International Commission for the Northwest Atlantic Fisheries

Serial No. 5332

ICNAF Res. Doc. 79/II/7
Revised

SPECIAL MEETING OF STACRES - FEBRUARY 1979

An acoustic estimate of capelin biomass in ICNAF Divisions 3LNO

by

A. Mari
Centro de Investigaciones Pesqueras
Havana, Cuba

ABSTRACT

An acoustic survey was carried out to estimate the biomass of the spawning capelin stock from Divisions 3LNO. Survey was conducted by the cuban research vessel Isla de la Juventud during the period 3-14 July, 1978.

The estimate of capelin biomass for the Divisions above mentioned was 4 500 metric tons, which represents a very low value in comparison with assessments of former years. In the whole area surveyed low concentrations of this species were found.

Biological analysis fulfilled on board showed a high per cent of small and inmature individuals, unusual fact for the time in which cruise was developed.

INTRODUCTION

The Southeast Shoal have been a traditional spawning zone for the capelin from Divisions 3LNO, being, for this reason, an area where commercial fisheries have taken place on this species.

Capelin fishery in this region is extended during the whole spawning period, that is, from June to July, specifically from June 15 to July 15, Carscadden (1977), being obtained the best catches in this time interval.

In order to assess the spawning capelin stock, the cuban R/V Isla de la Juventud conducted an "acoustic swept" on a large extension of the Grand Bank of Newfoundland area, with special attention to Southeast Shoal. Acoustic survey was carried out from July 3 to July 14, thus covering the last stage os spawning for this species.

A few days before the starting of the acoustic survey, the research vessels Rjsk from the USSR and Gadus Atlanticus from Canada had concluded their investigations on the Grand Bank, founding some difficulties in contacting with capelin concentrations due to scattering of the fishes (Carscadden, pers. comm.)

During 1977 the capelin stock from Divisions 3LNO was assessed by different authors and methods. Regarding this, Klochkov and Seliverstov (1978) using the photogrammetric techniques and underwater observation gave and estimate of 10^6 tons; and Carscadden, Miller and Winters (1978) based on an analitical method, found a biomass ranging from 80 000 to 130 000 tons.

Because of the differences between biomass estimates which originated certain uncertainty on the species abundance, it was decided to assess the stock during the spawning season in 1978.

MATERIALS AND METHODS

Calibration

The acoustic equipment was first calibrated to obtain the relationship between the integrated echointensity, M, and the number of fish per unit of area, ρ_A, i.e.,

$$\rho_A = C\,M + d$$

Fish counts were made for every different distance in meters, over a sailing distance of consecutive nautical miles. The selected integration interval was from 6 to 20 meters of depth. This short-range interval selected, prevented the overlapping between the consecutive sonic pings. The density coefficient, C, was calculated plotting the integrators readings (echo intensity) against the number of fish counted, and consequently the coefficient expressed the number of fish per unit of area which contributed to one unit of the integrated echo intensity. In the straight line the density, d, is the threshold density. The density coefficient mentioned above depends on fish species, size and on the characteristics of the sounder and integration system. The information explained before, together with the knowledge of the effective sampling area of the sound beam, permits to calculate the fish density ($\rho_A = C\,M$) in number of fish per unit of area, where C is the density coefficient and M is the integrator reading in millimeters when the echosounder TVG function is set to the 20 log R+ 2αR function, Midttum and Nakken (1971).

Survey vessel and equipment

The R/V Isla de la Juventud was used to survey the Grand Bank of Newfoundland during the spawning season of 1978 (Fig. 1). The instruments on board the vessel were Simrad SK3, Simrad EKS 38 (38 Khz) scientific echo sounder, Simrad echo integrator QM-MKII, Hewlett Packard storage oscilloscope and other recording and calibration instruments.

Survey Method

To survey the fishing area, a track pattern was selected taking into account the fish distribution during the cruise. The maximum distance between the basis of these tracks did not exceed the 20 nautical miles. It was apparent that capelin was not commonly distributed according to the normal pattern. When the vessel surveyed the Southeast Shoal the track was broken in order to take the largest available information. The vessel speed for survey purposes was aproximately 10 knots. This speed was reduced during the rough sea, when a considerable increase of interference ocurred.

Data Collected

The two channels of the echo integrator on board were set to cover aproximately the water column from 6 to 300 meters of depth. The echointegrator values were stored for each nautical mile (Fig. 2) and scrutinized each day together with the ecograms. When the "false echoes" (noise or false bottom) were put out, the correct echo intensities values were obtained.

