INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 856
(D. c. 5)

Document No. 14

ANNUAL MEETING - JUNE 1961

Continuous Plankton Records: Preliminary Report on Sampling between Iceland and Newfoundland

by V. Bainbridge and G. A. Robinson
Scottish Marine Biological Association-Oceanographic Laboratory-Edinburgh

In May 1959 sampling along the Recorder route running south west from Reykjavík was extended to the longitude of Cape Farewell and, since September 1959, sampling has been further extended to the coastal waters of Newfoundland. The Recorder is towed by commercial ships and obtains a continuous sample of plankton from a depth of 10 m. Whenever possible sampling is carried out at monthly intervals along a track from Reykjavík to the Grand Banks region during the period January to June and from Reykjavík to the Straits of Belle Isle during the months July to December. At this early stage there are several gaps in the sampling but it is possible to make some provisional comments on the quantity and composition of the plankton along the route for several months of the year.

Spatial distribution

Some of the more important features of the phytoplankton along the route running to the Straits of Belle Isle (i.e., July to December) are shown in Fig. 1. The intensity of any green colour in the samples is estimated by a visual technique, and can be used as a rough measure of the standing crop of phytoplankton. During the second half of the year, phytoplankton was confined mainly to the eastern half of the route, i.e., the Icelandic Shelf and the Irminger Sea and the extreme western end from about 51°W to the Straits of Belle Isle, a region influenced by the Labrador Current (e.g., Sverdrup et al., 1942). Thalassiothrix longissima and Chaetoceros spp. were the predominant diatoms in the Irminger Sea while Thalassiosira spp. were chiefly responsible for the high colour values in the region off the Straits of Belle Isle. A full list of species and genera recorded along the route is given in Table 1. The region of the Irminger Sea appeared to have a richer variety of species than the other areas.

With the exception of coastal communities, the bulk of the zooplankton along the route consisted of the copepod Calanus finmarchicus and the euphausiid Thysanoessa longicaudata (with Meganyctiphanes norvegica over the eastern half). The average numbers of Calanus and the combined numbers of all species of Euphausiacea along the track towards the Belle Isle Strait from July to December are given in Fig. 1. It can be seen that there were considerable variations in the total numbers along the route. During the period sampled, average numbers were highest west of longitude 39°W. There appeared to be a minimum in the total numbers of Calanus and euphausiids in the region roughly between 35° and 39°W. This is near the region in which Joseph (1959) recorded minimum quantities of plankton, as measured by turbidity, during a survey of the Irminger Sea from May to July 1955.

Calanus finmarchicus was clearly the dominant copepod, but during October and December many of the Calanus present in the region off the Belle Isle Straits agreed with the description given by Jaschnov (1955) of the stage V copepodites of Calanus glacialis, an arctic form. The only other copepod constituting a significant part of the standing crop was Euchaeta norvegica, a species which has been recorded intermittently along the route.

Of the two common species of Euphausiacea, Thysanoessa longicaudata was present in quantity along the whole of the route and Meganyctiphanes norvegica (Fig. 1) was found mostly in the Irminger Sea. Einarsson (1945) notes the preference of Meganyctiphanes for waters of the continental slope and its presence in the Irminger Sea may be related to the proximity of the Reykjanes Ridge. Several specimens of Thysanoessa rashii and T. inermis have been found in the coastal waters at both ends of the route.

Other species recorded regularly along the whole route, but in small numbers, included Themisto compressa (Hyperiidae), Eukrohnia hamata (Chaetognatha), Tomopteris septentrionalis (Polychaeta), Clione sp. and Spiratella sp. (Pteropoda).

The results showed that the plankton along the route could be divided roughly into 4 regions which have been delimited as follows:

Icelandic coastal waters,
Irminger Sea from the edge of the Icelandic Shelf to 39°W,
Atlantic south of Greenland from 39°W to 51°W,
Labrador Current from 51°W to the Belle Isle Straits.

The areas are indicated by heavy vertical lines in Fig.1.

Seasonal distribution

Histograms showing, for each month sampled, the average values for colour intensity and the average numbers of Calanus spp. and Euphausiacea in three of these areas are presented in Fig.2; these results were obtained by combining all the available material for each month during the years 1959 and 1960. The histograms for Calanus have been divided to show the relative numbers of copepodites I - IV and stages V and VI; those for the Euphausiacea have been divided to show the proportion of furcilia and post larvae (including adults) in the population.

