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# Continuous Plankton Records during the NORWESTLANT surveys, 1963.

by

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The principal features of the Continuous Plankton Recorder survey have been described by Glover (1962). Recorders are towed by merchant ships and ocean weather ships, every month where possible, along a number of standard routes, sampling at a depth of 10 metres and filtering the plankton on silk of 60 meshes to the inch. From 1948 to 1955 the survey was confined to the North Sea and the eastern North Atlantic; thereafter, the survey has been extended progressively westwards across the North Atlantic. The routes in use in 1963 are shown in Fig. 1a.

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This brief report is intended to provide a spatial and temporal background to the NORWESTLANT cruises. Results are presented for a few organisms from a part of the western North Atlantic which includes the area covered by NORWESTLANT. It was thought that it might be useful to provide data for the whole year rather than confining them to the period of NORWESTLANT. Results from other areas, and for other organisms, will be provided on application to the Oceanographic Laboratory, Craighall Road, Edinburgh, 6, Scotland.

For the routine treatment of data, the area is divided into rectangles ($2^{\circ}$ Long. by $1^{\circ}$ Lat.). The counts of organisms in individual samples are transformed, using $y = \log_{10} (x + 1)$; the logarithmic mean number per sample is then calculated for each organism in each rectangle in each month. These rectangle means are averaged to provide, for each month, the mean number per sample in each of the standard areas shown in Fig. 1b. These area means are shown in the histograms in Figs. 2-4. In two of the areas (B6 and B7) it has been possible to calculate long-term means for each month, and these provide a measure of the 'normal' seasonal cycle of each organism. They were obtained by combining all the results obtained with Plankton Recorders during the six years 1957-1962; the long-term means are shown as line graphs in Figures 2-4. Sampling in the other areas was started in recent years and it is not yet possible to provide long-term means.

Phytoplankton colour (Fig. 2) is assessed visually according to the intensity of the green colour of the silks. The values were much lower than the six-year mean in area B6 and rather low in B7 (but there was no sampling in August). In general, phytoplankton was scarce everywhere (Fig. 2) except in the coastal waters west of Greenland (B8) where there was a strong spring peak in May which consisted almost entirely of Thalassiosira spp. Similar results were obtained in 1962 in this area, when the spring peak was about a month later. Comparisons in most of the region is limited by the weakness of sampling in previous years but such material as is available suggests that there was an unusually poor phytoplankton crop in 1963 in areas C8 and D8 (east and north-east of Labrador). As in 1962, numbers of Thalassiothrix longissima (Fig. 2) and Chaetoceros spp. were low, particularly in area B6 and B7.

Numbers of copepods (Fig. 2) were close to the six-year average in areas B6 and B7 with maximum numbers about a month later than usual. Numbers were low in area B8 and D8 until June, but high for a longer period in areas C7, C8 and D7 where there was a spring peak of abundance in April.

The /

The results for Calanus finmarchicus, which was the dominant copepod throughout the whole area, are presented in two series of histograms, one for copepodite stages I-IV (Fig. 3) and the other for stages V-VI (Fig. 3). The young stages were abundant in all areas, with peak numbers in June in B6, B7, B8, C6 and D7 and July in C7, C8 and D8. Numbers were close to the long-period average in B6 and B7 with the seasonal maximum about a month later than usual.

Adult Calanus were abundant almost everywhere except in West Greenland (B8) where they were less numerous than in 1962 (the only year for which there is comparable data in this area). Numbers were above the six-year average in B6 and B7, particularly in March and August in B6 and April, June, July in B7; in contrast to the young stages, the adults were present in large numbers earlier than usual. There was a marked spring peak in April in all areas except B8 and B6, when it occurred in May (there was no sampling in C6 in April). Numbers remained high until October or November, with additional peaks in summer and autumn.

Pareuchaeta norvegica (Fig. 3) was the only other copepod that was abundant and widespread but it was absent from the waters west of Greenland (B8, where it occurred in May and June of 1962). It was much more numerous than usual in B6 and B7. Because of the strong diurnal migrations of this species, the histograms in Fig. 3 (right) are based on night samples only.

