I.O.S.

R R S FREDERICK RUSSELL

CRUISE 19

7th – 11th DECEMBER 1981

# NOISE TRIALS

CRUISE REPORT NO 121

1982

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Wormley, Godalming,
Surrey, GU8 5UB.
(0428 - 79 - 4141)

(Director: Dr. A.S. Laughton FRS)

Bidston Observatory,
Birkenhead,
Merseyside, L43 7RA.
(051 - 653 - 8633)

(Assistant Director: Dr. D.E. Cartwright)

Crossway,
Taunton,
Somerset, TA1 2DW.
(0823 - 86211)

(Assistant Director: M.J. Tucker)

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Institute of Oceanographic Sciences,
Brook Road, Wormley,
Godalming, Surrey GU8 5UB.

CONTENTS

DATES

| | | |
|---|---|---|
| 7th December 0700 | Ship left Weymouth | Part A |
| 9th December 1900 | Ship arrived Weymouth | " " |
| 10th December 0730 | Ship left Weymouth | Part B |
| 11th December 1200 | Ship arrived Plymouth | " " |

PERSONNEL

| | | Part A | Part B |
|---|---|---|---|
| Mrs G.F. Caston | IOS Wormley | X | X |
| Mr C.R. Griffiths | Southampton University | - | X |
| Mr A.J. Harris | IOS Wormley | X | X |
| Mr R.N. Head | MBA Plymouth | - | X |
| Mr G.T. Mardell | IOS/MBA Plymouth | - | X |
| Dr R.D. Pingree | " " " | - | X |
| Mr A.R. Stubbs* | IOS Wormley | X | X |
| Mr P.G. Taylor | RVS Barry | - | X |
| Mr R.K. Young | MBA Plymouth | X | - |

*Principal Scientist

OBJECTIVES

1. Radiated Noise

To obtain the radiated noise signatures of the ship at a range of speeds and under various operating conditions. These trials to be conducted over the Sound Range at Portland in collaboration with the A.U.W.E.

2. Sea Noise

(i) Using 10 kHz transducer record the received waterborne noise in $\frac{1}{3}$ octave bands on a Brüel & Kjaer recorder from 25 Hz to 10 kHz.

(ii) Measure received waterborne noise from 3 transducers mounted on a plate fixed to the hull and operating at 37 kHz, 80 kHz and 255 kHz.

(iii) Repeat (i) and (ii) as convenient at various ship's speeds over a range of water depths and a variety of bottom features.

3. Airborne Noise

To obtain the internal airborne noise signatures in various compartments under similar conditions to those in 1 above.

4. EM Log

To instal the ship's EM log and calibrate using a measured distance either at Anvil Point or off Plymouth.

5. Ship's Fishfinder

To examine potential of ship's Elac fishfinder to be used in the side-scan mode.

6. PES

Deploy new PES fish and examine operation of complete system.

7. Side-Scan Assessment

To examine the use of hull mounted transducers when employed in the study of sand banks and bed forms. These will be assessed as the ship passes over suitable ground using transducers of 2(ii), either separately or simultaneously and recording signals on magnetic tapes for analysis ashore.

8. Current Meters

(a) To recover current meter, designation 061, previously laid at $50^{\circ}30.12'N$, $2^{\circ}23.14'W$.

(b) To lay current meter, designation 062, at $50^{\circ}25.15'N$, $2^{\circ}59.2'W$.

9. Hydrographic/Biological Survey

To repeat survey carried out in Lyme Bay by the "Frederick Russell" in August.

NARRATIVE

Equipment for the cruise was loaded during the afternoon of Sunday 6th December and the EM Log hydraulic assembly installed by the ship's engineers and crew. The scientific personnel for Part A also embarked during the afternoon.

The ship left Weymouth at 0700 Monday 7th and made passage to Anvil Point near Swanage where the EM Log was calibrated. Anchorage was then made at 1130 in Swanage Bay where the towing arrangements for the overside gear were set up, the laboratory equipment checked and the PES system tested. Between 1800 and 1930 the engineers carried out slow speed engine trials; course was then set for Weymouth Bay where anchorage was made at 2200.

The anchor was weighed at 0800 on Tuesday 8th and the Sound Range Officer, Mr G. Warmington, boarded at 0845 inside Portland Harbour. The ship then proceeded to carry out Sound Range Trials in conjunction with AUWE - which were finished for the day at 1600 when the Sound Range Officer disembarked. During the afternoon it was discovered that the Sound Level Meter (for internal noise) was faulty and a link call made to IOS Wormley to obtain a replacement. After leaving Portland Harbour the ship was stopped over 20 m of water and the overside gear rigged (i.e. side-scan pole, tadpole and dolphin towed bodies). Noise measurements were made on all equipment at various speeds. At 1830 the ship then proceeded to the west of Portland Bill where a side-scan survey was carried out on a small bank. Between 2100 and 2330 more noise measurements were made over 40 m of water south of the Shambles Bank. All gear was then recovered and the ship returned to Weymouth Bay and made anchor at 0030/9th.