The controls settings of the echo-sounder and the echo-integrator used during the survey were as follow:

Echo sounder

Recorder range: BI, BII, BIII
TVG and gain: 20 log R/0 dB
Discriminator: 5
Mode: WL
Band with and pulse length: 3 Khz and 0.6 MS
Output power: 1/1 Kw
Recorder gain: 7

Echo integrator

	Channel A	Channel B
Gain	30 dB	30 dB
Threshold	2	2
Interval	8-92	6-94 (variable)
Marker	on	on
Speed compensator	automatical	automatical

Biological Data

In each successful fishing operation (Fig. 3) a sample of 200 individuals was taken, being measured to the total lenght and to the nearest centimeter. Total lenghts were measured from the tipo of the mandible to the end of the ventral lobe of the caudal fin deflected back in a straight line with the body (Templeman, 1948). Once they were measured, the individuals were grouped in half centimeter lenght class. After this, all fishes were weighted and counted in order to calculate its mean weight. Subsequently, fishes were sexed and the gonadal maturation stages determined (according to the 4 points scale of Carscadden's, 1978). Otoliths were also removed, trying to complete 5 individuals per each lenght class. These otoliths were kept dry and stored in vials.

RESULTS AND DISCUSSION

Acoustic estimation

The best density values expressed in millimeters of deflection and read from the echointegrator, corresponded to the initial transept, aproximately in the area among 46°35' and 47°00' north latitude and 52°00' and 52°55' west longitude. The second best zone was found between 44°50' and 45°05' north latitude and 48°55' and 49°05' west longitude (northeast of Southeast Shoal) and finally the third best area of concentration was located to northeast of the Shoal above mentioned between 45°14' and 45°20' north latitude and 49°56' and 50°20' west longitude. All the areas described were considered as dense, attending to the abundance found and to the scale employed in this cruise. The remainig areas with lower density can be observed in Fig. 4.

Results of the density coefficient determinations are shown in table 1. Considering the values of M (millimeters of deflection) in the 30' X 30' ICNAF quedrancles on which the acoustic track was situated, a value of 4 500 tons was estimated.

Table 1. Estimates of the density coefficient (c) and threshold (d) during the calibration.

Year	(modal class)	(d)	(c)	(r)
1978	8 (cm)	11.1×10^3	12.85×10^3	0.76

$$d = \frac{\text{number}}{\text{mm(nautical mile)}^2} \qquad c = \frac{\text{number}}{\text{mm(nautical mile)}^2}$$

During the acoustic survey 12 fishing operations were made, from which 3 of them (1, 6 and 8) were successful. The modal classes obtained in the former operations were 8.0, 11.5 and 10.0 cm respectively (Fig. 5) not corresponding to the expected ones according to the fishing season in which the cruise took place. On the other hand, after analizing the length composition of fishes from all samples, a modal class of 10.5 cm was found (Fig. 6). The analysis of the proportion by sex and lengths of the individuals sampled gave a 69.9% of immatures, 16.7% of females and 13.4% of males (Fig. 7), in the modal classes of 10.0, 11.5 and 11.0 cm respectively.

It should be pointed out that all the length composition figures presented in this paper have a discontinuity to the end of the curve where the largest sizes occur. This is due to the poor representation of the traditional lenght classes (15-19 cm) in these divisions during the time of the survey, fact which may be explained because of the low abundance of adult fishes in the area. This also agrees with the fact of having only 3 successful trawls in 12 fishing operations and the similarity observed in the lenght composition figures.

Oceanography

In the area of the Grand Bank of Newfoundland, surface temperatures ranged from 9.6°C (station 2) in the northeast part and 9.1°C (station 20) in the east, to 18.2°C in the south part (station 30). In general, temperatures show an increment from north to south and east to west (Fig. 8), Gómez (1978).

Bottom temperatures on the Southeast Shoal (Fig. 9) attained the values of 4.5°C in station 23, showing a decrease to the north and south. In the area out the coast, where traditionally the spawning of capelin occurs (Southeast Shoal), temperatures were within the range of 2.0-4.5°C which, according to Carscadden et. al. (1977), Domasnes (1973), Sangolt and Ulltang (1976), Klochkov and Seliverstov (1978) and other authors is the optimum for the spawning of the species.

ACKNOWLEDGMENTS

We want to thank to Engineer Armando Cárdenas and the Acoustic Technician Omar Linares for the calibration of the acoustic equipments. Similarly, go our thanks to the captain and crew of the R/V Isla de la Juventud by the help given during the survey.

REFERENCES

CARSCADDEN, J.E. 1977. The capelin (Mallotus villosus) population spawning on the South east Shoal, 1976. ICNAF Res.Doc. No. 77/VI/14. Serial No. 5034.

CARSCADDEN, J.E.; D.S. Miller and G.H. Winters. 1978. Biological aspects of the Div. 3NO capelin stock in 1977 and a capelin secuential abundance model. ICNAF. Res.Doc. No. 78/VI/52. Serial No. 5217.

DOMMANES, A.T.; Monstad and B. Sangolt. 1974. The norwegian fishery on Grand Bank, Newfounland, 1973. (The "Nordglobal expedition"). ICNAF. Res.Doc. No. 74/63. Serial No. 3283.

