I.O.S.

R V EDWARD FORBES

Cruise 10, 10A and 15

Cruise 10, 25 June – 5 July 1977
Cruise 10A, 10 – 15 August 1977
Cruise 15, 13 – 23 September 1977

# Research on Sandwaves and Sea-bed Mobility in Start Bay

Cruise Report No. 64
1977

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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R V EDWARD FORBES
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# Research on Sandwaves and Sea-bed Mobility in Start Bay

Cruise Report No 64

1977

D N Langhorne
Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

CONTENTS

SCIENTIFIC STAFF

IOS (Taunton)

| Cruise No<br>Dates | 10<br>25 June-5 July | 10A<br>10-15 August | 15<br>13-23 Sept |
|---|---|---|---|
| R Gleason | - | 11 Aug | - |
| F D Hammond | 1 July | - | - |
| P M Hooper | 24 June-4 July | 10-14 Aug | 12-21 Sept |
| J Humphery | 30 June-4 July | - | 13-20 Sept |
| D Joyce | - | 11-13 Aug | - |
| D N Langhorne (Principal Scientist) | 25 June-4 July | 11-15 Aug | 13-21 Sept |
| M Ledgard | 1 July | - | - |
| B Lees | 26-27 June | - | - |
| J O Malcolm | 26 June-4 July | 11-13 Aug | 13-20 Sept |
| A J Marks | 26 June-4 July | 10-14 Aug | 13-21 Sept |
| E J Moore | 24 June-4 July | - | 12-20 Sept |
| M A S Moore | 24 June-26 June | 12-15 Aug | - |
| SHIP'S OFFICERS | | | |
| Captain | F Dunning | P Coombes | K Avery |
| First Officer | P Tilbury | P Tilbury | P Tilbury |
| Second Officer | D Thompson | P Oldfield | A Barton |
| Engineer | I McGill | I McGill | J O'Keeffe |

VISITORS

| | |
|---|---|
| A J Harrison, IOS (Bidston) | 28 - 30 June |
| K Richards, Southampton University | 29 June |
| K McLean, Contract Diver | 27-29 June, 11-13 Aug |
| A J Harris, Decca Navigator Co Ltd | 1 July |
| B D'Olier, City of London Polytechnic | 11-12 Aug |
| Y D Barve, Central Water & Power Commission, New Delhi | 15 September |
| Lt Cdr Browne, Hydrographic Department, MOD | 16 September |
| Lt Cdr Banyard, Hydrographic Department, MOD | 16 September |

OBJECTIVES

1. To continue the study of seabed mobility in the Start Bay area using:
   (a) Shipborne survey methods
   (b) Diver measurements
2. To obtain tidal data to the East of the Skerries Bank for the period of a month using an IOS(Bidston) offshore tide gauge.
3. To carry out acceptance trials of the Decca Trisponder Microwave position fixing system.
4. To obtain tidal stream data in the Bristol Channel for the period of a month using the Marconi current meter system.
5. To continue trials with Rangemaster relative position fixing system.
6. To relay the Start Bay Wave Rider Buoy.
7. To relay the Eddystone Wave Rider Buoy.
8. To carry out drilling rig site surveys in the English Channel on behalf of the Institute of Geological Sciences (Leeds).

NARRATIVE

1. The study of seabed mobility in Start Bay.

(a) Shipborne survey techniques

An area of large sandwaves (wave heights of up to 15m) has been selected for observations of mobility in relation to energy conditions (ie: Spring and Neap tide and wave conditions). The sandwaves occur on the Eastern flank of the Skerries Bank in water depths which range between 7 and 50m. The latter depths are characteristic of 'pits' which occur in the troughs between some sandwaves. Within the sandwave field an area of 4000 x 250m was selected for detailed observations. On each of the three cruises detailed surveys were carried out in the designated area (survey line spacing average 12.5 m). Position control for the surveys was provided by Trisponder interfaced to both a 350 T/S track plotter and Decca Data logger (Maglog). Depth measurement was made using a Raytheon DE 719B (200 kHz) echo sounder. All depths are reduced to LAT (OD-2.62m) using tidal data recorded at Hallsands and, for the first two cruises, an IOS(B) offshore tide gauge. EG & G sonar data (Hull-mounted, port side only) was also obtained in order to study the dune configuration in relation to the large sandwaves.