The pteropod Spiratella retroversa (Fig. 4) was scarce everywhere. The season was very short and numbers were extremely low in B6 and B7 compared with the long-term means and it was not found at all in these areas in the second half of the year. Maximum numbers were found in March in C7, June in B6, B8 and C6, and in August in D7. This species has also been rare in the eastern north Atlantic since 1954, although it showed signs of a recovery there in 1963 when it was more abundant than in any year since 1956.

Numbers of Euphausiacea (Fig. 4) were close to the six-year average in B6, but were much higher and earlier than usual in B7 (February to April) followed by a decline to below average numbers from May to September. Large numbers at the beginning of the year (mostly adults of Thysanoessa longicaudata) were also found in C7 in the NORWESTLANT area and D8, north-east of Newfoundland. Young stages were abundant later in the year, particularly in C8 and D7.

The young stages of the redfish (Sebastes, Fig. 4) were much less numerous than usual in areas B6 and B7 and were abundant only in C7 (south-east of Greenland) and D8 (north-east of Newfoundland where the larvae had the sub-caudal melanophores which are absent from the oceanic stocks). Their distribution is discussed in more detail by Henderson in Document No. 42, Serial No. 1377 (D.c.10).

The distribution of the plankton within the area sampled by the Plankton Recorder shows a pattern which appears to be related to the main current systems. A rough distinction is made in Table I between species normally associated with warm or cold water conditions; the distributions of members of these two groups together with the surface isotherms * for 0, 5, 10 and 15°C are shown in Fig. 5. Extensive patches of warm water species show an apparent northerly shift from May to July. The sampling in August was too poor to follow the northerly spread in that month. As the 10°C isotherm moved northwards, there was a corresponding northward shift in the distribution of the warm-water species which are presumably associated with the Gulf Stream System whilst the cold water group may belong to the waters of the Labrador current. The association with surface temperatures is evident.

SUMMARY /

* The surface isotherms are taken from charts produced by the Marine Division of the Meteorological Office.

## SUMMARY

Calanus finmarchicus and Thysanoessa longicaudata are the two dominant members of the plankton found in every sub-area discussed here.

Sampling in the waters west of Greenland was mainly in the coastal water and was characterised by the dense outbreak of phytoplankton in April and May, the absence of Pareuchaeta norvegica and the relatively later occurrence of adult Calanus in the spring. The first peak in numbers of young stages of Calanus was late in all three western areas (B8, C8 and D8), indicating possibly, a later planktonic season in the colder waters of these areas.

The distributions in areas B6 and B7, which can be compared with the long-term mean, show that the spring outbreak of phytoplankton was weak, numbers of Calanus and Pareuchaeta were above average in B6, with high numbers of adults in spring in B7; Sebastes, Spiratella and Thalassiothrix were well below the long-term means. It is possible also to make tentative comparisons of the distribution in 1963 with those obtained in previous years, particularly 1962. Adult Calanus were more abundant in C7 and D7 (along with B7, the eastern part of NORWESTLANT), but less abundant for most of the year in C8, D8 and B8 (the western half of NORWESTLANT). Numbers of young stages of Calanus were similarly lower in C8 and D8 but, together with Euphausiacea, were more abundant in B8 (West Greenland coastal waters).

There is sufficient data, particulary in areas B6 and B7, to show that there can be considerable variation in the seasonal timing and abundance of the dominant members of the plankton of the western North Atlantic. In a few more years it should be possible to provide estimates of the annual and seasonal variations in the plankton over the whole Atlantic.


## TABLE I.

Cold water forms: Calanus glacialis, Metridia longa, Calanus hyperboreus, Ceratium arcticum.

Warm water forms: Doliolum nationalis, Salpa fusiformis, Dolioletta gegenbauri, Clausocalanus spp., Calocalanus spp., Mecynocera spp., Calanus helgolandicus, Calanus gracilis, Calanoides carinatus, Euchirella rostrata, Euchaeta acuta, Undeuchaeta plumosa, U. major, Pleuromamma abdominalis, P. borealis, P. gracilis, P. piseki, Rhincalanus nasutus, Euc alanus elongatus, Centropages bradyi, Scolecithrix danae, Temora stylifera, Namocalanus minor, Heterorhabdus papilliger.

## REFERENCE.


GLOVER, R. S. 1962. The Continuous Plankton Recorder. Rapp. Cons. Explor. Mer, 153: 8-15.


