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The Biology of Metridia lucens Boeck in the Northern North Sea

Preliminary Results for 1961

by

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Introduction

Glover (1957) has shown that marked changes in the composition of the zooplankton over the north-western North Sea herring fishery grounds were associated with contemporary changes in that fishery. He also pointed out that a detailed examination of the biology of the individual species is necessary to understand these changes (Glover et al., 1961) - see also Russel (1935).

The present paper will deal with the preliminary results of population studies of the calanoid copepod Metridia lucens Boeck occurring in the area dealt with by Glover (1957) and Glover et al. (1961). From the extensive work of the Recorder team (Rae 1949-1957 a; Glover & Barnes, 1959-61) it has been shown that M. lucens appears progressively later from south to north in the north-east Atlantic, while in the North Sea, it has two periods of relative abundance - early spring and late autumn. However, no details have yet been published of the seasonal changes in the stage composition of this species in the northern North Sea, and it is mainly with this aspect of its biology that the present paper deals in a preliminary way.

Methods

All samples on which this study is based were taken by oblique hauls with the Gulf III high-speed sampler from near bottom to surface (Adams, 1962). Equal sampling of all levels will be of great importance as Metridia has been shown to undergo marked diurnal migration (Rees, 1957), and the distribution of the immature copepodites must be limited in depth as the occurrence of young stages is extremely rare at 10 metres (Rae, 1957 b).

The Gulf III sampler was fitted with a net of o.231 mm mean mesh size; a comparison of the width of the cephalothorax with the mesh aperture suggests that copepodite stages IV, V and VI will be efficiently caught, that probably at least 50% of stage III escape, and that stage II will only be caught in very low numbers. Younger stages have not been recognised in the samples.

The samples were sub-sampled with a stempel pipette and the number of each stage counted in a ruled petri dish. Cephalothorax length of the females was measured with micrometer eye pieces. Unfortunately, this latter measurement was not included as a routine part of the analysis during 1961, and this has resulted in the absence of data for June.

Results

It will be convenient to describe first the changes in numerical abundance (Figure 1 h), population structure and length of female cephalothorax (Figure 1 a-g) as recorded at station M (see Figure 4) for which there are observations in March, April, May, June, August, September and November 1961.

The numerical abundance, total of all stages caught by the Gulf III, increased from March to April, remained about the April level until June, then fell to a low level in August, but recovered through September to November when levels similar to the April-June period were again recorded.

The March population was predominantly adult, with females of a modal cephalothorax length 1.4 mm. The April population had representatives of most stages which can be caught by the Gulf III, and stages III to VI were present in almost equal proportions. The female cephalothorax had a mode of 1.6 mm but a small peak also occurred at 1.4 mm.

The May population was rather similar to that in April, but stage IV was of greater importance. In June adults had become the most abundant stage present. No cephalothorax size frequency data were available for June but those for May gave a mode of 1.8 mm. The August population had two main stages - stage IV and adult - and the size frequency data, extremely limited as in May, gave a mode of 1.7 mm. Two main stages were present in September, stage III and adults. The length of the female cephalothorax had a mode at 1.7 mm. In November the late stages, V and adult were dominant, and the cephalothorax length had a mode at 1.4 mm.

Figure 2 shows the seasonal changes in abundance of the early stages (II-IV) and the late stages (V-VI) at station M.

Turning to the wider area of the study, Table 1 shows the number of early and late stages averaged for the north-western and central areas (Figure 4) in April, June and September 1961. These areas correspond closely with areas A & B in Figure 2 in Rae and Rees (1947).

In April, the numbers of early stages were similar to those of the late stages in both areas, but they were two to three times more abundant in the central area. In June late stages were far more abundant than the early, and were twice as abundant in the central area. In September the late stages were also the more numerous, but were then more abundant in the north-western area.

Discussion

On the basis of the data shown in Figures 1 and 2, it appears that the yearly cycle at station M was as follows: a predominantly adult generation (A), with females of modal size 1.4 mm, present in March reproduced between then and the middle of April. The numerous copepodite stages in April and May then appeared to have given rise to the late stages recorded in June - generation B.

