Northwest Atlantic Fisheries Organization

Serial No. N786 NAFO SCR Doc. 84/VI/13

SCIENTIFIC COUNCIL MEETING - JUNE 1984

Preliminary Results of the R/V *Gizhiga* Research Cruise on the Short-finned Squid, *Illex illecebrosus*, in NAFO Subareas 3 and 4 during March to June 1983

by

P. P. Fedulov, A. I. Arkhipkin, E. N. Shevchenko

Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO)
5 Dmitry Donskoy Street, Kaliningrad, 236000, USSR

and

T. W. Rowell

Invertebrates and Marine Plants Division, Fisheries Research Branch
Halifax Fisheries Research Laboratory, Department of Fisheries and Oceans
P. O. Box 550, Halifax, Nova Scotia, Canada B3J 2S7

Introduction

Large concentrations of juvenile Illex illecebrosus were first discovered in the area between the Gulf Stream and the Scotian Shelf edge in 1979 during the joint Soviet-Canadian cruise of the R/V Belogorsk (Amaratunga et al., 1980; Fedulov and Froerman, 1980; Froerman, 1980). Since 1979, there has been a concerted effort under NAFO, of both national and international research cruises, directed at elucidating the early life cycle and environmental influences on the distribution and abundance of I. illecebrosus. Much information has been obtained, and some of the main features of this squid's distribution and migration during various life stages have been determined (Froerman et al., 1981; Dawe et al., 1981; Dawe et al., 1982a; Amaratunga, 1982; Amaratunga and Budden, 1982; Hatanaka et al., 1982; Trites, 1982).

Additional information important to the understanding of the reproduction and early life history of I. illecebrosus has been developed using the aquatron facility of Dalhousie University in Halifax, N.S. (O'Dor et al., 1977; Durward et al., 1980; O'Dor et al., 1982) and through the reassessment of

previously collected data (Dawe and Beck, 1982; Dawe et al., 1982b).

During March to June 1983, the R/V Gizhiga was allocated to further Soviet-Canadian studies on I. illecebrosus in NAFO Subareas 3 and 4.

The objectives of the 1983 research were to: 1) determine the distribution and abundance of young I. illecebrosus in the area between the Gulf Stream and the Scotian Shelf edge; 2) determine the influence of water dynamics to abundance and distribution; and 3) collect further information on the biology of the species.

This paper summarizes preliminary results of the 1983 Gizhiga cruises.

Materials and Methods

The R/V Gizhiga operated from March 10 to June 14, 1983, in the area between the Gulf Stream and the Canadian shelf from 65° to 61°W. The cruise consisted of four legs. Location of stations for each leg and dates of operation are presented in Figures 1 to 6.

Nansen bottles were cast at each station down to 1000 m. A TO_2D probe giving a continuous record of temperature and dissolved oxygen content was also cast down to 1000 m.

A large midwater trawl with a small-meshed liner (10 mm) was used. The mouth openings of the liner had almost a circular shape and a radius of 7.5 m; its mouth area was 176 m^2. It was assumed that juvenile squid was caught only with the trawl's small-meshed liner and the gear did not catch animals when being retrieved since it moved slowly and vertically as a result of inadequate power to the winch.

A total of 354 trawl sets at 201 stations were made. Sixty-one tows lasted for 30 minutes while all the rest had a duration of 15 minutes. Towing speed was 3.5 knots. Depth of towing was measured as the centre of the trawl opening.

The number of sets at stations varied from one to five and was dependent on the vertical hydrographic structure of the

water as well as the availability of I. illecebrosus at the station. In the Slope Water areas, where the greatest number of trawl sets were made, daytime tows were usually made either directly above the oxygen minimum layer or on the lower boundary of warm Slope Waters while at night they were usually made at 50 m and 100 m.

A total of 115 large bongo tows were made using a 0.6 m bongo with 0.505 mm mesh. There were three types of bongo tows: oblique tows from 200 m up to the surface, step-tows at 25 m and 50 m, and a subsurface step-tow at 10-5-1 m. Only the bongo samples for Cruises 83-01 and 83-02 were sorted aboard for I. illecebrosus larvae.

Two diurnal trawling stations were completed during Cruises 83-01 (42°07'N, 63°36'W) and 83-04 (43°07'N, 57°59'W) for the purpose of studying the vertical distribution and migration of young I. illecebrosus. At the first diurnal station (covering a 56 h period) tows were made every 6 h at 35 m, 50 m, 100 m, 150 m, 200 m, 300 m, and 500 m, while at the second station (with a duration of 24 h) the tows were made at 35 m, 50 m, 100 m, and 200 m.

A bottom trawling survey of the Scotian Shelf was carried out in Cruise 83-04 using a Hake 4M type trawl (with the same small-meshed liner as that used in the mid-water trawl). Tow duration was 30 minutes.

After each tow, the catch was sorted by groups of organisms (fish, euphausiids, shrimps, other crustaceans, jellyfish, salps, and cephalopods). Each group was then weighed.

All cephalopods were identified to species or genus, then counted and weighed.

In each catch, biological analysis was made on 30 specimens of Illex. If the number of Illex captured was over 100 specimens, an additional 70 dorsal mantle lengths were required. Where catches exceeded 100 specimens, the remaining Illex were counted and weighed. With larger specimens, maturities were determined according to the scale of Burukovsky et al. (1977).

Results and Discussion

Cruise 83-01

This cruise took place March 10-29 in an area occupied by Sargasso Sea, Gulf Stream, and Slope Waters between 59° to 65°W (Fig. 1). Based on data from the previous surveys, it was postulated that a great number of post-larvae and juvenile Illex were transported by the Gulf Stream and concentrated in the Slope Waters just near the northern edge of the Gulf Stream.

