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The R.V. Lady Hammond Larval-juvenile Survey, February 1982 in Subarea 4

by

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#### Introduction

As a result of a larval/juvenile survey in early 1977 (Amaratunga et al., 1980), in September, 1980, NAFO Scientific Council identified the need to conduct a comprehensive research program focused on squid Illex illecebrosus spawning stock and larval. The NAFO coordinated program in 1981 resulted in valuable descriptions of spatial and temporal distribution of larval and juvenile Illex. The 1982 program expanded the area of geographical coverage to include Subareas 5 and 6 extending to Cape Hatteras and a more intensive study of the water masses in the immediate vicinity of the Gulf Stream was intended (NAFO SCS Doc 81/VI/20). The R.V. Lady Hammond (Canada), one of four vessels committed to the program, was assigned to conduct intensive surveys within a small geographical area, in the vicinity of 63°W, in the region of the Slope Water-Gulf Stream-Sargasso Sea water masses and their interfaces. The objective of this study was to determine the abundance, distribution, and transport of Illex with emphasis on hydrographic and water-mass definition.

### Materials and Methods

The survey cruise consisted of two legs: Leg 1 from February 2 to 12; and Leg 2 from February 12 to 25, 1982.

A relatively small geographical area between 59°W and 63°W and the region between the Scotian Shelf and Sargasso Sea (Fig. 1) was chosen as the survey area. Exploratory, "coarse," transects were defined extending from the edge of the Scotian Shelf (approximately 42°30'N) southward through the Gulf Stream to 38°N with stations placed at approximately 30 mile intervals. The first such transect was located at 63°W and subsequent parallel transects were located eastward at 1° intervals (approximately 60 miles).

Operations along the coarse transects were interrupted when a high concentration of <u>Illex</u> was encountered, and then an "intensive" survey was carried out on a 10 mile square grid around that station. Intensive surveys were conducted at four such areas in the survey (Fig. 1).

At each coarse survey station four 15 min. midwater trawls (at 50, 100, 300 and 500 m) were attempted using a 510 Pelagic Trawl (Fig. 2). Also two oblique bongo tows at 50 m and 200 m were attempted with a 60 cm net with  $333/\mu$  mesh during Leg 1 and  $505/\mu$  mesh during Leg 2. Hydrographic operations consisted of an XBT cast and Kneudson bottle sampling at 0, 10, 20, 30, 50, 75, 100, 150, 200 and 250 m. Reversing thermometer temperatures were recorded and the water samples were analysed for dissolved oxygen content, salinity, chlorophyll, and nutrients.

At each intensive survey station the full complement of hydrographic and bongo operations was carried out, and only one 300 m oblique midwater trawl was conducted.

All midwater trawl samples were sorted at sea for cephalopods. Cephalopods were identified later in the laboratory and morphometric analysis (Amaratunga and Budden, 1982) was carried out on <u>Illex</u> samples.

## Results and Discussions

The coarse survey consisted of four north/south transects at 63°W' 62°W, 61°W and 60°W (Fig. 1). The objective of the intensive survey was to determine water mass structure in the areas of large squid concentrations. However, total interpretation of the water profile data is not completed; hence unless otherwise stated, the intensive survey data are considered here along with the coarse survey data. Table 1 summarizes all station operations.

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Midwater trawl net samples were sorted but all cephalopods have not been completely identified yet. It is probable that a few small-sized I. illecebrosus may be among them. Preliminary identifications have resulted in a total of 2,458 Illex ranging from 6.1 to 46.4 mm mantle length (ML). Table 1 gives the number of Illex caught in each midwater trawl. It is important to note that one set; Set Number 46 at 300 m (46-03) resulted in 1,058 Illex and this represented 43% of the total number of Illex caught in the cruise. This was an unusually large catch which tended to bias the interpretations of the general cruise data. When Illex catches were examined in relation to time of day and depth, it appeared that the greatest number were caught between 12:01-18:00 h at 300 m (Table 2). However when Set 46-03 was excluded, the more true pattern showed the greatest catches were between 18:01-00:00 h, followed by 00:01-06:00. Similarly catch rates (mean number of Illex per tow) after the exclusion of Set 46-03 were highest between 18:01-00:00 h followed by the 00:01-06:00 time segment. Catches and catch rates remained greatest at 300 m in all time segments except 18:01-00:00 h when they were apparently more dispersed in the water column.

