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A proposal for the introduction of organised echo-search in North Sea Herring investigations

by

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Apart from its direct value to the pelagic fisherman, the recording echo-sounder is an important tool in a number of fishery biological studies. Of these, perhaps the most important are studies of stock distribution and migration. The application of this gear, and the closely allied equipment ASDIC, to this type of problem is well illustrated by the recent investigations by Norwegian workers in the Norwegian Sea (Devold 1952).

Before the echo-sounder can be used effectively in this sort of investigation it is necessary that the types of traces given by any species of fish should be reasonably accurately known. Not until this difficulty has been overcome can the results of echo-sounder surveys be interpreted with confidence for any one species. In some areas, where only one pelagic species is found in abundance at any one time, this problem may be relatively easily solved; but, in those areas which maintain concurrently two or more pelagic species, it may necessitate very careful study of echo-charts taken over large areas and long time periods, with extensive sampling of the species giving rise to the traces. Even after intensive study it may be found that identification of any one species from the echo-charts alone cannot always be made with complete confidence because of the similarities between the traces resulting from shoals of different species. In fact, the usefulness of the echo-sounder in such studies as those mentioned above hinges very largely on the degree of confidence with which traces given by the species under investigation may be identified on the echo-chart.

The identification of herring shoals in the North Sea.

The identification of herring on echo-charts recorded in the North Sea has received much attention, notably by English, German and Scottish workers, following the large-scale introduction of the equipment in the herring fleets since 1945. The main principles underlying this work are discussed by Craig in his contribution to this meeting. The problem has been facilitated in two important respects: that much was already known about the shoaling habits and behaviour of herring in the area, and that they are usually the only pelagic species present in abundance over a large part of the North Sea. This is particularly so in the northern regions, clear of the coasts.

The important result which emerges from these investigations is the association of a class of traces, sometimes called "plumes", with herring. Scottish investigations have shown that "plume" traces are associated with herring over the northern North Sea fishing grounds, particularly during daylight, in spring and summer, and German records illustrate the same type of trace from the Fladen, Gut and Dogger Bank areas. English results (Cushing 1953) show that this type of trace is common also in the southern North Sea.

Some examples of this class of traces, illustrating the sort of range of variation which may be encountered, are presented in Figures I to III(1).

Whilst it cannot be claimed that herring can always be identified on the echo-chart, it is evident that at least in the areas north of the 100 metre contour during spring and summer, particularly in daylight, the "plume" trace can be labelled herring with reasonable confidence. Furthermore, it is considered that sufficient is known of the appearance of traces, other than the "plume", to which herring give rise in different areas and seasons for confident assessments of herring distribution to be made by experienced workers from large-scale echo-sounder surveys over the North Sea.

(1) The actual form of the trace will of course depend on the composition and size of the fish shoal, and also on such factors as the distance of the fish from the oscillators, the speed of the recording vessel relative to the shoals, and the beam angle and paper speed of the echo-sounder.

A proposed programme of echo-search for the North Sea.

One of the important preliminary results which has emerged from the recent international programme of herring tagging in the North Sea and neighbouring areas has been the wide scatter of tagged fish from the points of liberation. From these results alone there is evidence of considerable interchange of stocks between the various fishing grounds, some of which are widely separated.

While important advances towards a fuller understanding of stock interchange and migration of the North Sea herring are being, and will continue to be, made from tag recoveries, it is unlikely that the full story of herring movement will be completed without the introduction of other methods of investigation.

Two additional methods of approach are possible; firstly, extensive sampling and analysis of the fish stocks in all areas where herring are found in abundance, and secondly, the introduction of frequent extensive echo-sounder surveys over the North Sea. The first approach is being pursued by most European countries at the present time and the results from some sources are being published in the Annales Biologiques. But no attempt has yet been made to introduce a co-ordinated programme of echo-search, from the results of which the movements of the main centres of herring in the North Sea might be followed and plotted throughout the year. Hitherto, only localised surveys, covering specific fishing grounds and seasons, have been made (Cushing, 1952 and 1953; Craig and Parrish, 1952).

The employment of search vessels.