During the cruises it was demonstrated that it was possible to control the ship's track to an accuracy of $\pm$ 2.5m on either side of a designated track

plotted on the Trisponder controlled track plotter.

(b) Diver measurements

In November 1976 an area on the Skerries Bank (Position: 50°15'12"N, 03°36'18"W) was selected for sandwave observations by divers. In the study area maximum water depth reached 15m, and the seabed morphology consisted of sandwaves with heights of up to 4m and secondary features with heights of approximately 0.3m. Three diver Rangemeter Transponders were laid on railway wheel sinker modules in a triangular pattern (distances between transponders: 206.5m, 112.95m; 128.4m). Initially it was intended to make detailed studies of an individual sandwave which lay to the south of the Transponders. Owing to adverse weather little progress was made with the study during the winter and on returning to the area in June it was found that the selected sandwave had degenerated into a series of dunes at its western end. During Cruise No 10 it was decided to concentrate on a sandwave which occurred to the north of the Transponders on account of its apparently uniform crestline.

Eleven metal stakes (2.0m x 0.015m) were driven vertically into the seabed at a spacing of 50cms transversely across the sandwave. The tops of the stakes were levelled and the height of the seabed was measured at each stake. The stakes were also levelled to the nearest Transponder rig which acted as a local bench mark. Repeated height measurements were made at slack water in relation to flood and ebb,and Spring and Neap tides, and under varying wave conditions. Owing to the movement of the sandwave it became necessary to add three additional stakes to the north of the line and eight to the south. Lateral movement of the crestline was also measured using Rangemeter in conjunction with the seabed transponders. Ranges were obtained at approximately 7m intervals along a crestline length of 100m. The data was relayed to the surface support craft (either the Inflatable dinghy or the IOS(T) launch Sandpebbler) by Helliphone acoustic telephone link. Studies of dunes, associated with the longer sandwave, were made using conventional tape measurements and sidescan sonar.

Tidal stream observations were made over a 12-hour period using direct reading current meters. Integrated velocity readings were obtained over 5-minute periods every six minutes together with direction. The current meters were positioned at 1 m above the seabed and midwater (using Seafarer echo sounders) at a carefully controlled position over the crest of the sandwave. During the period of these measurements three sets of diver stake measurements were obtained at successive slack waters.

At the end of cruise No 15 the area was left marked by a Toroid with flashing light and radar reflector. The position of each Transponder was also marked by surface floats.

All the diving was carried out from either the inflatable dinghy or Sandpebbler, but the presence of RV Edward Forbes acting as a support vessel was very important to the success of the study.

2. Tidal data from a position to the East of the Skerries Bank obtained by an IOS(B) Offshore Tide Gauge.

Precision surveys of the sandwaves on the Eastern flank of the Skerries Bank are horizontally position controlled using the Trisponder micro wave system, whilst vertical depth measurement is obtained using a 200 kHz Raytheon narrow beam echo sounder. Depth measurements are reduced to LAT Datum ($\equiv$ OD - 2.62m) using tidal data obtained from an experimental FM pressure transducer tide gauge situated at Hallsands. Only theoretical estimations can be made of what amplitude and phase corrections should be applied to the Hallsands tidal data when applied in the survey area. For this reason an IOS(B) offshore tide gauge was made available for use in conjunction with the Hallsands tide gauge.

