

The Spring Development of Phytoplankton in the Atlantic

Waters of the Norwegian Sea in 1958

By

(E. Paasche)

Previous Norwegian investigations on the phytoplankton in the Norwegian Sea include extensive surveys of the vegetation in June 1952 and June 1953 (Ramsfjell, 1960) and June 1954 (Paasche, 1960). The results of these surveys suggest that in Atlantic as well as in Arctic and Polar waters, the spring development in each of these years followed a different course. As early as the beginning of June 1952, a small-celled summer vegetation consisting of minute diatoms and of coccolithophorids was predominant everywhere in the Atlantic part of the Norwegian Sea. In 1954, at the same time of the year, an abundant occurrence of a variety of large and medium-sized diatoms indicated that the phytoplankton was still in its spring phase. Finally, in June 1953, various stages in a transition between spring and summer conditions were encountered.

The yearly differences in the spring phytoplankton development which are suggested by these observations on the spring-summer transition, were presumably due to a very complex interaction of a number of factors. Thus, for instance, the hydrographical, climatic, and grazing conditions during the spring period certainly exerted a profound direct influence on the course of the spring development. In addition, long-term or yearly variations in the same factors may have had an indirect effect as well, by regulating the seeding of Atlantic water with initial stocks of the different plankton algae, as well as by governing the distribution of these throughout the Atlantic part of the Norwegian Sea.

It was expected that a further study of the material collected during the spring and early summer in different years might serve to elucidate more fully any possible relationship between the specific composition, the quantitative development of phytoplankton, and the duration of the spring period. As a first step an investigation was made of material collected by R.V. "Johan Hjort" in May 1958, as part of the IGY programme.

The survey included samples from 72 stations, mostly located within three main sections through the central part of the Norwegian Sea (Fig. 1). Samples from 0, 10, 20, and occasionally 30 metres were sedimented and counted by means of an inverted microscope. The counting was done by Miss A.M. Rom. The stations were divided into three main classes (see Fig. 1), according to hydrographical data from the cruise (kindly supplied by Dr. J. Eggvin). The easternmost stations in each section represented coastal water with low surface salinities, while the western extremes of all three sections were located in Arctic water of 0-1.5° and with salinities of about 34.90 ‰. The remaining stations thus formed three complete cross-sections of the Atlantic part of the Norwegian Sea, with temperatures ranging from 2.5°C to 7.5°C and salinities above 34.95 ‰. The eastern and western borders of the Atlantic area are indicated by the broken lines in Figs. 1-4.

It should be pointed out that there was a time lapse between the southern section, which was worked between 5. May and 10. May, and the two northern ones, which were worked between 20. May and the end of the month.

The vegetation in coastal waters as well as in Arctic waters was poor in species. It was a small-celled plankton of the summer type known to succeed the rich spring vegetation. In contrast, the majority of Atlantic localities, at least in the two northern sections, supported an abundant phytoplankton of the spring type, comprising a number of species among which large and medium-sized diatoms of the genera Chaetoceros, Nitzschia, Rhizosolenia, and Thalassiosira were amply represented.

The quantitative aspect of the vegetation in Atlantic water is depicted in Figures 2 and 3, showing the distribution of total cell surface at the 0 and 20 m levels respectively. Berge (1959), who made determinations of primary production by means of the ^{14}C technique at the same time as the phytoplankton samples were collected, has presented charts showing the distribution of production capacity at the same depths. There is quite a good agreement between Berge's charts and Figures 2 and 3, standing stock values as well as production capacities in May 1958 in general being much greater in Atlantic water than in adjacent water masses. It is noteworthy that according to Berge (1959), the production in Atlantic water declined after the middle of June and was then no longer significantly higher than in neighbouring areas. This would indicate that the spring period in 1958 lasted no longer than until the middle of June.

With respect to the development prior to the time of sampling, it can be stated that the spring outburst in 1958 did not commence until the end of April or the beginning of May. Vinogradova (1960) found that the Atlantic waters in March and April of 1958 supported only very small amounts of phytoplankton, while on the other hand, the Norwegian coastal waters at the same time were populated by a rich spring vegetation. The progress of the spring development of the Atlantic waters during May is brought about by the contrast between the fairly modest standing stocks in the southern section at the beginning of the month, and the much larger values recorded a fortnight later in the central and northern sections (see Figs. 2 and 3).