After June an interpretation of the yearly cycle becomes more difficult, probably because of the lack of data for July. Two features suggest that the females present in September were not of the same generation as that present in June - the time interval, and the fall off of the numbers in August. It is more likely that the September adults belong to a generation, here designated C, which was derived from a spawning about July, the early stages of which were not sampled until August when they formed the peak of stage IV. The generation C, present in September as adults, started to reproduce about this time to give rise to a new generation D, of modal size 1.4 mm, in November. No data are available for December 1961 and the January 1962 collections have not yet been examined, but it would not be surprising if another cycle of propagation began in this period so that generation D was not the same as A of the following year. Rees (1949) has discussed the breeding of Calanus during late autumn and winter, and Wiborg (1954) has shown that spawning in M.lucens takes place during this period.

Thus the present data suggest three new generations in the period April to November 1961, with the possibility of a fourth over winter (Figure 3). Wiborg (loc. cit.) and Rae (1951) suggest three generations a year for Norwegian waters and North Sea and north-east Atlantic respectively.

It is now necessary to consider how the data for the wider area of the survey (Table 1) fits with the data for station M. On the whole agreement is good - April appears in both as an important period of reproduction with early stages forming about 5o% of the total, while the June and September appear as months when late stages were dominant.

The data presented in this paper give no conclusive answers to the problem, stressed by Rae (1951), as to what extent the generations shown to occur in the area are due to local breeding and what extent to recruitment from outside. It must not be thought that these two processes are incompatible for, in the region of station M, Craig (1959) suggests a net surface water movement of 6 km per day while at the bottom he gives a more tentative suggestion of 1 km per day. Thus, taking an average developmental period of 1o weeks - which our data would suggest - animals living near the bottom would drift only 7o km (43.5 miles) during that period, while animals near the surface could drift six times that distance - 42o km (261 miles).

In conclusion, it must be stressed that the data presented above are only the results of a preliminary investigation, which, it is hoped, will form the basis for a more detailed study of the biology of M.lucens. For example, an attempt will be made to sample the stages not efficiently caught by Gulf III, and to study the depth distribution of the different copepodite stages.

Summary

Marked changes in the composition of the zooplankton over the Scottish summer herring fishery grounds have been associated with contemporary changes in that fishery (Glover, 1957). A study of the biology of some of the constituent species has been started and this paper deals with the preliminary results for the Calanoid copepod Metridia lucens Boeck during 1961.

The samples were collected by oblique hauls, with a Gulf III high speed sampler, fitted with a mesh of mean aperture o.231 mm. This means that probably at least 5o% of stage III escape, while stage II will only be caught in very low numbers.

The yearly cycle is described for one position, station M. A generation (A) present in March gave rise to generation B which became adult in June. It then seems that a spawning probably took place in July which resulted in copepodites at stage IV in August, and adults in September - generation C. This generation then produced the late stages present in November - generation D. The possibility of another generation during the winter months is discussed (Figure 3).

The data for the north-western and central areas in April, June and September are compared with those for station M and agreement is shown to be good.

The problem of distinguishing local breeding from changes resulting from water movements is mentioned, and it is shown that these two factors are not incompatible. An outline of future work is given.

