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Biological Characteristics and Biomass estimate of the Squid (Illex illecebrosus)

on Scotian Shelf (Div. 4 V-W-X) in Late Summer 1981

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I - Introduction

A squid survey was carried out on board French R/V Thalassa (stern trawler class 5) from August 28 to September 22 on Scotian shelf (NAFO Div. 4 V W X). This paper presents data collected on abundance, size distribution, maturity stages, of <u>Illex illecebrosus</u> with reference to hydrographic conditions. A biomass estimate is also provided per stratum. Moreover comparisons with the situation observed in 1980 during a similar survey is made.

II - Material and method

The gear used was the Lofoten bottom travl with following specifications: 31.20 m headrope, 17.70 footrope and 50 mm stretched mesh in the codend. A total of 100 tows were made during the trip on which 96 were used to estimate biomass, the remaining sets being in deeper water, out of the boundary of the strata. After each tow, an hydrographic station was occupied using XBT thermograph.

On the surveyed area (fig. 1), the stations were distributed randomly using the stratification sheme proposed by HALLIDAY and KOHLER (1971) and recommanded by NAFO, for divisions 4 V W X. The boundary of strata were limited to depth ranging from 50 fath. (92 m) to 200 fath. (366 m) and a total of 22 strata were covered during the cruise. Four additional stations were made on the slope of the shelf between 450 and 800 m for a better knowledge of migration.

Tows were of standard duration (30 minutes). Then the area swept by the trawl is assumed to be constant and was 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 covered per tow is estimated to 0.015 square nautical miles (0.05 km^2) . After each tow, the catch was sorted by species. The total quantity of squid was weighted and if necessary, a representative subsample (200 individuals by set) was analysed. Maturity stages by sex, related to length measurements (mantle length to the half - centimeter below) were recorded using maturity scales defined by AMARATUNGA and DURWARD (1979). Furthermore, individual weight by length keys were obtained for males and females.

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III - Results

Squid, <u>Illex</u>, represented the fourth commercial species by the weight with 2 672 kg (against 5 500 for silver hake, 5 190 for haddock and 4 984 for the redfish) and the third by the number (11 000 individuals) for the whole survey, but great variations were observed in its distribution and biological characteristics.

A. Geographical distribution in relation to hydrographic situation

Squid were found in 98 on a total of 100 tows. The mean catch per 30 minutes was close to 30 kg or 120 individuals of <u>Illex</u>. The yield per tow was very inequal depending the area (fig. 2). Theirs largest concentrations were obtained in the central and southwestern part of the shelf, with yield up to 529 kg in the vicinity of the western gully (stratum 65) and 442 kg per 30 minutes in the southern slope of Browns bank (stratum 81). The corresponding bottom temperatures were 9°6 and 6.0°C respectively.

On the other hand, squid were very scarce in the northeastern part. of the surveyed area, all along the slope of the Banquereau bank.

During the survey, the three layered structure of water masses described by SIGAEV (1979) and GOMEZ (1979) for the Scotian shelf, was again observed

- the surface water (0 to 30 m depth was ranging from 15° to 20.5°C with a mean at 17.2°C (against 16.1°C in the same period for 1980);
- the intermediate water (30 to 100 m depth) covering most of the shallower strata with low temperatures (1° to 6°C); the mean of minimum temperature registred in the water column for all tows was 5°1 C against 4.8°C in 1980;
- the slope water, characterised by warm temperatures (6° to 11°C) stretching all along the edge of the shelf and entering in the central area, infront of Halifax, by the depression between Emerald and La Have banks (fig. 3) the mean bottom temperature was 7°4 C for 1981 against 7°6 in 1980 that is to say relatively stable if compared with the warmer temperature of surface and intermediate layers.

In figure 4, the catch rates were expressed by bottom temperatures and minimum intermediate temperatures. Moreover, the 1980 observations are presented in the figure 5. It appears from both year that :

- i) very few squid were caught for bottom temperatures lower than 4°C ;
- squid are also scarce for intermediate temperature lower than 2°C and greatear than 8°C;
- iii) highest catch rate were observed for bottom temperature ranging from 7°C to 10°C and intermediate temperature from 5° to 8°C. But when

the same bottom temperatures are associated with lower intermediate temperatures catch rates are low.

