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The results of the survey on abundance and distribution of herring larvae on Georges Bank, 18-30 October 1974

by

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SUMMARY

The results of herring larval survey on Georges Bank carried out from October 18 to October 30, 1974 during the cruise SRTM "Prognoz" (AtlantNIRO, Kaliningrad) according to ICNAF Programme adopted in 1971 are given in this paper.The results of the survey data analyses showedt that herring in 1974 was spawning later than in 1973. The lesser biomass of seston in comparison with 1973 was found in the majority of Georges Bank area. The analysis of hydrological conditions in October showed considerable influence of hydrometeorological factors on seston and larvae distribution.

INTRODUCTION

The survey made by SRTM "Prognoz" from October 18 to October 30, 1974, was the continuation of the activities started in 1971 according to ICNAF Programme on estimation of spawning herring stock in Georges Bank area basing on herring larvae counts and their habitats study.

The survey covered the area from 42°45'N to 40°00'N between meridians 65°30'W and 31°30' W (Fig. 1), where 90 stations were made. The adjacent waters of the Gulf of Main were to be covered during the survey but because of the lack of time the stations in this area were not made. The activities in the Gulf of Main were continued by the R/V "Albatross IV ", USA.

METHODS AND MATERIAL

The collection of herring larvae was made by the obligue towing method with the help of paired Bongo sampler with an opening diametre of 61 cm and the vessel speed of 3.5 knots. The mesh sisez were 0.505 and 0.333 mm and the towing was started from a layer of 100 m. In case of 100 m depth, the towing at station started from 5 metres above the bottom. The lowering speed of Bongo net was 50 m/min while lifting speed - 8-10 m/min. Bongo net was directed into the definite layer with the help of time depth recorder (GDR). To estimate the amount of filtered water the flow meters were used. Ichthyoplankton was selected and treated with the help of binocular microscope MBI-1. A total length of herring larvae was measured to 1 mm below. In large samples 100 randomly-selected larvae were measured. To speed up the sorting of samples a Folson divider was used. Detailed station data and length frequencies and hydrographic observations were summarized on the standard Basic Data Summary sheets, and sent to the ICNAF Secretariat.

Seston and microplankton sampling were made during the larvae surveys. The majority of seston samples was for zooplankton. Seston and microplankton were sampled with a smaller model of Bongo net fastened to the large one 1m above. Mesh sises of the small net were 0.168 mm and 0.053 mm correspondingly. Seston biomass was estimated by volumetrical method with the help of Yashnov's device, and then biomass was calculated in grams under 1 sq. m. On the base of the data obtained by calculations the chart of biomass distribution was drawn (Fig. 8).

During the surveys Nansen bottles were lowered at standard layers of each station to estimate temperature and salinity; besides, wind velosity and direction, air temperature and roughness of the sea were estimated.

RESULTS

In this report the results of treating the samples taken by 0.505 mm Bongo net are given. A total of larvae sampled by this net was 32012 specimens, while in October 1973 their number was 58687 specimens. This difference in number is, perhaps, due to the fact that according to the data obtained, the herring in 1974 spawned a bit later in comparison with 1973, spawning being started in the end of the first decade of October.

A general pattern of larvae distribution in October 1974 (Fig. 9) is similar to that in previous years (Balkovoy V.A., 1973; Balkovoy V.A., Sushin V.A., Sigaev I.K., 1974). In the area investigated the irregular distribution of larvae was observed but they didn't occur outside the zones with high temperature and salinity gradients, which are usually observed along the south-eastern and southern borders of the Bank in this period. The largest concentrations of herring larvae was observed in the eastern Georges Bank area. Their less considerable concentration was found to the west of Nantucket Isle. The position of the former concentration suggests that this one comes from herring spawning grounds on Georges Bank, and latter one seems to come from the spawning grounds on Nantucket Shoals. This is supported by the analysis of the length composition (Fig.14) and the larvae distribution charts drawn for different length groups (Figs. 10-13). As Fig. 14 shows larvae of 7-8mm length dominated in Georges Bank area and that of 6-7 mm - in Nantucket Shoals area. This difference in dominant sizes of larvae from two areas is an indirect indication that herring from Nantucket Shoals area spawned later than on Georges Bank as usually.

The results of hydrological observations are shown in Figs. 2-7. Water temperature fistribution (Figs. 2-4) represents the hydrological typical situation for October. The isotherm position shows the gradient zone along the southern and south-eastern Bank slopes; this zone is most pronounced on the surface and at the depth of 30 meters. In this zone and to the south of it herring larvae do not occur as a rule. This zone at first sight may be considered as a natural barrier that is formed as a result of Gulf Stream and Georges Bank water masses interchange. This barrier prevents herring larvae from carring them out of the Shelf area.

The gradient zone, that was most pronounced on the chart of bottom - 100 m (Fig.4), was also found in the north-western Bank slopes area and at the entrance to the South Channel. This zone is formed due to wedging out and lifting of cold water of the intermediate layer in the South Channel area and its interaction with warmer water over the bank. Western Bank area where the largest concentration of herring larvae was observed, seems to be the most perspective area for the analysis of hydrometeorological conditions having influence on herring larvae distribution (Fig.9.). In this part of the area water temperature fluctuated from 11.6° to 12.8°C from the surface to the bottom, and isotherms of 12° and 13° had the shapes of the tongues, stretched parallel to eastern and south-eastern slopes according to anticyclonic water gyre around the Bank (Figs. 2-4). The observational data indicate that during the survey a north-western and northern wind predominated (table 2), with a sharp strengthening (to 10-17 m/sec) on October 18-22, i.e. when the stations in the eastern half of the survey area were occupied. It is likely, that strengthened influence of the northern and north-western wind on the regular currnt directed eastwards to the spawning ground, and south-eastwards along the slopes, caused an increased volume of wind driven water from the spawning ground and adjacent part of the Gulf of Maine towards the eastern and south-eastern Bank region resulting in formation of the major concentration of larvae in October. The influence of this effect upone the seston biomass distribution is discussed below.

The larvae concentration, second in magnitude, formed in the eastern Nantucket Sheals (Fig.9) is timed to a boarder dividing the zone of lowering water (anticyclonic gyre around the Nantucket Shoals) and that of lifting water (cyclonic gyre at the entrance to the South Channel). The results of calculations of geostrophic circulation made on the base of hydrological survey data obtained by the AtlantNIRO vessels in 1972, 1973, indicate that these zones occur in summer and fall. In figs 2-7 the zones manifest themselves indirectly, and can be seen by a peculiar curve of the isotherms and isohalines in these regions.

Salinity distribution (Figs. 5-7) is typical of the situation in fall, on the whole, however, a gradient zone along the south-eastern and southern slopes of the Bank seems to be considerably more dense compared with that in October 1973, especially, in the upper 30 m, which also results from the correlation between wind driven water and advection of water from the south.

The analysis of the seston biomass distribution showed that its predominant concentration was comparatively low (below 25 g/m^2). This biomass was distributed over the larger part of the Bank within 100 m isobath, and adjacent Gulf of Maine (Fig. 8). In October 1973 the seston biomass of the above density prevailed in the central Gulf of Maine, while the major area of the Bank was occupied by the biomass of over 25 g/m^2. In October 1974 the young organisms and adult forms of Copepoda predominated the zooplankton in the seston of below 25 g/m^2.

The highest seston biomass (over 100 g/m^2) represented mainly by Salpae and a small number of tropical Copepoda, was observed in the north-eastern and south-western parts of the survey area. The formation of large Salpae concentrations in thosec areas is due to advection of the Gulf Stream water.

In the eastern Bank region and eastwards of the Nantucket Shoals, where the largest concentrations of herring larvae were discovered, such Copepoda as Psendocalanus elongatus, Clausocalanus arcnicornis and Centropages typicus, The nauplial and copepodite stages of which surve as a diet for larvae, constituted a considerable share of the zhoplankton. Because of small size these forms do not make up large biomass, however, they occupy the major part of the area. Thus, the position of maximum larvae concentrations in October 1974, coincided with that of the main seston biomass, where the feeding objects of the larvae predominated.

