

**I.O.S.**

B. O. D. S.

29 JUL 1974

R.R.S. DISCOVERY  
CRUISE 57

10th NOVEMBER – 1st DECEMBER 1973

CURRENT METER MOORING AND DEEP SEA  
TIDE GAUGE RECOVERY  
AND  
LONG RANGE SONAR EXPERIMENTS (G.L.O.R.I.A.)

CRUISE REPORT NO. 6

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NATURAL ENVIRONMENT  
INSTITUTE OF  
OCEANOGRAPHIC  
SCIENCES  
RESEARCH  
COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES  
Wormley, Godalming, Surrey

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Duration: Sailed Barry 08.10 on 10th November,  
arrived Barry 10.00 on 1st December 1973

Scientific Staff:

Leg 1

10-18th November

B.J. Barrow  
R. Dobson  
D.I. Gaunt - Leader of the tide gauge  
recovery team  
D. Grohmann  
T.J.P. Gwilliam  
M.J. Morgan  
D.G. Roberts  
J.S.M. Rusby - Principal Scientist  
J. Sherwood  
W.T.J. Slade  
R. Spencer

Leg 2

19th November - 1st December

B.J. Barrow  
J. Casson  
R. Dobson  
R.H. Edge  
D. Grohmann  
T. Hogarth  
Mrs. J. Legg  
R. Peters  
J. Revie  
J.S.M. Rusby - Principal Scientist  
A.R. Stubbs  
S.K. Willis  
P.G. Woods

OBJECTS

The cruise was in two parts. The purpose of the first leg was to try and recover both a current meter mooring to the west of Anton Dohrn seamount and the prototype deep tide gauge lying 100 miles north of the Butt of Lewis. In the second part the object was to make a long range herring survey in winter temperature conditions in the Sea of the Hebrides, and to carry out certain sonar experiments in cooperation with the Navy (G.L.O.R.I.A.).

NARRATIVE

Leg 1 - Current meter mooring and deep-sea tide gauge recovery

R.R.S. Discovery sailed from Barry at 08.10 on the 10th November 1973 and sailed up the Irish Sea on passage to Anton Dohrn seamount to attempt the recovery of mooring number 152 laid on the 11th September 1973. The precision echo sounder and magnetometer were streamed, and XBT casts were made on passage and compared with bathythermograph observations. On the 12th the magnetometer was recovered due to a fault in the sea end. The approach to the current meter mooring position was slow due to gale conditions from the NW, however this moderated to force 5-6 and the position was reached at 09.00 hours on the 14th November (see Fig. 1). Good agreement was obtained between satellite and Loran C, and this correlated well with the depth information. The command pinger was interrogated unsuccessfully using about 500 watts of power from the Mark III echo-sounder array. But transmission on the release frequency gave a positive result, and release occurred six minutes after the start of transmission. The mooring was monitored during ascent, the rise time indicating no loss of buoyancy in the new deep spheres. It was recovered successfully, surfacing about one cable from the ship.

Course was set for the deep sea tide gauge position (not recovered on the I.C.E.S. overflow cruise, 'Shackleton' Cruise Report No. 3), but due to 40-50 knot winds a decision was made to go for shelter in the North Minch. The second magnetometer was streamed but was found to be also in poor condition. Later in the evening of the 14th water was being shipped aft, and it was decided to turn head to sea. The ship lay hove to during the night of the 14/15th with wind gusting to 70 knots. The propulsion motor came off loop four times in the period from midnight till 04.00. By noon of the 15th the wind had reduced to 35 knots and the ship was turned to continue course into the lee of Lewis. On arrival the forepeak was inspected for damage, but was found to be sound. At 02.00 on the 16th a sharp front went by, with winds gusting to 70 knots and snow showers. Later in the morning 'Discovery' stood by a coaster in the North Minch whose deck cargo of timber had shifted. A trawler was also in attendance, so 'Discovery' later left the area to proceed to the deep sea tide gauge position.