In the Irminger Sea region the spring outburst of phytoplankton took place during May and June and was followed by a slow decline to very low numbers by October. Appreciable numbers of adult Calanus and post larval euphausiids first appeared in the Recorder samples at 10 m in April and, by June, large numbers of juveniles of both groups were present. Older stages showed a second maximum in September and the population density decreased towards the end of the year.

Sampling is not yet so complete in the sea area to the south of Greenland but a similar succession of events appears to have taken place. The February record, which extended as far south as the Grand Banks, showed that phytoplankton was already present in quantity in this region. In March and April detectable colour values were also found off the north eastern slope of the Banks. Adult Calanus and post larval euphausiids showed a significant increase in March. It would appear, therefore, that in the sea area east of Newfoundland the onset of biological spring occurred at least one month earlier than in the Irminger Sea.

Because of ice conditions, sampling in the region off the Straits of Belle Isle will alway be restricted to the latter half of the year. In the three months for which comparisons could be made, records showed higher colour values between Belle Isle and 51°W than in the sea area to the north east. During September and October the numbers of Calanus were also greater.

Warm and cold water species off Newfoundland

The distribution of warm and cold water zooplankton species off Newfoundland during the winter of 1959 to 1960 is of particular interest and appears to throw some light on the changing pattern of water movement. The western portions of the Recorder routes during the winter months of 1959 to 1960 are shown in Fig.3. The December record shows the distribution of the arctic form Calanus glacialis, presumably associated with the Labrador Current. In February 1960, the sampling followed a course towards Cape Race and a clearly defined patch of warm water species was found off the north eastern slope of the Grand Banks. These included the copepods Nannocalanus minor, Clausocalanus arcuicornis, Lucicutia flavicornis, Pleuromamma gracilis, Pleuromamma borealis and Heterorhabdus spinifrons together with the euphausiids Thysanoessa gregaria and Euphausia krohnii. The March record followed a closely similar course to that taken during February; no warm water species were observed but two species normally associated with cold water conditions, the copepod Metridia longa and the chaetognath Sagitta maxima, appeared in the same area. In April the Recorder was towed along a more southerly course and again no more warm water species were encountered but two patches of cold water copepods, M. longa and Calanus hyperboreus, were found.

The presence of warm water species to the north east of the Grand Banks may indicate a temporary extension of the Gulf Stream System. It is not known whether such events occur at regular or irregular intervals but it is noteworthy that Kielhorn (1957) found several warm water species of zooplankton in January and February at Weather Station B in the Labrador Sea during a survey throughout 1950.

Concluding remarks

Recent work on the hydrography and plankton of the Irminger Sea (Joseph 1959, Gilbricht 1959, Einarsson 1960) has shown that there are two areas rich in plankton, one situated south west of Iceland and the other extending along the Polar Front close to the eastern coast of Greenland. Joseph suggests that there is intermittent upwelling of deep sea water, rich in nutrients, in the former area.

Sampling with the Recorder has confirmed that a relatively high standing crop of zooplankton occurs in the sea area to the south west of Iceland. A comparison of results with other areas sampled by the Recorder in European Seas shows that the mean numbers per sample of Calanus in the Irminger Sea have been exceeded only in the northern North Sea and off the Norwegian Coast and during the summer months euphausiids have been more numerous than in any other area.

There appears to have been very little previous sampling in the oceanic region south of Greenland and one of the unexpected features of this present work has been the very high numbers of Calanus finmarchicus and Thysanoessa longicaudata found in this region. There are indications that the region may prove to be about equally rich in zooplankton as the sea area to the south west of Iceland but it will be necessary to obtain more records particularly during May and June before any firm conclusions can be made.

Except for the brief appearance of a patch of warm water species, the zooplankton found in the surface layers had a very restricted species composition. Over most of the oceanic part of the route only three or four species made a significant contribution to the standing crop, the majority of other species being represented by occasional records. Dr. Henderson also finds that virtually all the fish larvae are one species, Sebastes marinus. The results provide yet another example supporting the general inverse relationship between the diversity of species and the magnitude of the standing crop which has been noted by several workers (e.g. Sutcliffe, 1960).