Assisted by A Harrison (IOS(B)), the offshore tide gauge was laid in position $50^{\circ}15'08"N$ $03^{\circ}33'45"W$ in a depth of approximately 38m on 28 June 1977. The system, consisting of a pressure and temperature gauge, as well as a direction velocity sensor, was set to record for a period of up to 45-50 days at 10 minute intervals. The tide gauge was marked by a surface toroid with flashing light and radar reflector.

A second experimental rig was also laid on 28 June in a position 700m SSW of the main system. This latter system was recovered on 30 June.

The tide gauge was recovered by RV Edward Forbes on 12 August (44 days after deployment). On recovery it was found that severe chaffing had nearly parted the soft eye in the mooring wire securing the surface toroid. Translation of the data tape confirmed that good data had been obtained over the period of deployment.

3. Acceptance trials of Decca Trisponder Microwave position fixing system.

The newly purchased Decca Trisponder system consisting of a Distance Measuring Unit (DMU), Master Tx/Rx Unit, 3 Remote Tx/Rx Units and 10295 Drive Unit (ie: interface between the DMU and Decca 350 T/S Track Plotter) were used for the first time on RV Edward Forbes Cruise No 10.

Comprehensive calibration checks were carried out on 26 June. Initially the system was calibrated between the National Grid Trig Points at Berry Head (294563.89E 56538.12N) and Gattery (29157.99E 54267.87N), a grid distance of 3798.89m (scale factor 0.99973m, height difference 87m), true range 3800.89m. The equipment was then transported to the IOS(T) calibration range on Slapton Beach and the ranges to the three remote Units were checked over the following ranges: 3583m, 3558m, 2265.5m, 1325m, 1301m. The three remotes were then set up at Start Point (282917.0E, 37138.25N) which is the Southern control point for the Start Bay surveys, and the base line to Strete (283803.75E, 46333.77N) of 9238m was checked. The DMU was then transferred to the Northern Control Point at Compass Cove Cottages (288498.0E, 49685.75N) and the range of 13735m to Start Point was checked. In all cases the required accuracy of $\pm$ 0.5m was obtained. The system was then set up for the duration of the cruise with remote unit No 72 at Start Point, No 74 at Strete and No 76 at Compass Cove Cottages. Power supplies were provided by 2 x 12 v batteries at each station.

During the course of the cruise opportunities were taken whenever the ship anchored to obtain 'near' simultaneous ranges from the three remote stations. Using these ranges in pairs three positions were calculated. In all cases, (except when close to the Compass Cove Cottages to Start Point Base line) the calculated positions agreed to better than 1m.

At the end of the cruise further calibration checks were carried out before demobilisation.

The Trisponder system performed with complete satisfaction throughout the cruise. The only associated incident occurred in relation to the interface with the Decca Data Logger (Mag log). The failure was traced to the interface card which was subsequently replaced by Decca.

Certain problems were experienced with the initial use of the Drive Unit. These necessitated a visit to the ship by Mr Harris of the Decca Navigator Company at Brixham. The faults were found to lie with both a faulty fuse holder in the Drive Unit and power failure on the IOS(T) track plotter. These were rectified and the equipment operated satisfactorily. On occasion the track plot stopped, but continued to operate after switching off and re-setting up. No explanation was found.

The operation of the Drive Unit is eased considerably with the use of a Hewlett Packard 25c programmable calculator.

The Trisponder system was again used for position control on Cruise 10A

(10 - 15 August) as on the previous occasion the initial calibration and adjustment was carried out between Berry Head and Gattery Trig Points. On checking the ranges on the Slapton Range at between 1130 and 1330 BST and on setting up the remote stations at between 1500-1800 BST(on a very hot day) it was found that consistent range readings were not obtained from all three Remote Units. Variations of up to 4m were recorded at the longest calibration range (13735m). On checking the ranges on completion of the cruise (2000-2300 BST on 13 August, poor visibility, cool) accurate and consistent ranges were obtained, eg: 13735 $\pm$ 0.5m. It is considered that temperature may have affected the range calibration on 10 August, and it is proposed to carry out further trials to establish whether this was indeed the case.