Although a large number of biological stations were sampled on this cruise in areas with favourable environmental conditions for Illex juveniles, Illex occurred only on seven stations out of 37. In the northern edge of the Gulf Stream juveniles were caught in small numbers and only at Station 34 (modal length was 2.5 cm to 3.0 cm) (Fig. 7). Juveniles of Illex were caught in great numbers only at Stations 35 and 36. These stations were located in Slope Waters shoreward of a well-defined Gulf Stream meander (Fig. 1). A small catch of juveniles was also caught in Slope Water at Station 10. Modal length of these squid was 3.0 cm to 3.5 cm (Fig. 7).

Young Illex were caught in the eddy's periphery at three stations. There appear to be two modes, one at 3.0 cm to 3.5 cm and one at 5.0 cm to 5.5 cm, although the low number of Illex in the sample makes the determination of the 5.0 cm to 5.5 cm mode uncertain.

At Station 37, 45 specimens of Illex were captured at a depth of 50 m in the surface boundary between Slope and Shelf Waters.

Cruise 83-02

Cruise 83-02 took place from March 31 to May 4, in the same water masses as Cruise 83-01 but further to the east between 65° and 55°W.

Of the five stations in the Gulf Stream, Illex was caught only in small numbers (modal length 3.0 cm to 3.5 cm) (Fig. 8) at Station 54.

In the northern edge of the Gulf Stream squid occurred in small numbers at all stations (mantle length varied from 2.5 cm to 7.0 cm with a mode at 3.0 cm to 3.5 cm) (Fig. 8).

Fifty-five Illex were captured at five stations in the periphery of Warm Core Eddies. Modal length was the same as in the northern edge of the Gulf Stream (Fig. 8).

Illex was caught only once in an eddy core, at Station 91; two specimens of 2.5 and 5.5 cm.

In the Slope Water between the Gulf Stream and Shelf-Slope Water surface boundary, juvenile Illex appeared to be uniformly dispersed in small numbers (Fig. 2). Shoreward of this boundary, Illex was found in grearter numbers (Fig. 3) in Slope Water below the surface layer of Shelf Water. Illex caught in Slope Water ranged from 2.0 cm to 10.5 cm, with no apparent modes. This broad range and lack of modes may be the result of averaging length compositions of all stations. Larger squid (8.5 cm to 12.5 cm) occurred as a rule in the area near the continental slope as indicated by data from Station 123 (Fig. 8). Illex of the same size were caught in large numbers at Stations 41 and 42, which also were near the continental slope.

Illex also were caught in the Shelf Water just near the zone of Shelf-Slope Water interface. Lengths of these Illex were generally in the range of 7.5 cm to 10.0 cm, with a modal length of 8.5 cm to 9.0 cm.

Cruise 83-03

Cruise 83-03 was made from May 7-18 in an area southward and eastward of the Grand Banks. The main objective of this cruise was to attempt a determination of the degree to which juvenile Illex are carried with the North Altantic current into the central areas of the North Altantic. Only one Illex (mantle length 10.5 cm) was caught (Station 156) from the 21 stations fished east of the Grand Banks (Fig. 4). It was captured in Shelf Water at 25 m depth.

Cruise 83-04

Cruise 83-04 took place from May 21 to June 14 and consisted of three legs involving different survey activities. During the first leg (May 21-31) the Gizhiga operated mainly between the surface Shelf-Slope Water boundary and the edge of the Scotain Shelf. Near this boundary (Stations 179, 184) (Fig. 5) a great number of Illex were caught. Mantle lengths of these squid were very small (only 3.0 cm to 3.5 cm) for this period of the year when compared to those of previous years.

Seaward of this boundary, squid was virtually absent (Fig. 5). At Station 194, near the edge of the Shelf (depth 400 m) on the upper 100 m layer of Slope Water, 259 specimens of Illex were caught. The length composition of these squid indicates two modal groups, one at 5.5 cm to 6.0 cm and one at 7.5 cm to 9.0 cm (Fig. 9).

In the second leg (June 1-11) a bottom trawl survey of the Nova Scotia Shelf was conducted (Fig. 6) to study the distribution of Illex during the early on-Shelf migration period. Tows were made at three depth strata (I - <91.5 m; II - 91.5 to 183 m; III - >183 m). Illex was found in only 11 of the 66 trawls. Almost all were captured in depths greater than 150 m in the area between 64°20' to 63°40'W. Highest catches of Illex were at Stations 205 and 216 (Fig. 6). All stations, with the exception of Station 216, had modal mantle lengths of 11.5 cm to 12.0 cm. At Station 216, Illex was larger with modes of 10.5 cm to 12.0 cm, 14.5 cm to 15.0 cm, and 16.0 cm to 17.0 cm. The largest male and female squid were at the third stage of maturity.

During the third leg (June 12-14) several stations were made just near the Slope-Shelf Water zone of interaction between 55°W to 58°W (Stations 263 to 267) (Fig. 5). At two of them (Stations 265 and 266) a great number of Illex was captured. Modal length of Illex captured was different at each station: Station 265 - 4.0 cm to 4.5 cm; at Station 266 - 6.0 cm to 7.0 cm.

