

NATIONAL INSTITUTE OF OCEANOGRAPHY
Wormley, Godalming, Surrey.

R.R.S. DISCOVERY
Cruise 42

21st - 30th September 1971

LONG RANGE DETECTION OF HERRING BY G.L.O.R.I.A.

N.I.O. Cruise Report No. 49

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Duration: Sailed Stornoway 11.05 on 21st September,
arrived Barry 07.30 on 30th September 1971.

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OBJECT

The main purpose of the cruise was to see whether commercial pelagic fish could be detected at long ranges by the N.I.O. long range side-scan sonar, G.L.O.R.I.A.; and if so, to use this ability to examine shoal distribution and movement in a limited area as a function of time. A purse-seine vessel, the 'LUNAR BOW', was under contract to identify the targets located by G.L.O.R.I.A. by ringing and catching them. The area selected was an autumn inshore herring fishery in the Sea of the Hebrides, where the bathymetry was suitable for the experiment.

NARRATIVE

R.R.S. 'DISCOVERY' left Stornoway, Isle of Lewis, at 11.05 on the 21st September and steamed down through the Minches towards the selected herring survey ground in the Sea of the Hebrides. 36kHz short range side-scan sonar records were obtained during this passage. She arrived off Barra Head at 20.00 on the evening of the same day and started a box survey of the Sea of the Hebrides fishery area. The object of this initial survey was to use the short-range side-scan sonar and the 10kHz echo-sounder to determine which part of the area had fish in good quantities and was free of rock targets. The area surveyed is shown in figure 1 and in greater detail in figure 2. 10 legs were made using the $\frac{1}{2}$ mile range of the side-scan sonar. This initial survey was completed at 10.00 on the 23rd September. It showed that the region occupied by the NW half of the survey area was fairly flat but devoid of useful quantities of fish, but that the region lying to the SE, on the edge of Hawes Bank and within 7 miles to the NW of it, had good quantities of fish and was basically free of rock targets.

On completion of this work a sonar target was laid consisting of 20 fisherman floats hung vertically at a depth of 65 metres from a free floating dan buoy to provide a target of known acoustic strength. This buoy was deployed 7 miles to the NW of Hawes Bank (position 'A' in figure 3), in the expectation that the target would lie in the field of view of the long range sonar when runs were started. A sound velocity dip was then made, Station 7743, to enable the computer to draw a ray diagram before the sonar was launched. After this (14.00 on 23/9) a plankton net haul was made (Station 7744), using a 54 mesh 1 metre diameter net hauled vertically from 80 metres at about 1 knot. Finally, two drogue buoys were deployed, buoys 'B' and 'C', with the parachutes set to track currents at 50 metres. Echo-sounding runs were then restarted along the original track of leg 8 (see figure 2), with the short range side-scan turned to look downwards as a narrow beam sounder, in order to find out more clearly what happens to

the fish at dusk. Run 19 of this series was finished at 23.20. This was followed by a night net haul to complement Station 7744 using the same net and method of hauling. The catch, like the day haul, contained mainly calanus in good quantity, with some siphonophores, euphausiids and one larval fish. It was then decided that the long range sonar should be launched next morning, meanwhile the time was spent usefully tracking drogue buoys B and C, as well as keeping a watchful eye on the target buoy A.

The G.L.O.R.I.A. sonar vehicle was launched at 10.30 on 24th September in the lee of Canna Island. Launching was completed by 14.30 and the sonar was towed out to start a series of runs along a 10 mile SW-NE track lying 11 miles off Hawes Bank. This track is shown in figure 3 marked 'G'. It was hoped that this track would allow the sonar to look SE through the gap between the end of Canna Bank and shoal ground lying to the SW. The Bank and the shoal ground would then act as markers at each end of the runs. These rock targets were seen on the records at each end of a run, but the propagation didn't allow detection of fish targets beyond about 2-3 miles. This was due to the formation of a temperature layer which caused severe refraction.

'LUNAR BOW', the chartered purse-seine vessel, appeared at 17.00 and was very helpful, giving the Decca positions of some of her catches in the last fortnight. She felt that it was unlikely we would see much in the way of shoals off the edge of Hawes Bank, as all her catches had been on or near the edge of the bank. This was disappointing as it was unlikely that the sonar would detect shoals over the bank with any certainty of identification, unless they were unusually shaped or particularly large. She searched in our viewing area but saw no good herring marks to account for the odd few targets seen on the long range sonar records. We decided to move in over the weekend (25/26th September) to look more closely at the area defined by her catches.