References

Adams, J. A.	1962	"Zooplankton surveys in the northern North Sea with the Gulf III sampler". ICES, Plankton Committee, No.51.
Craig, R. E.	1957	"Hydrography of Scottish coastal waters". Mar. Res.Scot., 1959, 2, 3o pp.
Glover, R. S.	1957	"An ecological survey of the drift-net herring fishery off the north-east coast of Scotland. Part II: the planktonic environment of the herring". Bull.Mar.Ecol., 5, pp.1-43.
Glover, R. S. & Barnes, B. I.	1959-61	"The continuous plankton recorder survey". Ann. Biol., Copenhagen, 14, pp.67-69; 15, pp.58-61; 16, pp.76-8o.
Glover, R. S., Cooper, G. A. & Forsyth, D.C.T.	1961	"An ecological survey of a Scottish herring fishery. Part III: geographical and ecological groups in the plankton". Bull.Mar.Ecol., 5, pp. 195-2o5.
Rae, K. M.	1949-1957a	"The continuous plankton recorder survey". Ann. Biol., Copenhagen, 5:pp.56-6o; 7:pp.72-76; 8:pp.1oo-3; 9:pp.113-17; 1o:pp.95-9; 11:54-8; 12:pp.84-7, 6:pp.87-91.
Rae, K. M.	1957 b	"A relationship between wind, plankton distribution and haddock brood strength". Bull. Mar.Ecol., 4:247-69.
Rae, K. M. & Rees, C. B.	1947	"Continuous plankton records: the copepoda in the North Sea 1938-39". Hull Bull.mar.Ecol., 2:95-132.
Rees, C. B.	1949	"Continuous plankton records: the distribution of Calanus finmarchicus (Gunn.) and its two forms in the North Sea 1938-1939". Hull. Bull. mar. Ecol., 2:215-75.
Rees, C. B.	1957	"Continuous plankton records: the distribution of Calanus finmarchicus (Gunn.) in the North Sea and north-eastern Atlantic 1946-1953". Bull. mar.Ecol., 4:211-46.

Russel, F. S. 1935 "A review of some aspects of zooplankton research". Rapp.Cons.Explor.Mer, 95:3-3o.

Wiborg, Kr. Fr. 1954 "Investigations on zooplankton in coastal and offshore waters of western and north-western Norway". Fiskeridirek.Skr.Havundersøk.,11:246 pp.

Table 1. Average number of early (II-IV) and late stages (V-VI) of *M.lucens* per m^3 for areas shown in Figure 4.

Date	Stages	North-western area No. per m^3	Central area No. per m^3
3oth March - 2oth April, 1961	II-IV	7	19
	V-VI	8	2o
14th-25th June, 1961	II-IV	7	8
	V-VI	24	48
7th-22nd September,1961	II-IV	4	4
	V-VI	37	2o