General Discussion

In Cruise 83-01, large numbers of Illex of 3.0 cm to 3.5 cm modal length were caught only late in March (Stations 35 and 36) (Fig. 1). This suggests that intensive concentration or transportation of juvenile Illex had not yet begun. By April (Cruise 83-02) Illex began to occur in great numbers in the northern edge of the Gulf Stream and in Slope Water. Taking into account the mean length of these squid, we suggest that the peak of spawning occurred later in 1983 than in previous years. For example, in 1982 according to Hatanaka et al. (1982), peak spawning likely occurred in January; and as a result, in late February and early March 1982 great numbers of larvae and small juvenile Illex were captured in this area.

The occurrence in late May of large numbers of small squid (3.0 cm to 3.5 cm modal group) of the same size as those caught in April suggests a second peak of spawning roughly a month later than the first.

In contrast to the 1982 findings of the Evrika cruises (Dawe et al., 1982) only a single Illex was captured eastward and southward of the Grand Banks during Cruise 83-03.

The bottom trawl survey and information from Soviet fishing vessels operating in NAFO Subarea 3 indicate that Illex had began to migrate onto the Scotian Shelf by early June. Abundance of Illex east of 63°W appeared to be rather low. Highest catches were made near the Shelf edge in an area where there was an intrusion of warm (10°C) slope water (Fig. 6).

References

Amaratunga, T. 1982. Population structure of the squid Illex illecebrosus. NAFO SCR Doc. 82/IX/104.

Amaratunga, T. and F.G. Budden. 1982. The R.V. Lady Hammond larval-juvenile survey, February 1982 in Subarea 4. NAFO SCR Doc. 82/VI/34.

Burukovsky, R.N., G.V. Zuev, Ch.M. Nigmatullin, and M.A. Tsymbal. 1977. Methodic bases for developing of scales of maturity of reproductive system of squids after the

example of Stenotethis pteropus (Cephalopoda, Ommastrephidae). J. Zool., USSR, 52(12): 1781-1791.

Dawe, E.G. and P.C. Beck. 1982. Rhynchoteuthion larvae from the northwest Atlantic and aspects of the distribution of larval Illex. NAFO SCR Doc. 82/VI/26.

Dawe, E.G., Yu.M. Froerman, E.N. Shevchenko, V.V. Khalyukov, and V.A. Bolotov. 1982a. Distribution and size composition of juvenile short-finned squid (Illex illecebrosus) in the northwest Atlantic in relation to mechanism of transport, February 4 to April 30, 1982. NAFO SCR Doc. 82/VI/25.

Dawe, E.G., M.C. Mercer, and W. Threlfall. 1982b. On the stock identity of short-finned squid (Illex illecebrosus) in the northwest Atlantic. NAFO SCR Doc. 82/IX/91.

Durward, R.D., E. Vessey, R.K. O'Dor, and T. Amaratunga. 1980. Reproduction in the squid, Illex illecebrosus: first observations in captivity and implications for the life cycle. Int. Comm. Northwest Atl. Fish. Sel. Pap. 6: 7-13.

Fedulov, P.P. and Yu.M. Froerman. 1980. Effect of abiotic factors on distribution of young short-finned squids, Illex illecebrosus (Le Sueur, 1821). NAFO SCR Doc. 80/VI/98.

Froerman, Yu.M. 1980. Biomass estimates of young Illex illecebrosus (Le Sueur, 1821) from a survey in Subareas 3 and 4 in March to April 1979. NAFO SCR Doc. 80/11/36.

Froerman, Yu.M., P.P. Fedulov, V.V. Khalyukov, E.N. Shevchenko, and T. Amaratunga. 1981. Preliminary results of the R/V Atlant of short-finned squid, Illex illecebrosus, in NAFO Subarea 4 and between 3 March and 4 May, 1981. NAFO SCR Doc. 81/VI/41.

Hatanaka et al. 1982. Aspects on the spawning season, distribution, and migration of short-finned squid (Illex illecebrosus) in larval and juvenile stages in the northwest Atlantic. NAFO SCR Doc. 82/VI/52.

O'Dor, R.K., R.D. Durward, and N. Balch. 1977. Maintenance and maturation of squid (Illex illecebrosus) in a 15 m circular pool. Biol. Bull. 153: 322-335.

O'Dor, R.K., N. Balch, E.A. Foy, R.W.M. Hirtle, D.A. Johnston, and T. Amaratunga. 1982. The embryonic development of the squid, Illex illecebrosus, and the effects of temperature on development rates. J. Northw. Atl. Fish. Sci. 3: 41-45.

Trites, R.W. 1982. Physical oceanographic features and processes relevant to Illex illecebrosus spawning areas and subsequent larval distribution. NAFO SCR Doc. 82/VI/24.