Two important factors which govern the success of a programme of this sort are the intensity of echo-search and the frequency of survey; the greater the intensity of search the more accurately can the centres of population be plotted, and the more frequently the surveys are made the more detailed can be the assessment of the migration patterns. The intensity and frequency adopted in practice must be conditioned on the one hand by the available facilities and costs of operation, and on the other by the direct benefits which the surveys would bring to fishermen operating in different areas at the time, and by the minimum data necessary for significant biological analysis.

It cannot be denied I think that, considerations of cost apart, the best method by which an intensive echo-search programme could be conducted would be by search vessels equipped with the best echo-sounders available, and employed specifically for this purpose for the duration of each survey. While it is probable that the detailed requirements might differ to some extent between areas and seasons, it is considered that for the fullest biological benefit the surveys made by the search vessels should be conducted on a regular and close grid, to be completed within the shortest practicable period (say, one week), some 10-15 times each year. A possible survey grid is shown in Fig. IV.

An essential requirement for the successful working of any such programme is a centre for integrating all information collected by the search vessels. This might consist of a team of workers, experienced in echo-chart interpretation, to whom all echo-charts taken during the surveys would be forwarded for analysis. Alternatively, and perhaps preferably, the records taken in different parts of the North Sea could be analysed by local workers having expert knowledge of echo interpretation in their respective areas. Their results would be sent subsequently to a central pool where composite plots covering the whole North Sea could be made and issued to all interested workers. During the course of each survey, of course, each search vessel could impart up-to-date information on the whereabouts of fish concentrations to fishermen working in the area, either of their own or all countries.

Unfortunately, the praticability of such an undertaking is difficult to gauge at the present time. It must be admitted that the proposals made above are expensive, and that a programme of this magnitude could only receive serious consideration if satisfactory evidence of its worth has been obtained. However, it may now be claimed that in several areas the immediate financial benefits to the fishermen alone would more than pay for the cost of operation, so that the overall cost of the entire operation would be much less than might be expected. (Indeed, it seems likely that search vessels may soon be introduced in some areas at the instigation of commercial interests on the expectation of substantial financial reward). Therefore, it is urged that the scheme should not be discarded too lightly, because of the real direct benefit which it could well bring to the commercial fisheries. In the first place, it might be practicable to undertake an initial costing trial, involving one or two search vessels, over only part of the North Sea, in conjunction with the supplementary surveys mentioned below.

Other sources of information.

Even if such a programme of organised echo-search proves impracticable in its entirety at present, many valuable data on herring distribution and movement can still be accumulated from other as yet largely untapped sources. Of these, the most important are: (1) research vessels, and (2) regular freight and passenger ships, and commercial fishing vessels (especially those on regular passage over the North Sea to and from distant fishing grounds), as was envisaged for the more northern waters in the resolution passed by the Consultative Committee in 1949 (Rapp. Cons. Explor. Mer 127, p.36).

Research vessels

While those research vessels employed directly on herring investigations in the North Sea are often engaged in programmes of intensive echo-search from which biological data are being collected, it is probable that at present insufficient use is being made of those not engaged in herring research as sources of echo-search data. It is considered that valuable information would accumulate if echo-search was carried out by all research vessels during their North Sea operations and if these data were forwarded to a central pool for analysis.

Although this source of data would undoubtedly prove of great value in the investigation envisaged, it is unlikely that it would alone provide the required intensity and frequency of echo-search. It is probable, therefore, that unless special search vessels were provided, additional sources of data, to supplement those derived from research vessels would be necessary.

Commercial shipping lines and fishing vessels.

Other sources of data which we have begun to use in the northern North Sea recently comprise the regular commercial shipping lines operating in the North Sea and long distance British trawlers on passage to and from northern waters. Their chief merits, particularly of the first, are their constancy of route and the relatively small cost at which their frequent records can be made.