## LEGENDS FOR FIGURES. /

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Fig. 1a. A chart showing the standard positions of the Continuous Plankton Recorder routes in 1962. The ships' courses varied slightly from month to month, and two ships followed different routes in summer and winter.

Fig. 1b. A chart showing the area sampled by the Continuous Plankton Recorder west of 19°W. The area has been divided into standard areas (see text). Results are presented for the stippled areas.

Fig. 2. Histograms showing a month-by-month estimate of the phytoplankton, Thalassiothrix longissima and copepods during 1963. The colour estimate is based on visual assessments of the green colour of Recorder silks, and the numbers of diatoms and copepods are given as the average number per Recorder sample. The letters and numbers (B6, etc.) refer to the sub-areas shown stippled in Fig. 1b. A break in the base line indicates that there was no sampling in that month. The line graphs show the long-period means in sub-areas B6 and B7 based on a combination of all Records in these sub-areas in the period 1957-1962. A Recorder sample represents the plankton in about 3m$^3$ of water.

Fig. 3. Histograms showing the average number, per Recorder sample, of copepodite stages I-IV of Calanus finmarchicus, copepodite stages V-VI of C. finmarchicus and all stages of Pareuchaeta norvegica during 1963. For further details see text and Fig. 2.

Fig. 4. Histograms showing the average number, per Recorder sample, of Spiratella retroversa, Euphausiacea and Sebastes spp. during 1963. For further details, see text and Fig. 2.

Fig. 5. Charts showing the distribution of warm- and cold-water species in Recorder samples from April to August 1963. (See Table 1). The surface isotherms for 0°C, 5°C, 10°C and 15°C, taken from charts produced by the Marine Division of the British Meteorological Office, are superimposed on the distribution charts.