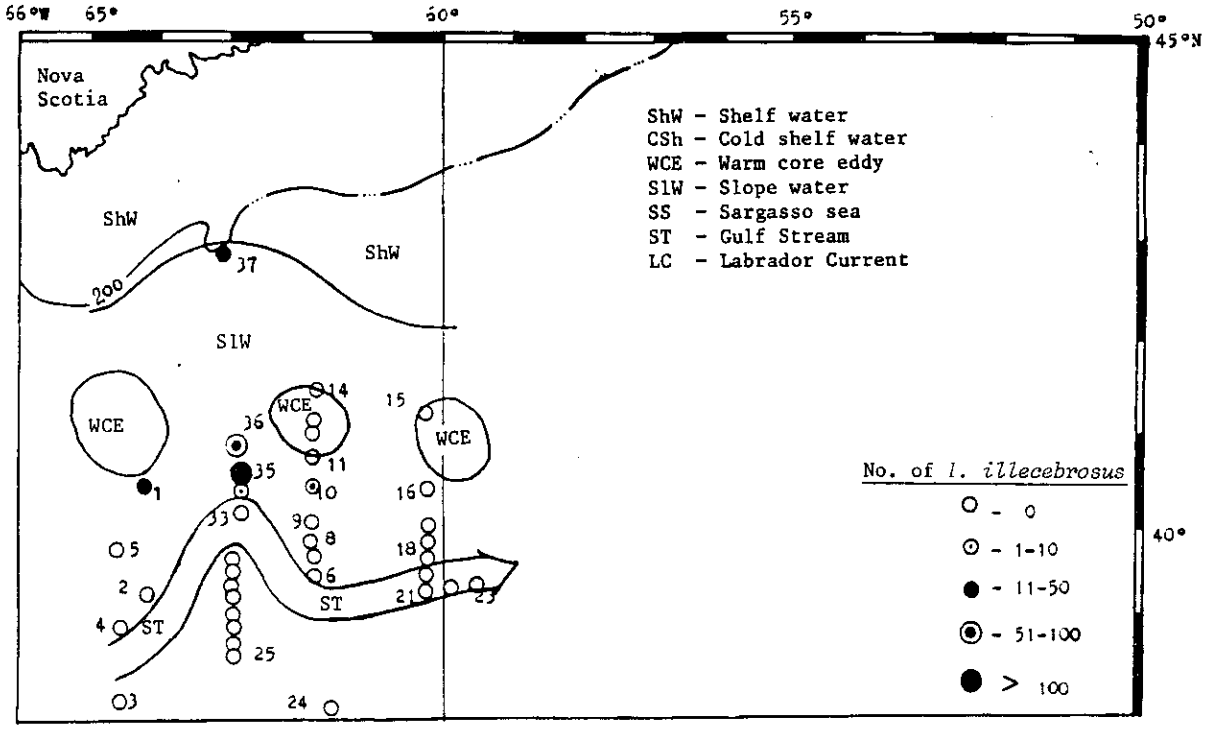

Fig. 1. Location of sampling stations and *Illex illecebrosus* captures in relation to water types during cruise 83-01 (March 10-28, 1983).

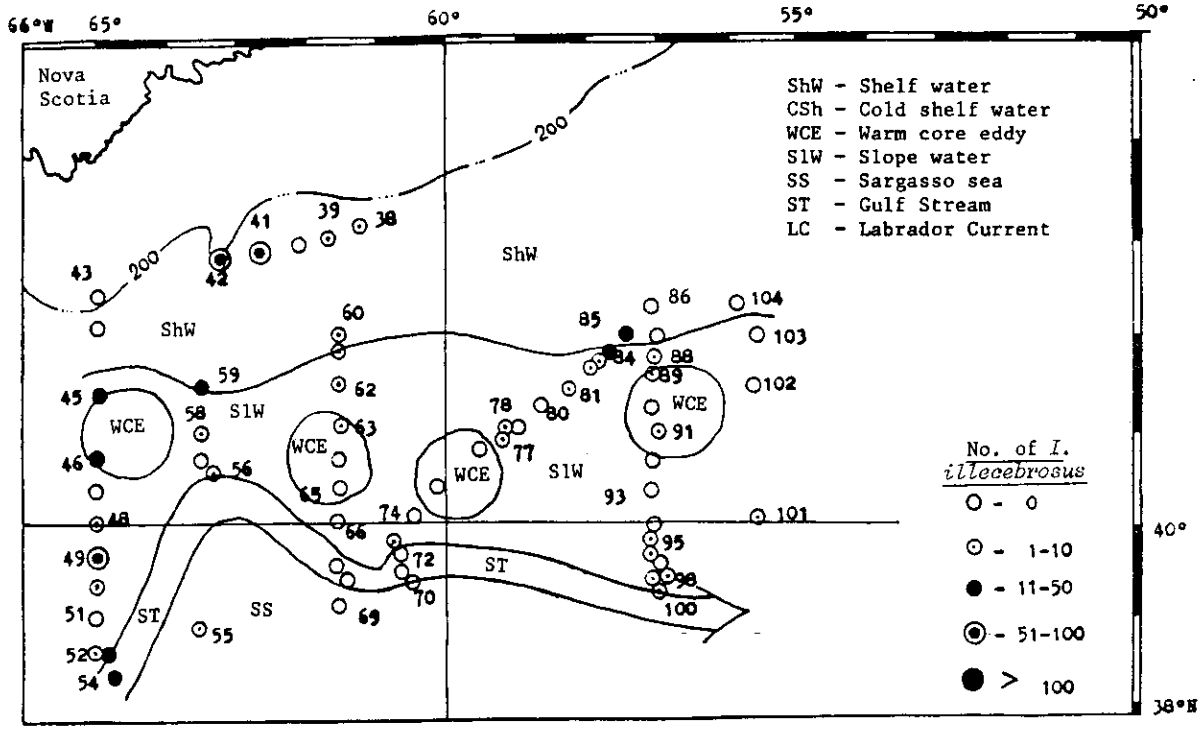

Fig. 2. Location of sampling stations and *Illex illecebrosus* captures in relation to water types during cruise 83-02 (March 31-April 21, 1983).