It should be noted that the region of seston concentration in the eastern part of the Bank with the biomass of over 25g/m^2, coinciding with the region of maximum larvae concentration, coincides with the above mentioned configuration of 12-13° isotherms in the same region as well (Figs. 2,8,9). The effect of wind and current correlation evidently influenced the formation of higher concentration of zooplankton and larvae in this region.

In the eastern Nantucket Shoals, where a larvae concentration of smaller size was found the seston biomass was below 25 g/m^2. Water temperature there was somewhat lower than in the area of the main concentration.

DISCUSSION

The distribution of herring larvae on October 18-30, 1974, was typical of October, while
from a ratio of the larvae caught in October 1973 and

October 1974, as well as from the results of expeditionary observations on fishing, we have every reason to suggest that the spawning of herring in 1974 occurred later than in 1973. In October 1974 the influence of hydrometeorological factors on the distribution of water temperature, seston and herring larvae was pronounced more clearly.

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2. BALKOVOY V.A., SUSHIN V.A., SIGAEV I.K., 1974. Preliminary results of herring larvae survey on Georges Bank, 15 October - 1 November 1973. Annu. Meet. ICNAF, Res. Doc. 74/13. Ser. No 3160.

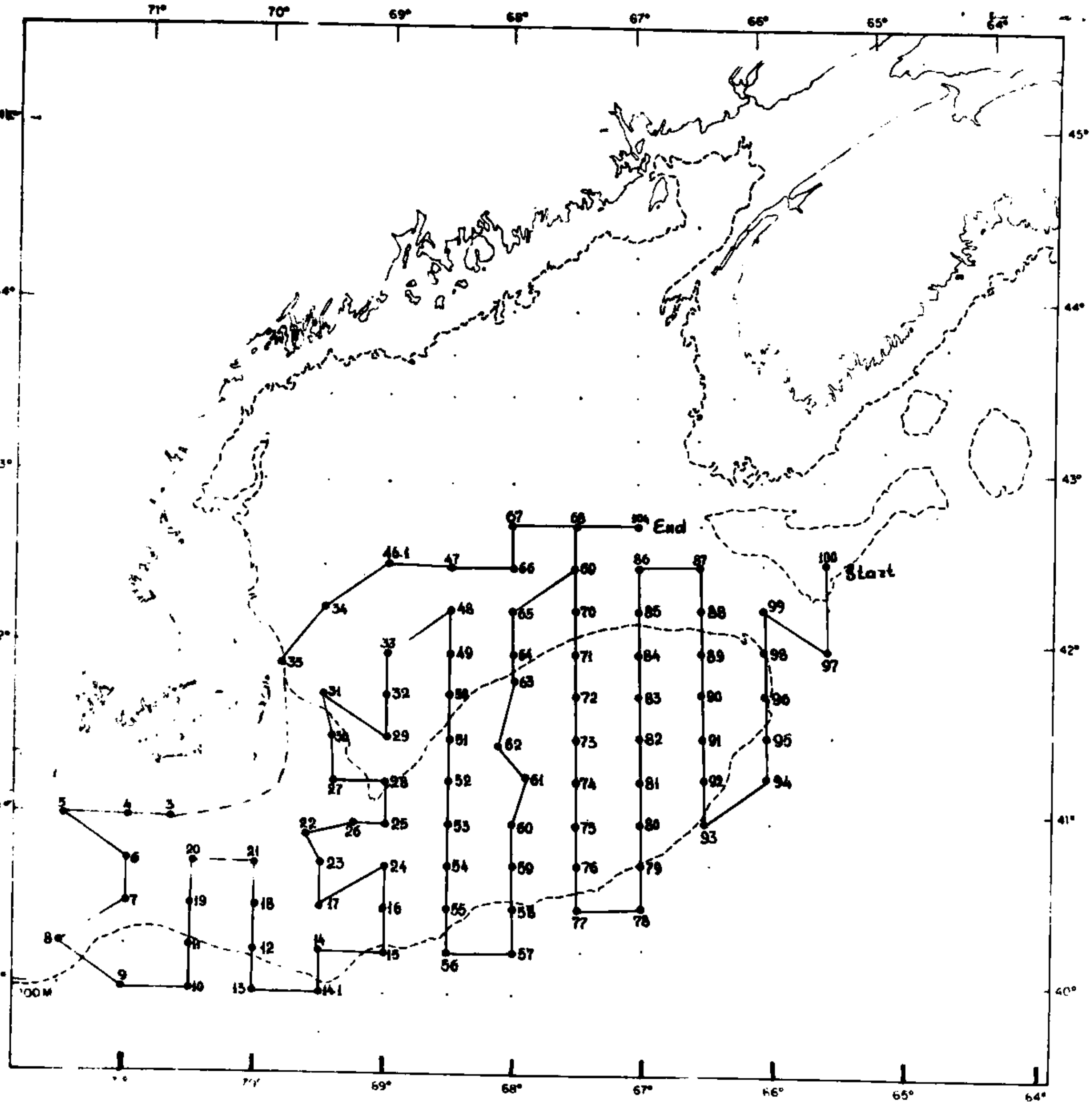

Fig. 1. Chart showing actual route of the survey.