Another interesting feature of the zooplankton was the great scarcity of small copepod species (adult length < 1.5 mm) and any other metazoa of comparable size. For example, the copepods Acartia, Oithona and Scolecithricella have attained the moderate numbers of 30 per m^3 in only 4 samples out of a total of more than 550 taken over the oceanic part of this route. An exception was Evadne nordmanni which was present in fairly high numbers over the Reykjanes Ridge in July 1959. The absence of small zooplankton may be important in relation to the nutrition of fish larvae since it is the general opinion that these feed almost exclusively upon invertebrates with sizes ranging upwards from 40-50μ in diameter (Morris, 1954). Einarsson (1960), however, has said that the young of Sebastes "prefer food of about 150μ ". Calanus finmarchicus, with an egg diameter of ca. 150μ is, in fact, the smallest common member of the zooplankton. The composition of the plankton in this oceanic area, coupled with the relatively advanced development of the newly extruded Sebastes larvae, may help to explain the exclusiveness and success of this fish.

References

Einarsson, H., 1945, Dana Report No.27.
Einarsson, H., 1960, Rit. Fiskideildar, 2 (7).
Gillbricht, M., 1959, Ber. dtsch. Komm. Meeresforsch. 15 p. 260.
Jaschnov, W.A., 1955, Zool. Zh., 34, p. 1201.
Joseph, J. , 1959, Ber. dtsch. Komm. Meeresforsch. 15, p. 238.
Kielhorn, W. V., 1952, J. Fish. Res. Bd. Can., 9, p. 223.
Morris, R.W., 1954, J. Cons. int. Explor. Mer, 20, p.255.
Sutcliffe, W.H., 1960, Ecology 41, p. 585.
Sverdrup, H.U., Johnson, W. and Fleming, R.H., 1942, "The Oceans", Prentice Hall, New York.

TABLE I

The seasonal occurrence of the phytoplankton found in three areas in 1960. The extent of these areas is shown in Fig.1.

Blank = not sampled,
. = none found,
r = rare,
c = common
a = abundant.

1960

	Labrador Current area						39 - 51°W.										Irminger Sea area											
	Jy	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Thalassiosira spp.	c		a	a			r	r	c			.		r	r		.		.	.	.	r	c	r	r		c	r		.
Rhiz. styliformis	r		r	r			.	r	.			r		.	.		.		.	.	.	.	r	c	c		r	.		.
Rhiz. heb. semispina	r		r	r			.	r	r			c		.	.		.		.	.	.	r	r	r	r		.	.		.
Hyalochaetes	c		r	c			r	r	r			r		r	r		.		.	.	.	.	a	r	r		r	r		.
Phaeocerids	r		c	c			r	r	r			r		r	r		.		.	.	.	.	c	c	a		r	r		.
Thal'x. longissima	c		r	r			r	r	r			r		r	r		.		.	.	.	.	c	c	a		r	r		.
Thal'a. nitzschiodes	r		r	r			.	r	r			.		r	r		.		.	.	.	.	r	c	r		r	r		.
Ceratium fusus	.		.	.			.	.	.			r		r	.		.		.	.	.	.	r	c	c		r	r		.
Nitzschia seriata	r		r	r			.	.	.			.		.	.		.		.	.	.	r	c	c	r		r	r		.
N. delicatissima	.		.	.			.	.	.			.		.	.		.		.	.	.	.	c	r	r		r	.		.
Rhiz. imb. shrubsolei	.		.	.			.	.	.			.		.	.		.		.	.	.	.	r	c	r		.	.		.
C. furca	.		.	.			.	.	.			.		.	.		.		.	.	.	.	r	r	r		.	.		.
C. lineatum	.		.	.			.	.	.			.		.	.		.		.	.	.	.	.	r	r		.	.		.
C. tripos	.		.	.			.	.	.			.		.	.		.		.	.	.	.	.	r	.		.	.		.
C. horridum	.		.	.			.	.	.			.		.	.		.		.	.	.	.	.	r	.		.	.		.
C. arcticum	r		r	r			.	.	.			.		.	.		.		.	.	.	.	.	.	.		.	.		.
Skeletonema costatum	c		.	r			.	.	.			.		.	.		.		.	.	.	.	.	.	.		.	.		.