KLOCHKOV, D.N. and A.S. Seliverstov. 1978. Assessment of abundance and biomass of the spawning stock of capelin in ICNAF. Division 3N in summer of 1977. ICNAF. Res.Doc. 78/VI/29. Serial No. 5190.

MIDTTUN, L. and Nakken, O. 1971. On acoustic identification, sizing and abundance estimation of fish. Fisk Dir. SKr. Ser. Havunders, 16(1):36-48.

SANGOLT, G. and Ø Ulltang. 1976. Norwegian capelin fishery and capelin investigation in Newfounland and Labrador waters in 1975. ICNAF. Res.Doc. 76/VI/23. Serial No. 3803.

TEMPLEMAN, W. 1948. The life history of the capelin Mallotus villosus (Müller) in Newfounland waters. Res. Bull. No. 17, Newfoundland Sout. Lab. 151 pp.

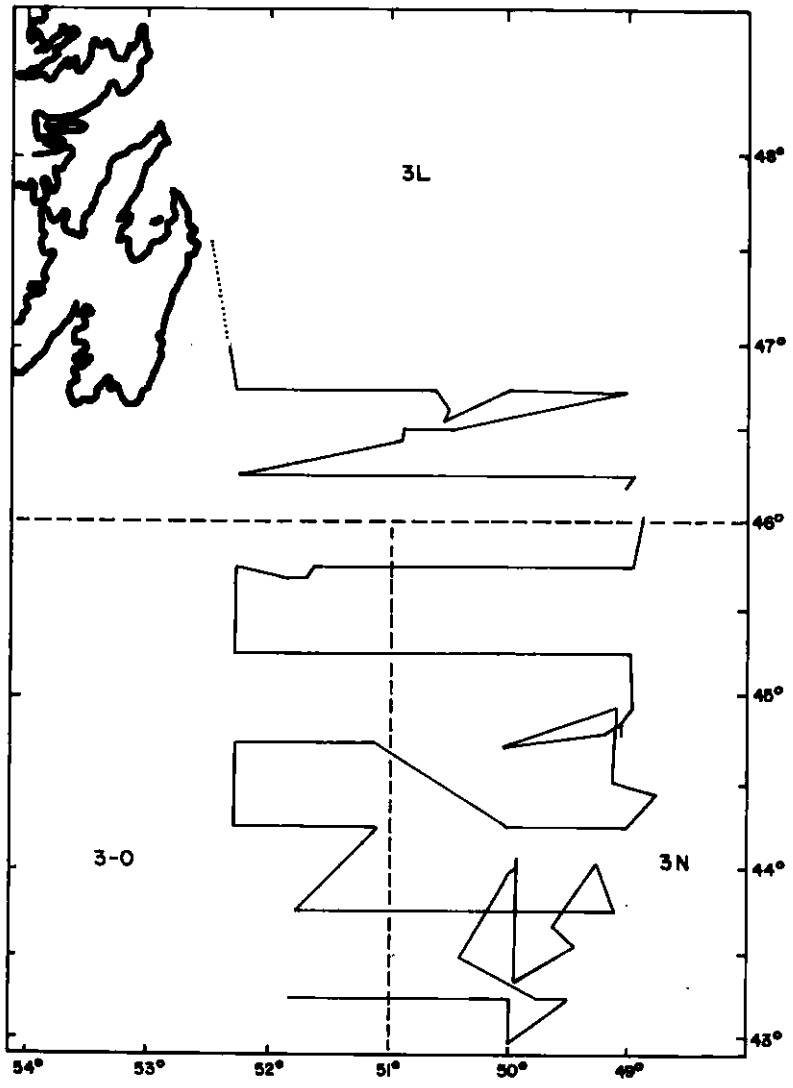

Fig.1 - Survey route of R/V Isla de la Juventud. 3 - 14 - July 1978.

Barco Nº		Fecha		Posicion de comienzo							Firma		Hoja Nº
Bitacora	Hora	Prof.	Capas codificad.	Contactos del sonar	Integrador A	Integrador B	Especies					Notas	

Sonar	Ecosonda EK 38		Integrador	A	B	
Rango	Rango		Estrato			
Transductor	TVG y aumento Lg dB		Aumento dB	dB		
Banda W y pulso /	Ancho banda y long. pulso KH ms		Umbral			
Aumento y pot. /	Rx aumt. y lineas/cm. /		Tope de fondo			
Inclinacion	Potencia de salida		Funcion			
Modo en serie	Discrm. y modo /					

Fig. 2. Logsheet for acoustic data.

