Northwest Atlantic Fisheries Organization

Serial No. N068

NAFO SCR Doc. 80/II/37

SPECIAL MEETING OF SCIENTIFIC COUNCIL - FEBRUARY 1980

# Abundance Estimation of *Illex illecebrosus* on the Scotian Shelf in 1979

by

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## INTRODUCTION

The data used in this report were generated from two research cruise programs undertaken in 1979: i) the Canada/USSR joint research program on the RTM Belogorsk which included Cruise 7901, February 16 to March 6; Cruise 7905, May 7 to May 22; and Cruise 7906, May 25 to June 4; ii) the Canada/Japan joint research program on the Hakurei Maru which consisted of Cruise 7912, October 23 to November 10, and Cruise 7913, November 11 to November 29. They provide an indication of squid abundance along the edge of the Scotian Shelf during three phases of residency of Illex illecebrosus population: i) early immigration (Cruise 7901); ii) pre-season (Cruises 7905 and 7906); and iii) late-season (Cruises 7912 and 7913).

The areal expansion method was used to estimate biomass with recognition of limitations to the application as indicated by Amaratunga and McQuinn (1979).

## METHODS

Ten transects (Figure 1 and Table 1) were established along the edge of the Scotian Shelf between Georges Bank and Banquereau Bank. Cruises 7901, 7912, and 7913 specifically

sampled within the defined transects. Cruises 7905 and 7906 surveyed more wide-ranging areas but much of the sampling took place within the transects. The objectives of the individual cruises were varied and therefore gave rise to different cruise tracks (Amaratunga et al., 1980a and 1980b). However, each cruise did conduct a bottom trawl survey. Differences such as vessel size and other experimental variations existed between programs. They all used random stratified sampling. Although the programs varied from one to another, there was sufficient similarity in the trawling methods and sufficient overlap in areas sampled to produce comparative biomass estimates.

During Cruise 7901, 17 bottom trawl sets were completed within seven transects, while during Cruises 7905 and 7906, 54 sets were completed within six of the transects. The surveys conducted during Cruises 7912 and 7913 completed 90 bottom trawl sets within all ten transects. The trawls made in each of the cruises varied with respect to depth, trawl time, and time of day. The data collected for each set included date, starting and finishing time, depth, location, and surface and bottom temperatures. However, no analysis was done with respect to these parameters. This study utilized only catch weights (kg) which were recorded by species.

The biomass estimates were developed from the squid catch weights by the areal expansion method. The area swept by the trawl, K (hectares), is the product of the distance between the trawl doors, D (meters), and the distance trawled, L (the product of boat speed and the trawl time). That is,

$$K = D \times L \text{ (where D and L are in meters)}$$

The catch per unit area is:

$$Ca = Co/K \times g$$

Where Ca is in kg/ha, Co is Illex caught in kg, and q is a catchability coefficient; q was given the value of 1.0 in the following calculations.

Ca estimates were made for each set in a transect. Subsequently, a mean catch per unit area, $\overline{Ca}$, was computed for each transect (Table 2). The boundaries of each transect for the purpose of these calculations were defined by predetermined longitudes and by the latitude of the northernmost and southernmost sets. The areas of the transects are given in Table 2. The mean catch per unit area was expanded to the area of the transect (H) by the equation:

$$BIO = \overline{Ca} \times H$$

to obtain biomass per transect. This was done for each transect in each cruise (Table 2). The average biomass per unit transect area was then calculated for each of the three periods (Table 3). These were then expanded to the area of the edge of the Shelf. The edge of the Shelf was calculated by multiplying the length of the Shelf, estimated at 1000 km, by the width of the Shelf edge, estimated by taking the average length of the transects (Table 3 and Figure 1). Thus, estimation of biomass per transect was extrapolated to obtain biomass estimates for each period of the season for the entire edge of the Scotian Shelf.

## RESULTS AND DISCUSSION

In Section A of Table 2, the early immigration phase, there were 17 sets made within seven transects with $\leq$ four sets per transect. The pre-season phase, Section B, consisted of 54 sets made within six transects. Transects 5, 6, and 10 had two sets or less, whereas Transects 4, 7, and 9 had 16, 19, and 14 sets respectively. During the late-season phase,

Section C, each of the ten transects were surveyed. Transects 5 and 6 each had 16 sets, while $\geq$ four sets were made in the remaining eight transects. The early immigration phase is based on fewer sets than the later periods. The biomass is overestimated in Cruise 7906 because of a "search-and-fish" strategy employed.