On Wednesday 9th the ship left Weymouth Bay at 0800 and proceeded to Portland Harbour to re-embark the Sound Range Officer, Mr Warmington, inside Portland Harbour at 0830. During the forenoon further sound ranging occurred to supplement the results obtained on the previous day. The Sound Range Officer left at noon. The ship then steamed to the south of Portland Bill and after deployment of equipment at 1240 sea noise measurements were made using different propeller drive combinations to obtain various speeds. The overside gear was recovered at 1720 and course set for Weymouth Harbour where the ship docked at 1845. Change of personnel occurred that evening, equipment for Part B taken on board and a replacement Sound Level Meter collected from Weymouth Railway Station.

The ship left Weymouth Harbour at 0745 on Thursday 10th and steamed to the Shambles Bank arriving at 0840 to retrieve current meter mooring 061. This took until middday due to a broken rod on the current meter. The position for current meter mooring 062 was occupied in the middle of Lyme Bay at 1400 and after successful launch the ship left at 1630 to steam back to near Portland Bill where the Hydrographic/Biological survey commenced at 1745 and carried on overnight. Airborne noise measurements were made and the ship's Elac sound ranging gear was tested as convenient during the above operations.

The Hydrographic/Biological survey finished at 0400 on Friday 11th and after deploying the side-scan transducers at 0415 a survey was carried out of the Skerries Bank from 0515 until 0900. Hydrophones were then deployed to obtain noise measurements in 60 m of water south of Start Point. All gear was recovered at 1000 and the ship set course for Plymouth and docked at 1200.

NOTES ON EQUIPMENT AND RESULTS

1. Radiated Noise

The programme of runs[1] was agreed between the Sound Range Officer, the ship's engineers and Mr Young and most of this programme was completed on the first day. The slow speed drive run was prematurely terminated when the drive belts burnt out. The short programme on the second day was mainly devoted to confirming cavitation speeds. The maximum speed possible without propeller cavitation is 9 knots using 600 rpm at 4.5 pitch. On main drive at 500 rpm the slowest speed (without cavitation) is 5 knots using 3.2 pitch. Slower non-cavitating speeds should be possible when the slow speed drive problem is solved.

2. Sea Noise

A 10 kHz Tadpole fish was towed from the short boom on the Port quarter and a 10 kHz Dolphin fish from Starboard quarter. Being very light, it was possible to launch and recover the latter easily. However, the Tadpole fish although being smaller is much heavier and since the boom is located at gunwale level the cable lead is difficult to arrange from the sheave because the latter, of necessity, must be below the gunwale. An additional rope and sheave on the 'A' frame had to be used after the first recovery.

The outputs from both of these were fed into a Brüel & Kjaer recorder via a B&K stepped $\frac{1}{3}$ octave filter and records were obtained at various speeds up to 6 knots and over depths up to 60 m. In addition while at anchor in Swanage Bay the output from a single element of the PES fish was recorded.

In addition spot measurements were made at 37 kHz, 90 kHz and 255 kHz of signals obtained from the 3 side-scan transducers at the same time as the lower frequency spectra[2].

3. Airborne Noise

The malfunction of the first Sound Level Meter restricted opportunity for measurement to the last full day and so the majority of the figures were obtained only at a ship's speed of 12 knots[2].

4. EM Log Calibration

The measured distance at Anvil Point near St Albans Head was used to calibrate the EM Log. Two runs were made over the distance in opposite directions at nominally 6 and 12 knots and the average time of two stop watches taken to calculate the speed over the ground. The output test voltage and corresponding digital reading of speed were recorded every half minute for each run to complete the calibration.

Measured distance = 1848.9 metres ≡ 0.9977 nautical miles.

Speed over the ground = 3591.72/t  t = time in seconds.

| Run | Direction | Time for run (secs) | Speed over the ground (knots) | Average output voltage (volts) | Average indicated speed (knots) | Volts / knots | Mean ground speed (knots) | Mean indicated speed (knots) | Error (knots) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | W-E | 632 | 5.68 | 1.89 | 7.09 | 0.266 | 7.63 | 6.51 | -1.12 |
| 2 | E-W | 375 | 9.58 | 1.57 | 5.92 | 0.266 | | | |
| 3 | W-E | 363 | 9.89 | 3.04 | 11.41 | 0.266 | 12.27 | 11.10 | -1.17 |
| 4 | E-W | 245 | 14.66 | 2.85 | 10.80 | 0.264 | | | |

5. Ship's Elac Fishfinder

This is a permanent piece of ship's equipment - the transducer being mounted in a pod normally housed inside the ship's hull but deployed when required by remote control buttons on the combined recorder and operating console mounted on the bridge.