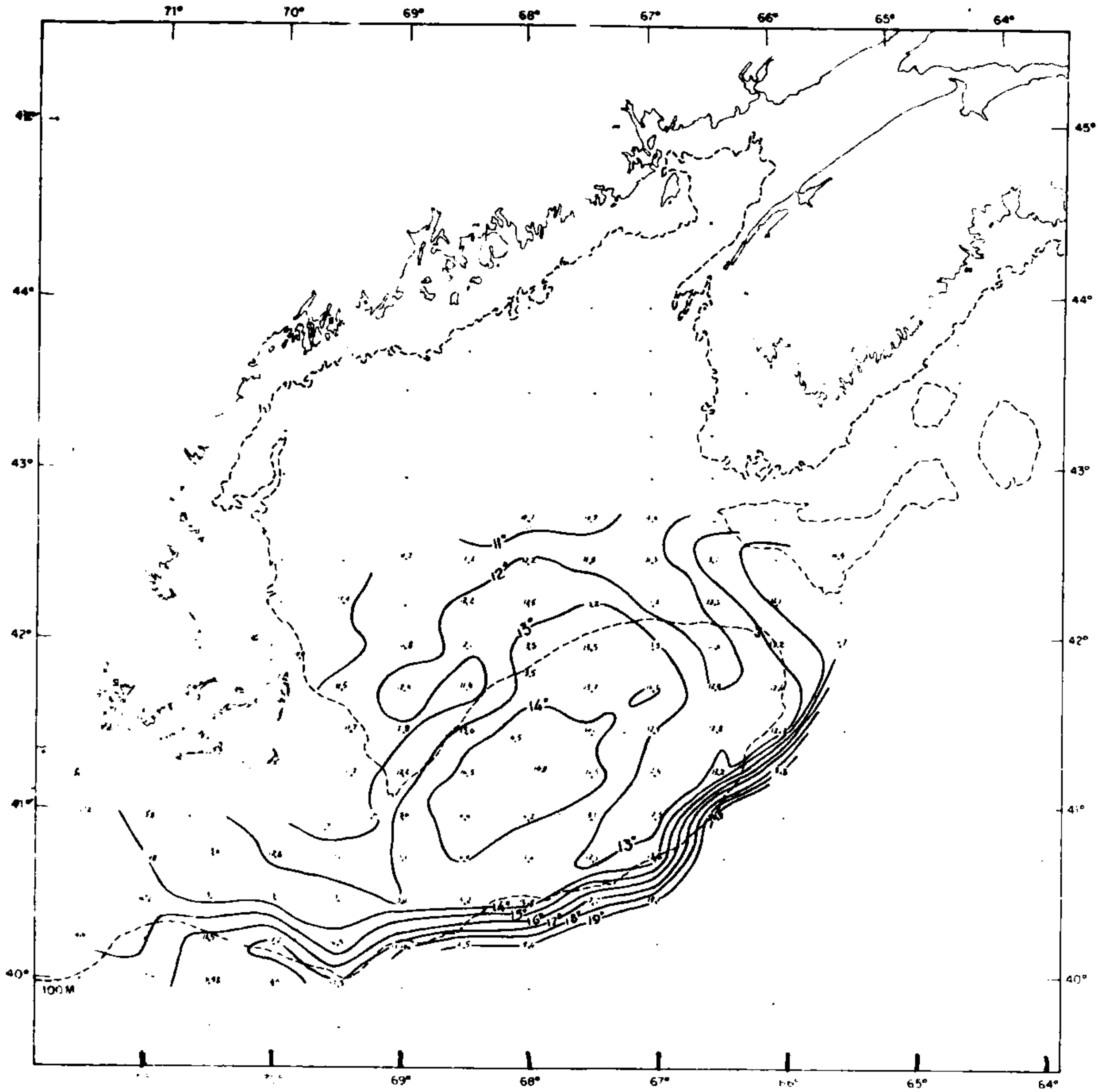

Fig. 2. Water temperature distribution on the surface.

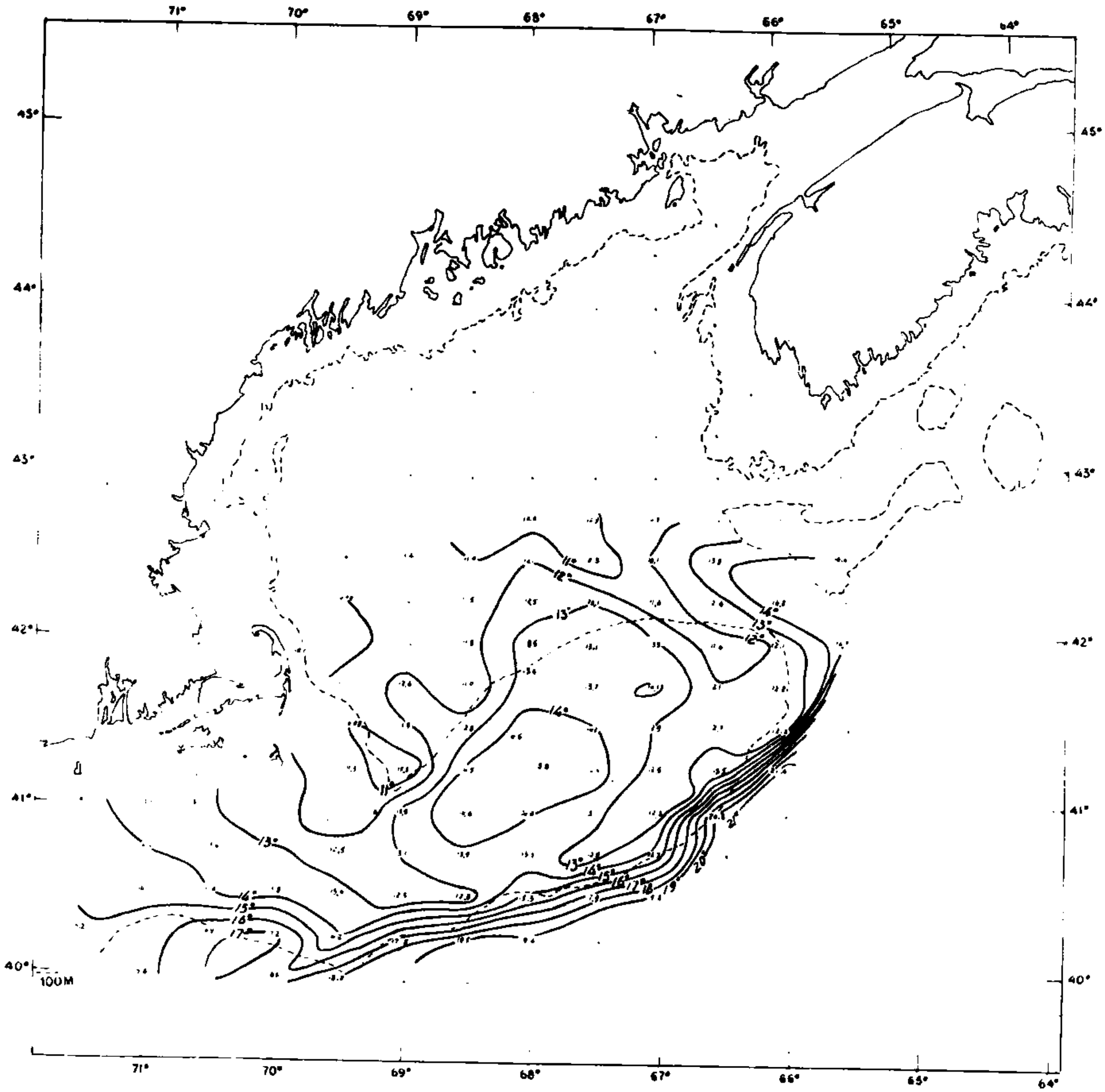

Fig. 3. Water temperature distribution in the 30-m layer.