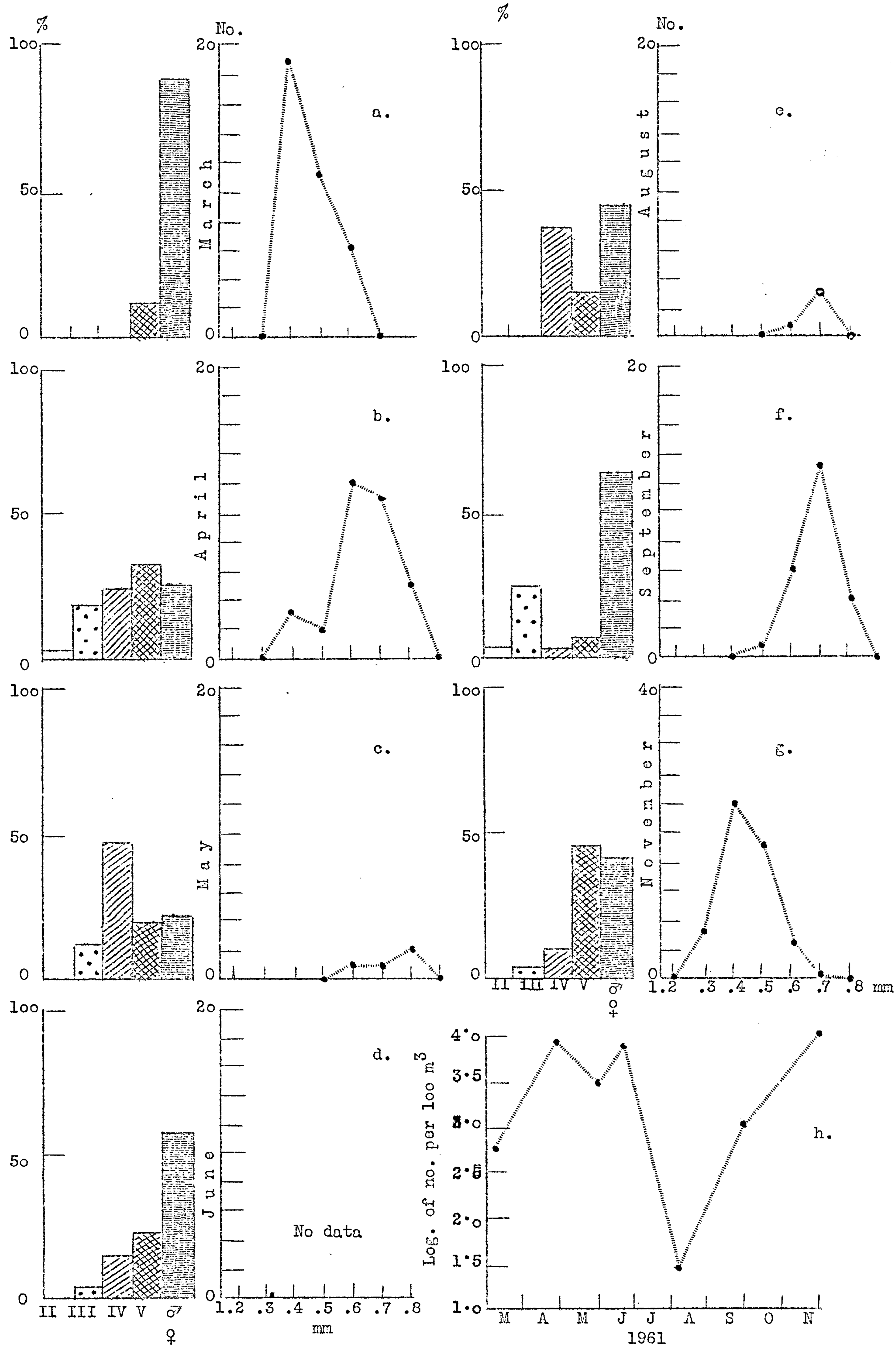

Figure 1. a-g shows population structure on left, and length of female cephalothorax on right, of M.lucens at station M; h shows changes in abundance of M.lucens at station M for the same period as shown in a-g.