A search facility is available by variation of azimuth and tilt positions of the transducers, and switches provide a choice of pulse length and ranges.

The main operating parameters are:-

| | |
|---|---|
| Frequency | : 24 kHz |
| Horizontal beamwidth | : $18^{o}$ |
| Vertical beamwidth | : $21^{o}$ |
| Azimuth search angles | : $\pm 135^{o}$ ($0^{o}$ Ahead) |
| Tilt search angles | : $0^{o}$-$90^{o}$ ($0^{o}$ Horizontal) |
| Pulse lengths | : 2, 3 and 10 mS |
| Ranges | : 300-2400 metres |
| Power output | : 600 watts |
| Time marks | : Manual/Auto internal |
| Deployed distance | : 1 metre below hull |

As supplied the controls are designated by symbols which are not self-explanatory. Dymo labels were therefore added in an attempt to ease operating confusion.

To test the equipment the transducer was directed on to the beam and depressed a few degrees from the horizontal, the normal side-scan mode. The records obtained were average to poor. High resolution is not to be expected due to the large horizontal beam angle. However, features like rock outcrops and the trends of large sand waves should present no problem. Only a short time was available for trials - so it is expected that when operators have the time to gain more expertise higher quality records will be produced. It is suggested an input socket be added and wired into the time mark circuits so that signals can be used from a scientific clock when fitted.

6. Precision Echo-Sounder (IOS No. 9)

It was not possible to tow the PES fish because the special purpose winch had yet to be fitted; also the after deck arrangements and sheaves were not considered suitable. However, the fish was deployed using the main 'A' frame over the stern whilst the ship was at anchor in Swanage Bay. The very shallow water produced multiple reflection on low gain. The system was checked through and an earth fault rectified. Later in the cruise low level signals were fed through the receiver circuit from a 10 kHz Tadpole transducer, the signals (including propeller cavitation noise) were displayed using high gain settings.

7. Side-Scan Assessment

Three transducers operating at frequencies of 31 kHz, 90 kHz and 255 kHz were mounted on a tufnol plate attached by a swivel bracket to the end of a metal pole.

This assembly (based on the Kelvin Hughes MS47 Transit Sonar) could be rigged with minimum effort when required on brackets welded to the ship's hull on the port side. The transducer plate was arranged to be about 1 metre below the surface and the angle of depression was set by the swivel bracket. Conventional side-scan electronics and double helix recorders were used to receive sea floor data. In addition a 4 channel tape recorder was used to store analogue signals for future replay.

Surveys were made of two areas, one a small bank just to the west of Portland Bill and the other the Skerries Bank near Start Point. Useful information was obtained on both surveys but the records were marred by interference. On the first survey by propeller cavitation noise and on both due to quenching from bubbles produced by ship motion. Propeller cavitation can be easily avoided by the right choice of engine speed and pitch (see "Radiated Noise"), but quenching cannot be removed entirely, only reduced by careful design of the transducer assembly.

## 8. Current Meters

Current meter mooring 061 was laid on 6th December on the Shambles Bank to the east of Portland Bill. This comprised of an Aanderaa current meter 1 metre off bottom and a V.A.E.C.M. directly above it measuring at 2 metres off bottom. Problems were encountered recovering this mooring on 10th December and by the time it was secured the tide had started streaming to the east. The mooring should have come inboard with one lift but unfortunately the shackles would not go through the guide rollers on the dredge winch when the wire was under tension. This fault has since been modified in refit. As a result of this fault an attempt was made to remove the sub-surface buoy first. As there were communication problems as well as difficulties in keeping the ship on station a lot of strain was imparted on the wire and caused the ½" diameter Aanderaa current meter spindle to break. As a consequence the meter was lost. The rest of the mooring including the V.A.E.C.M. was recovered intact.

The ship then steamed to 062 and deployed a U-shaped mooring with 2 Aanderaa current meters. This mooring was trawled in mid-January, one week before it was planned to be recovered. The trawler recovered the top current meter and sub-surface buoy. It is planned to grapnel for the rest of the mooring.

## 9. Hydrographic/Biological Survey

This survey consisted of the continuous monitoring of sea surface temperature, salinity and fluorescence whilst steaming. Chlorophyll 'a' and nutrient samples

were taken every 30 minutes and filtered sediment samples every 20 minutes. The legs shown on the track chart were the same as those completed on the "Frederick Russell" in August, thus giving a comparison between summer and winter conditions. These results will also help in assessing the coastal zone colour scanner images from Nimbus-7.