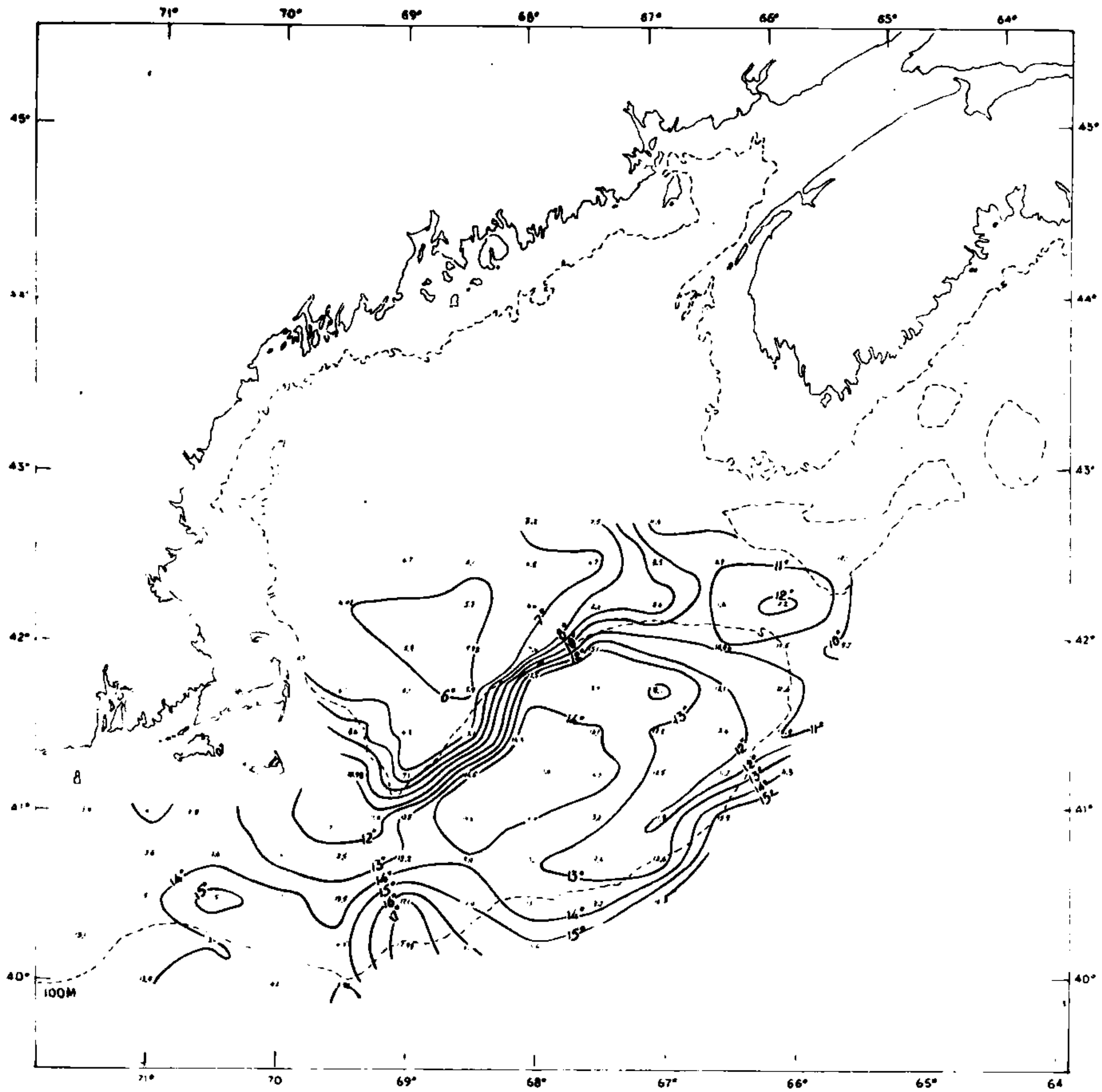

Fig. 4. Water temperature distribution on the chart of the bottom-100 m.

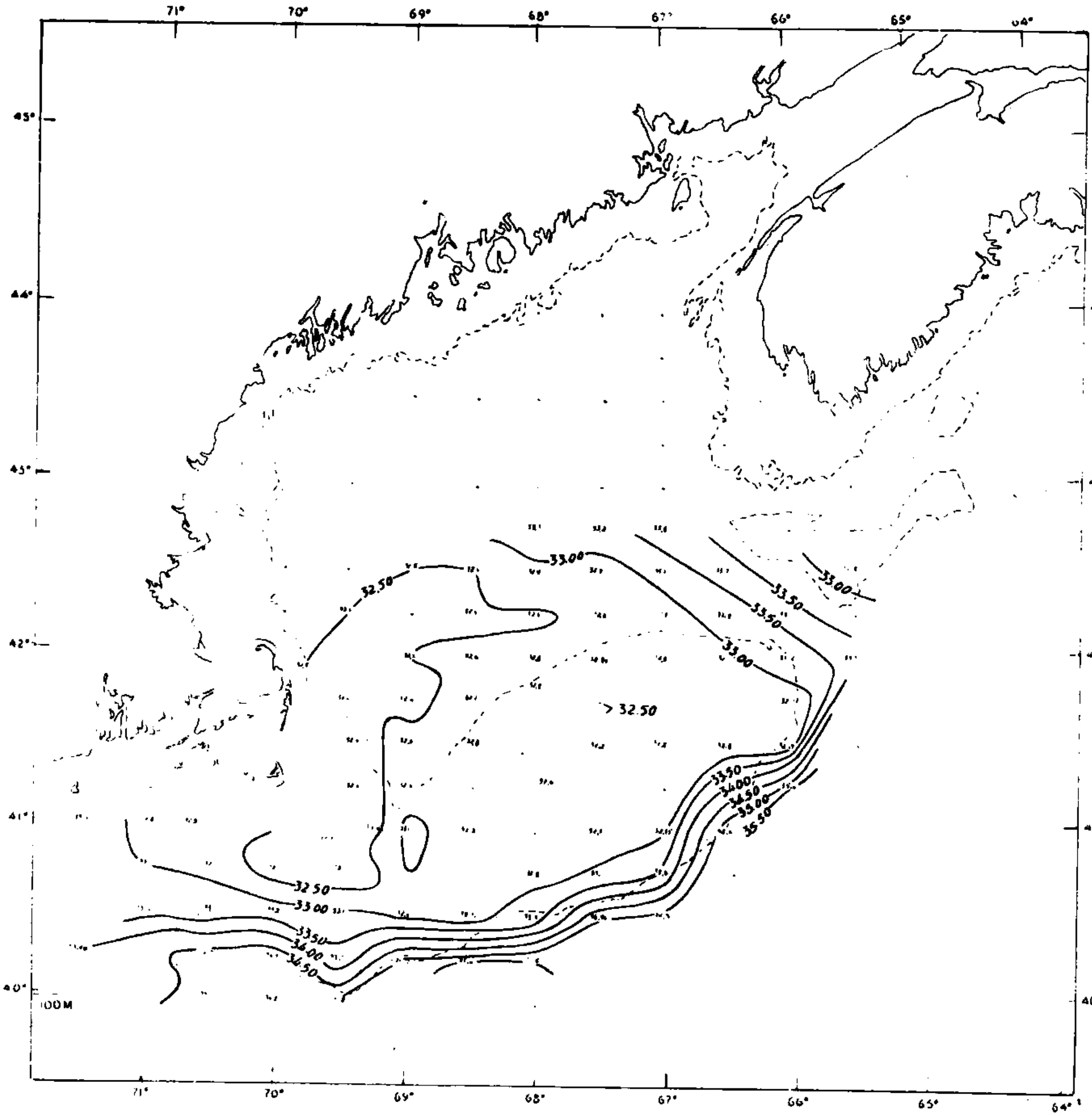

Fig. 5. Salinity distribution in the 10-m layer.

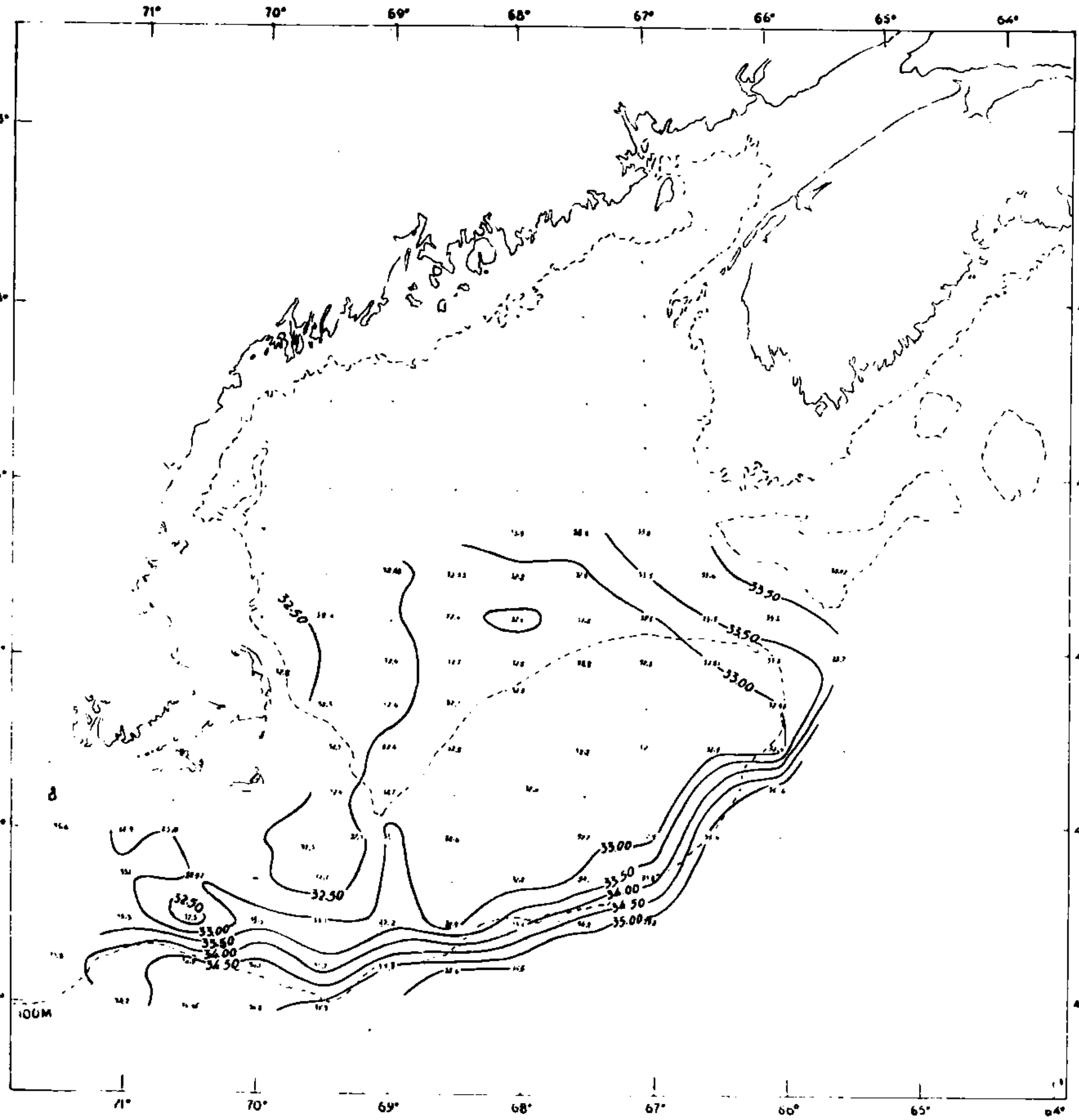

Fig. 6. Salinity distribution in the 30-m layer.