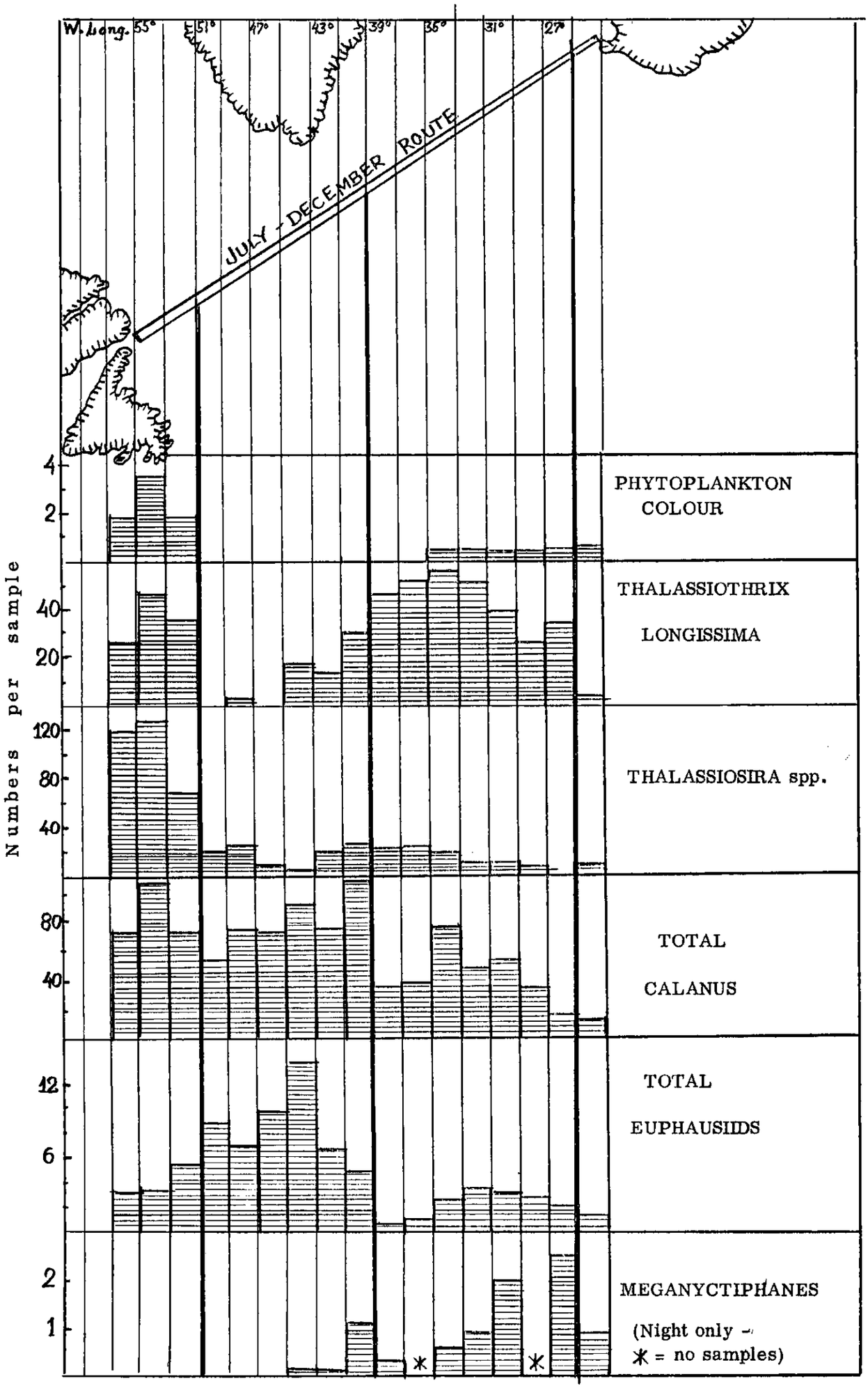

Figure 1 - Histograms showing the average values of phytoplankton colour and the average numbers of Thalassiothrix longissima, Thalassiosira spp., total Calanus, total Euphausiids and Meganyctiphanes between each 2° of longitude from July to December 1959 and 1960. The phytoplankton colour is assessed on an arbitrary scale.