These preliminary observations have to be confirmed but the role of intermediate temperature on distribution of squid can be explained by the diurnal vertical migration of <u>Illex</u>. Too large differences in temperature between the two layers are possibly insuitable for vertical migration.

B. Biological characteristics of squid

The length-frequencies distributions (fig. 6), each sex apart, are expressed in consideration of depth interval of travling.

As in september 1980, three modal groups were found on Scotian shelf :

a) a group of small squid ranging from 5 to 11 cm for a weight of 5 to 30 g, mostly encountered after september 15, principally in the central depression between La Have and Emerald bank (strate 60, 65, 66) and along the edge of the shelf from Sable Island Gully and the western Gully (strata 53 and 54). All these specimens were immature. Because the selectivity of the trawl, their mean size close to 8 cm is probably overestimated and their relative proportion in the whole catch (10 %) underestimated.

b) A group of medium squid more abundant in the 50-100 fathoms depths level. Their size ranged from 12 to 17 cm (mean size at 14.5 cm) and the corresponding weight from 30 to 100 g. Most of these squid were still immature some specimen being in beginning of maturation. They represent about 2 % of the total number of individuals.

c) The bulk of the population (about 88 % of individuals) was composed of large squid. Males size was comprised between 18 and 26 cm (mean at 22 cm) and females between 18 and 29 cm (mean at 23 cm). Weight of males ranged from 100 to 350 g and for females from 100 to 500 g. These large squid were present on all the area surveyed and from depth from 50 to 440 fathoms. Their mean size and weight increase from shallower to greater depth. Most of these individuals were maturing (see fig. 6). Moreover it is important to note that on a total of about 2 800 females examinated, 4 were mature (stages IV and V) and one was mated. These specimens were caught from september 1 to 6 on depth from 50 to 100 fathoms in central and western part of the shelf.

		Males	1	! Females			Mâles + females
Depth level (faths)	50-100	100–200 <mark>!</mark>	240-400	50 1 00	100-200	240-400	Overall
Mean length (cm)	19.47	19.95	12.35	21.74	22.07	23.71	20.89
Standard deviation (cm)	2.31 ! !	2.28 !	1.22 !	2.24	2.24	1.85	2.29
Mean Weight (g)	173	184	223	223	233	260	240
Number mesured	1 258 ! !	1 412 !	27 !	1 376	1 379	28	5 544

Characteristics of squid referring to depth are presented in the following table :

The percentage of males was of 46 % for the 50-100 fathoms level, and 49 % for depths ranging from 100 to 440 fathoms. This can reflect that migration of mature males offshore was just beginning in september.

C. Biomass estimates

The biomass of squid present on the surveyed area during this survey (August 29 - September 21, 1981) is estimated using the swept area method based on stratified random sampling.

Assuming that the efficiency of the trawl used was 100 % for the squid present on the path of the gear, then the biomass Bi and variance Bi can be calculated in weight and number for each stratum, by following equations :

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$$B_{i} = \overline{Y}_{i} A_{i}/b$$

Var.B_i = A_i² x s_i²/n_ib²

where \overline{Y}_{i} is the mean catch of <u>Illex</u> by tow in the stratum i

 A_i is the surface of stratum i

b is the surface swept by the trawl per 30 minutes (estimated to 0.015 sq.naut.miles)

s, is the variance of catch per tow in the stratum i.

The standard error of biomass for each stratum is the square root of $Var.B_{1}$. The total biomass by depth level and the overall for the area covered by the survey, were obtained by adding each B_{1} and the corresponding standard error by extracting the square root of sum of variance. The results are expressed in Table 1. The overall values of biomass about 52000 metric tons representing 222 million of individuals are affected by low confidence level of 33 %. The schooling behaviour of squid can explain such a variability from tow to tow. Thus, the random procedure for selecting stations avoids overestimates in our figures. Moreover, the low vertical opening of the trawl (3 m to 3.50 m) compared with the vertical distribution of Illex in the water column and, on the other hand, the assumption of 100 % efficiency of the gear rather irrealistic because the high velocity of the squid, tend to conclude to a strong underestimation of the biomass.