From about 12.00 on the 25th September we started a new series of runs about 6 miles closer to Hawes Bank (runs H in figure 3). The wind started to increase during the afternoon and evening, so that by 23.00 it was blowing at 30 knots producing 4-5 foot waves. The increase in both noise and surface backscatter further reduced the range available during the night. Run H18 was finished at 12.10 on the 26th September.

It was then decided to try to get better control of false targets by improving the short range side-scan coverage near the 100 metre line marking the edge of Hawes Bank. Two runs were made, B1 and B2 in figure 2;

these proved very useful and helped to confirm that the ground was basically clear up to the edge of the bank. In addition it allowed G.L.O.R.I.A. to obtain a good record across Hawes Bank to a range of 7 miles, in which all the major geological features on the bank were clearly delineated in shape and target strength. This was rather a turning point in the experiment as the control was considerably improved for the future identification of fish shoals, and for their movement relative to known strong rock targets. At 16.45 the H series of runs was restarted under much more favourable conditions. By 19.19 the wind had dropped to 15 knots. Much better propagation was obtained and ranges of 7 miles were standard. It was clear that the high winds experienced the previous night were a blessing in disguise, the water had been well mixed and the reasonable ranges which were experienced were due to near isothermal temperature conditions. Run H27 was completed at 04.17, all runs during the afternoon and night showing up a large number of fish shoals lying off Hawes Bank. At 02.30 'LUNAR BOW' had appeared again (Monday the 27th September) and we sent her to investigate positions where we had reasonable targets. She reported only light quantities of fish.

A new series of runs was started at 07.30, the J series shown in figure 3; good propagation was obtained as the weather continued to moderate. By 08.00 the wind was 11 knots and the sea had reduced to 2 feet. Large quantities of fish were detected on these runs, believed to be lying at a depth of about 120 metres from the previous echo-sounder surveys. This was too deep for 'LUNAR BOW' to catch, so she lay hove to waiting for the rise of the fish at sunset.

At 16.50 the L series of runs were started at a slightly increased range compared with the H and J series. Good geological control was obtained through the identification of characteristic rock targets on Hawes Bank at a range of 6-7 miles. It was also found possible to improve the speed with which fish shoal targets were plotted so that 'LUNAR BOW' could be vectored on to them. 'DISCOVERY' took about 1 hour to complete a 7 mile run, so that a target appearing mid-way in any run would only be seen at scanning intervals of $1\frac{1}{4}$ hours. It was found essential to position 'LUNAR BOW' reasonably near a shoal of interest so that as the next detection of that shoal was made she could be given the latest course and range based on the fresh information. When she had been guided by 'DISCOVERY' to within $\frac{1}{4}$ of a mile of a shoal she could then take over using her Elac sonar and investigate its size and density. In this way

'LUNAR BOW' made three catches on the evening of the 27th September, at 18.57, 21.50 and just after midnight, under the guidance of the long range sonar. All three catches were made well off Hawes Bank, in an area untouched by the other 13 vessels in the purse seine fleet. Next morning she landed 240 crans (about 50 tons) of herring at Mallaig, the highest of the day.

By 02.00 'LUNAR BOW' had emptied her nets of the final catch and left for Mallaig. A new series of runs was started near the original 9 runs (series M in figure 3), to see if the better propagation conditions would allow the detection of fish out to 12 miles. Fish were detected out to about 8 miles, with certain high target strength geological features seen at slightly longer ranges. Run M5 was completed at 09.00 on the 28th September, and the recovery of the G.L.O.R.I.A. vehicle was started at 10.30 hours without going for a lee. Wind force was 3-4, with some swell.

At 13.45 Station 7748 was begun, a sound velocity dip to complement the earlier measurement made on the 23rd September before the sonar vehicle was launched. This dip showed near isothermal conditions, and the ray diagram produced agreed with the good propagation conditions we had observed. After completion of this station 200 metres of damaged electric strain cable from the hydrographic winch was paid overside, and then the ship made tracks to recover the drogue buoys. 'LUNAR BOW' had recovered one buoy the previous day, but unfortunately it was not possible to locate the other two which had been drifting steadily to the SW throughout the last three days of the experiment.

