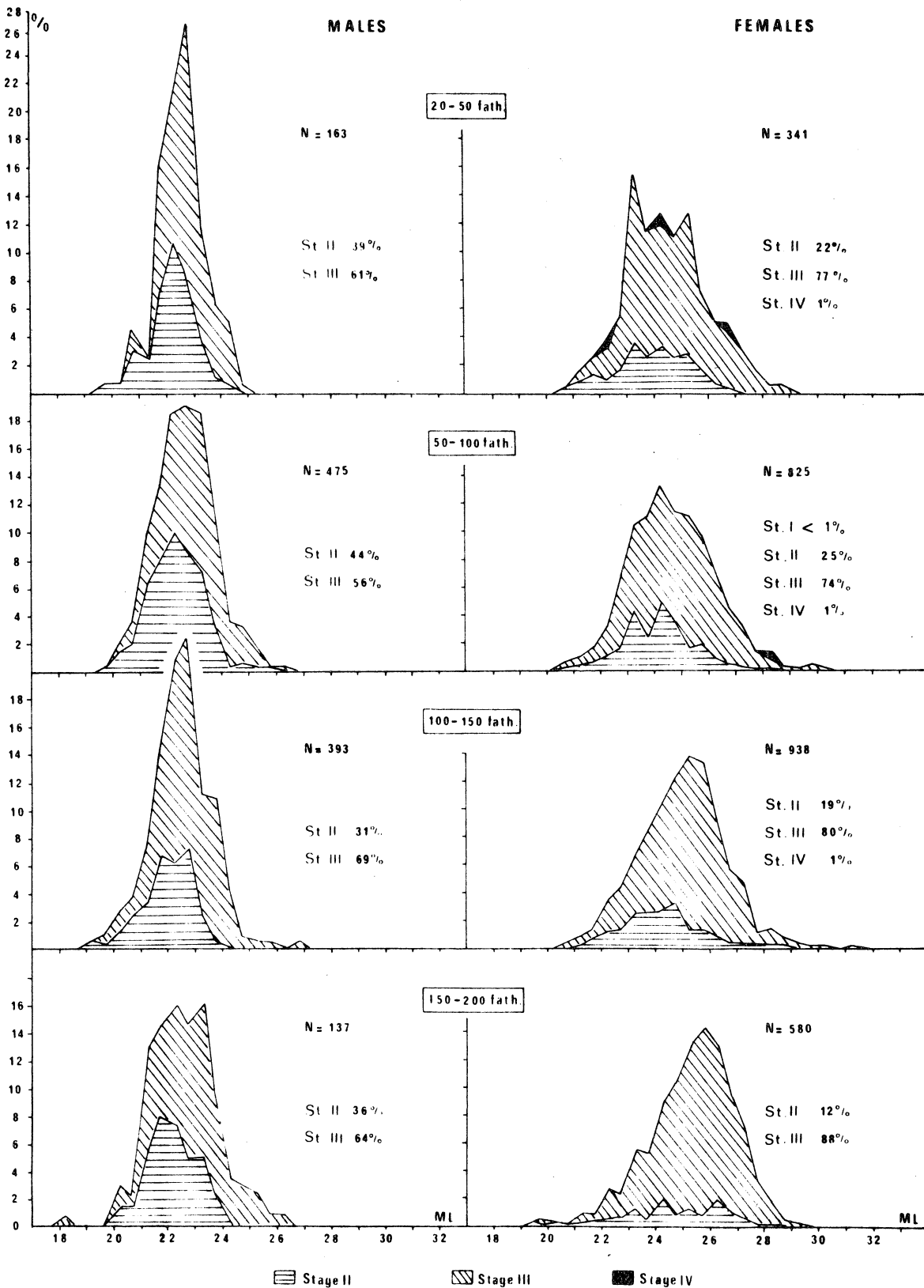


Fig.3 - Length distribution and maturity stages of squid, *Illex illecebrosus*, in NAFO Subdiv. 3Ps (R/V *Cryos* cruise, 12 to 31 October 1979).