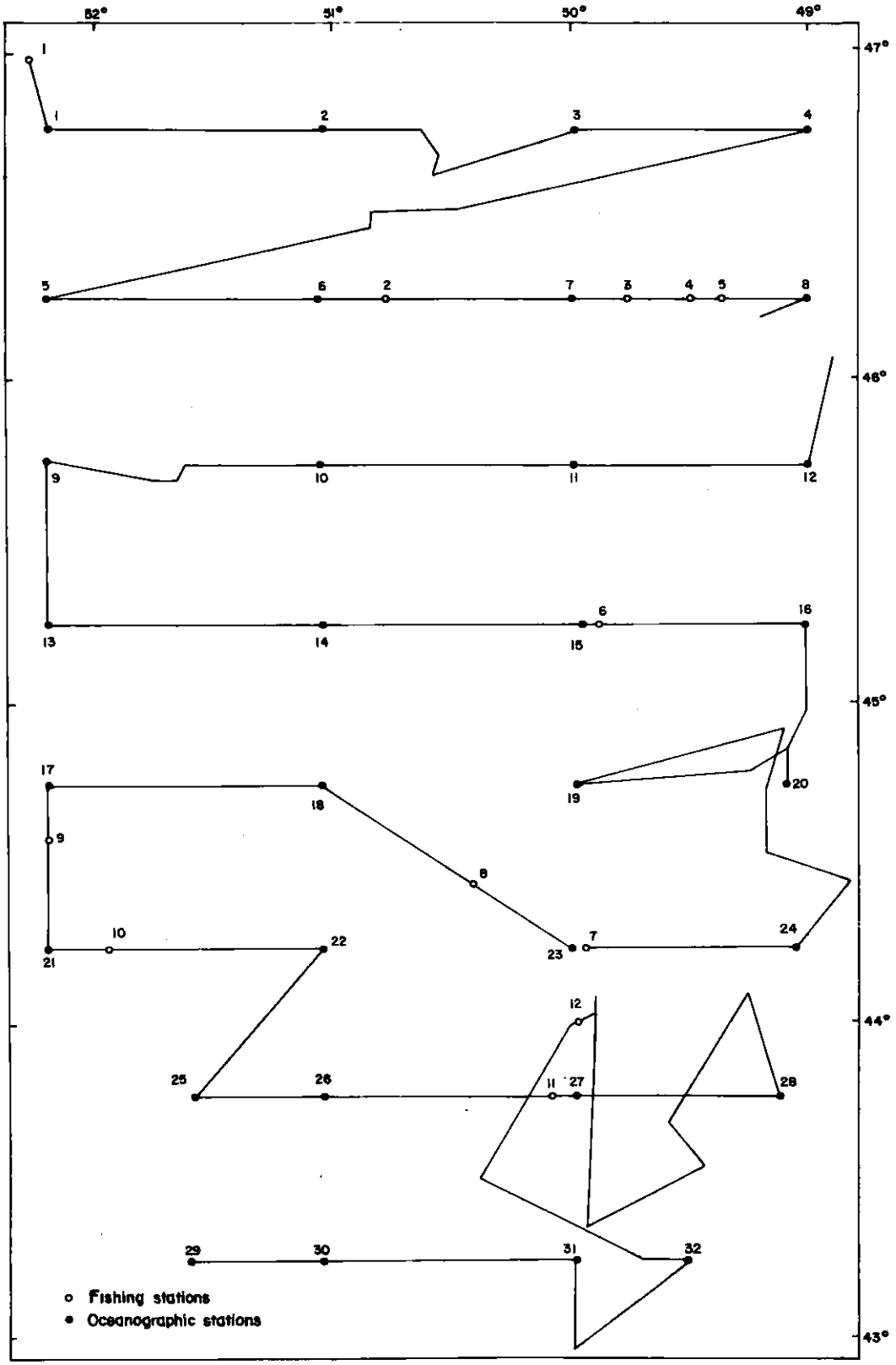

Fig. 3 - Survey route, oceanographic and trawl stations from 3 - 14 - july.