After the abortive search for the two buoys was ended a course was laid for the Irish Sea (16.00 on 28/9). The homeward track to Barry is shown in figure 1, the short range side-scan being used continuously. The track passed to the east of the Isle of Man since no side-scan records had been obtained in that area. At 07.30 on the 30th September 'DISCOVERY' anchored in Barry Roads.

STATIONS WORKED

Station No.

| | | | | | |
|------|-------|------|---------|--------|-------------------------------|
| 7743 | 12.20 | 23/9 | 56°50'N | 6°58'W | Sound velocity measurement |
| 7744 | 14.00 | 23/9 | 56°41'N | 7°08'W | Day plankton haul |
| 7745 | 15.25 | 23/9 | 56°47'N | 7°02'W | Deployment of drogue buoy 'B' |
| 7746 | 16.20 | 23/9 | 56°51'N | 6°57'W | Deployment of drogue buoy 'C' |
| 7747 | 23.40 | 23/9 | 56°42'N | 7°08'W | Night plankton haul |
| 7748 | 14.00 | 28/9 | 56°43'N | 7°00'W | Sound velocity measurement |

ACKNOWLEDGEMENTS

Both the Marine Laboratory, Aberdeen, and the Fisheries Laboratory, Lowestoft, provided members who took part in the experiment, either on board 'DISCOVERY' or the catcher 'LUNAR BOW'. Their help and advice was much appreciated. Detailed bathymetric charts of the Sea of the Hebrides were kindly provided by the Hydrographer, Royal Navy.