The passage north was made at 6 knots against a head sea with wind speeds around 30-40 knots. Scientific crew kept watch on the bridge motor speed indicator during the night of the 16/17th, adjusting the revolutions to the pitch of the ship so that the main breakers stayed in at the above average ship's speed. At 03.00 on the 17th the ship was at the tide gauge position, and the wind speed had moderated to 20 knots. Again there was good correlation between Loran C and the depth, with the satellite navigator providing adequate accuracy for Loran C lane identification. The command pinger on the mooring was switched on using 500 watts from the precision echo sounder driven from a continuously rated power amplifier. A dan buoy was laid one cable to the west of the position and the ship hove to, keeping station on the dan until daybreak.

At 07.00 the release frequency was transmitted, at the 500 watt power level. After 17 minutes the bottom echo from the command pinger was seen indicating that the tide gauge had lifted from the sea floor. The ascent was monitored on the echo-sounder recorder, and the bridge informed when it surfaced. It was soon found after surfacing, and recovered without mishap. The dan buoy was recovered and course laid for the Butt of Lewis using three engines. At 20.00 on the evening of the 17th 'Discovery' was hove to 15 miles off Stornoway in 40-50 knot winds unable to enter harbour. These continued throughout the night, and the ship entered harbour at 15.30 on the 18th when the wind speed had moderated to 25 knots. The tide gauge recovery team left in Stornoway, and the G.L.O.R.I.A sonar team joined.

Leg 2 - Long range herring survey, and acoustic measurements in cooperation with the Navy (G.L.O.R.I.A.)

'Discovery' left Stornoway at 16.15 on the 19th November to start the second leg of Cruise 57. From 17.30-20.30 a box search was carried out 5 miles east of Chicken Head for a fisherman lost overboard, but with no success. At 20.30 the short range side-scan sonar was mounted on the port side (Kelvin Hughes transit sonar) and was found to give useful results out to a range of 500 metres, but was limited by flow noise to a maximum speed of 8 knots. From 22.00 hours various courses were made between the Shiant Isles, Trodday and Rhu're to observe fish in the North Minch, then the ship turned south through the Little Minch to enter the Sea of the Hebrides.

During the 20th, and the forenoon of the 21st, a fish survey was carried out in the Sea of the Hebrides using the hull-mounted echo-sounder

and the transit sonar. From radio conversations with Mallaig, and those made with local fishing vessels by VHF, most effort was concentrated near Curachan, Eriskay, Eynort, Ushinish and Loch Maddy where shoals were reported. Good fish marks were seen off Curachan, both in shallow and deep water near the 100 metre contour. From this survey it was decided to accept the Curachan/Eriskay region as best suited to the G.L.O.R.I.A. long range work.

Having selected the area of interest a sound velocity measurement was made, and a current meter mooring laid about 3 miles east of Curachan Rock. After this a further echo-sounder and side-scan sonar survey was carried out to a distance of 10 miles from Curachan; the sonar gave useful details of the main rock features to be found in the selected region, some of which would provide good position references for the subsequent long range survey of the area.

'Discovery' entered Loch Boisdale at 09.00 on the 22nd in readiness for the G.L.O.R.I.A. launch. But the wind was found to be too strong, and she later moved across the Minch to Loch Dunvegan to inspect two possible launching sites in that loch. By then the wind had increased to 30-40 knots so the launch was cancelled. 'Discovery' steamed to Loch Slizort to pass the night under sheltered conditions to allow the transit sonar to be tested with a prototype logarithmic receiving amplifier. Runs were made throughout the night of 22nd/23rd using both rock and sand wave targets on the bed of the loch. Useful calibration records were obtained covering a high dynamic range of signals.