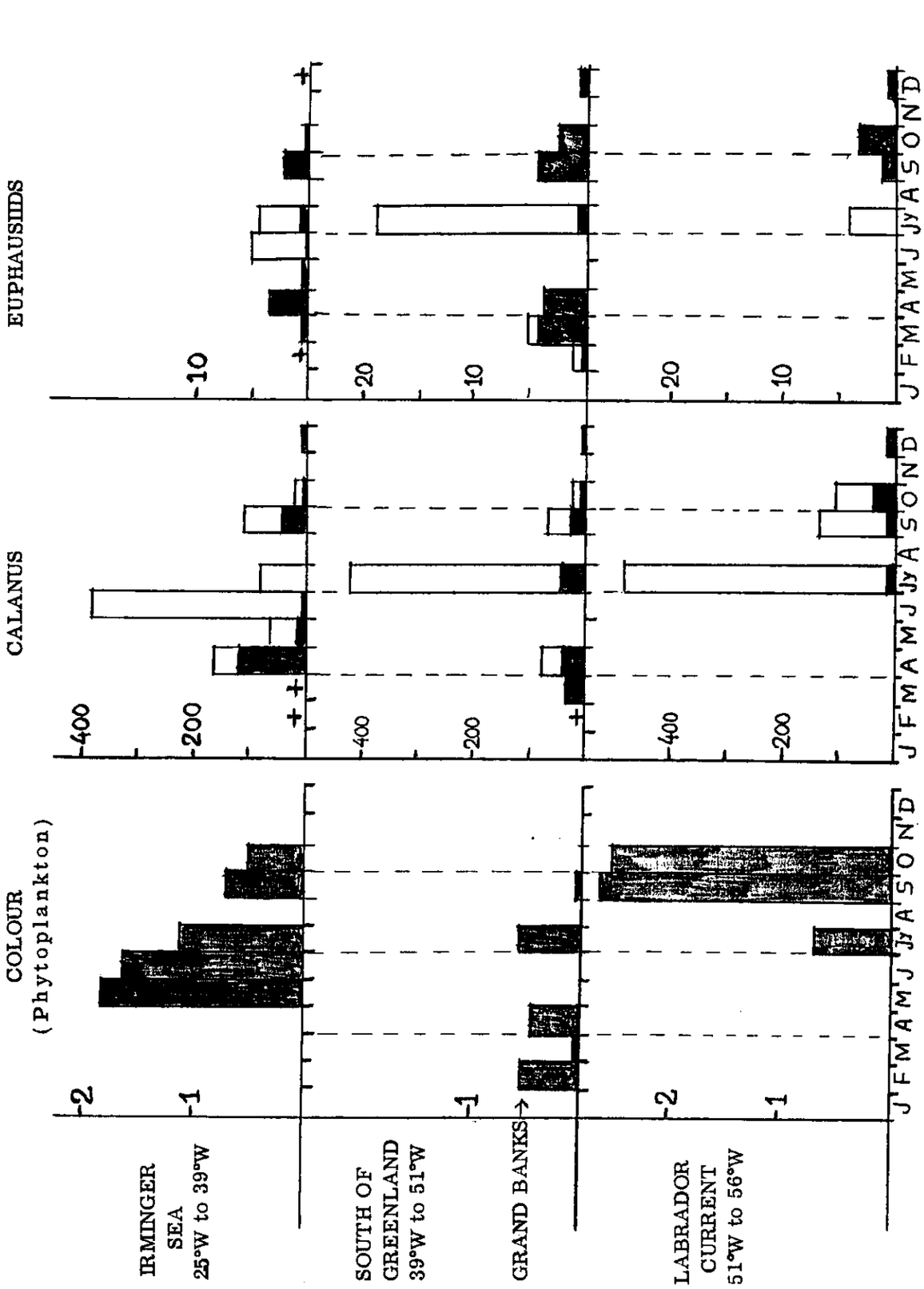

Figure 2 - Seasonal distribution of phytoplankton colour, total Calanus and total Euphausiids along different sections of the route. Mean values for each calendar month; all records May 1959 to October 1960. Stages I-IV Calanus and Euphausiid furcilia as shown as open histograms. Stages V-VI Calanus and Euphausiid post larvae are shown as black histograms. A thin base line indicates that there was no sampling in that month during 1959-60. The scales show the average number per Recorder sample: the phytoplankton colour is assessed on an arbitrary sc2