The first shipping line utilised in the Scottish area was that operated between Aberdeen and the Shetlands by S.S."St. Clair"owned by the North of Scotland and Orkney and Shetland Steam Navigation Company. The route surveyed, which is completed twice in each direction each week, is also shown in Fig. IV. The strategic value of this particular route is that it traverses the areas fished by the drifter fleets operating from the Scottish east coast and Shetland fishing ports so that regular information on the whereabouts of herring concentrations can be given to the commercial vessels. This route is also of particular biological interest in that it crosses the Orkney-Shetland Channel, through which Atlantic water may enter the North Sea.

Once the cost of the echo-sounder and its installation had been met initially, the running costs of this scheme were restricted to the purchase of recording paper, repairs and maintenance of the equipment. Almost immediately, the direct benefit to fishermen from information obtained along this route far more than balanced the initial costs and running for the first year, and meanwhile valuable biological information is being accumulated at relatively negligible cost, with further fishing benefits.

It should be noted that the echo-sounder installed on S.S."St. Clair" is of standard commercial pattern, with a pierced-hull installation. Records of the highest quality have been taken at the vessel's running speed of approximately 14 knots.

There is no doubt that data of both immediate and long term value could be accumulated at relatively small cost if similar echo-sounder surveys could be conducted over the main shipping routes in the North Sea, not only those crossing important herring fishing grounds but also those over the "blank" areas. Some routes, over which regular European shipping lines operate, which it is considered would provide further valuable regular data, are also shown in Fig. IV.

Although less frequent and regular than those taken by "St. Clair", data collected recently from long distance trawlers running between the Humber ports and the Arctic fishing grounds have demonstrated the value of this source of information. Again, a number of such records have been collected at relatively negligible cost.

Recommendations.

It is considered that the pooling of regular echo-search data taken over the North Sea and neighbouring areas would provide valuable information on outstanding problems of herring biology. While it is hoped that a programme of organised echo-search, involving special search vessels, may soon prove practicable, it is meanwhile recommended that immediate steps be taken to pool data from as many other sources as possible. Those which are considered most practicable and least costly are research vessels, commercial shipping lines and fishing vessels. The quality of the data obtained from the one shipping line utilised regularly in the North Sea so far, prompt the strong recommendation that this source be utilised to the fullest extent possible.

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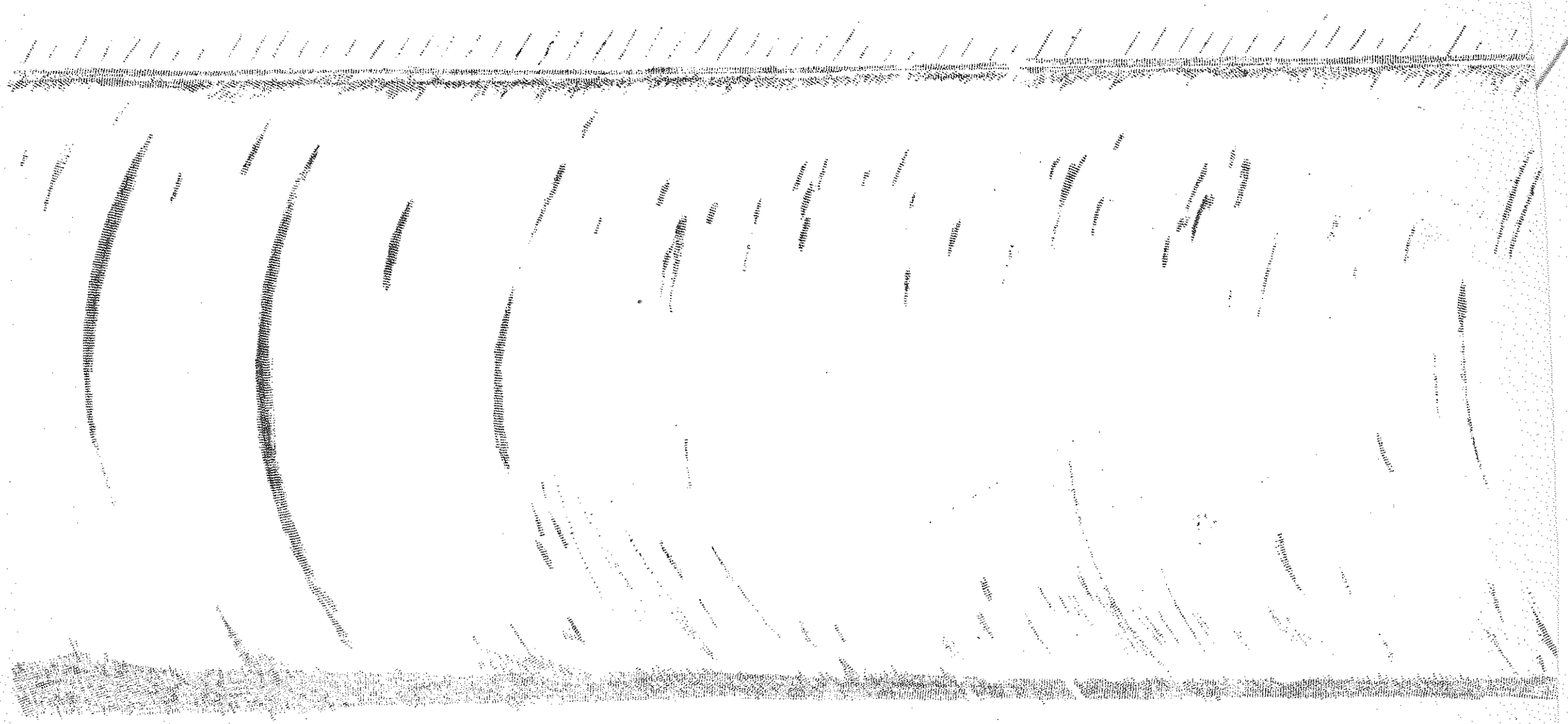