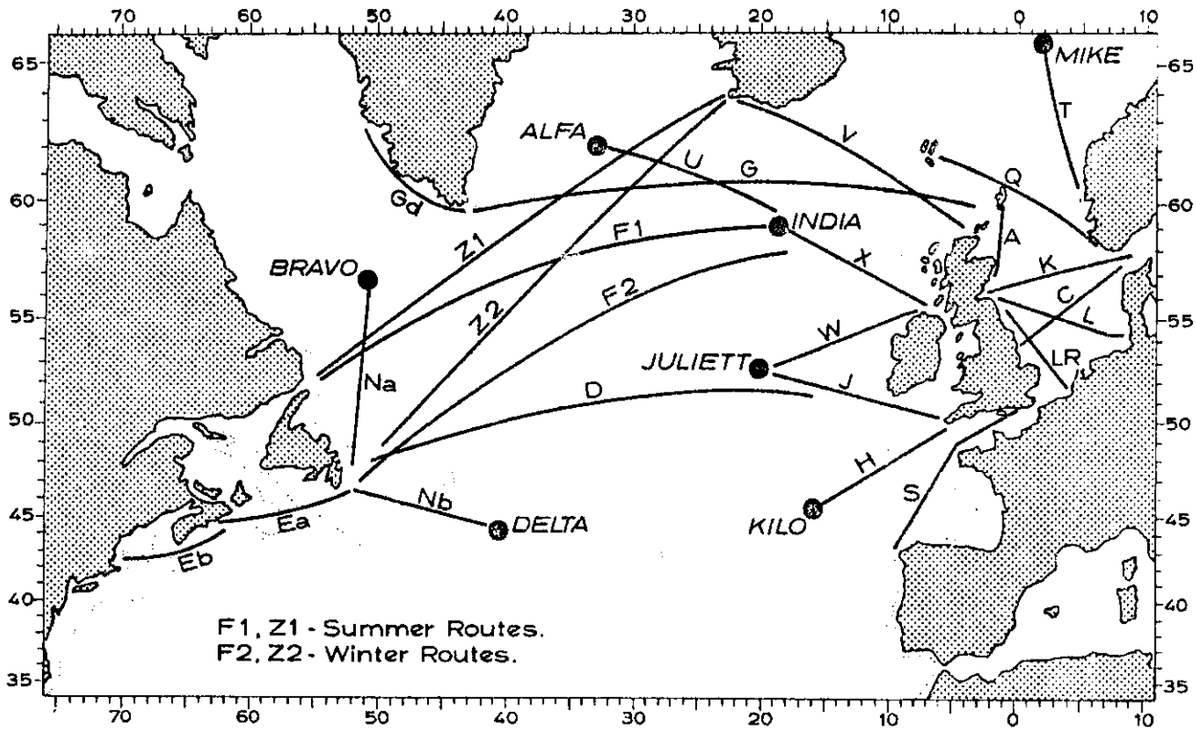


*Figure 1a*

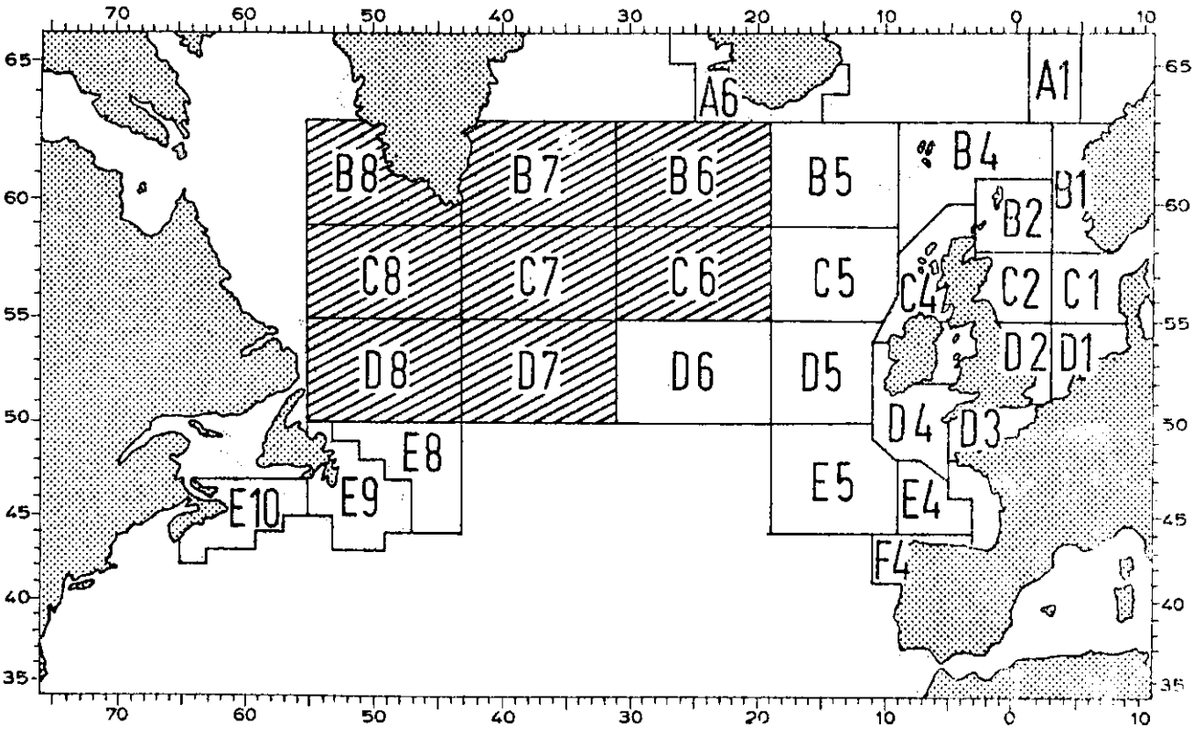


*Figure 1b*