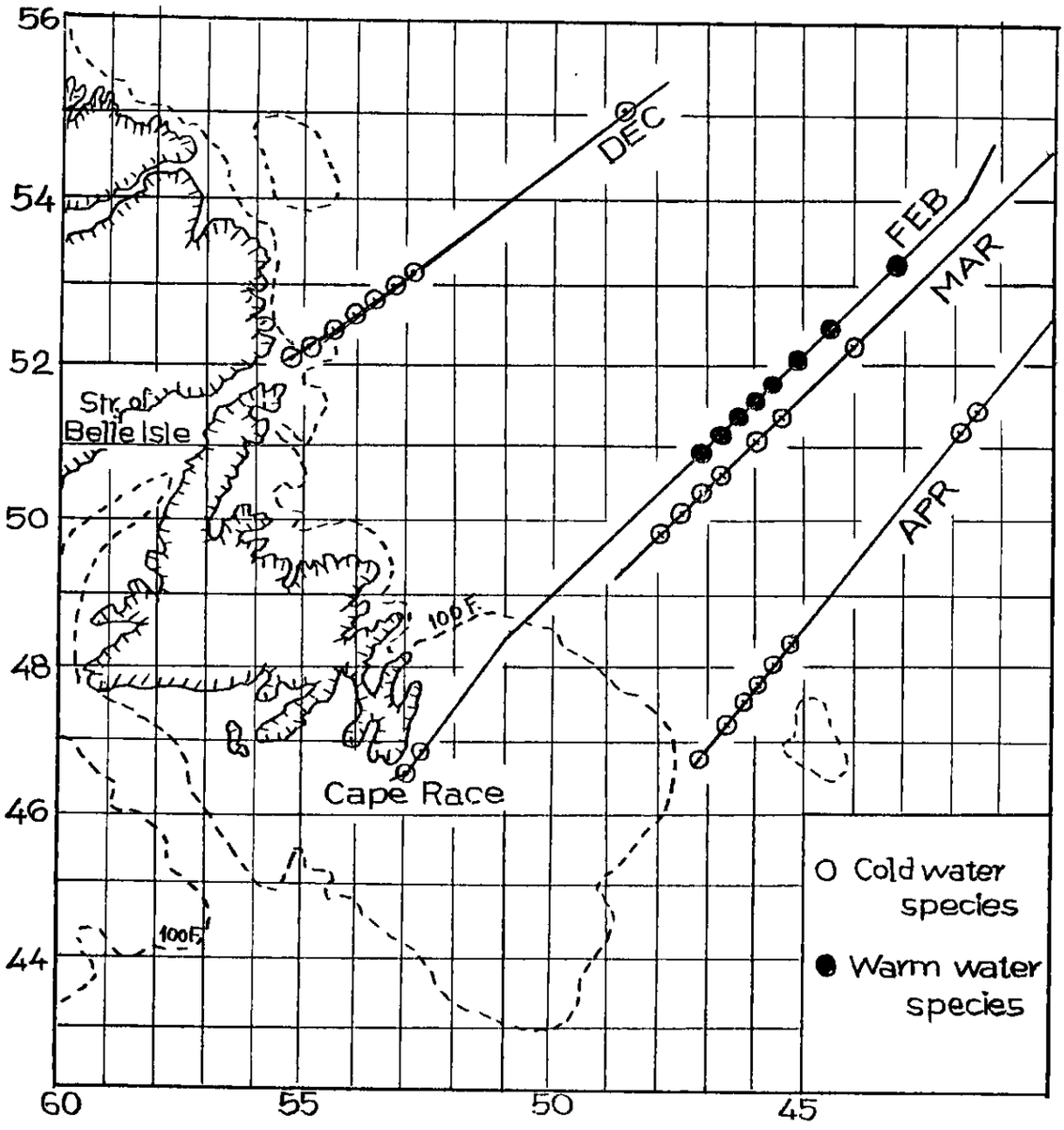

Figure 3 - Recorder routes in the region of the Newfoundland Grand Banks. December 1959 to April 1960.