FIG. I. Large and Small "plumes" recorded throughout water column. Approximate position 59°N., 2°30'E.

Date: 5.8.53 Time: 1700 - 1725 Hrs. Speed of Ship = 8 knots.

Echosounder: [illegible] Marine US.24. Paper Speed = 0.5 inch/minute.

Distance covered by echochart = 3 1/3 miles.

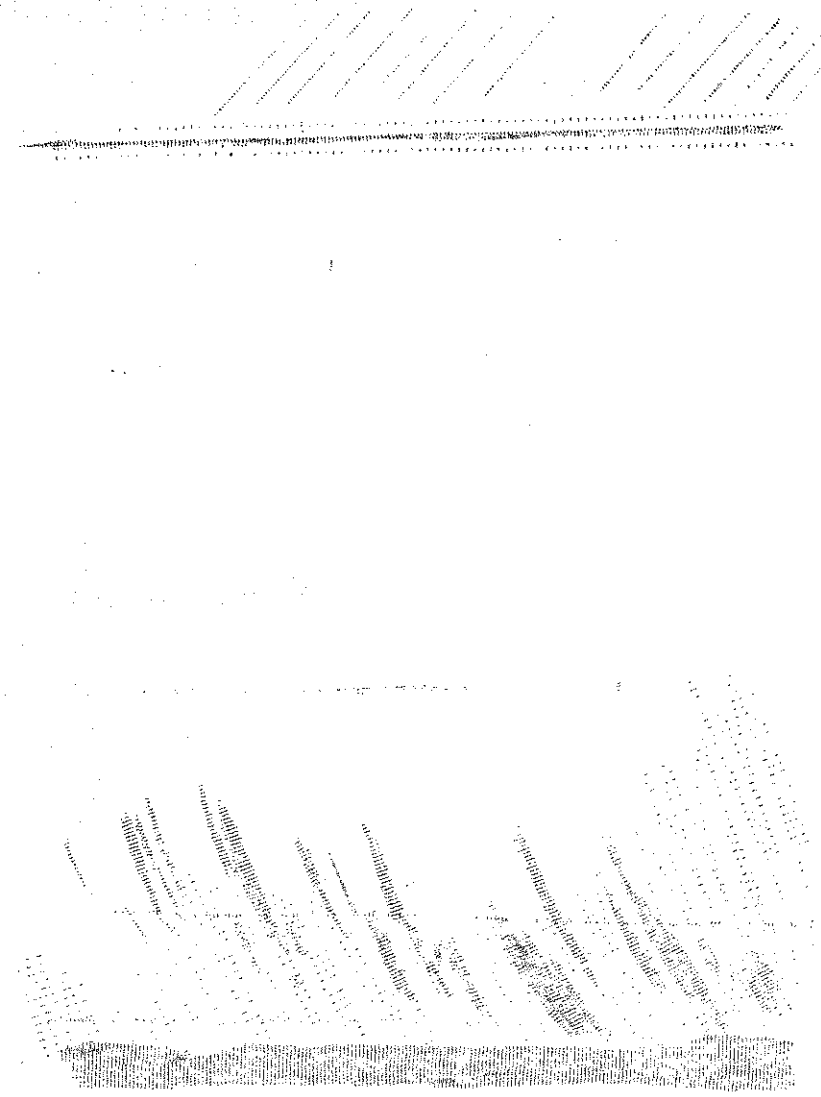

FIG. II. Group of prominent plumes off sea bed. Position 58°18'N.,1°15'E.