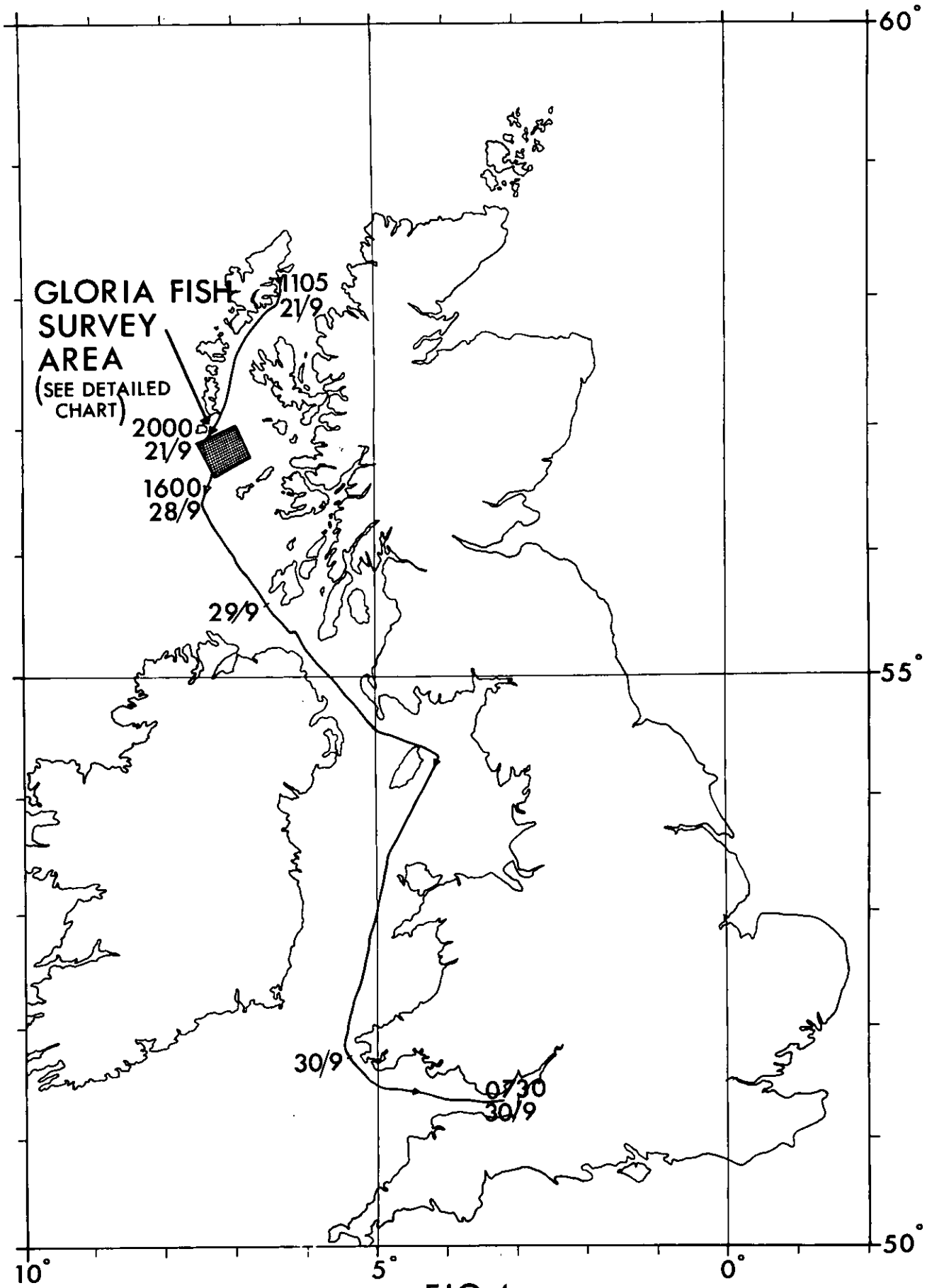


FIG. I

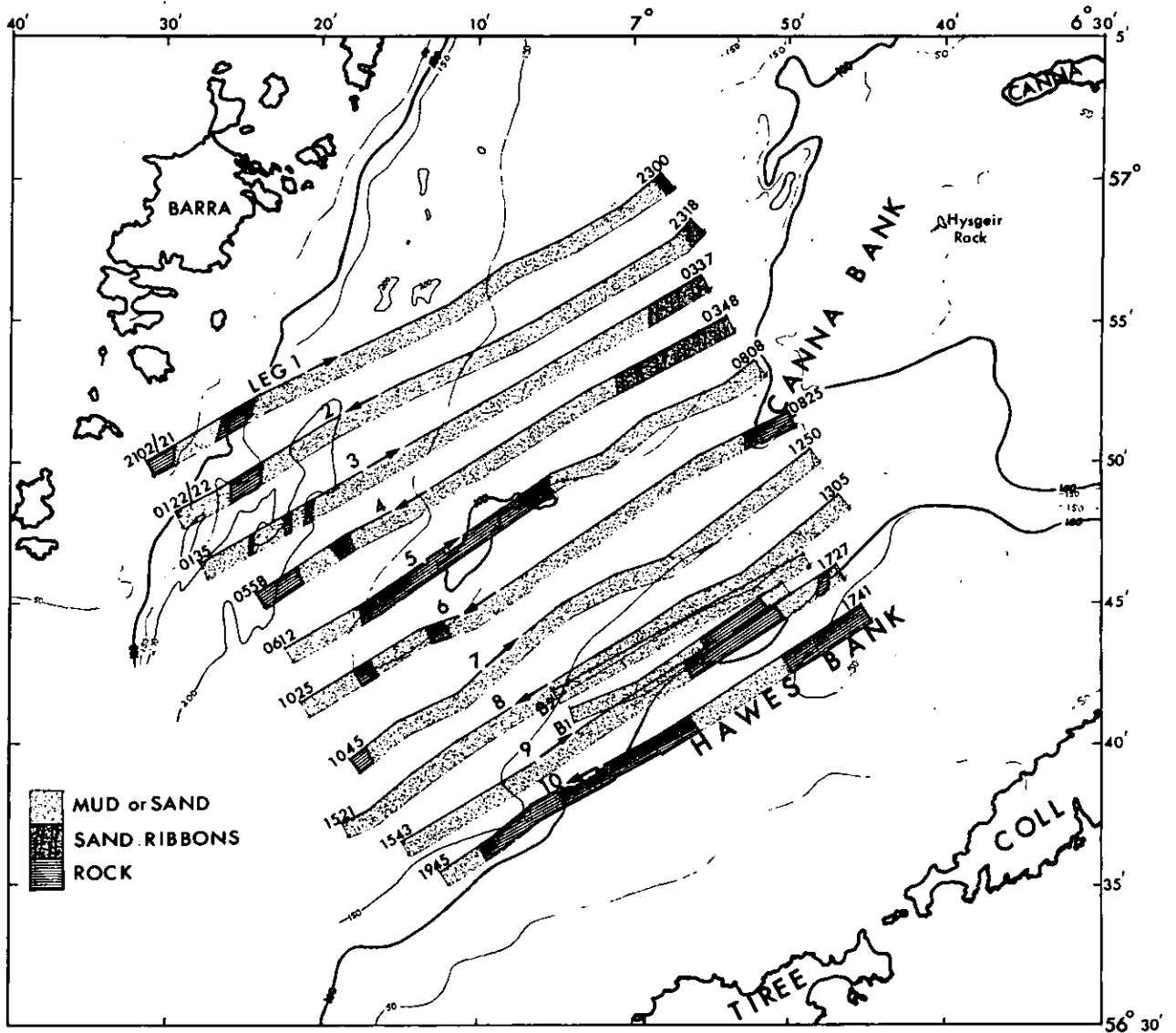