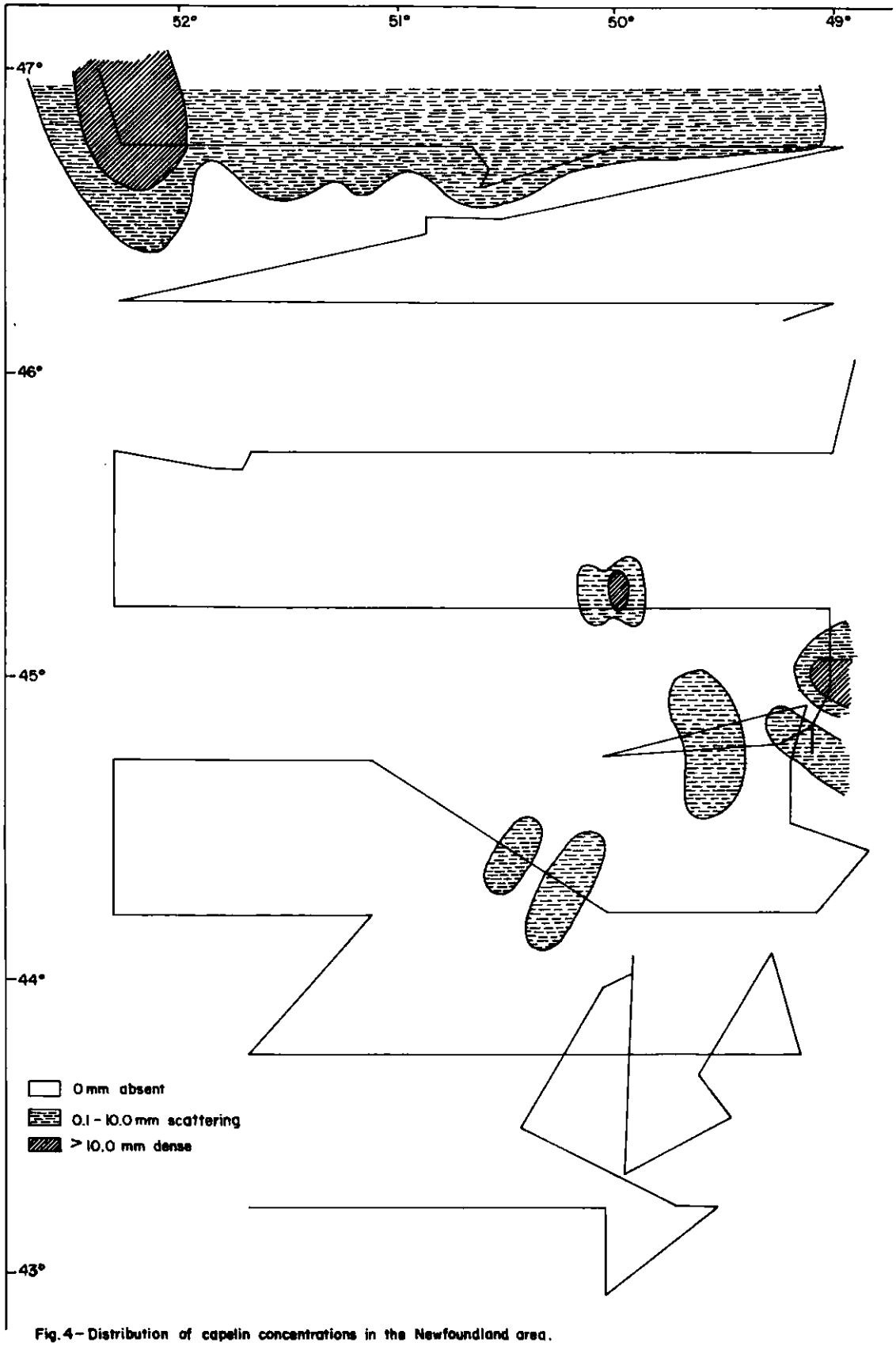

Fig. 4 - Distribution of capelin concentrations in the Newfoundland area.