By 06.00 on the 23rd the wind had moderated to about 15 knots, and the G.L.O.R.I.A. vehicle was launched in Loch Dunvegan at 09.00. Records were obtained out to a range of 7 miles initially in the Minch, but by evening the weather had again deteriorated, ranges had reduced to 3-4 miles as the



sea state increased under 40 knot winds from the west. During the night courses were laid E-W in the deep water along  $57^{\circ}15'N$ , giving 25 miles of sea room between the Outer Hebrides and Skye, in winds gusting to 50 knots. There were problems of ship handling under these conditions, into wind she would not make more than  $3\frac{1}{2}$ -4 knots with the vehicle under tow, down wind she tended to lose steerage way if the speed was less than 7 knots. On the turn the ship's speed reduced to  $1-1\frac{1}{2}$  knots which allowed the G.L.O.R.I.A. float to drop about 50 metres or more (on retrieval 5 days later it was found that the vehicle had been in contact with the sea floor, this incident almost certainly occurred on a turn into wind off Skye during the above gale). Ideally the sonar system should be towed only within the speed range 4-7 knots.

By noon on the 24th the wind had moderated to 25-30 knots and 'A' type runs were started about 7 miles off Curachan rock. These were 7 miles long, lying nearly N/S, and included the current meter mooring position in each 1 hour scan. Good propagation was achieved to 7 miles, with many readily identifiable rock features seen on the records. These runs were continued through the 25th and were completed by run A24 ending at 10.00 on the 26th. During this period a number of inshore fishing vessels were working close to the 100 metre line off Curachan and Eriskay. Good fish targets were seen at dawn on the 25th, as groups of fish moved off the edge into deeper water. At other times some smaller fish targets were recorded.

After the 'A' series of runs a 'B' run was carried out 10 miles off Hawes Bank on the eastern side of the Sea of the Hebrides. Few targets were seen on this run, which tended to support the evidence given by Mallaig and the local fishing fleet that the herring were running mainly on the western side. At 13.00 'Discovery' completed a rendezvous with a

Royal Navy helicopter carrying two personnel for the forthcoming cooperative experiments. After they had been transferred, five 'C' runs were made between 16.00-22.00 hours lying only 5 miles off Hawes Bank. During this period good fish targets were found lying in ribbon aggregations many miles long. The ship then steamed towards a position south of Barra Head where she was joined at 11.00 on the 27th by a submarine for the combined experiments. Before moving into deeper water for these experiments the Royal Navy kindly agreed to lift a 'Discovery' crew member from the ship due to a personal loss at home.

Good records were obtained on the Shelf out to a range of 7 miles on the way out west to the Shelf edge. These could be correlated with the detailed short range records taken by the transit sonar at the same time. From this comparison it was clear that the G.L.O.R.I.A. sonar was differentiating between the sand and gravel fields on this part of the Shelf, and ribbon-like features could be traced for many miles. On crossing the Continental Slope a number of gullies were seen running down into the offlying sedimentary basin. The good definition in these shallow water results was no doubt due to the isothermal 'winter' water structure, which allowed low glancing angles at the sea floor because of the surface refracted propagation path. Various types of run were carried out in the deeper water with the accompanying submarine, which permitted sonar source level and directivity calibrations to be made. Some measurements were also successfully made on the level of an 800 Hz difference frequency produced parametrically by transmitting two high frequency components. The submarine detected and measured these levels at 5 miles while running at 70 metres.

At 19.00 on the 28th 'Discovery' signalled her thanks to the submarine and steamed back towards the Hebrides under increasing winds. She arrived at the entrance to Loch Scribian, Isle of Mull, at 08.00 on the 29th and the G.L.O.R.I.A. vehicle was retrieved. At 13.15 the two naval personnel were lifted by helicopter and the ship then steamed to the current meter mooring off Curachan. By 18.30 this mooring had been recovered and the ship was turned south on a course for the Irish Sea.

The 30th November was spent moving down the Irish Sea with further logarithmic amplifier trials in progress on the transit sonar. 'Discovery' made fast in Barry Dock at 10.00 on the 1st December.

STATIONS WORKED

Station No.

8469 <sup>A</sup>	16.00	11/11	54°50.5'N	5°30.5'W	BT/xBT dip
8470	14.00	13/11	56°38.5'N	9°53.0'W	BT/xBT dip
8471	13.30	21/11	57°0.5'N	7°13.5'W	Velocimeter dip
8472	15.00	21/11	56°58.5'N	7°12.5'W	Current meter lay.