It has repeatedly been found by earlier investigators that the spring development in Atlantic waters as a rule starts as late as the end of April or the beginning of May, due to the general lack of stability in the uppermost strata. Thus, while the development in all four years possibly started at about that time of the year, the spring period in 1958 seems to have lasted longer than in 1952^{and 1953} but not as long as in 1954. Unfortunately, since the 1952 and 1953 surveys were made at a time of the year when the spring vegetation had been superseded by a small-celled summer plankton, the 1954 results are the only ones that lend themselves to a comparison with the present data.

As far as the quantitative aspects are concerned, the standing stocks, as measured in terms of cell surface area, appeared to be of roughly the same magnitude towards the end of May 1958 (the two northern sections) as in June 1954. But in view of the complexity of the factors involved, and also because the 1954 material may have represented a later stage in the spring development, the material at hand is far too incomplete to allow any conclusion as to possible differences between the two years in the total amount of phytoplankton produced during the spring period.

Turning to the specific composition of the plankton, it can be stated that there were considerable differences between the two years. In this case, too, it is difficult to ascertain how far a comparison might be invalidated by the data having been obtained in two different months. But an evaluation of all available information has led the author to believe that the communities present in May 1958 did not simply represent an early stage in the spring succession, to be followed later on by a vegetation similar to the one observed in June 1954.

The vegetation in Atlantic water both years consisted of a mixture of oceanic and neritic species, but the latter category of plankton algae was much more predominant in 1958 than in 1954. Thus, Chaetoceros debilis was the only neritic Chaetoceros species of importance in the 1954 material, while in 1958 it was accompanied by several others (Ch. affinis, Ch. compressus, Ch. subsecundus, Ch. teres) with the same distribution in Atlantic water as Ch. debilis (see Fig. 4). In quantitative respects the neritic Chaetoceros species on the whole formed the most important group of plankton algae in 1958. Neritic members of other genera (Thalassiosira gravida, Phaeocystis pouchetti) were of about equal importance both years. This was the case with several oceanic forms as well (Chaetoceros borealis, Ch. densus, Ch. decipiens, Nitzschia seriata, N. delicatissima). But the vegetation in 1958 differed remarkably from the 1954 plankton with respect to some of the larger diatoms. Thus, Rhizosolenia styliformis and Coscinodiscus centralis were predominant in 1954; in 1958, on the other hand, the former was present in very modest amounts only while the latter was lacking altogether. In the 1958 material these two temperate species appeared to be partly replaced by Thalassiothrix longissima and Rhizosolenia hebetata f. semispina which, in the Norwegian Sea, definitely belong to a more Arctic (boreal) plankton element.

No attempt will be made to decide how far hydrographical differences in the two years may have favoured a selection of different categories of algae. But assuming that the differences in phytoplankton composition at least partly reflects yearly variations in the specific composition of the initial stocks, it may be concluded that the Atlantic waters early in 1958 were comparatively heavily seeded with stocks of non-Atlantic origin. Thus, the preponderance of neritic diatoms suggests an admixture of coastal plankton originating in the Faroe-Shetland area or off southern Norway. Similarly, the presence of some Arctic forms might indicate an admixture of plankton from the East Icelandic Arctic Current.

A full account of the results of this investigation will be published shortly (E. Paasche and A.-M. Rom: "On the phytoplankton vegetation of the Norwegian Sea in May 1958". Nytt. Mag. Bot., 9 (in press)).

References

- Berge, G. 1959 "Measurements of the primary production and recording of the water transparency in the Norwegian Sea during May-June 1958". ICES, C.M. 1959, Pap. No. 2: 1-5. (Also in Rapp. Cons. Explor. Mer, 149: 148-57. 1961.)
- Paasche, E. 1960 "Phytoplankton distribution in the Norwegian Sea in June 1954, related to hydrography and compared with primary production data". Rep. Norw. Fish. Invest., 12 (11): 1-77.
- Ramsfjell, E. 1960 "Phytoplankton distribution in the Norwegian Sea in June 1952 and 1953". Rep. Norw. Fish. Invest., 12 (10): 1-112.
- Vinogradova, L.A. 1960 "Phytoplankton distribution in the Norwegian Sea in the spring of 1958". Trudy BALTNIRO, 6: 56-60 (in Russian).