The mean catch per unit area, $\overline{Ca}$ (Table 2), is the mean squid biomass observed in a group of samples within a transect assumed to be representative of that transect. The variation in the $\overline{Ca}$'s between transects reflect the patchiness of squid distribution. During the early immigration period $\overline{Ca}$ was calculated for only seven of the ten transects (Transects 5, 8, and 10 were not surveyed). In the pre-season survey, Transects 4, 6, 7, and 9 produced a variable but consistent increase in the $\overline{Ca}$ of the same transects surveyed earlier. In addition, pre-season $\overline{Ca}$ for Transects 4 and 10 were calculated. The late-season survey continued the trend of consistently increasing $\overline{Ca}$ as well as establishing a late-season estimate for Transect 8. The increase in biomass is accounted for by two phenomena: immigration of squid into the Shelf edge area, and growth. The immigration of squid had begun previous to the pre-season survey (Amaratunga et al., 1980a) and would have made its greatest contribution to increasing biomass during this period. The number of Illex/MT changes as growth occurs. The number of Illex/MT during the early immigration period is 6,340 (unpublished data). The squid in this period, however, are presumed to be from the previous year class and are therefore much larger than the juveniles and thus tend to reduce the number of Illex/MT for that period. The number of Illex/MT increases to 10,606 during the pre-season survey and decreases to 3,273 at the time of the late-season program (Roberge and Amaratunga, 1980). The number of squid on the edge of the Shelf for the early immigration, pre-season, and late-season periods were

$2.25 \times 10^6$, $9.03 \times 10^7$, and $15.1 \times 10^7$ respectively (Table 3).

The total area within the ten transects was 17380 $km^2$, which constitutes 63.2% of the total area of the Shelf edge. However, the transects were well dispersed (Figure 1) and were thought to provide a suitable average. Thus, the estimates of 355 MT, 8510 MT, and 46044 MT for the three periods provide a general indication of abundance.

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Table 1. Transect coordinates.

| Transect | Latitude | Longitude |
|---|---|---|
| 1 | 42°00'-42°30' | 65°20'-65°40' |
| 2 | 42°10'-43°10' | 63°30'-63°45' |
| 3 | 42°10'-42°50' | 62°45'-63°00' |
| 4 | 42°20'-43°10' | 62°10'-62°30' |
| 5 | 42°30'-43°15' | 61°35'-61°50' |
| 6 | 43°00'-43°30' | 60°50'-61°05' |
| 7 | 43°05'-43°35' | 60°05'-60°25' |
| 8 | 43°20'-43°45' | 59°30'-59°45' |
| 9 | 43°35'-44°10' | 58°25'-58°50' |
| 10 | 43°55'-44°30' | 57°30'-57°45' |

Table 2. Squid biomass estimates, 1979 (Q = 1.0). A = early immigration
B = pre-season
C = late-season

| | Cruise | Transect | Number of sets | $\overline{Ca}$ (kg/ha) | H (ha x $10^5$) | BIO (MT) |
|---|---|---|---|---|---|---|
| A | 7901 | 1 | 4 | 0.202 | 1.545 | 31.14 |
| | | 2 | 2 | 0.037 | 2.318 | 8.44 |
| | | 3 | 3 | 0.121 | 1.545 | 18.62 |
| | | 4 | 3 | 0.384 | 2.576 | 99.05 |
| | | 6 | 3 | 0.013 | 1.121 | 1.51 |
| | | 7 | 1 | 0.063 | 1.494 | 9.47 |
| | | 9 | 1 | 0.084 | 2.801 | 23.43 |
| B | 7905 | 5 | 2 | 7.610 | 1.739 | 1322.48 |
| | | 7 | 4 | 0.880 | 1.494 | 131.47 |
| | 7906 | 4 | 16 | 5.067 | 2.576 | 1305.26 |
| | | 6 | 2 | 0.072 | 1.121 | 8.07 |
| | | 7 | 15 | 0.863 | 1.494 | 128.93 |
| | | 9 | 14 | 6.211 | 2.801 | 1739.70 |
| | | 10 | 1 | 0.961 | 1.307 | 125.60 |
| C | 7912 | 1 | 7 | 2.664 | 1.545 | 411.59 |
| | | 2 | 8 | 7.608 | 2.318 | 1763.53 |
| | | 3 | 4 | 7.187 | 1.545 | 1110.39 |
| | | 4 | 8 | 22.056 | 2.576 | 5681.72 |
| | | 5 | 8 | 26.480 | 1.736 | 4604.94 |
| | | 6 | 9 | 39.243 | 1.121 | 4399.14 |
| | | 7 | 8 | 30.677 | 1.494 | 4583.18 |
| | | 8 | 8 | 10.131 | 0.934 | 946.24 |
| | | 9 | 6 | 13.217 | 2.801 | 3701.98 |
| | | 10 | 7 | 8.171 | 1.307 | 1067.94 |
| | 7913 | 5 | 8 | 21.155 | 1.739 | 4174.48 |
| | | 6 | 7 | 5.251 | 1.121 | 588.60 |
| | | 7 | 2 | 18.957 | 1.494 | 2832.25 |