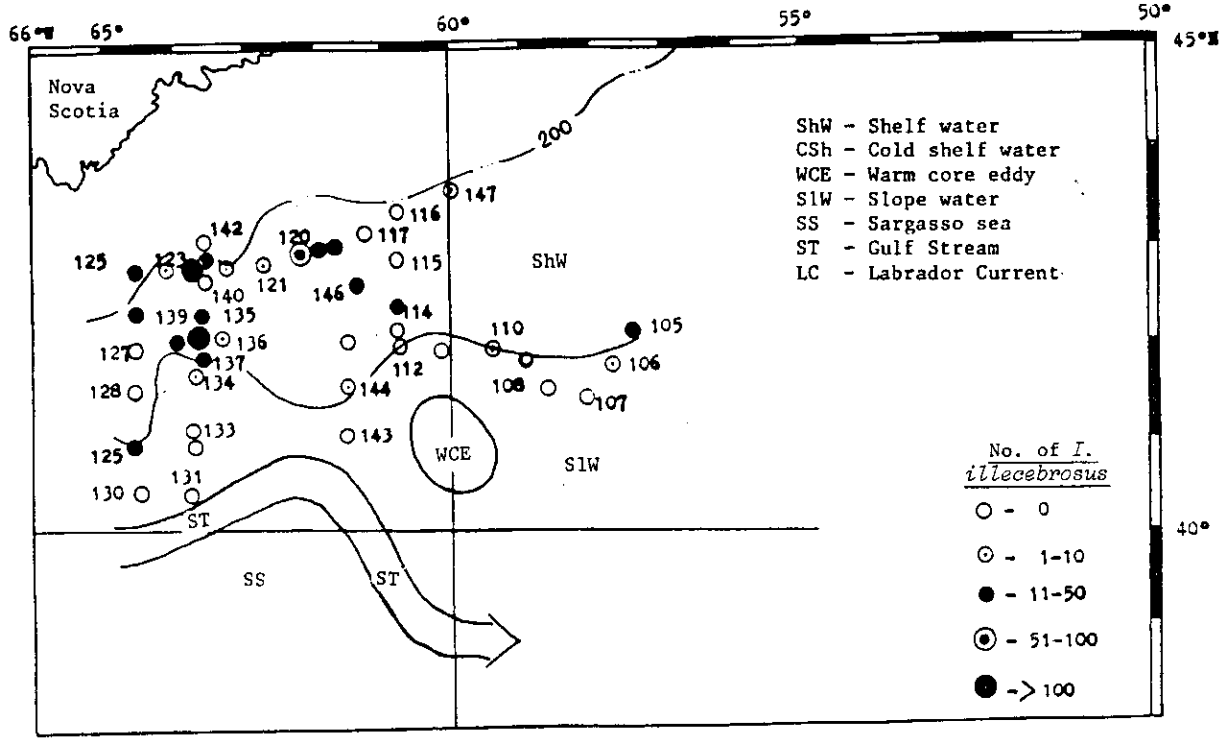

Fig. 3. Location of sampling stations and *Illex illecebrosus* captures in relation to water types during cruise 83-02 (April 22-May 4, 1983).

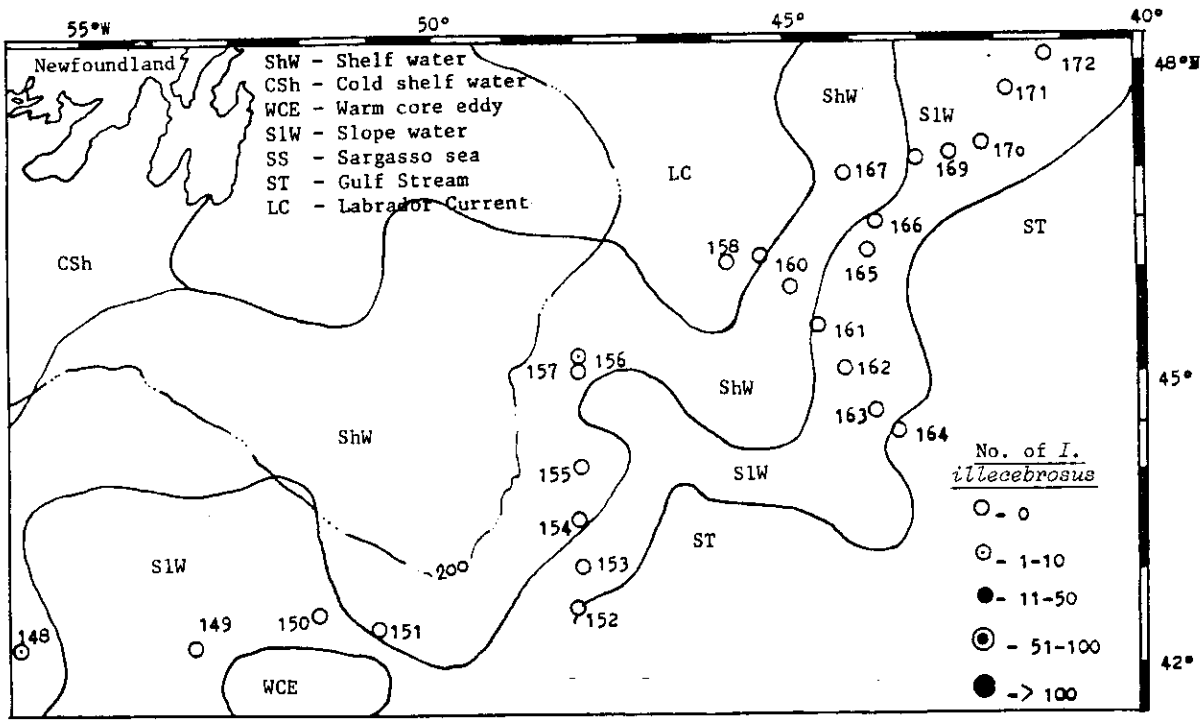

Fig. 4. Location of sampling stations and *Illex illecebrosus* captures in relation to water types during cruise 83-03 (May 7-18, 1983).