In order to optimise the accuracy of the surveys it is desirable to mount the Trisponder aerial as closely as possible above the echo sounder transducer. This requirement tends to conflict with the necessity to mount the aerial above any transmission path obstructions on the ship. Using a 6m aluminium pole it is possible to mount the aerial close to the outboard transducer (Raytheon); however in this position the aerial lies close to the beam of the ship's radar. It was found on 2 July, whilst working in poor visibility with the radar on, that fluctuations occurred on the DMU range displays. On moving the aerial to the top of the foremast, the fluctuations ceased. In this position the aerial is 3.8m inboard and 3m forward of the echo sounder transducer (port side).

The same calibration procedures were adopted on 13 September preceding Cruise No 15, and at the same time the opportunity was taken to instruct Lt Cdr Banyard (HMS Endurance - Hydrographic Department MOD) on the operational use of Trisponder. Despite the more moderate weather instability was again experienced over the base line range measurements. Between Start Point and Strete the scatter ranged over 2m, whilst between Start Point and Compass Cove scatter ranged over 4m.

4. Deployment of the Marconi Current Meter system in the Bristol Channel.

IOS(T) Project S11 (Dr K R Dyer) required tidal stream data from a position 51°16.5'N, 03°12.5'W in the Bristol Channel. The Marconi self-recording current meter system, using five direction/velocity sensors was deployed on the 25 June under supervision by D N Langhorne and M A S Moore. The sensor wire was supported by a 300 lbs lift subsurface float and anchored by the data logger/ railway wheel sinker module with an additional 3 cwt of scrap chain. The system

was marked by a surface spar buoy with flashing light and radar reflector. Deployment was carried out with the ship at anchor and assisted by the inflatable dinghy. In good sea conditions no problems were experienced on deployment. After checking the position the ship proceeded on passage to Dartmouth.

The system was recovered by RV Edward Forbes on 14 August. On recovery it was found that the subsurface buoy was missing and the sensor wire with five sensors was wrapped around the sinker module. Three of the sensors were damaged. It was apparent that excessive strain had been brought to bear on the sensor wire and the wire had parted beneath the upper electrode plate. Inspection of the data logger showed that the tape deck had continued to work for the full period and tape translation showed that the system had performed for a period of several days. About ½ litre of water had entered the data logger sphere probably through the sensor wire connector.

5. Rangemaster Trials

Cruise No 10

Objective: To evaluate the Rangemaster system under realistic conditions at sea, in an area where it may be required to operate.

Preliminary trials were carried out at the QE II Reservoir at Staines over the period 13 - 15 June. During these trials it was established that by adjusting the transmitter frequency good records could be obtained on the Mufax recorder out to surges of 800m. Apart from the approximately 10% spurious ranges obtained from well timed transponders, the ranges obtained agreed well with measured distances.

During the period of the cruise three transponders were deployed in an approximately 500m triangle in a depth of 20m. The continuous background noise could be reduced by means of the automatic gain control (AGC) and Time Varied Gain (TVG) and records could be obtained out to ranges of 1200 m whilst the ship drifted. Only poor records were obtained whilst under way with the transducers streamed on account of both bad towing qualities (no fairing) and lack of screening from ship noise.

Cruise No 15

Objective: (a) To test the Transducer array with fairing

(b) Evaluate the effects of longer pulse lengths

Due to adverse weather the trials were restricted to static operations in Dartmouth Harbour. Three transponders were suspended from mooring buoys

at distances from the ship of up to 750m, in water depths of 10 to 12m. The interrogation array had previously been dismantled and the two transducers were fitted horizontally in a plastic tube fitted with a nose cone and tail fins. A neoprene sheet covered the top $\frac{1}{3}$ of the fish to act as a screen from ship noise. A 40 dB pre-amp with bandwidth of 10 kHz was included in the fish. (This pre-amp was found to be damaged on starting the trials, and a replacement had to be constructed).