The overall cruise catches and catch rates are relatively uniform throughout the water column (Table 2). Therefore <u>Illex</u> catches at all depths were summed to depict geographical distribution (Fig. 3). Figure 3 also depicts the corresponding sea surface temperatures, while the position of the Gulf Stream and eddy represented in Figure 1 were estimated from sea surface temperature charts. A wide range of water temperatures (3.2°-21.8°C) were sampled, and <u>Illex</u> catches were greatest within an intermediate temperature range of 10.1-16.0°C (Table 3). In waters where surface temperatures were between 10.1° and 16.0°C, 2,374 or 96.6% of <u>Illex</u> were caught, while 91.8% were caught within a 4° range of 12.1-16.0°C. Mean mantle lengths of <u>Illex</u> decreased as water temperatures increased (Table 4).

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Geographically, <u>Illex</u> distribution was within a band of intermediate water temperature between the warm Gulf Stream and the cold slope water masses (Fig. 3). During the survey a well-defined warm core eddy, still attached to the Gulf Stream, was observed (Fig. 1). Largest catches were associated with this eddy and the water between the eddy and the Gulf Stream. Interestingly very few <u>Illex</u> were caught in the slope water, and except for one specimen in Station 41, no <u>Illex</u> were caught in the Gulf Stream.

The geographical distribution, when considered temporally, also shows interesting patterns. Transects were occupied sequentially: Transects 1 and 2 during the period Feb. 2-12, and Transects 3 and 4 between Feb. 14-25. If we were to neglect the potential influence of temperature and water mass structure, squid were then being encounted farther north and closer to the Shelf as time progressed (Fig. 3). This probable Shelfward movement of rapidly growing juveniles is further supported by an apparent increasing mantle size gradient northward (Table 5). Table 6 shows the mean ML at stations completed along each transect. The north-south mean size differential is 16.9 mm in a maximum period of 25 days, or a maximum mean daily growth rate of 0.67 mm. Amaratunga (1980), in a three-year study (1977-1979), estimated possible growth rates ranging from 0.95 mm to 1.63 mm per day for animals up to 130 mm ML.

Temperature and salinity profiles for survey transects are presented in Figures 4(a-d) and 5(a-d), showing catches at depth.

#### References

Amaratunga, T. 1980. Growth and maturation of the short-finned squid (<u>Illex illecebrosus</u>) on the Scotian Shelf. NAFO SCR Doc. 80/II/30. Amaratunga, T., T.W. Rowell, and M. Roberge. 1980. Summary of joint Canada/USSR research program on short-finned squid (<u>Illex illecebrosus</u>), 16 February to 4 June 1979: spawning

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stock and larval survey. NAFO SCR Doc. 80/II/38.

Amaratunga, T. and F.G. Budden. 1982. Allometry of the squid <u>Illex illecebrosus</u>. NAFO SCR Doc. 82/VI/28. NAFO SCS Doc. 81/VI/20. Table 1. Summary of station locations, operations, and <u>Illex</u> catches during cruise 8202 (Feb. 2-12, Feb. 14-25)

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Table 1. (continued)

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Table 1. (continued)

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100	12.89 (	116)	1.55	(]	.7)	0.71	(5)	17.18	(189)	8.61	(327)
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500	5.50	(33)	2.80	(]	.4)	1.00	(8)	16.00	(160)	7.41	(215)
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Table 2. Mean numbers of <u>Illex</u> per tow and absolute numbers of squid by time and depth.

Numbers in brackets represent values obtained when catches from set 46-03(1058 Illex caught) are included.

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Table 4. Mean dorsal mantle length (DML) of <u>Illex</u> caught in various temperature regimes.