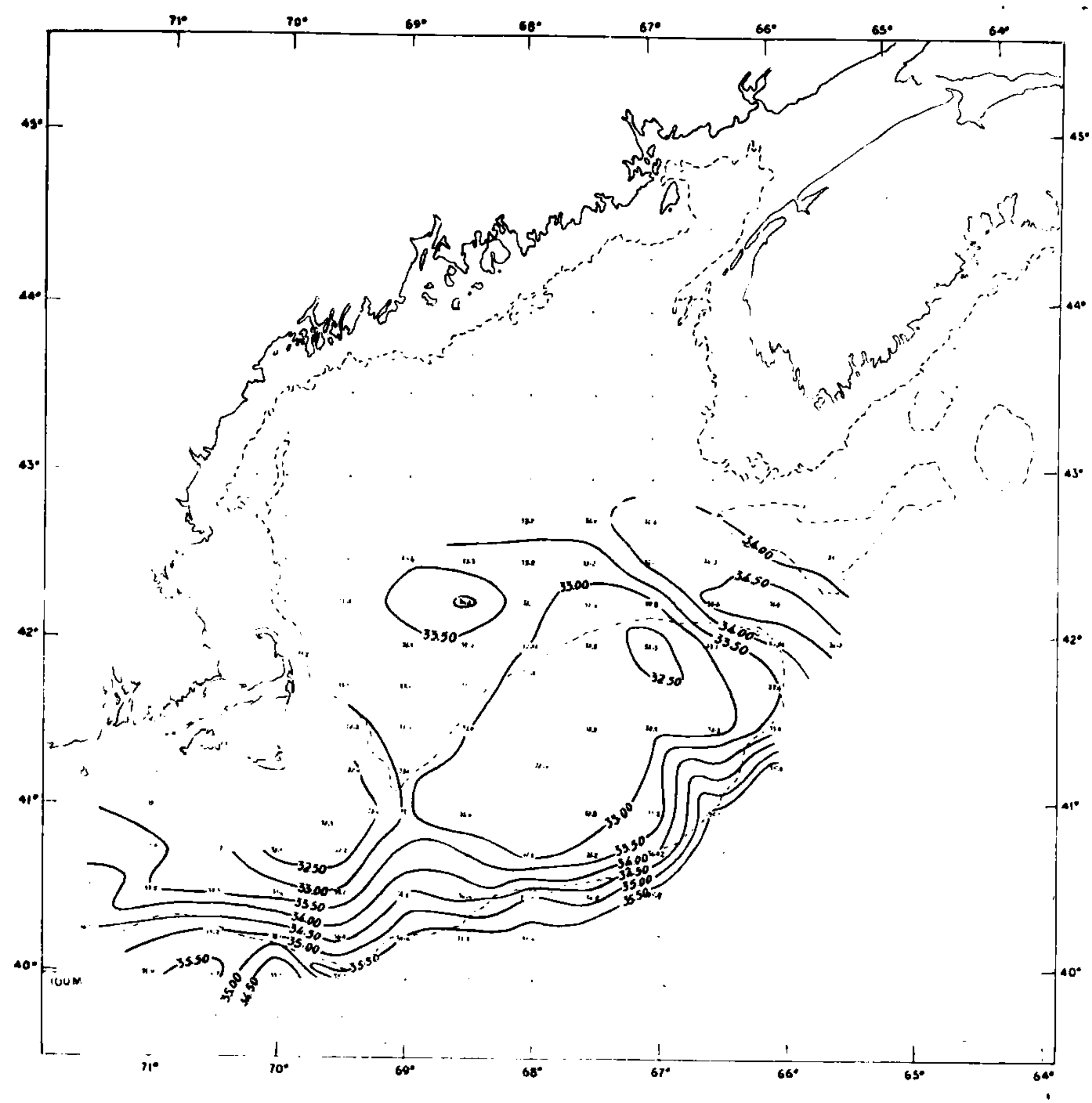

Fig. 7. Salinity distribution on the chart of bottom-100 m.

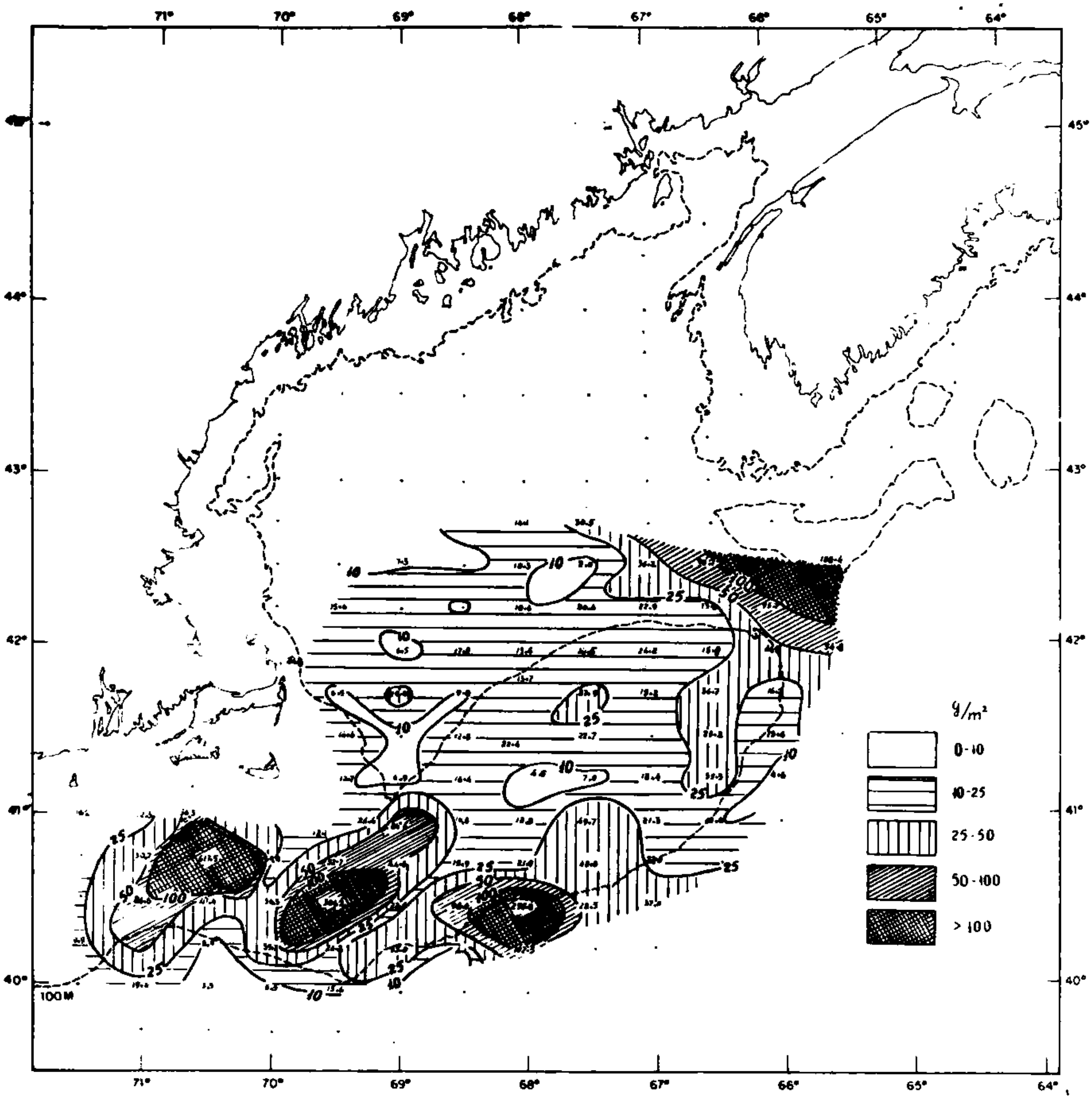

Fig. 8. Seston biomass distribution in g/m^2.