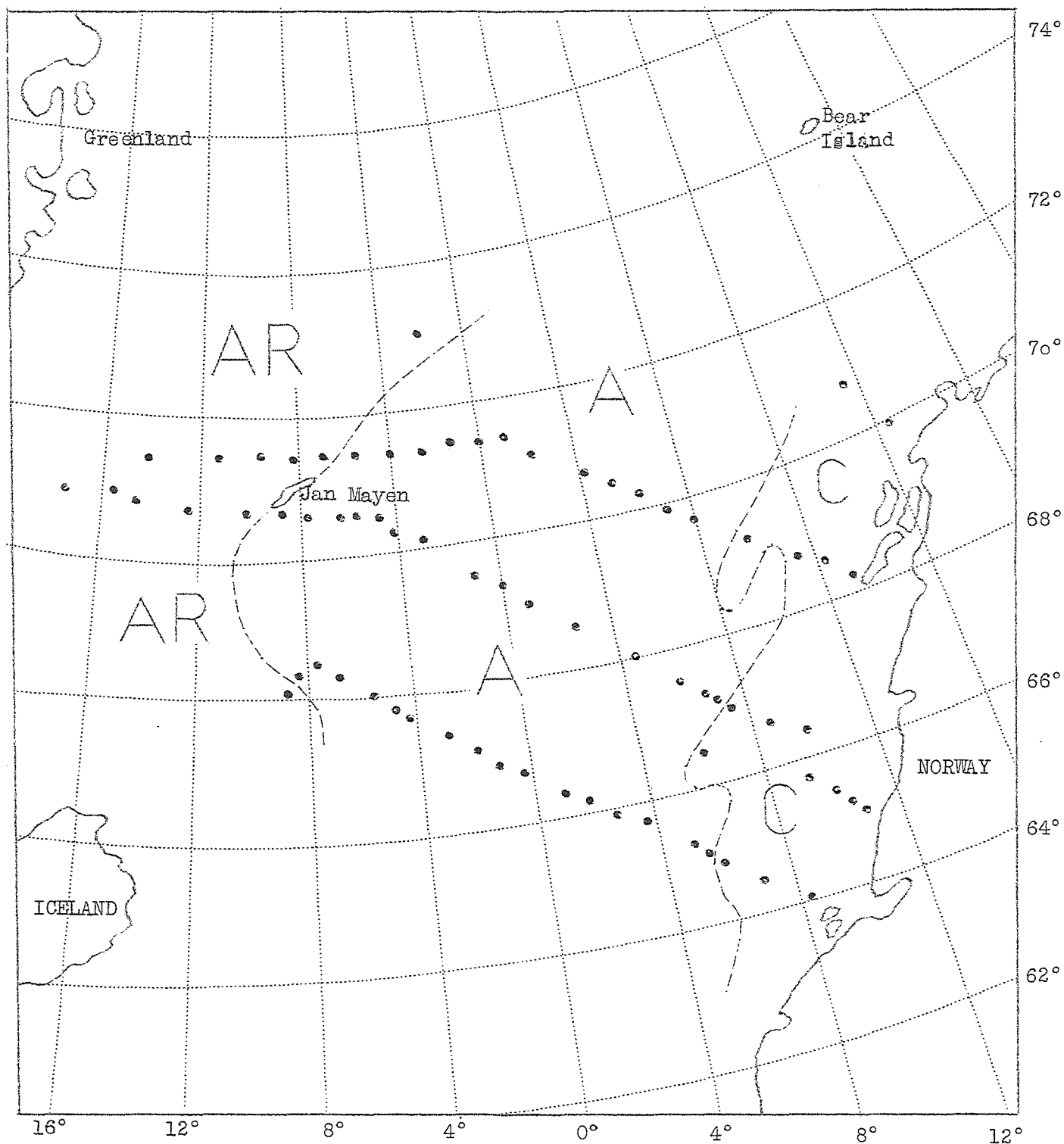


Figure 1. Phytoplankton stations. C: coastal water.
A: Atlantic water.
AR: Arctic water.