In a strong tide the fish was quite stable and streamed horizontally, and its depth could be adjusted by the amount of cable let out.

Replies from the three transponders could be observed, but they were very erratic. The depth of the fish was found to be critical in that one reply could be improved at the expense of the others. Removal of the neoprene shielding from the fish gave a slight improvement. If the fish was held vertically a great improvement was seen, but the depth remained critical. TVG and AGC reduced the reverberation to a reasonable level.

Extending both the interrogation pulse and the reply pulse from a transponder to about 20 m sec gave no definite improvement.

A tape recording from two transponders was made using both normal and extended pulse lengths.

Ship noise remained a problem when the transducer was located close to the ship's hull, which would be the case with shallow water operation.

6. Redeployment of the Start Bay waverider buoy

Under supervision of R Gleason the waverider buoy was relayed in position Decca Red B9.43 Purple B56.35 (Trisponder range to Start Point 6745m, Strete 5735m, Compass Cove Cottage 7229m, ie NG 287574.50E, 42014.31N). In good sea conditions no problems were experienced during deployment. R Gleason was afterwards landed on Slapton Beach and proceeded to Start Point lighthouse to change the crystal in the recorder and check the system.

7. Eddystone Waverider replacement

The Eddystone waverider was replaced on 14 September by J Humphery with the diving team in attendance. The diving team joined Edward Forbes off Plymouth and proceeded to the Eddystone. The existing waverider and surface moorings were removed by the divers and new buoy was attached to the existing anchor system. Sea conditions were good. The diving team were landed in Plymouth and Edward Forbes proceeded on passage to Dartmouth.

8. Drilling Rig site surveys

Shortly before the cruise started, IOS(T) were requested by IGS (Leeds) (Dr Wright) to carry out site surveys in the English Channel prior to the arrival of the ODECO semi-submersible drilling rig. Drilling was due to start on 4 July. On account of the urgency, IOS(T) agreed to survey priority sites 1 and 2 ($49^{\circ}51.25'N$, $03^{\circ}47.3'W$, and $49^{\circ}33.65'N$, $05^{\circ}18.7'W$) during the period of the cruise.

Owing to the good sea conditions experienced, both surveys were carried out whilst on passage from the Bristol Channel to Dartmouth. Priority 2 survey was carried out between 1530 and 1930 on Sunday 26 June, whilst Priority 1 was surveyed between 0300 and 0540 on Monday 27 June.

The surveys were conducted using EG & G sidescan sonar (1000 ft dual channel range scale, 500 ft tow cable, ship's speed 3½ kts) and echo sounder (MS 36) covering an area of one square mile (to cover the area of anchor spread estimated to be 5500 ft). Position control was by Navigational Decca.

The survey data was passed to R Dingwall (IGS) who visited the ship in Dartmouth on 28 June.

EQUIPMENT PERFORMANCE

1. Trisponder microwave position fixing system.

   See report in Narrative

2. Marconi Current Meter system

   See report in Narrative.

3. Rangemaster relative position fixing system.

   See report in Narrative.

4. Decca Data logger (Mag Log)

The Mag log (recording fix number, time, Decca Main Chain and Trisponder ranges) performed well during the first cruise (No 10). Power supplies were provided from the ship's 15 kVa generator through a constant voltage transformer. During cruises 10A and 15 considerable trouble was experienced with the Data Tape Reader (DTR). On some occasions the DTR failed to print, whilst when it did print the data was corrupted. Fortunately, the corruption was generated by the DTR and most of the data recorded on Mag tape was good.

Almost without exception the Trisponder Ranges were recorded without error.

5. Raytheon DE-719B 200 kHz Echo sounder

The Raytheon echo sounder transducer was mounted on a vertical pole on the Port side of the vessel. The transducer was located 1.8m below the surface in a position 3.8m to Port of the centre line of the vessel and 3.0m astern of the Trisponder aerial (which was fitted above the TV aerial on the foremast). Bar checks were carried out before and after each period when the instrument was used. The echo sounder performed well throughout the periods of the cruises.