Table 3. Extrapolation of squid biomass estimates to entire edge of Scotian Shelf.

i) Length of Shelf - 1000 km

ii) Width of Shelf edge (assume average of transect lengths is a good estimate) - 27.5 km

iii) Shelf edge area - 27500 $km^2$

| | A Early immigration | B Pre-season | C Late-season |
|---|---|---|---|
| Average biomass/area surveyed ($MT/km^2$=10 kg/Ha) | 0.0129 | 0.3095 | 1.6743 |
| Biomass estimate (MT) | 355 | 8510 | 46,044 * |
| Number of Squid | $2.25 \times 10^6$ | $9.03 \times 10^7$ | $1.51 \times 10^8$ |

* Revised from previous report.

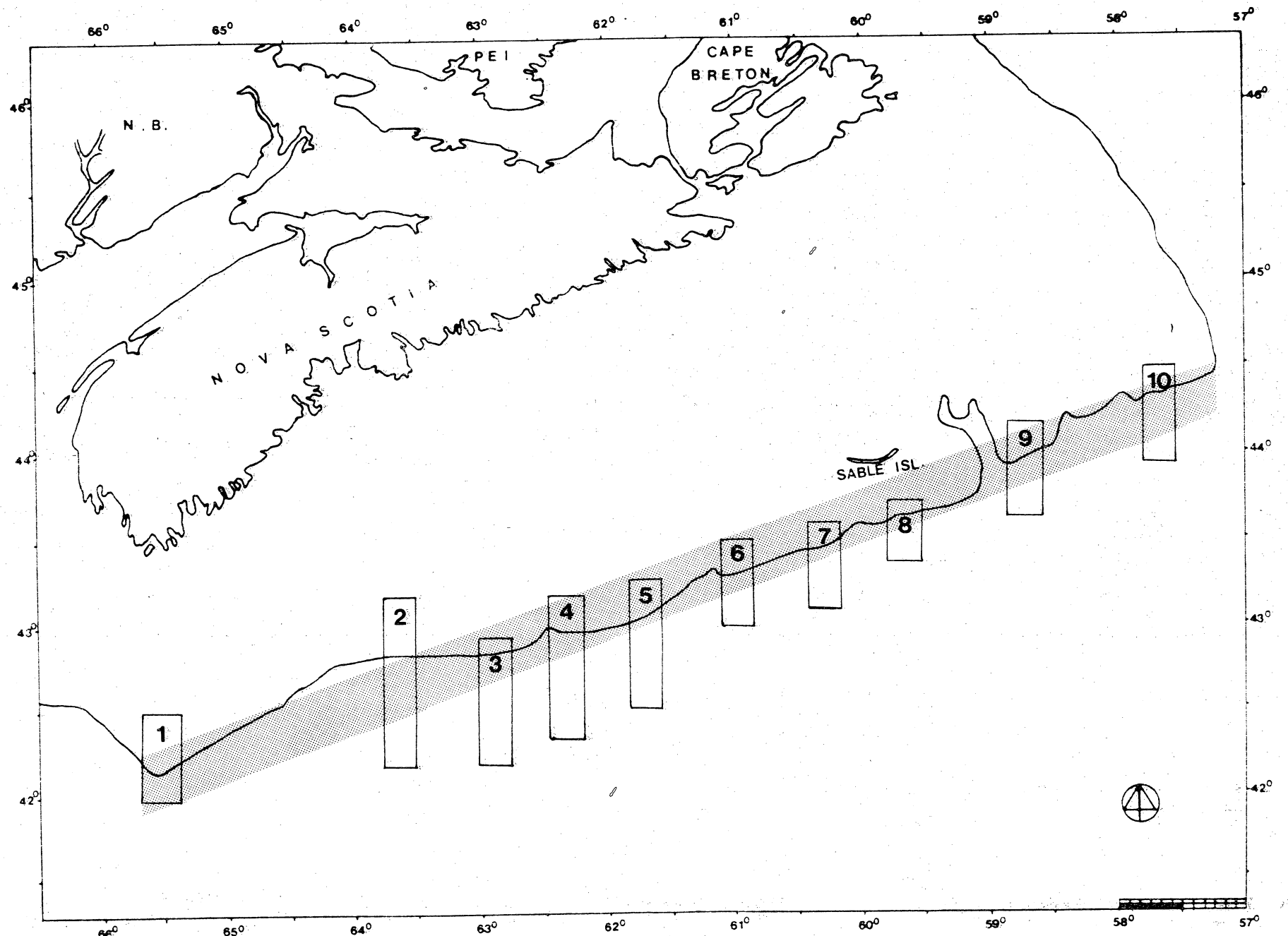


Figure 1. The ten transects used in the present study. The shaded area illustrates the Scotian Shelf edge.