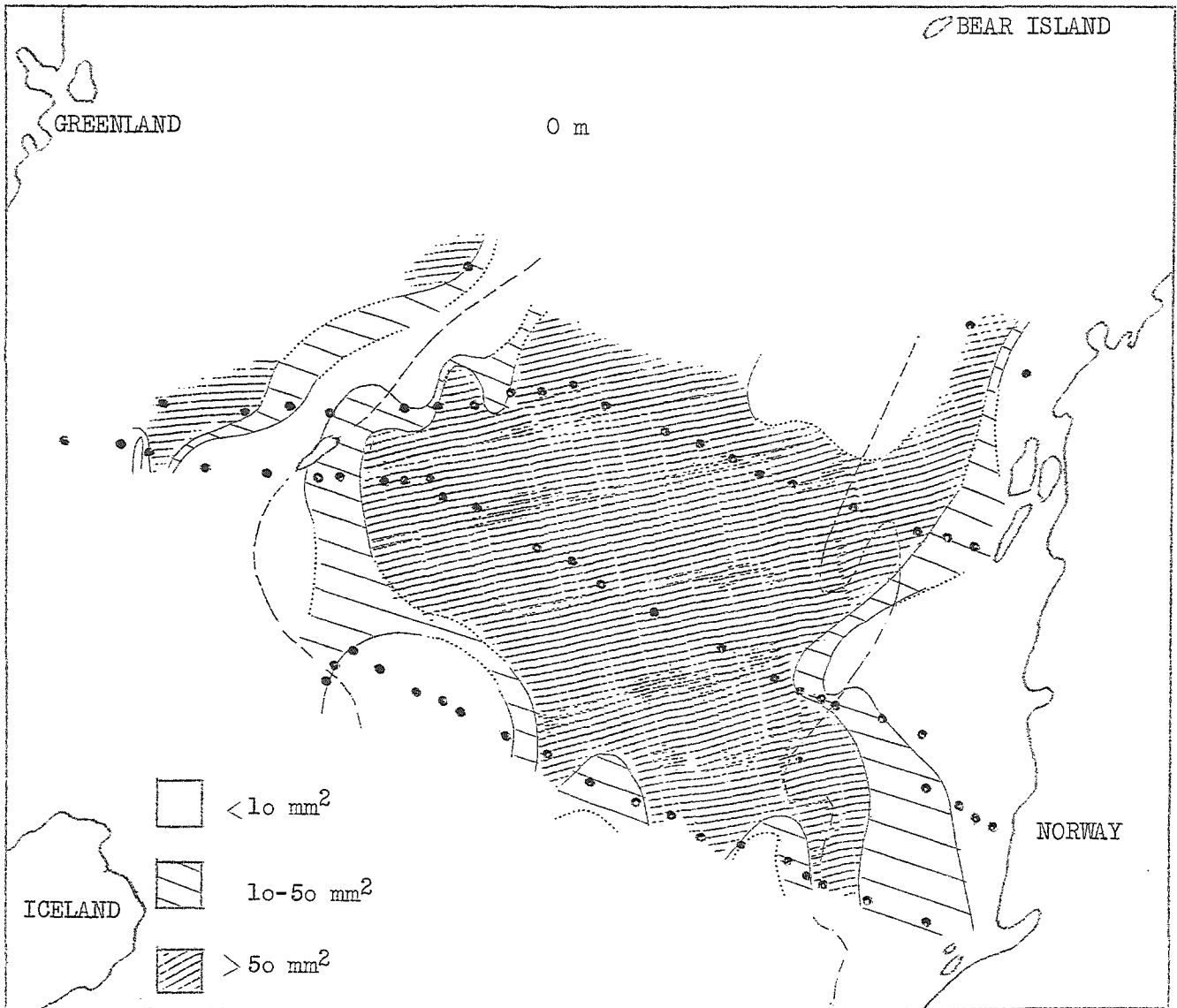


Figure 2. Total cell surface area of phytoplankton at 0 m.