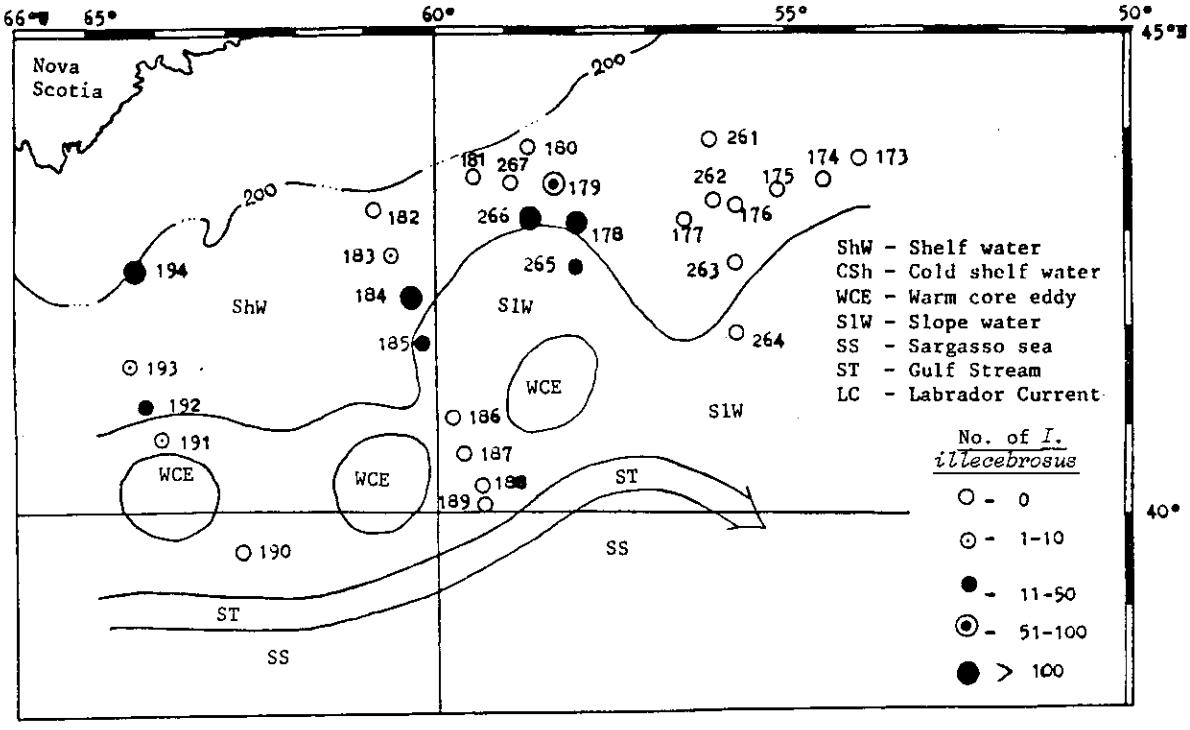

Fig. 5. Location of sampling stations and *Illex illecebrosus* captures in relation to water types during cruise 83-04 (May 21-June 14, 1983).

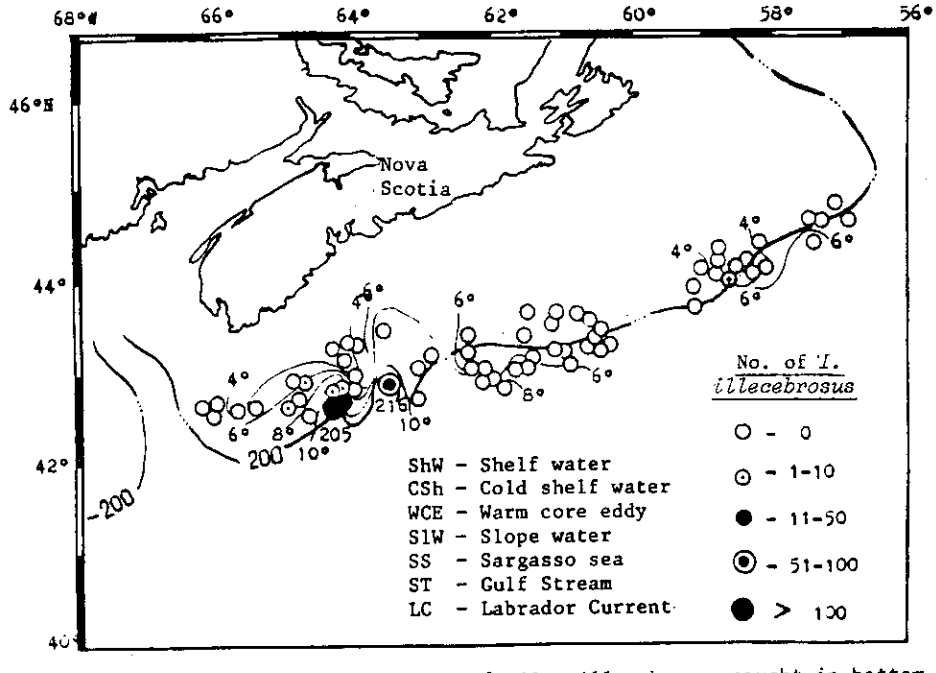

Fig. 6. Station locations and number of *Illex illecebrosus* caught in bottom trawl survey during cruise 83-04 (June 1-11, 1983) and temperature of water near the bottom.