Date: 5.5.58 Time: 0530 Hrs. Speed of Ship = 7 knots.
Echosounder: Kelvin & Hughes MS.24 Paper Speed =0.5 inch/minute.
Distance covered by echo-chart = 1 mile approx.

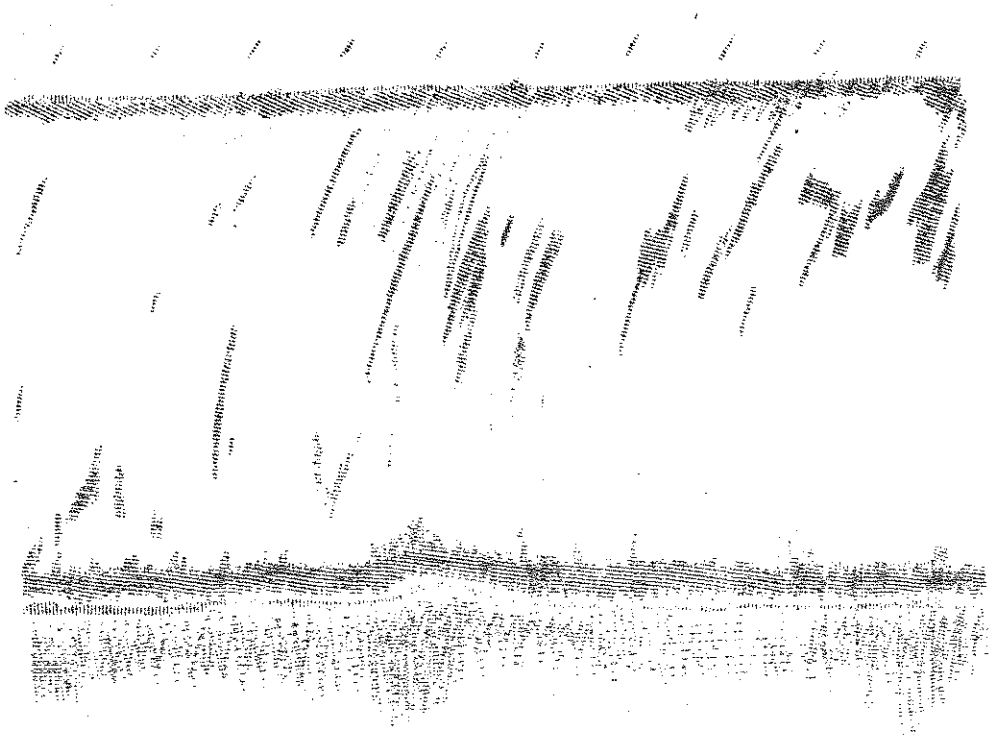

FIG. III Irregular "plumes" in midwater. Position 59°30'N.,2°15'W.
Date: 14.6.53. Time: 2230 Hrs. Speed of Ship = 14 knots app
Echosounder: Kelvi & Hughes MS.21b. Paper speed 0.5 inch/minute
Distance covered by echochart = 1/2 mile approx.