ACKNOWLEDGEMENTS

It is a pleasure for me to record my thanks and appreciation for the support and co-operation of Captain E. Dowell, and officers and crew of the Frederick Russell; and also to Mr R. Young of the MBA Plymouth for his help and advice.

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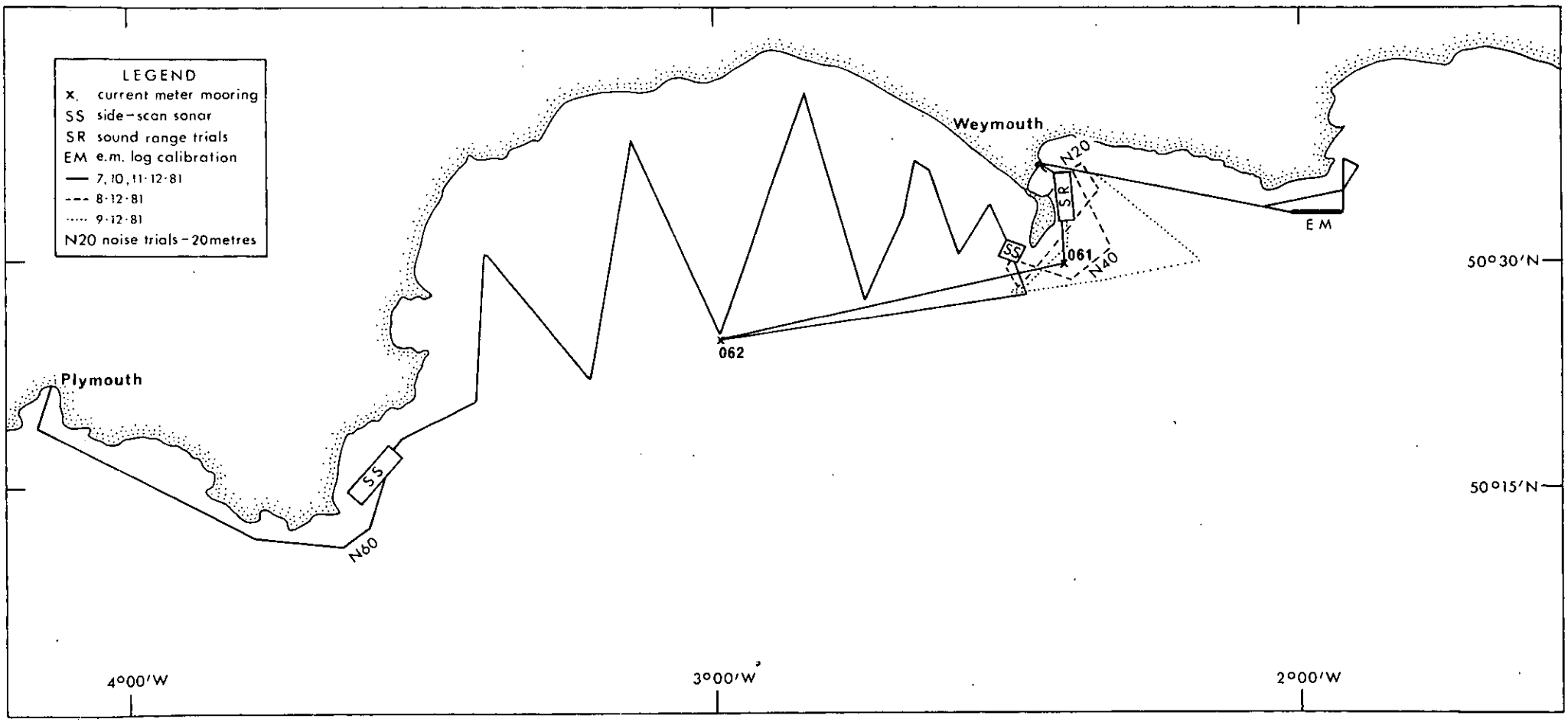
2. Stubbs, A.R., 1982. Noise measurements on R.R.S. Frederick Russell. IOS Internal Document No. 159.


LEGEND
× current meter mooring
SS side-scan sonar
SR sound range trials
EM e.m. log calibration
— 7, 10, 11·12·81
--- 8·12·81
····· 9·12·81
N20 noise trials – 20metres
Weymouth
Plymouth
N20
SR
EM
SS
061
N40
062
SS
N60
50°30'N
50°15'N
4°00'W
3°00'W
2°00'W