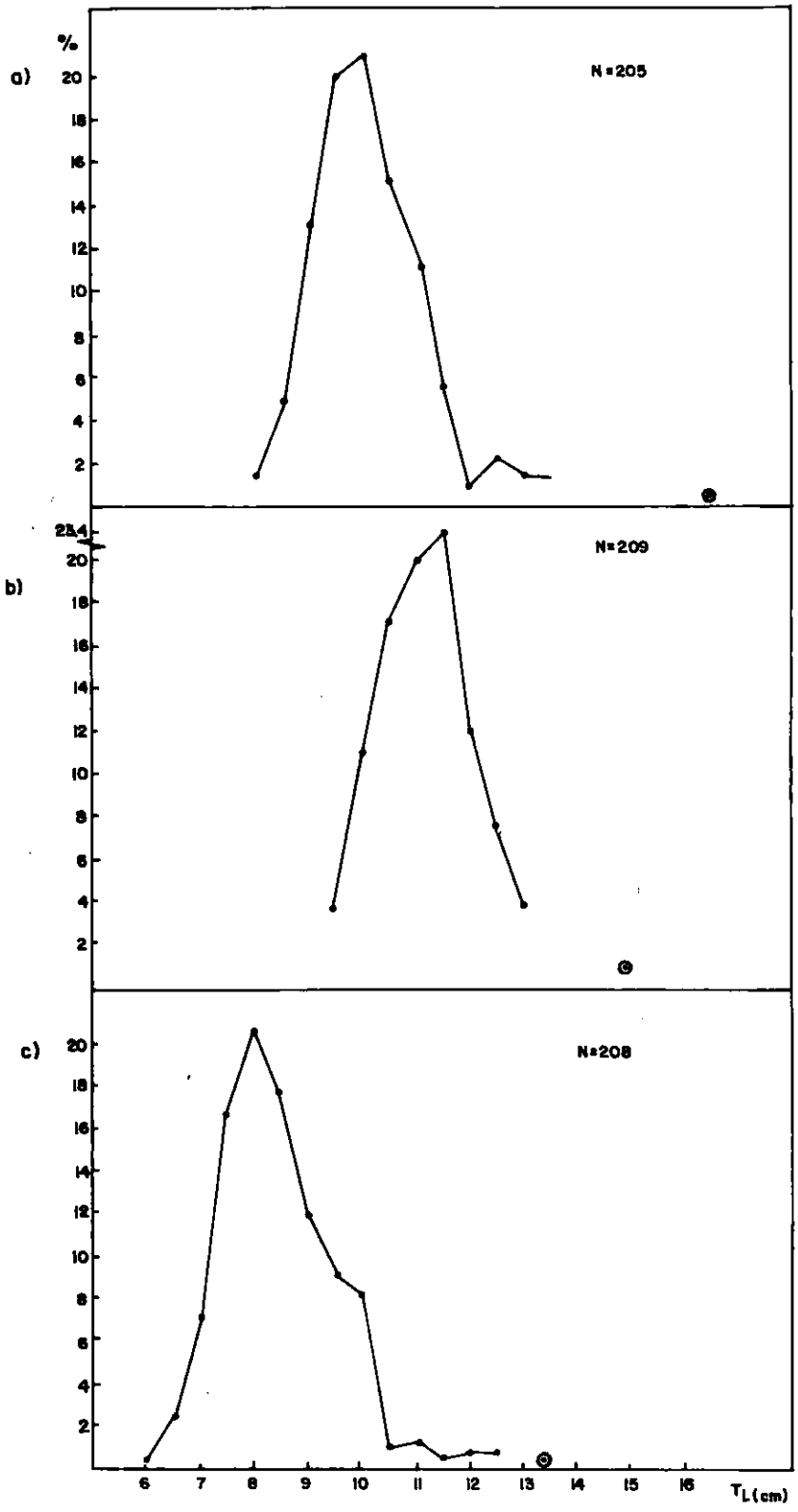

Fig.5-Size composition of capelin in trawl stations.
a) N°8 b) N°6 and c) N°1.

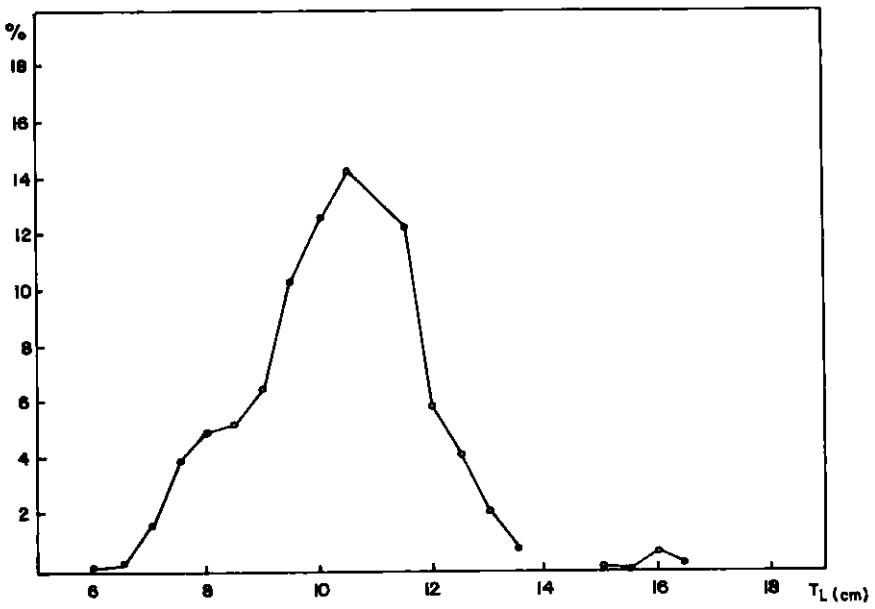

Fig.6 - Size composition for all the trawl stations.