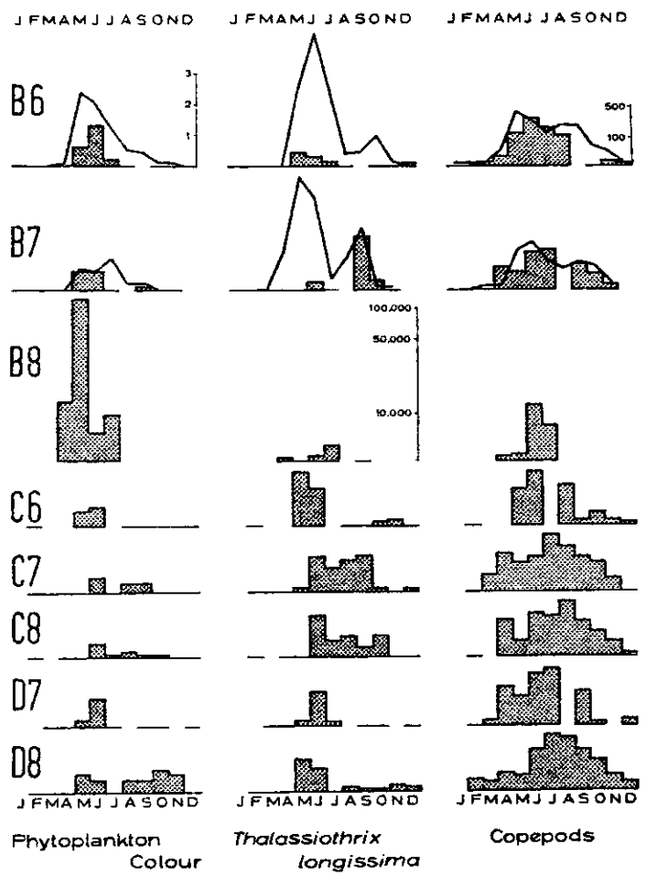


Figure 2

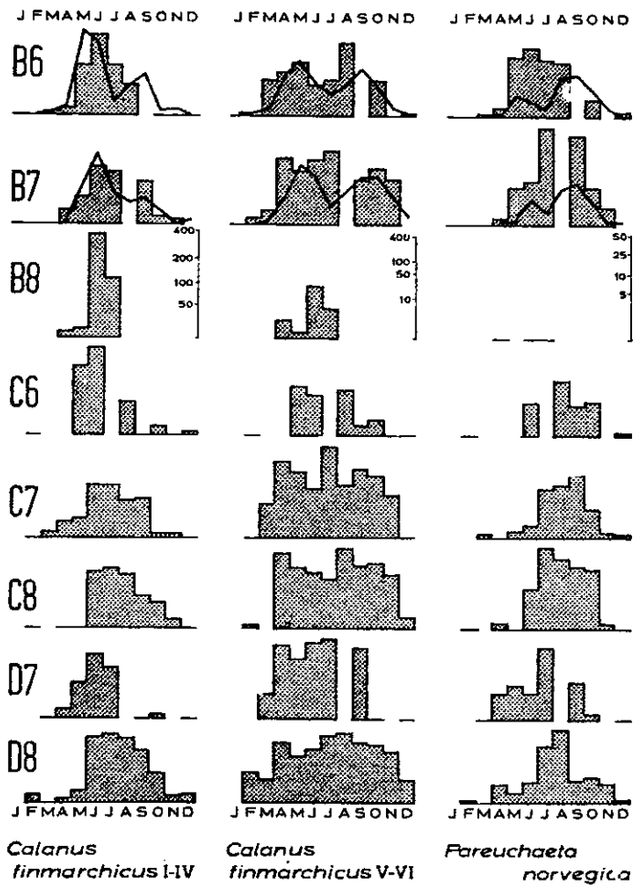


Figure 3

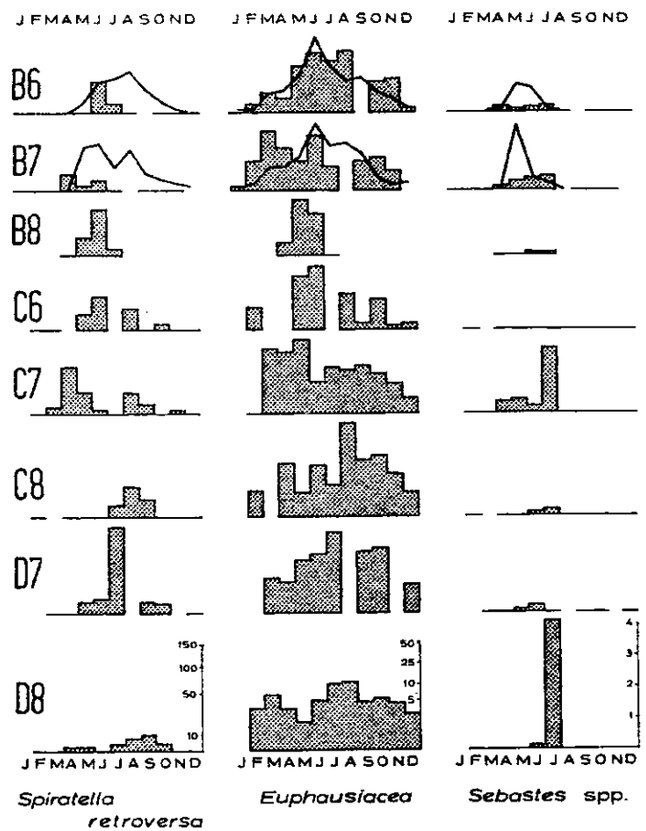