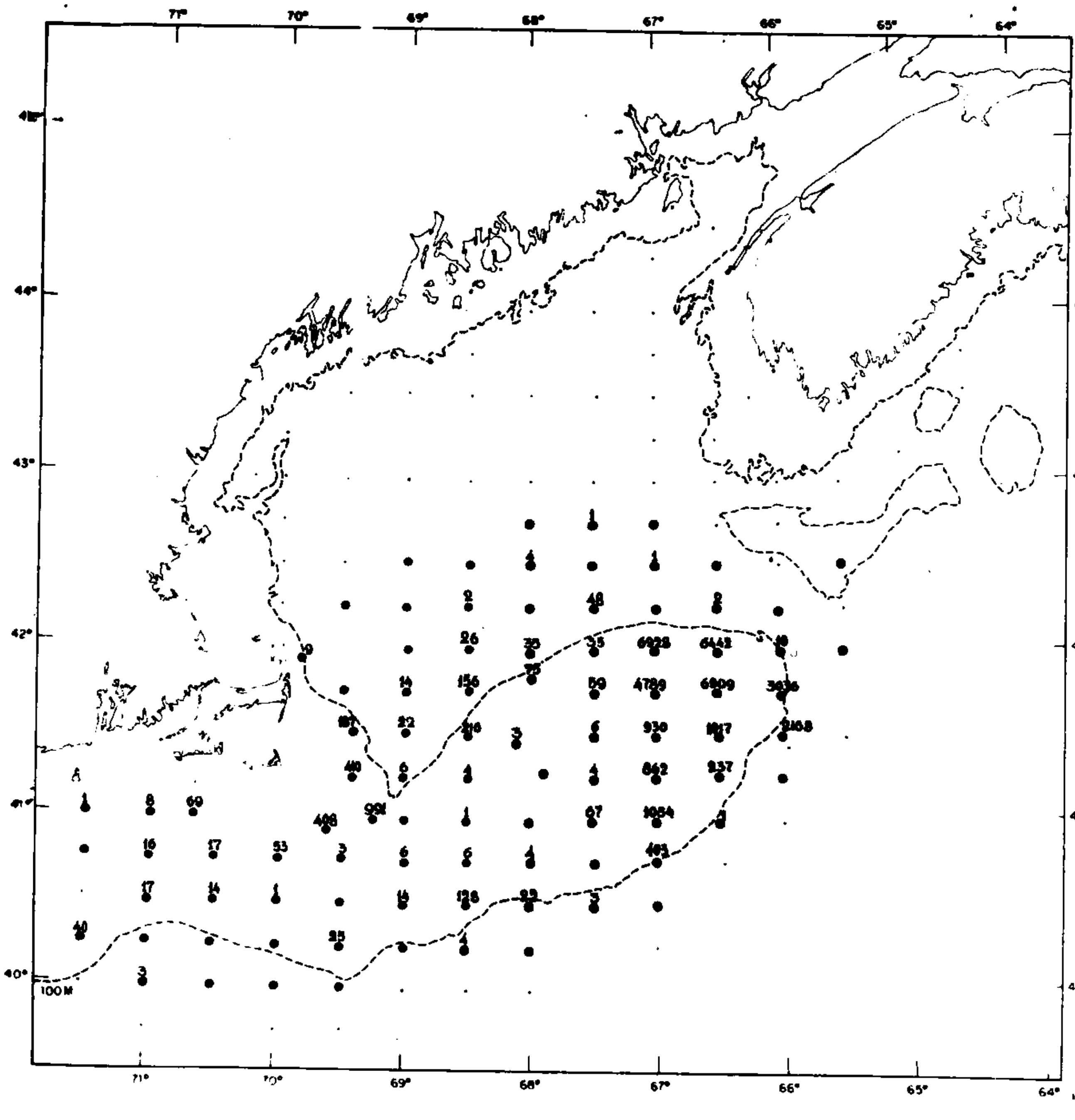

Fig. 9. Distribution of total number of herring larvae in sp/10 m^2.

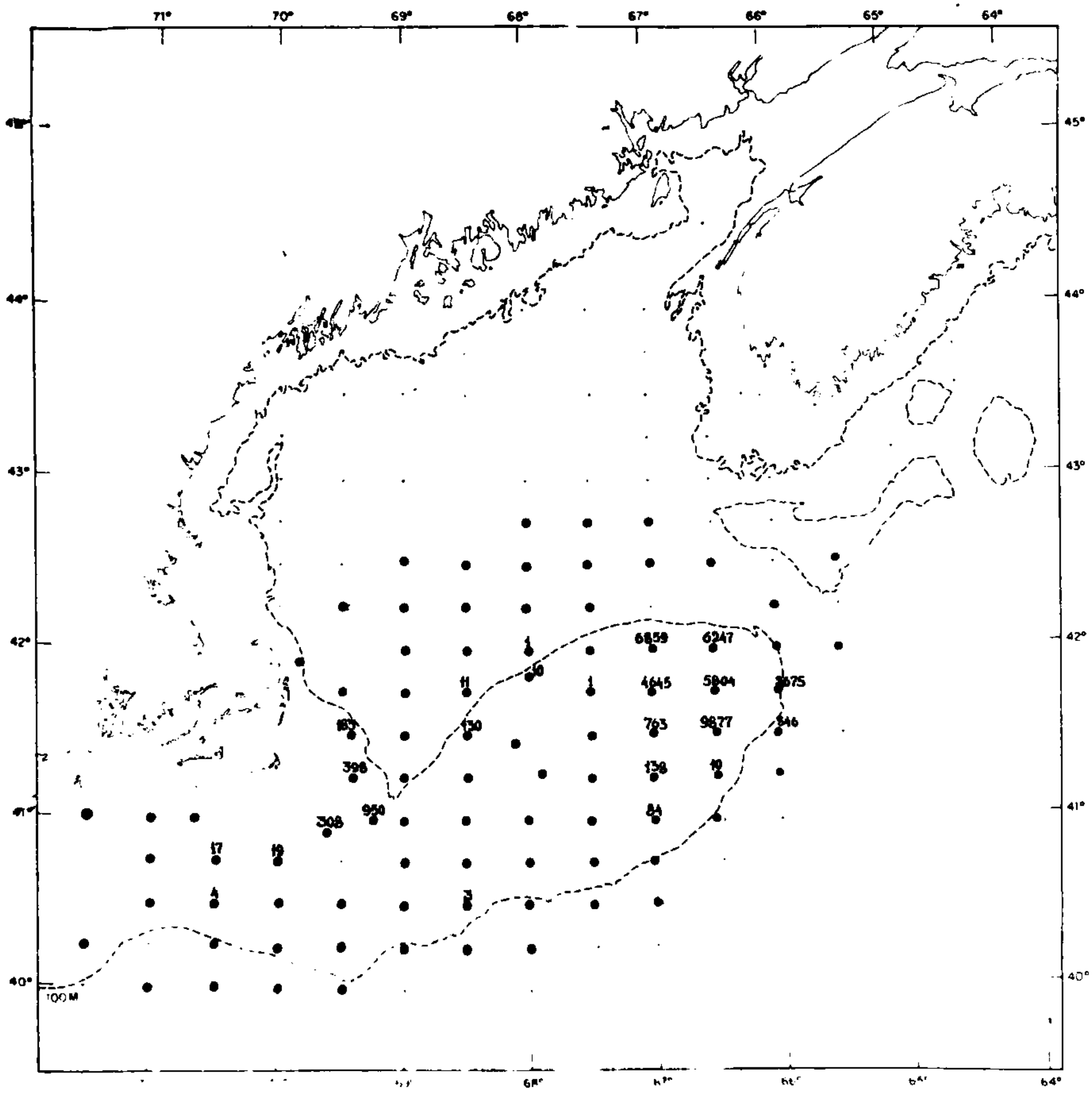

Fig. 10. Distribution of larvae of 10 mm in length.