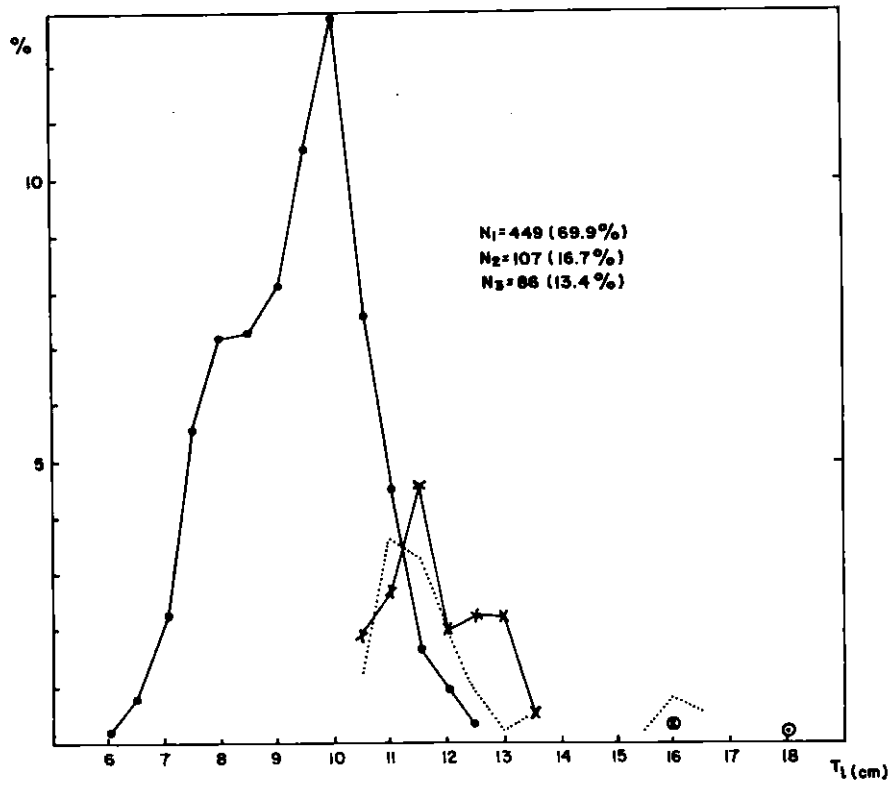

Fig.7 - Length composition by sex for capelin in divisions 3LNO.

N_1 = Inmature (•—•)
N_2 = Female (×—×)
N_3 = Male (·····)