IV - Discussion and conclusions

In late summer 1981, squid, <u>Illex illecebrosus</u>, were widely distributed on NAFO Div. 4 V W X, but few large concentrations were noted excepted in the western edge of the shelf (South of Browns bank) and in vicinity of the Western gully. Mean catch per tow was only 30 kg per set against 90 kg for the same period in 1980. The biomass estimate (about 50 000 m. tows) was only one third of previous year. This dramatic drop in availability of squid was also observed after the beginning of August 1981 in the coastal waters around St. Pierre and Miquelon archipelago (DUPOUY and MINET, 1982) and was related to an excessively high temperature in summer 1981. On Scotian shelf, an increase of temperature was also noted for surface (+ 1°1) and intermediate (+ 0.3° C) layers ; but bottom temperature was lower of 0.2° C, compare to 1980. Thus, temperature was not the only factor that intervened in 1981. This decline in abundance on Scotian shelf can result of a poor recruitment or by a change in migratory pattern.

On the other band, no big changes were noted in the biological characteristics of <u>Illex</u> on Scotian shelf. The three modal structures observed in 1980 (DUPOUY, 1981) was again noted. However, the proportion of small (5 to 11 cm) and large (18 to 19 cm) was higher in 1981 (10 % against 2 % and 88 %

against 80 % respectively). LANGE and SISSENIVINE (1981) stated that years of high abundance of small Illex in autumn is related to high level of recruited squid the following year, on Northeastern United States shelf. If this is confirmed, in 1982 abundance of large squid could be important.

Acknowledgements

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Depth range	Stratum	Area of	Number of	Mean Yield	per tow	! Biomass		Standard	error
	•00	stratum (miles)	auls	Number	i Kg	N thousands	W tons	N thousands	W tons
	49	144	. - .	14	2•5	135	24	93	9•5
	50	383	 m	5	6.0	115	1 23	37	13.5
	54	499	9	68	1 4.0	1 2,272	133	1,057	34.9
	57	811	5	7	1.0	362	54	198	26.5
	8	1,344	5	30	6.7	2,670	601	920	255.0
1 (00 100 Latus	62	2,166	9	11	15.9	10,862	2,243	3,167	770.5
(M COI- 24)	65	2,383	9	379	91.9	60,290	14,600	56,074	13,890.5
	70	920	4	146	31.9	i 8,985	1,957	4,200	873.5
	72	1,249	5	33	7.8	2,764	149	1,009	234.0
	76	1,478	4	87	20.7	8,592	2,039	2,792	671.5
	77	1,232	9	162	39.8	13,330	3,269	9,552	2,327.5
	6	1,875	10	451	108.8	56,350	13,600	44,604	10,484.5
Total			58	131	30.1	166,726	39,292	72,550	17,612
	46	491	3	24	4.2	795	138	449	79.6
	51	147	4	71	15.0	i 691	147	398	0°68
	52	345	2	13	! 3•0	1 299	i 69	115	23.0
1 100 200 E-the	53	259	- 2	110	1 13.0	1,896	1 224	827	66.5
(184 366 m)	61	1,154	4	23	6.5	1,792	200	769	202.5
	66	226	ŝ	129	19.1	1,948	288	318	56.0
	71	1,004	5	67	17.6	4,484	1,178	2,069	536.5
	. 28	233	7	133	14.8	2,065	230	426	54.5
	82 + 83	1,574	5	386	106.4	40,462	11,165	8,367	2,290
I Total			38	111	25.0	55,432	13,939	8,730	2,366
0verall			96	123	27.5	1 222,158	53,231	73,073	17,770

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Figure 4 - Mean catch rate of <u>Illex illecebrosus</u> (in kg per 30 minutes) related to bottom and intermediate temperatures (the number of tows is indicated in each block of 1°C x 1°C) - R/V Thalassa survey (Aug. 28 - Sept. 22, 1981).

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Figure 5 - Mean catch rate of <u>Illex illecebrosus</u> (in kg per 30 minutes) related to bottom and intermediate temperatures - R/V La Perle (Sept. 4-24 th, 1980).

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Fig. 6. Length distribution by sex and maturity stages for squid in Div. 4VWX - R/V Thalassa survey (28 August-22 September 1981).