FIG. 2

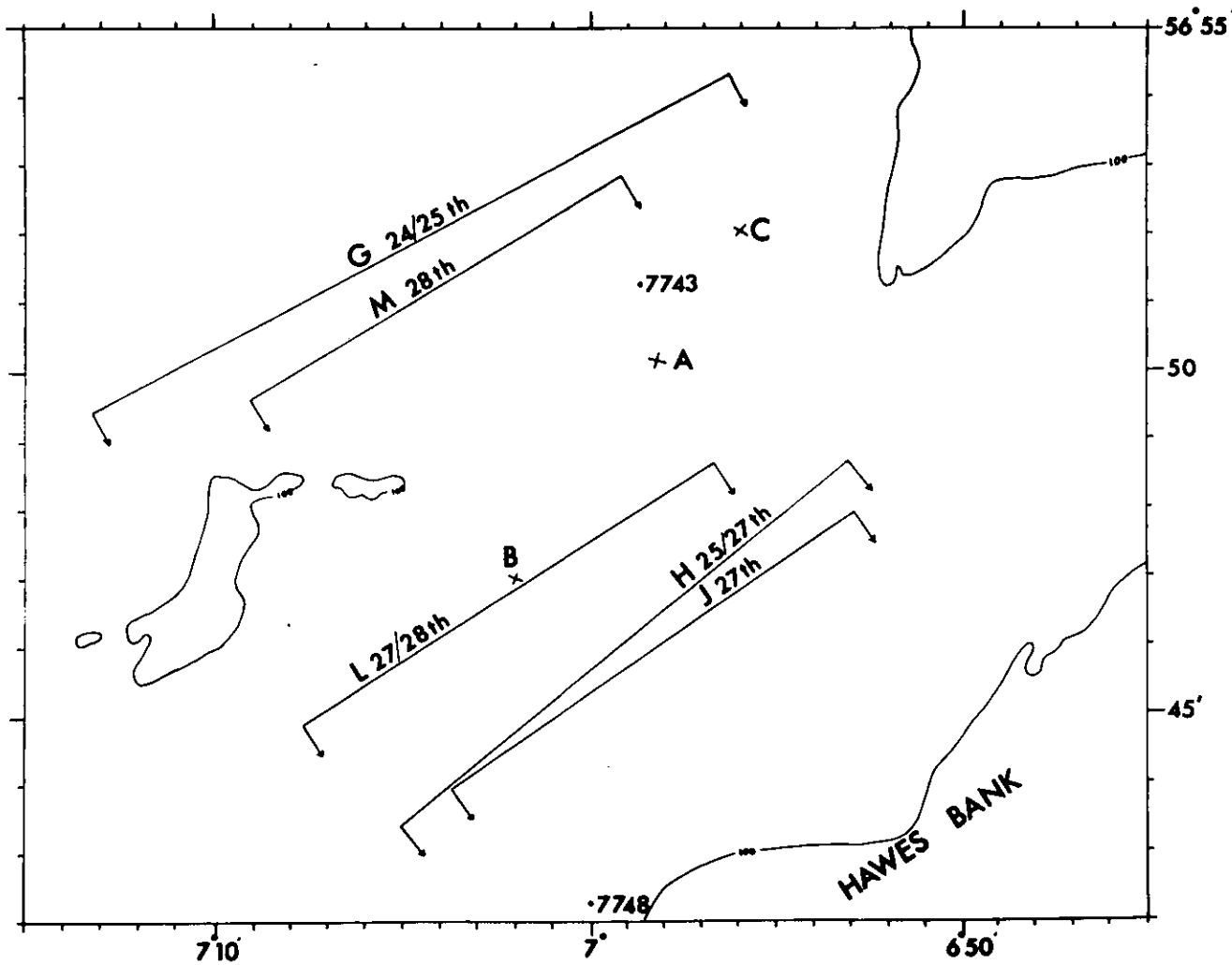


FIG.3