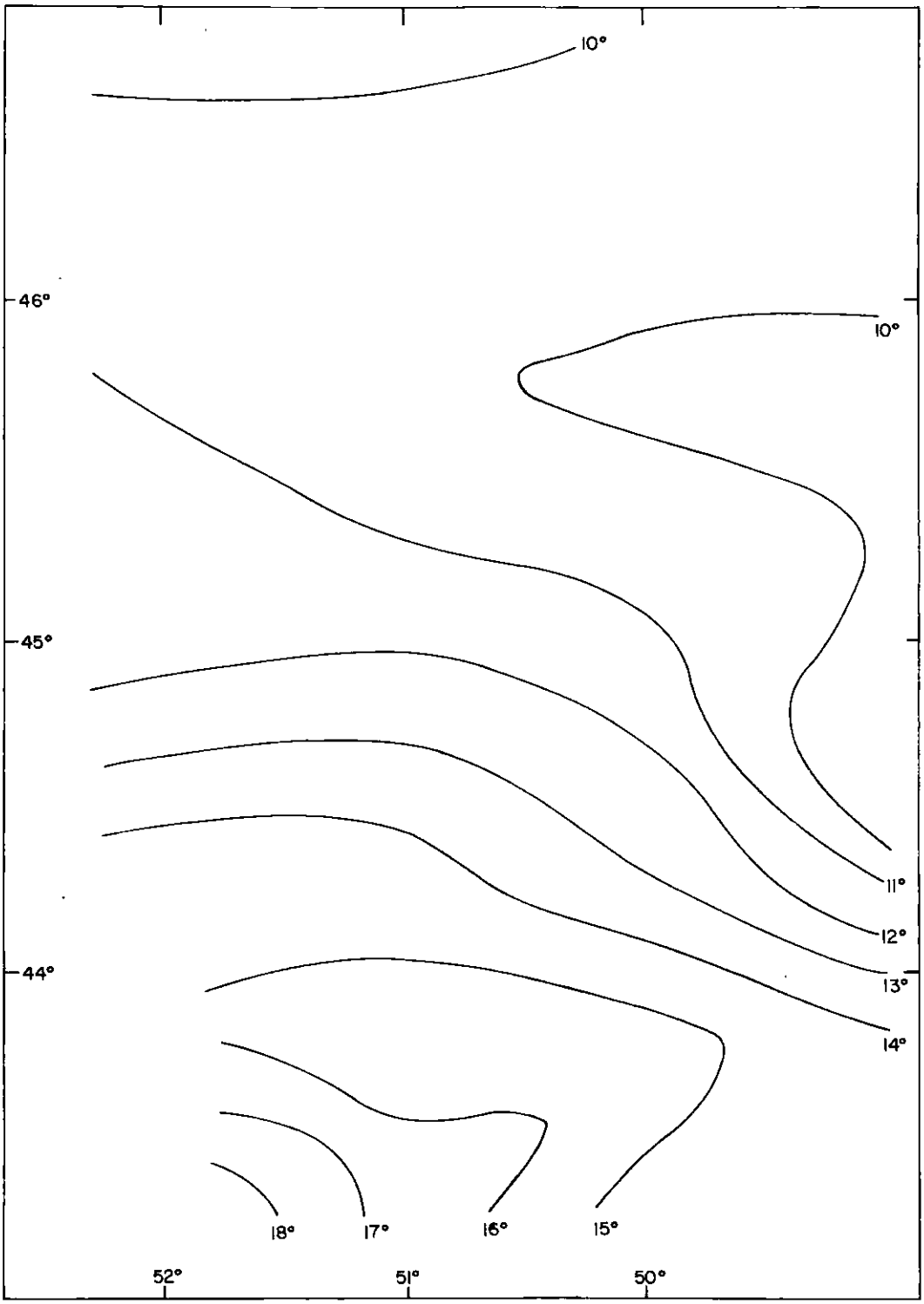

Fig.8 - Surface temperature during the cruise.

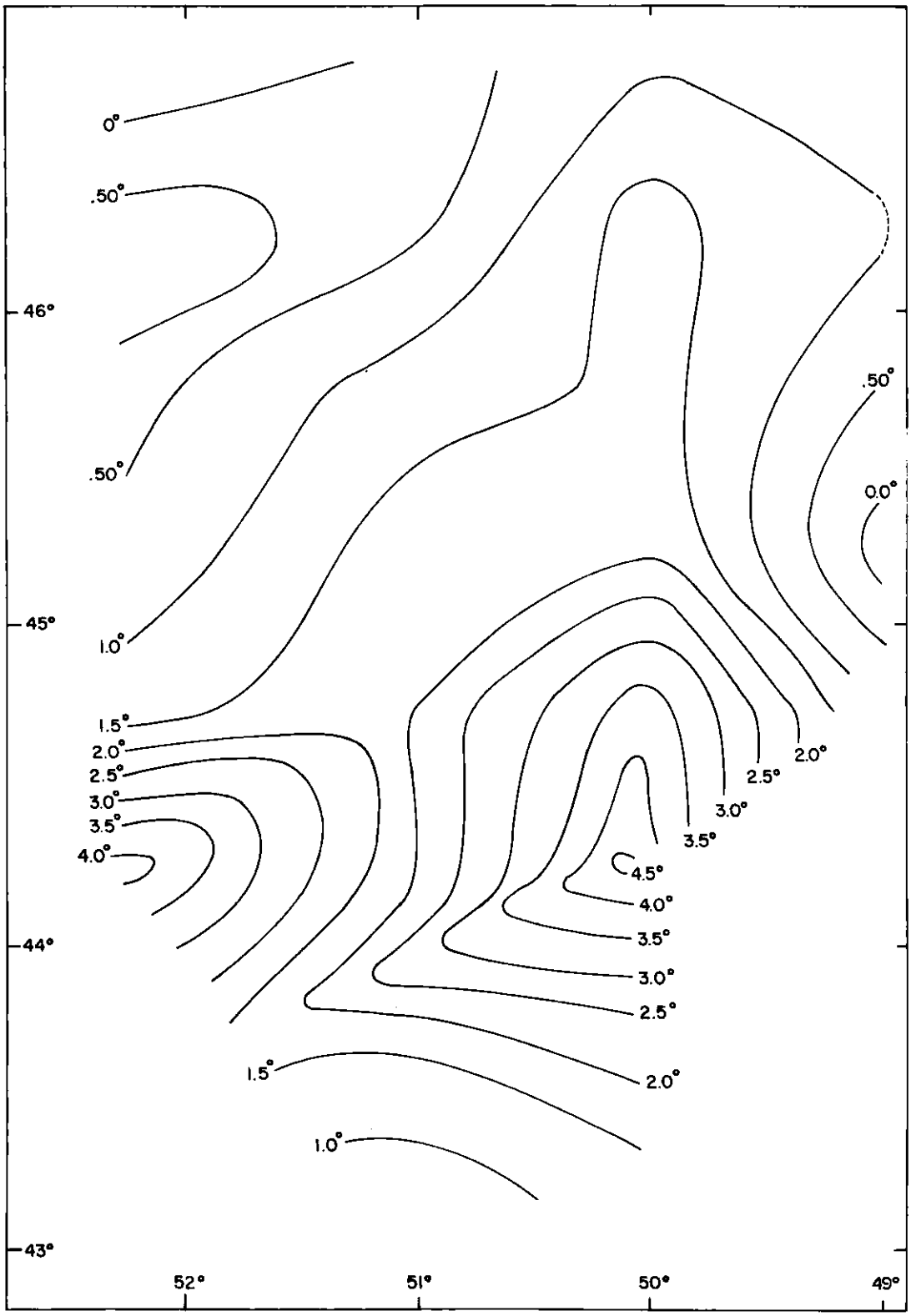

Fig.9 - Near - bottom waters isotherms.