6. EG & G Dual Channel Side Scan Sonar

The port transducer from the towed body was fitted in a streamlined pod, which was attached to the echo sounding pole on the port side of the vessel. This was done so that the precise position of the transducer was known, and also to avoid the danger of snagging crab pot float ropes. During cruise No 10A, noise interference occurred in the sonar records. This was traced to the ship's new 25 kVa generator which was not resiliently mounted. The records were improved by shutting down the 25 kVa generator and transferring to the original 15 kVa generator.

In ideal sea conditions during cruise 10A excellent records were obtained particularly in the sandwave area where detailed measurements are being made by the diving team.. The fourteen metal stakes (1.5 cm diameter) spaced at 50 cms intervals could be individually identified.

On Cruises 10 and 10A attempts to tape record the sonar data failed because of the malfunction of the Hewlett Packard 3960A tape recorder. The tape recorder was being used for the first time after its return from being serviced.

7. Underwater Television

The underwater T/V was used on one occasion on Cruise No 10. Its use was restricted to diver operation in a depth of 10 metres, without lights. The video replay failed to synchronise on replay.

8. Sound Velocity Meter (Plessey)

The sound velocity meter failed to operate. The failure was traced to a damaged transducer. The equipment was subsequently returned to the repair depot in Holland for repair.

SHIP'S PERFORMANCE

The ship, and ship's equipment, performance was generally good.

1. Interference occurred on the EG & G sonar record when the laboratory power supplies were produced by the 25 kVa generator. The new generator was not resiliently mounted.
2. On 3 July (Cruise No 10), the return to Dartmouth was delayed for approximately 4 hours as it was not possible to start the main engine. This was due to low power on the batteries.
3. In good sea conditions, aided by the 350 TS track plotter interfaced to Trisponder it proved possible to control the ship along a particular survey track to an accuracy of about $\pm$ 2.5m. This required considerable diligence for the watch officers on the bridge for which they should be commended.

WEATHER

Cruise No 10: Generally good sea conditions. On Saturday 2 July the cruise schedule had to be altered on account of fog. With poor visibility it was not possible to manoeuvre amongst the large number of pleasure craft and fishing boats.