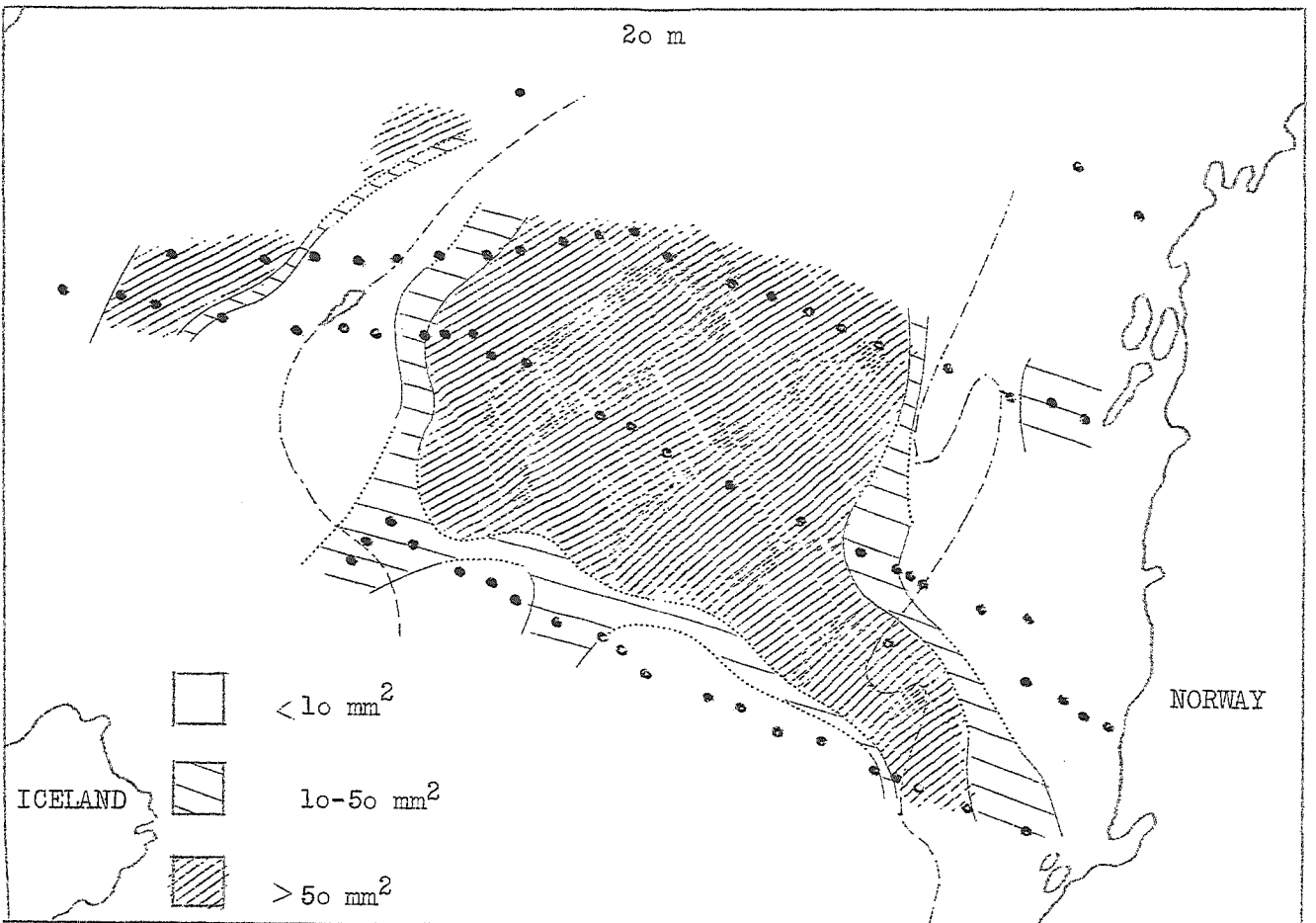


Figure 3. Total cell surface area of phytoplankton at 20 m.