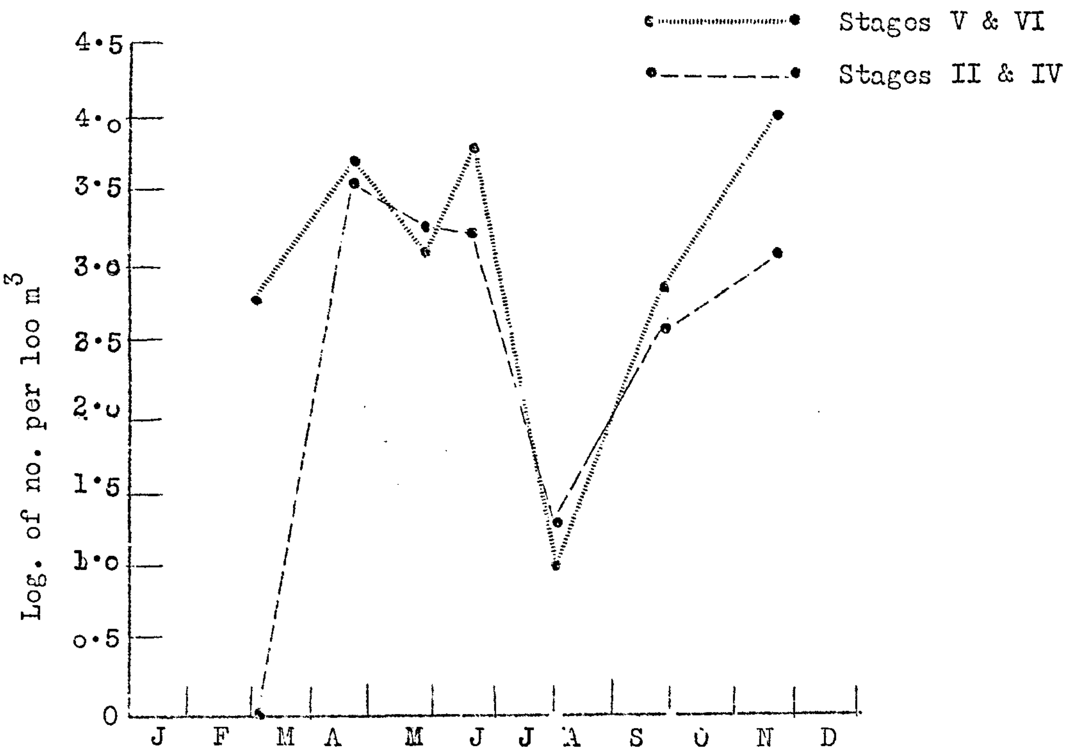

Figure 2. Changes of abundance of early stages (Copepodites II-IV) and late stages (Copepodites V-VI) of M.lucens at station M. Same period as shown in Figure 1 a-g.

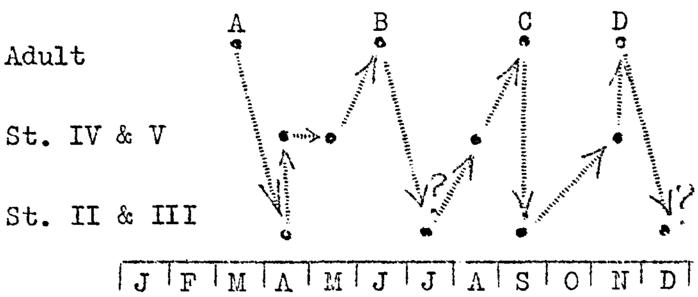

Figure 3. Suggested generation of M.lucens at station M. Periods of presence of stages II and III for which there is no direct evidence marked thus?

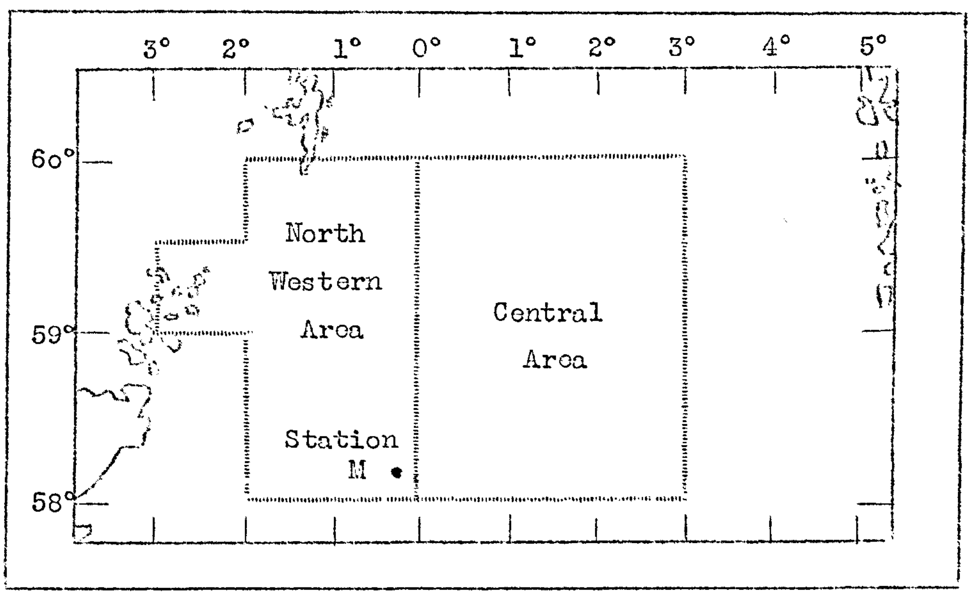

Figure 4. Chart showing north-western area, central area and Station M.