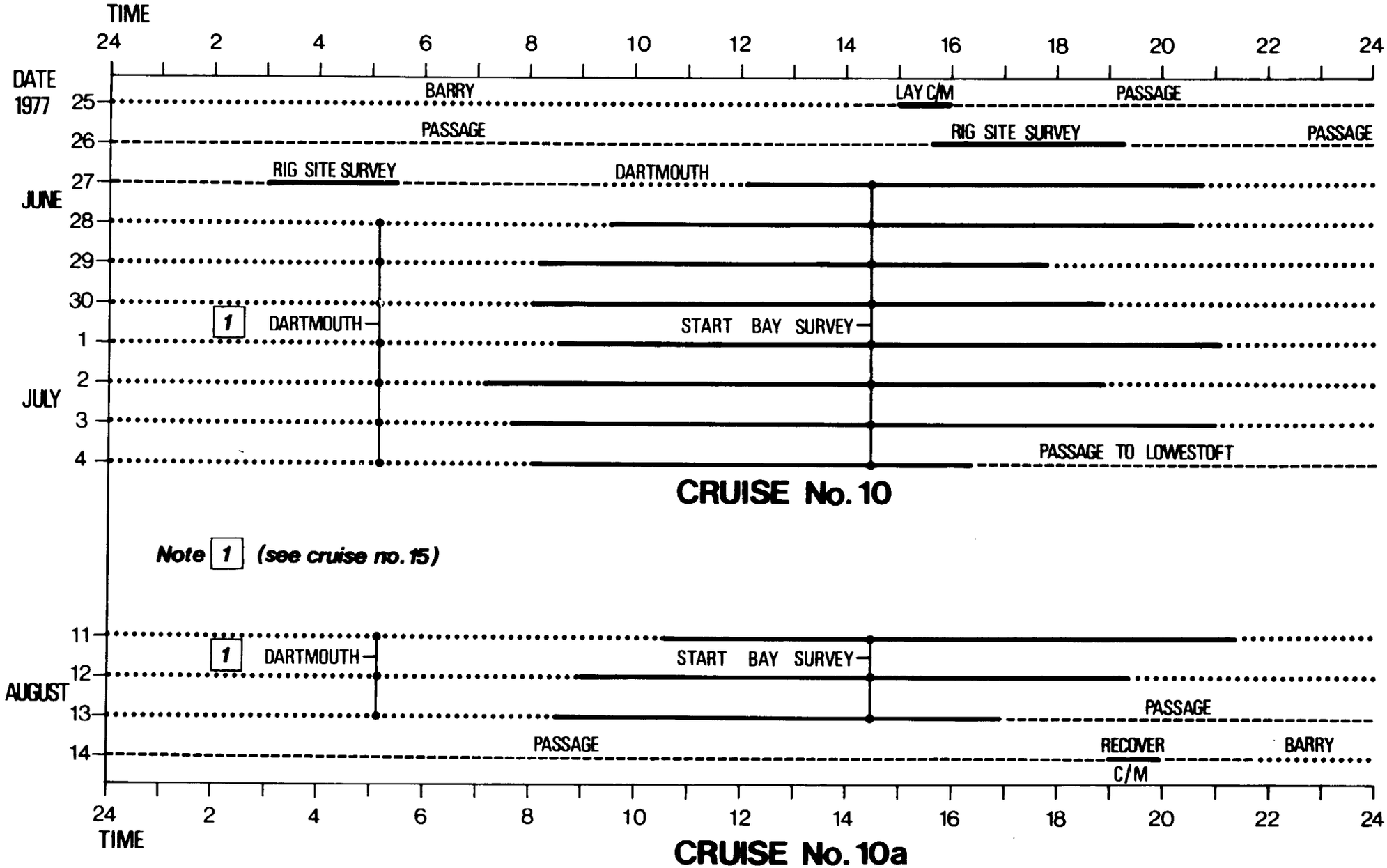
Cruise No 10A: Sea conditions excellent. On 11 August high temperatures in the lab caused the Decca Data logger to overheat.

Cruise No 15: On 16 September sea conditions deteriorated during the day with NE winds increasing to force 5. The NE wind persisted on 17th and 18th September making it not possible to carry out precision survey operations and diving in Start Bay. The changes of the sea bed resulting from the 2m waves generated by the NE winds were measured by divers in the sandwave study area on the evening of 20 September.