Figure 4

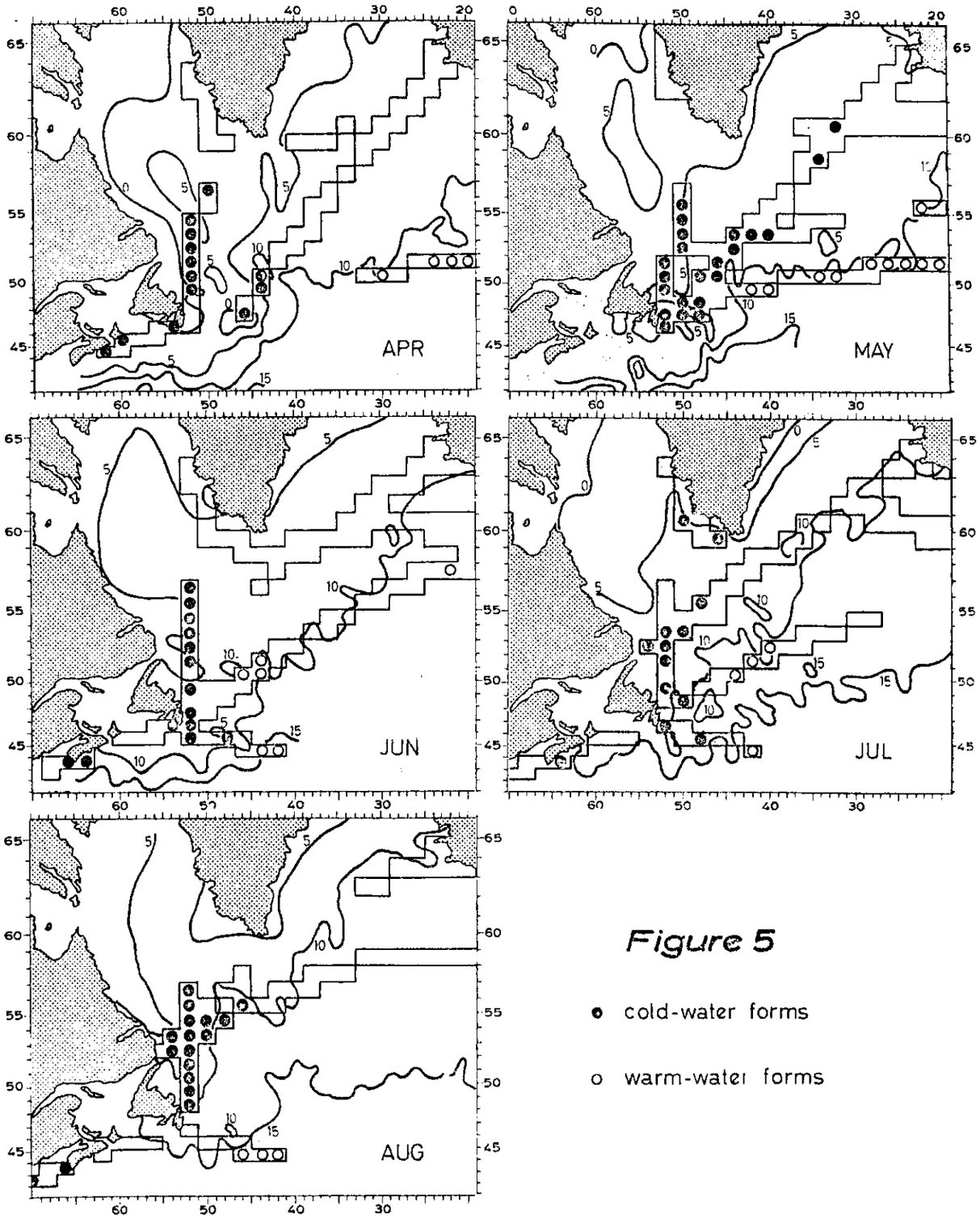


*Figure 5*

● cold-water forms

o warm-water forms