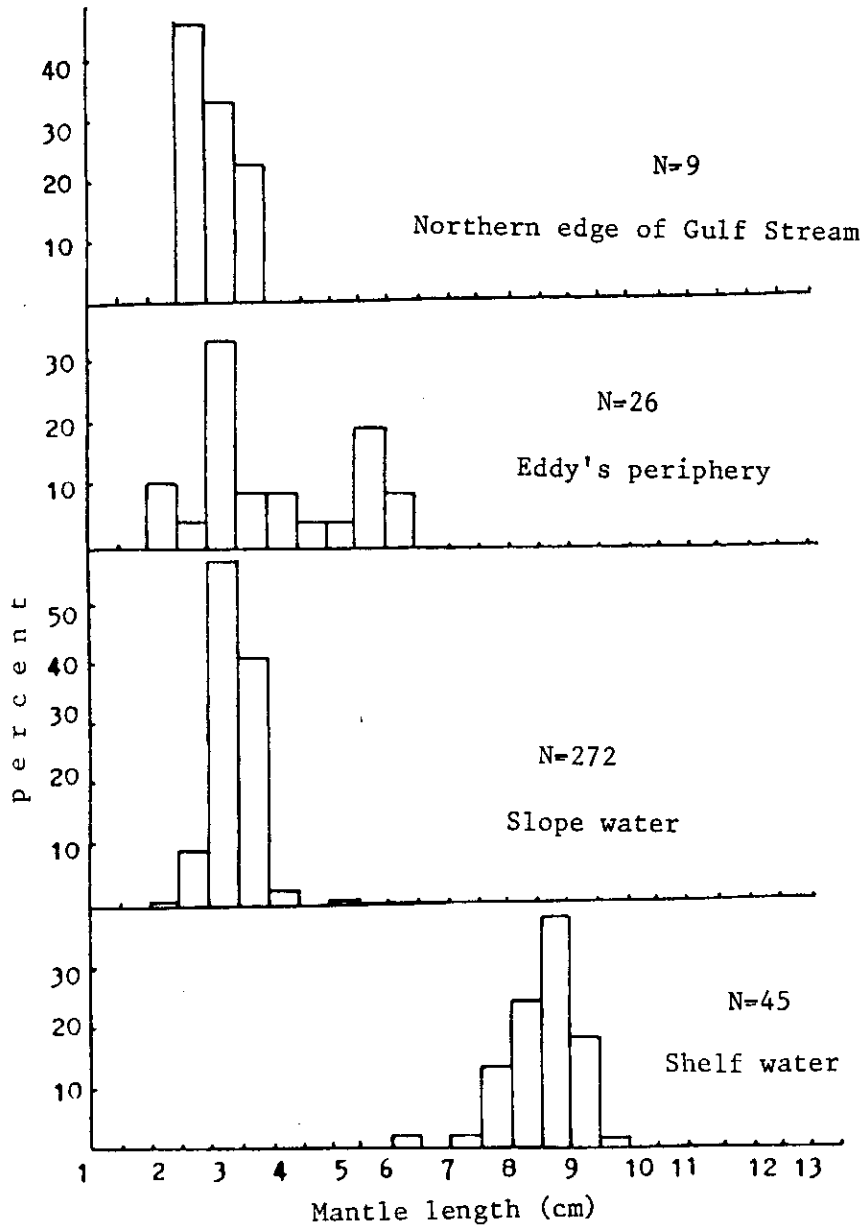

Fig. 7. Length composition of *Illex illecebrosus* in different water types. Cruise 83-01 (March 10-28, 1983).