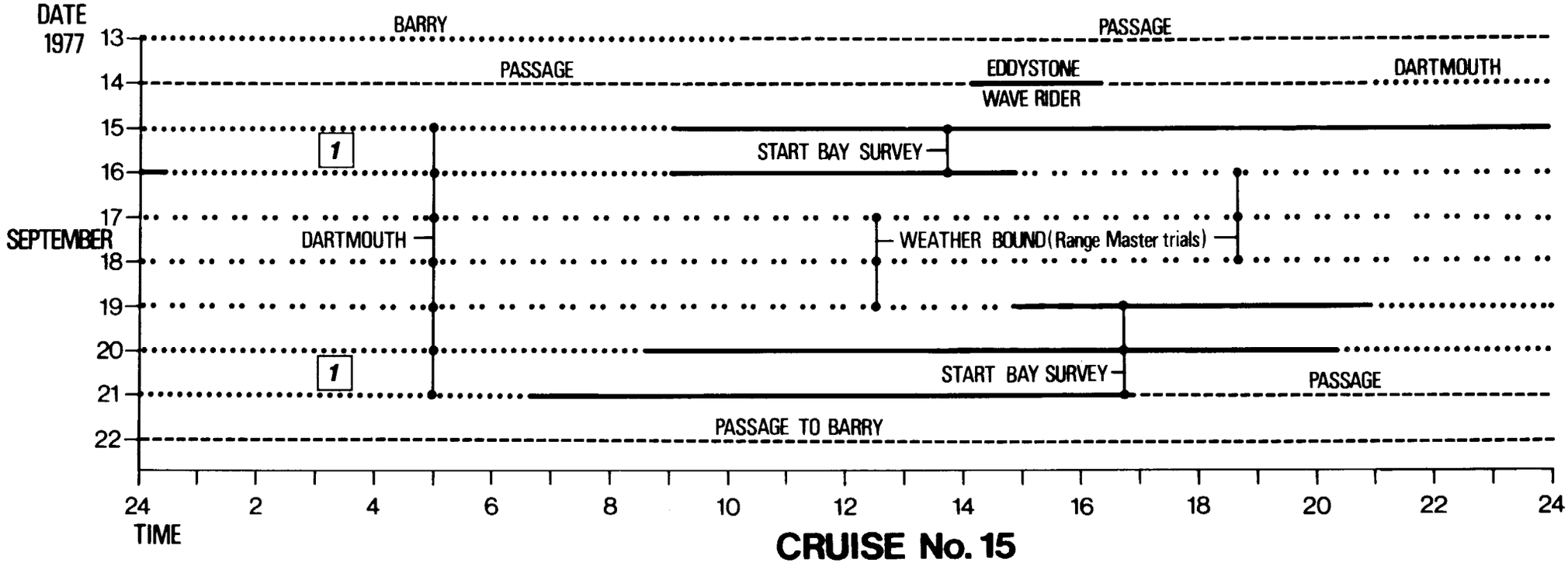
STAFF SPECIALISATION

| | |
|---|---|
| R Gleason (HSO) | Waverider deployment |
| F D C Hammond (SSO) | Survey Research Team - computer graphics |
| P M Hooper (SO) | Geophysics/electronics |
| J Humphery (HSO) | Diving team and waverider deployment |
| D Joyce (IG) | Diving team assistant |
| D N Langhorne (SSO) | Senior Scientist Survey Research Team |
| M Ledgard (HGCD) | Survey Research Team |
| B Lees (HSO) | For instruction on Trisponder |
| J O Malcolm (HSO) | Sedimentologist/Diving team |

| | |
|---|---|
| A J Marks (HSO) | Electronics/Rangemaster |
| E J Moore (HGCD) | Survey Research Team/Diving team leader |
| M A S Moore (SO) | Marconi Current Meter Deployment |




# CRUISE ITINERARIES




**CRUISE No. 15**

***Note 1: Owing to the presence of crab pots in Start Bay, permission to operate outside daylight hours is witheld by the fisheries authorities.***

# CRUISE ITINERARY

# CRUISE REPORTS

| CRUISE DATES | REPORT NO |
|---|---|
| **RRS "CHALLENGER"** | |
| AUG - SEP 1974 | IOS CR 22 |
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| MAR - APR 1977 | IOS CR 66 |
| **NC "MARCEL BAYARD"** | |
| FEB - APR 1971 | NIO CR 44 |
| **MV "RESEARCHER"** | |
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| **RV "SARSIA"** | |
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| AUG 1971 | NIO CR 42 X |
| **DE "VICKERS VOYAGER" AND "PISCES III"** | |
| JUN - JUL 1973 | IOS CR 1 |

# CRUISE REPORTS

RRS DISCOVERY

| CRUISE NO | | REPORT NO |
|---|---|---|
| 1 | JUN - AUG 1963 | 1* |
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| 3 | DEC 1963 - SEP 1964 | 3* |
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* REPORTS 1 TO 3 WERE PUBLISHED AND DISTRIBUTED BY THE ROYAL SOCIETY FOLLOWING THE INTERNATIONAL INDIAN OCEAN EXPEDITION

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