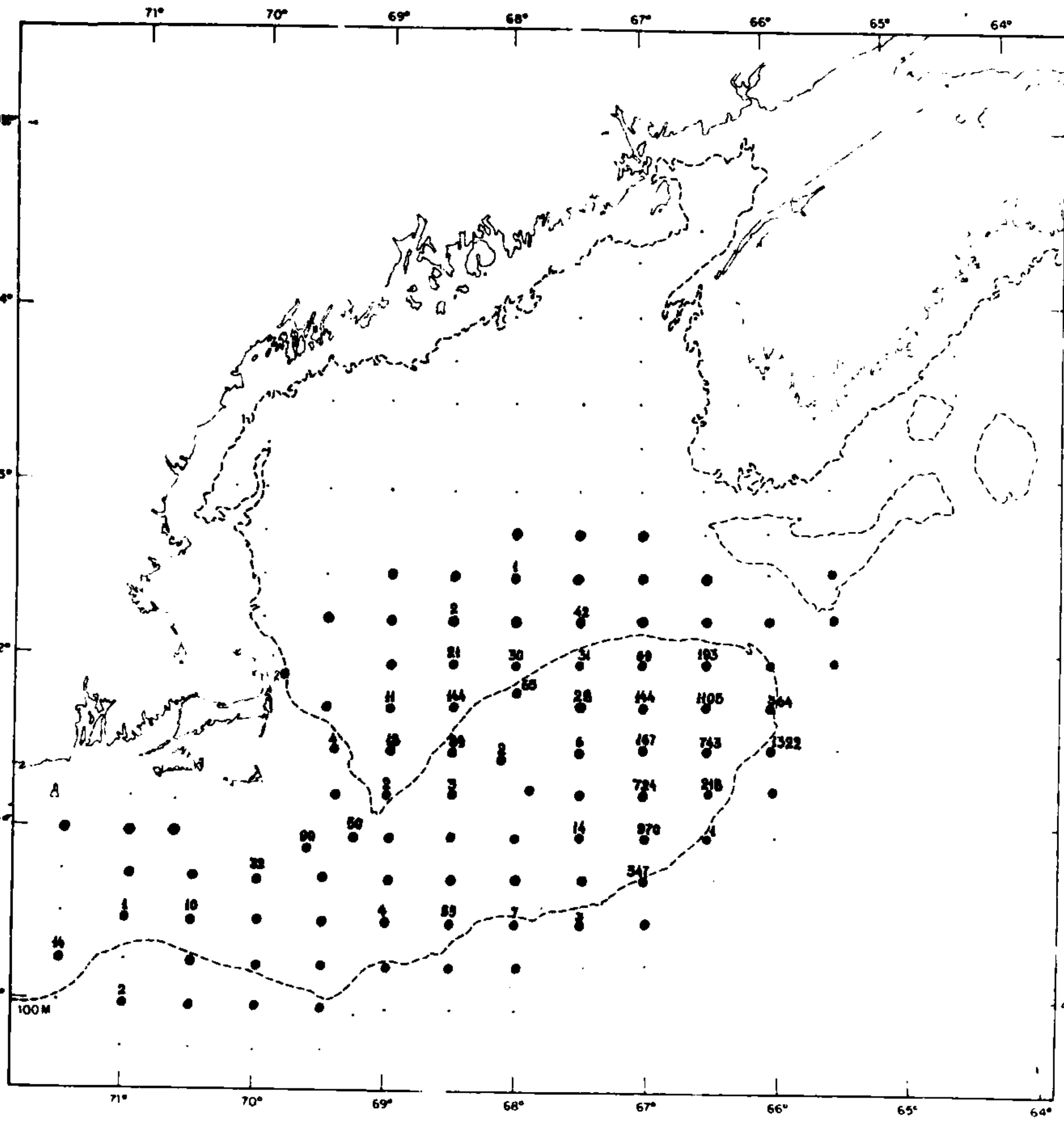

Fig. 11. Distribution of larvae of 10-15 mm in length.

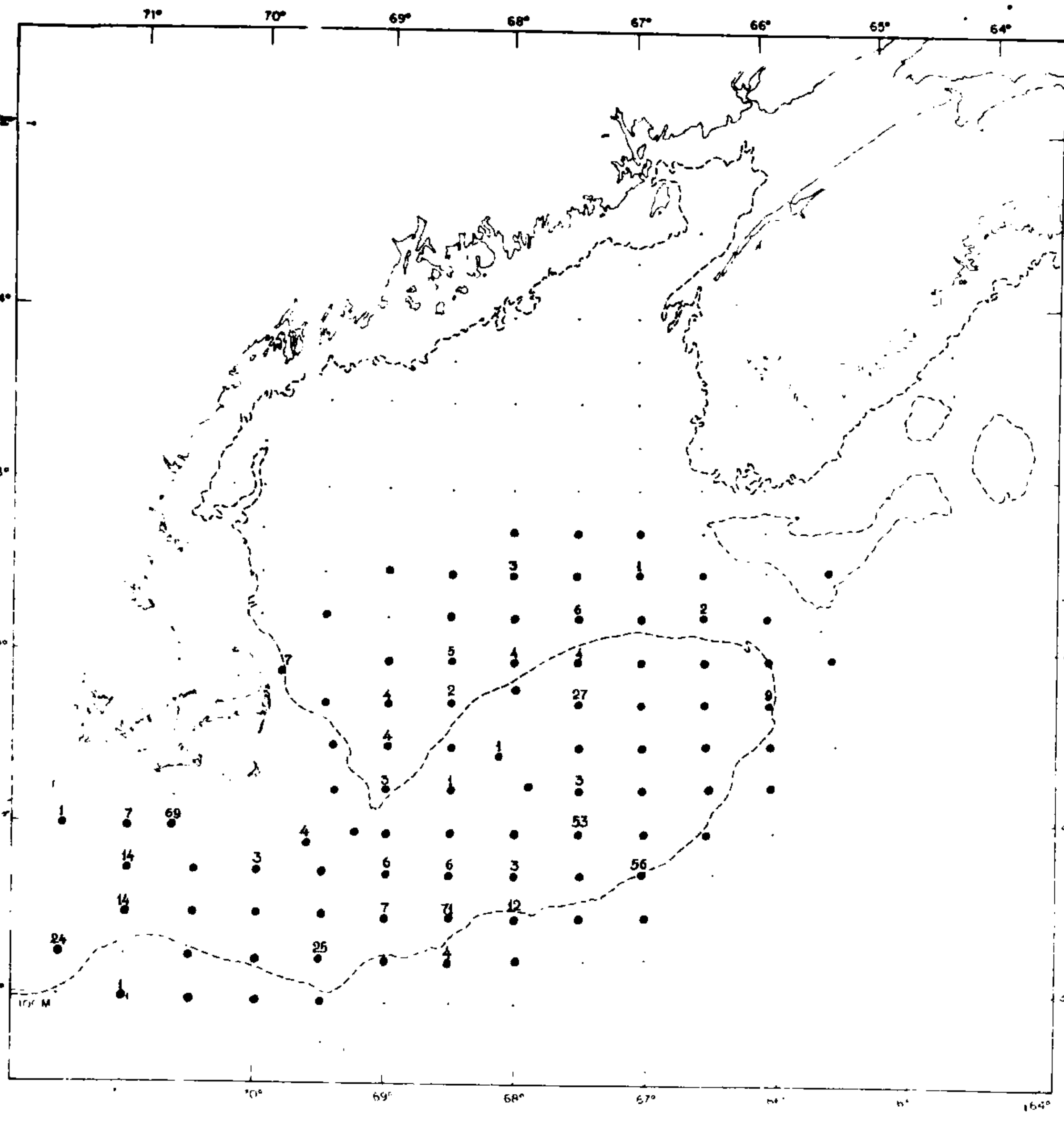

Fig. 12. Distribution of larvae of 15-20 mm in length.