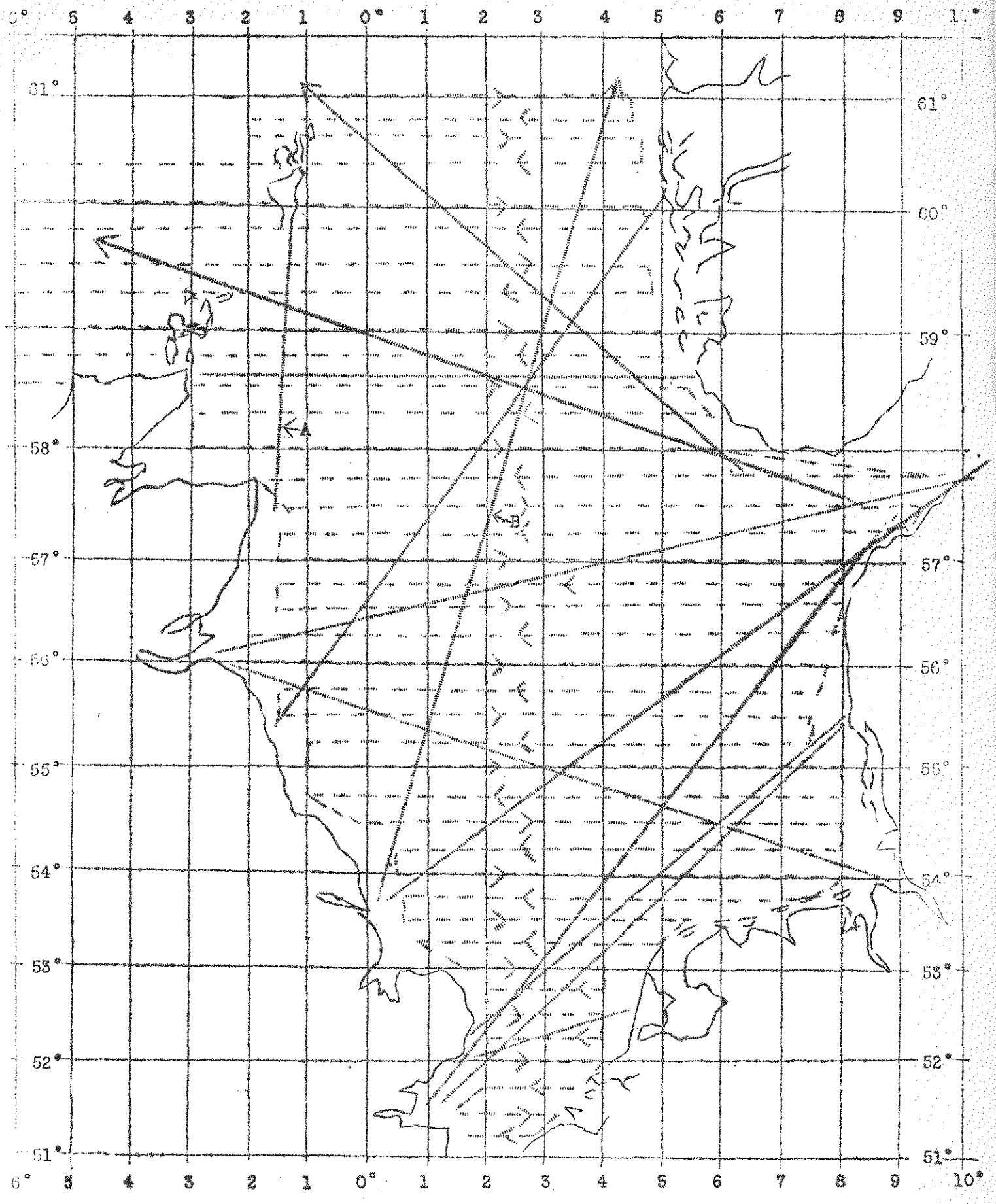

FIGURE IV Chart showing proposed echo-search coverage of North Sea.

Proposed North Sea echosounder survey grid.

Approximate routes followed by some shipping lines and commercial trawlers.

A= Route worked by S.S. "St. Clair".

B= Approximate route British Arctic trawlers working from Humber ports.