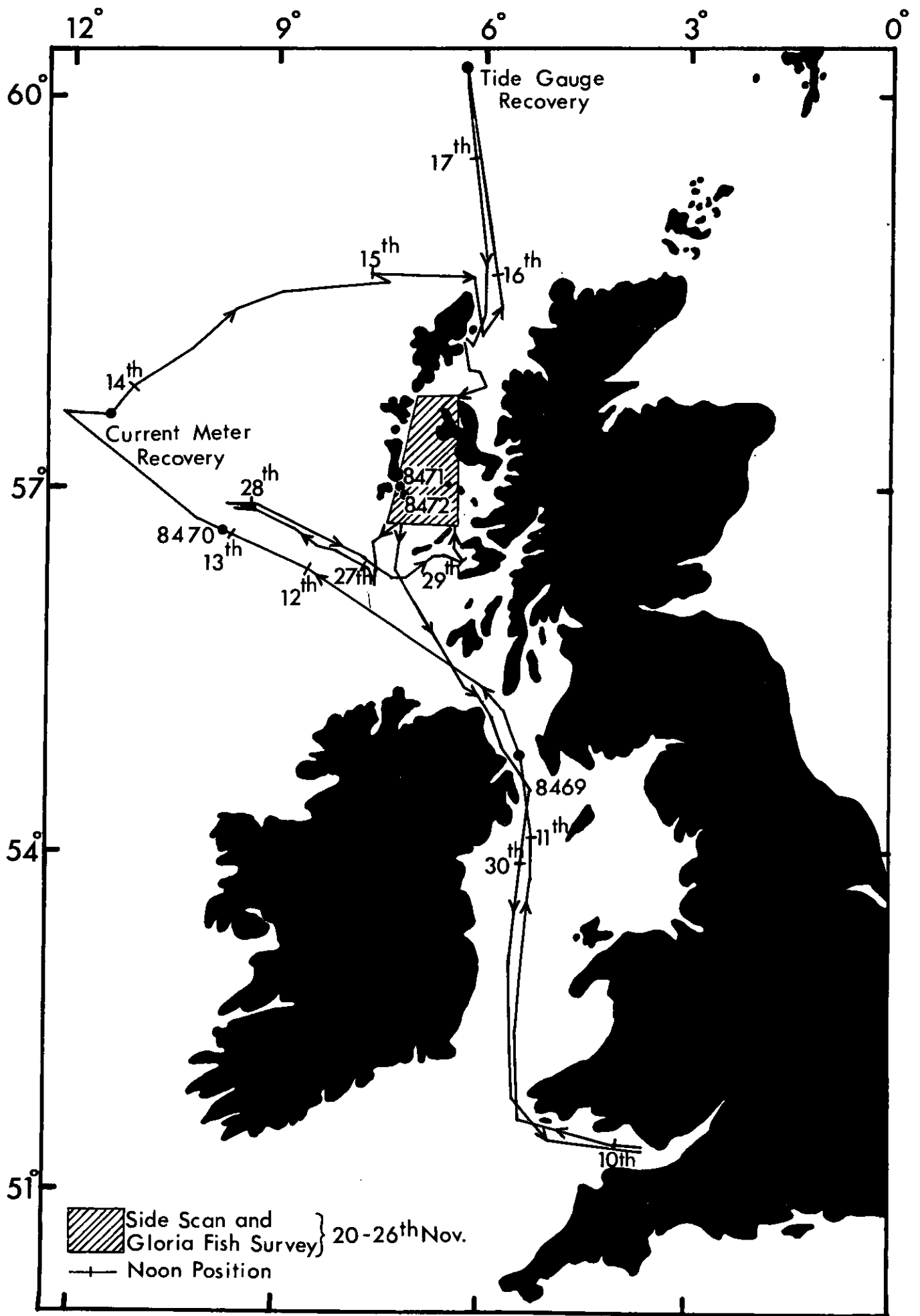


FIG.1