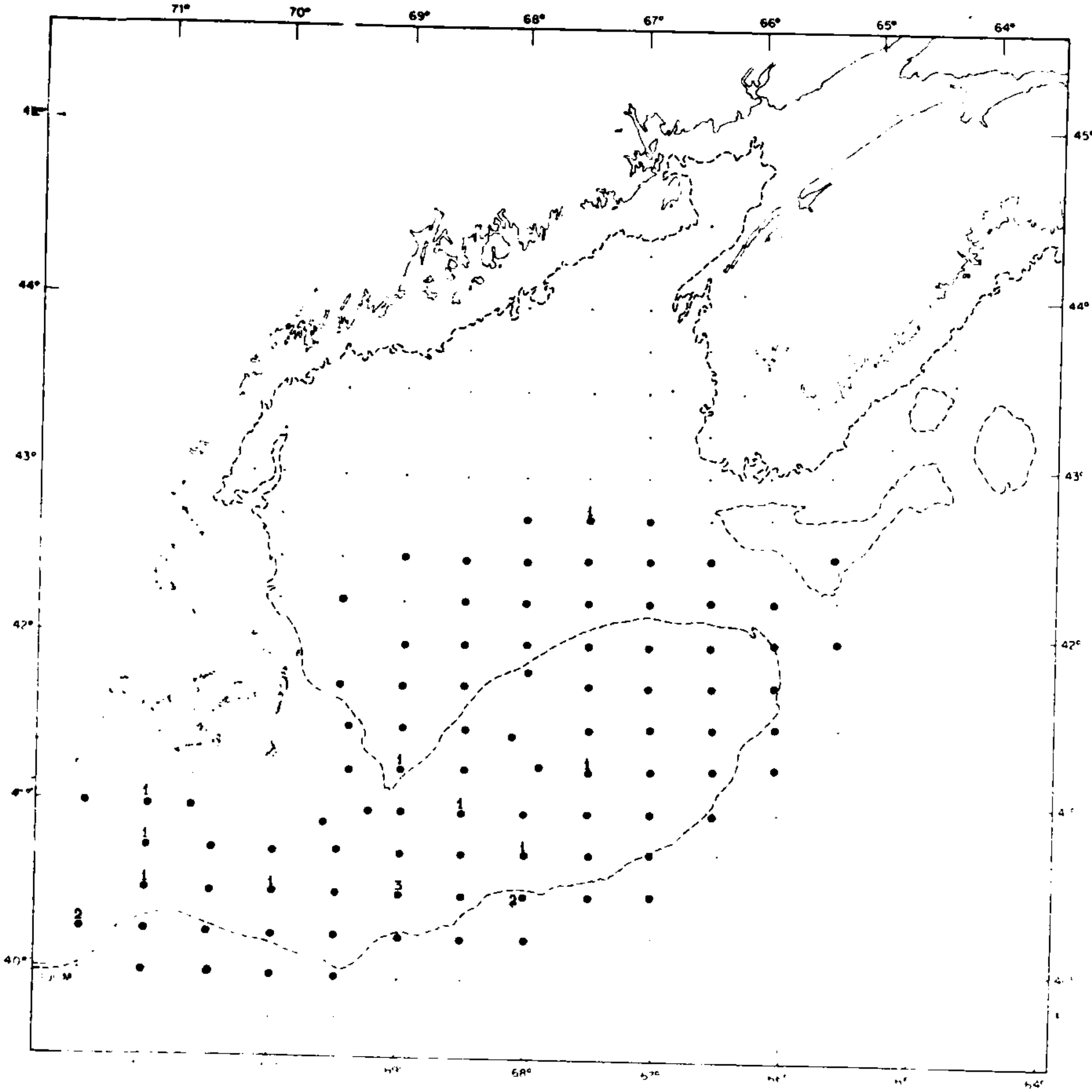

Fig. 13. Distribution of larvae of 20-25 mm in length.

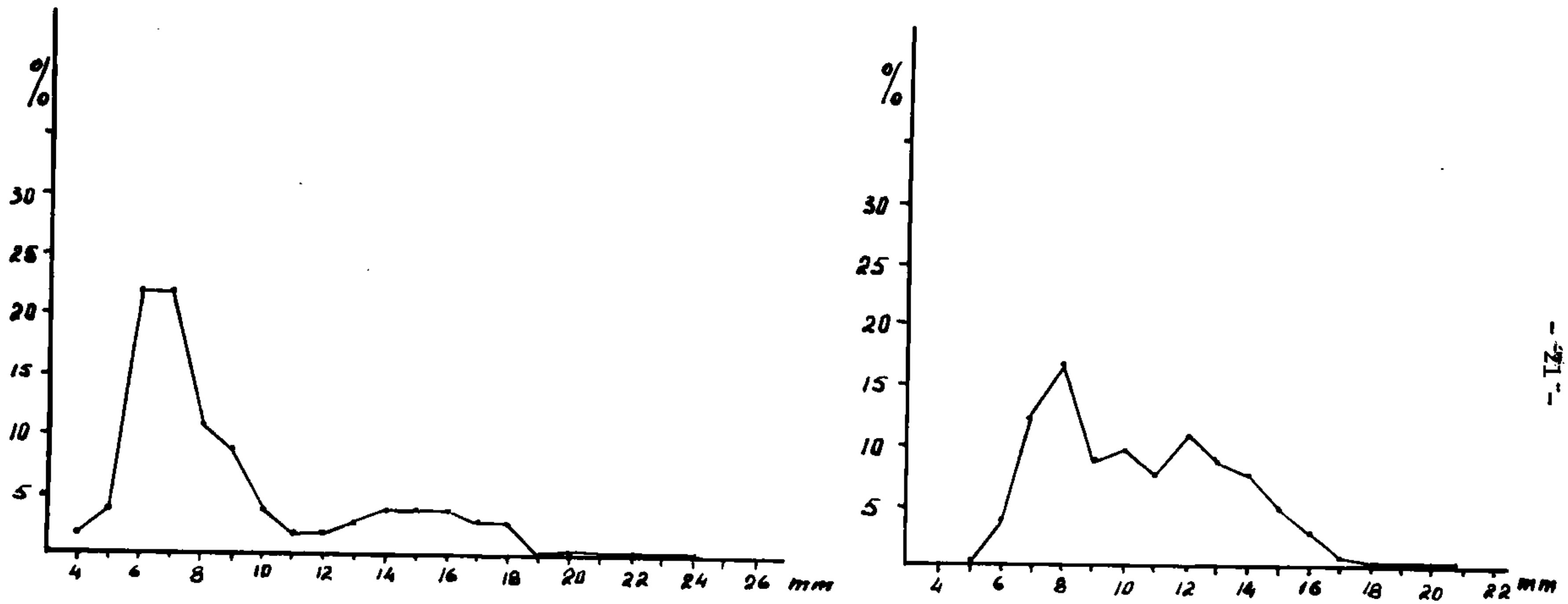

Fig. 14. Frequency of larvae occurrence in the Nantucket Shoals and Georges Bank regions by size.