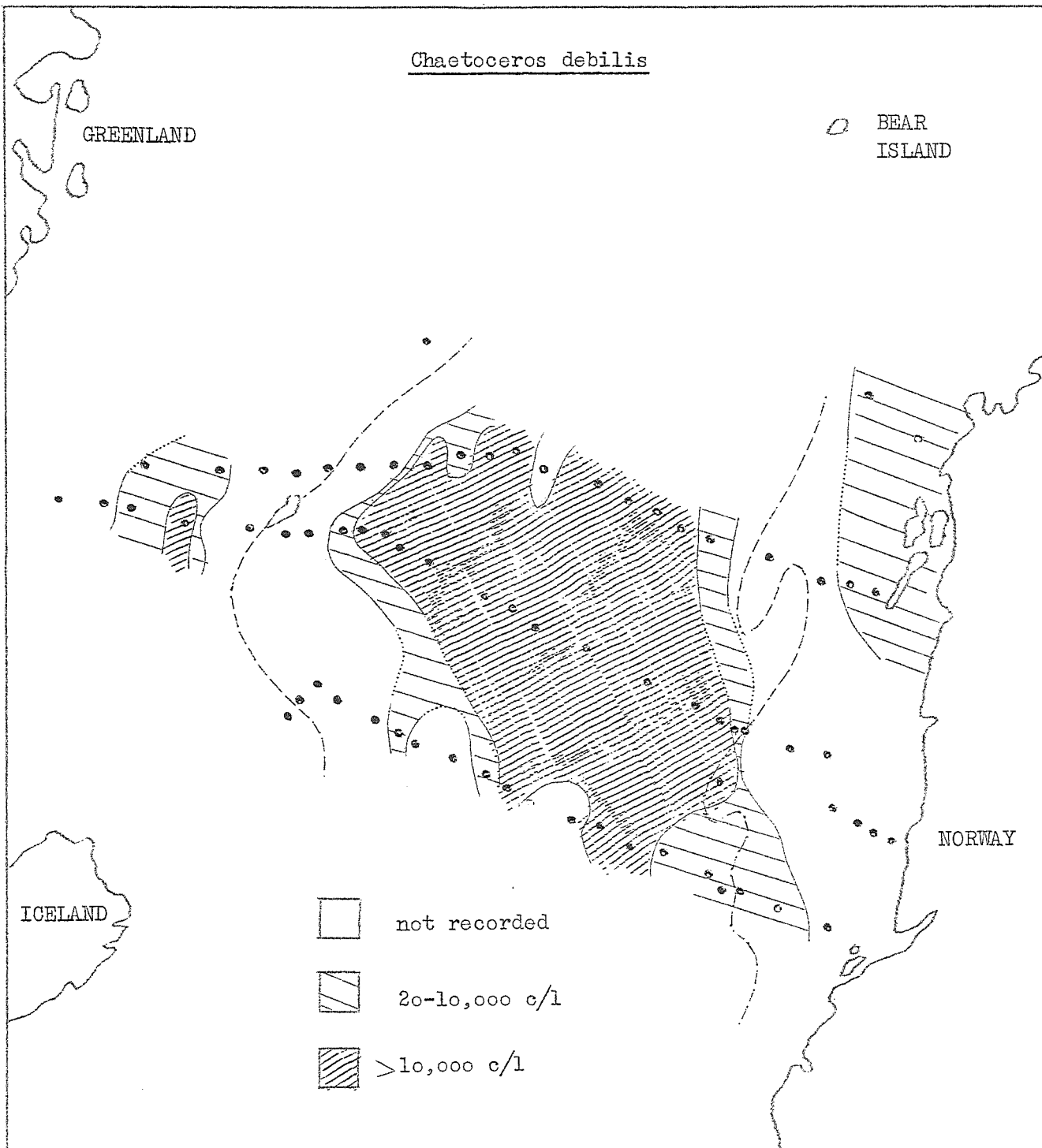


Figure 4. Distribution of Chaetoceros debilis