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	4.1-6	6.1-8	8.1-10	10.1-12	12.1-14	14.1-16	16.1-18	18.1-20	20.1-22
Mean DML(MM)	46.35	23.10	-	36.32	28.09	19.89	20.45	18.95	10.24
Number Squid measured	1	11	0	118	505	777	55	1	4

Table 5. Mean DML of <u>Illex</u> caught in 1 degree intervals of latitude.

	Geographical Location										
	North of 42°N	41°01' 42°00'	40°01' 41°00'	39 <b>°</b> 01' 40°00'	South of 39°N						
Mean DML(MM)	36.91	27.53	21.76	24.31	20.09						
Number Squid measured	113	72	334	670	293						

TABLE 6. Mean Length of Illex at Stations in Transects Completed During Cruise 8202.

			t Number				
1 (63°W)		2 (6	2°W)	3 (61	°W)	4 (60°	YW)
Station No.	Mean DML	Station No	. Mean DML	Station No.	Mean DML	Station No.	Mean DM
2 3 5 6 7 8	25.35 22.60 23.71 25.14 16.28 10.24	19 18 17 16 13	46.35 15.71 15.65 12.86 18.37	23 24 25 26 27 28 37	23.87 28.13 16.65 19.72 20.60 15.65 31.16 18.05	59 57 56 55 46 45	37.49 22.39 22.73 18.63 34.49 16.88





Fig. 2. Schematic of 510 Pelagic trawl used during cruise 8202.

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Fig. 3. Sea-surface temperatures and <u>Illex</u> catches at stations completed during cruise 8202.

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NUMBER	16.20 16.20 16.15 16.19	16.20	16.20	16.23 6	8/71	1653	16 H	9
STATION 46	13.90 13.71 13.71 13.61 13.72		61.41	0000 0000	0C.HI	ية. 1	с. <u></u>	
45 45	SHH SHH 02:H1 02:H1	OHHI	14.35	87 HI	13.95	14.05	ା <u></u> ଥାର ଭ	Transect 4.
<i>ΗΠ</i>	19.10 19.22 18.45 18.45	5161	19.15	°81 °81	18,50	00'8/	18,20	' e profiles for
цз Из	18.00 18.05 18.05 18.05	18.05 05	18.05	18.09 ©	19.05	18.02	0/8/ 0/8/	
S	0	- v 20	1 {	(m) H7	120- 120-		250-	500 - Fig. 6

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		0		(W) H	рЕ ЬТ	150-	- v 1 8 8	500-	Fig.	

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7						
1 10	32.57 32.48 32.48 32.57 32.57 32.57 32.57 32.57	35.04 35.04	35.11	٩	Q	
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6/	33.12 33.12 33.10 33.10 33.10 33.10 33.10 33.12 33.12 33.12 33.12 33.12 33.12	8°0 8°	3541	<b>©</b>	۲	
LMBER /8	35.56 35.57 35.55 35.62 35.62 35.58	- RE - LSSE	R	0	Θ	
STATION NU	34.54 34.52 34.52 34.53 34.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.53 36.54 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.55 56.555	34.53 Ø	36.56	<b>~</b> @	•	•
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2 <sup>3</sup> 2	<b>35.20</b> 35.20 35.20	35.38 35.38 35.38	as.6 Bo.6	35%	9	٥
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TION NUM	35,89 35,87 35,85 35,87	35.87 ©	12.05 28.05 28.05		0	3
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5	37 3572 3572 3573 3573	35.69	35.74	35.69		O
	0	رس) 20 1	рертн б	150-	~~~ ; ~ M	500-

Fig. 5c. Salinity profiles for transect 3.

$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	23 <sup>2</sup>					- 2	1 -				
$S_{00} = \frac{S_{00}}{100} = \frac{S_{00}}{100} = \frac{1}{360} = \frac{1}{360}$	46 STATION NUMBER	35.25 36.53	56.54 16.56	97 <u>5</u> 6	<b>56.71</b>	SS 3	<b>55.72</b>				
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