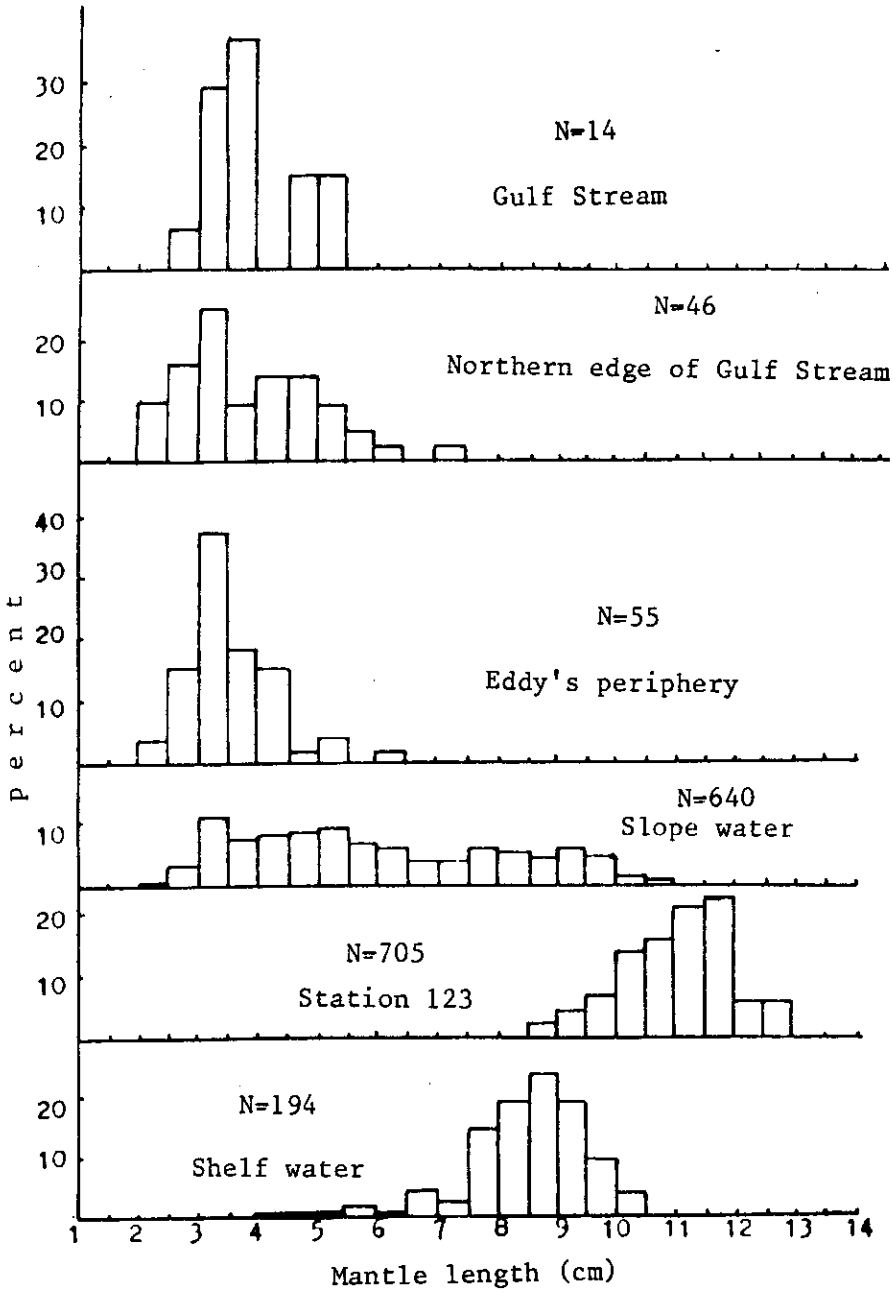

Fig. 8. Length composition of *Illex illecebrosus* in different water types. Cruise 83-02 (March 31-May 4, 1983).

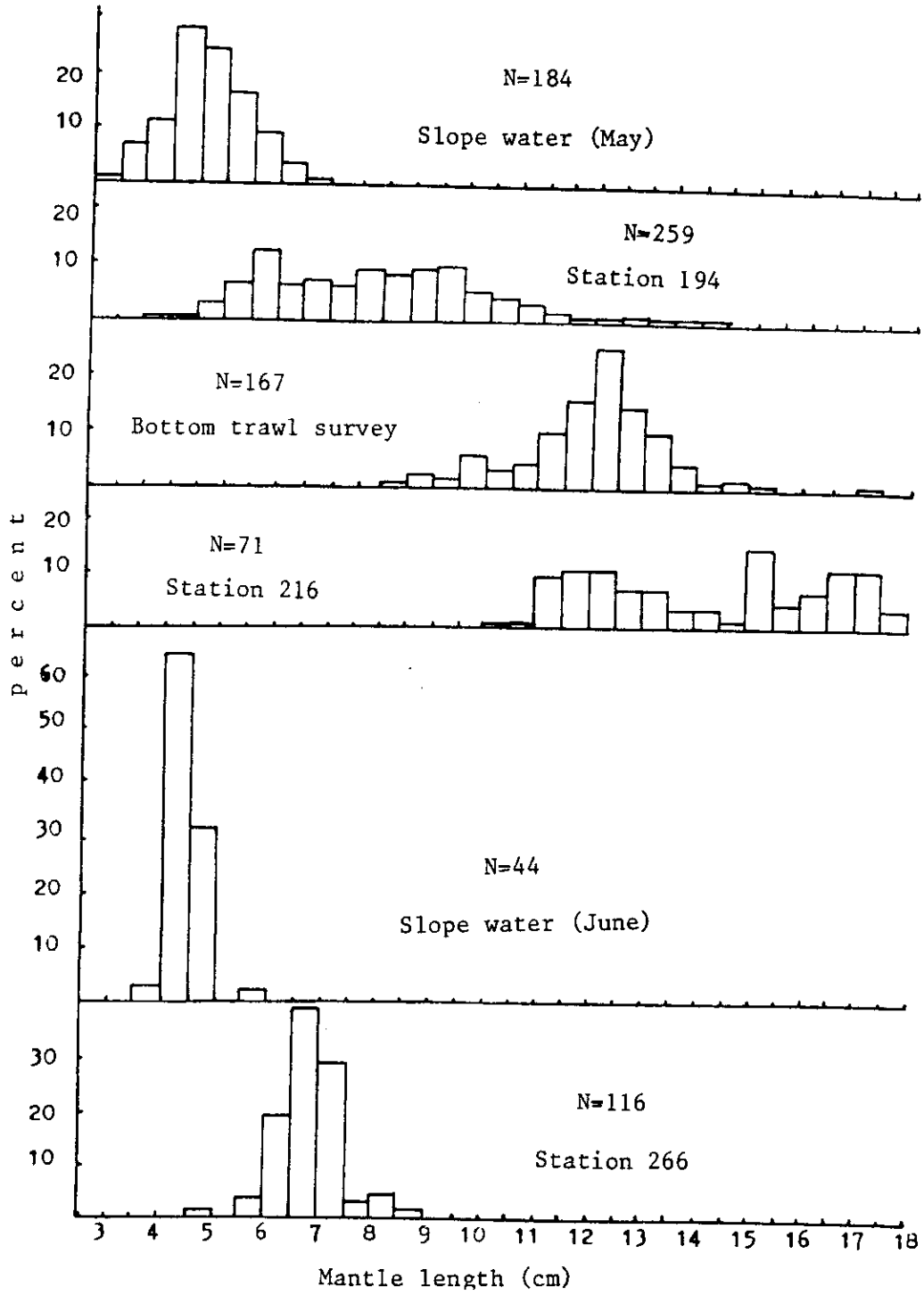

Fig. 9. Length composition of *Illex illecebrosus* in different water types. Cruise 83-04 (May 21-June 14, 1983).