I.O.S.

RRS DISCOVERY

CRUISE 105

29 AUGUST – 23 OCTOBER 1979

MIDWATER AND BENTHIC SAMPLING IN THE REGIONS OF THE ROCKALL TROUGH, PORCUPINE SEA BIGHT AND NORTH-WEST AFRICAN COAST, WITH ASSOCIATED PHYSIOLOGICAL INVESTIGATIONS.

CRUISE REPORT NO 82

1979

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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RRS DISCOVERY
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Midwater and benthic sampling in the regions of the Rockall Trough, Porcupine Sea Bight and north-west African coast, with associated physiological investigations.

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Institute of Oceanographic Sciences,
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[2] Joined at Barry 19.IX

[3] Joined at Santa Cruz 27.IX

ACKNOWLEDGEMENT

The success of a research cruise is dependent in very great measure on the expertise and enthusiasm of the ships personnel. It is therefore a particular pleasure to acknowledge with gratitude the able assistance and encouragement of the whole ships complement under the direction of Captain J.J. Moran, First Officer D. Noden and Chief Engineers C. Tottle and D. Rowlands. It is also appropriate to recognise here the particular efforts of those involved in the day and night operation of the fishing gear, namely H. Stewart (netman) F. Zommers (bosun) L. Cromwell (carpenter) D. Knox (bosun's mate) and C. Vrettos (A/B).

INTRODUCTION

The scientific aims of cruise 105 were to combine the various specific requirements of the I.O.S. Wormley biology programme with the collection of fresh biological material for shipboard physiological and/or biochemical investigations. The basic sampling programmes comprised:

1) Continued benthic and midwater sampling in the Porcupine Sea Bight area for comparison with data gained on previous cruises.

2) A day and night vertical series of midwater hauls for S.M.B.A. biologists at their routine benthic sampling station in the Rockall Trough.

3) A series of oblique midwater hauls along the 13°W or 17°W meridian to investigate the influence of the Mediterranean outflow and the delineation of zoogeographic boundaries.

4) A transect of benthic sledge tows out from the continental shelf of north west Africa to abyssal plain depths.

5) A survey of any fronts encountered in the Porcupine Sea Bight area.

6) Midwater hauls using the low level photometer to fish specific isolumes.

Bad weather prevented (3) being achieved and no adequate fronts were encountered during the survey period for (5). The remaining sampling programmes were successfully carried out and in addition the opportunity was taken to test a new I.O.S. corer and several improvements to the RMT system. A considerable body of physiological and biochemical data was also obtained during the course of both the main sampling programmes and additional specific physiological hauls.

ITINERARY

Leg 1: Barry to Tenerife

Discovery sailed from Barry at 2000h on August 29th. That the target sailing date was achieved only just over a week after Discovery's first return to a home port since 1978 reflects great credit on all those involved in the complex operations of refitting, loading and transport. These operations were further complicated by the similar departure dates of two other vessels involved in I.O.S. cruises and by the intervening Bank Holiday period.

The PES fish was streamed on the evening of the 29th and the salinity/ temperature profiler fish on the morning of August 30th. During the course of 30/VIII the RMT 1+8 multiple net and the benthic sledge were rigged and at 2200h a series of runs at different speeds were made in order to cross-calibrate the new push-button starboard electromagnetic log against the existing calibrated port log. In view of the prevailing good weather conditions and the forecasts for the area it was decided to commence work in the Rockall Trough at the S.M.B.A. station position of 54°40'N 12°16'W. The position was reached at 1830/31.VIII; the planned vertical series of day and night hauls, with the multinet system fishing 100m depth intervals from the surface to 900m and at 200m depth intervals below 900m, was begun 1900/31.VIII (Stn. 10105#1-3). The station work included a CTD and oxygen probe to 2945m and further RMT 1+8M hauls until 10105#17 & 18 began at 1200/12.IX. This tow comprised only two horizons, 1500-1700m and 1700-1900m. The third intended horizon (1900-2100m) was aborted as the weather worsened, in order to ensure that the night series was launched early enough to complete the 6 remaining night tows during the night of 2/3.IX. The dog clutch on the main winch jumped out on several occasions during the hauling of 10105#18 and the subsequent series of night hauls were therefore fished from the bottom up rather than as previously from the top downwards. This procedure reduced the strain on the winch as the nets were hauled in more gradually. Despite this precaution the clutch still jumped out and the projected otter trawl and benthic sledge at the Rockall Trough position were abandoned in order to allow the engineers time to rectify the problem. Course was made at 0430/3.IX for the Porcupine Sea Bight. A benthic sledge was fished in 2300m at 0630/4.IX but continuing winch problems forced further net hauls to be postponed and an overnight echosounding survey substituted. This was completed at 0600/5.IX but bad weather prevented the intended three replicate BN tows in the surveyed area. Course was made instead to the Goban Spur for a programme of CTDs, benthic sledges and RMT 1+8M nets at selected depths from 2000m up the slope of the Spur. A major object of this series of hauls was to fish narrow horizons close to the bottom to compare the near-bottom pelagic faunal density and diversity with similar hauls made on the Porcupine Bank side of the Sea Bight earlier in the year. The Goban Spur stations (10107#1 1639/5.IX to 10111#8 0020/9.IX) were undertaken at depths between 2098m and 905m. The near bottom tows were successfully achieved despite some uncertainty about their precise depth horizons but the ship noise picked up by the beam-steerable dolphin obviated its potential value as a receiver in depths greater than about 2500m. Nevertheless it did provide a more efficient transducer system for activating the net operation than the PES fish previously used. The benthic sledge tows were generally successful though minor problems with the camera and odometer took some time to resolve. At 0430/9.IX course was set to the position for the replicate benthic sledge tows previously postponed and 4 tows at depths between 2640 and 2760m were obtained (10112#1 - 10113#1). At 1340/10.IX the vessel headed for a position in the mouth of the Sea Bight in a depth of 4000m for benthic sledge and RMT 1+8M hauls, pausing on the way to interrogate a pop-up fish trap lost in 1977. The trap was located and responded to the release frequency - but remained adamantly on the bottom. Two sledges (10114#1 and 10115#1) were fished at the 4000m position commencing 1826/10.IX, followed by a day mini-series with the RMT 1+8M to 1500m and a night series to 900m (10115#2 - #23) together with a CTD/O_2 profile. This work at the 4000m station ended 0015/13.IX and the vessel steamed to the south west margin of the Goban Spur to start a CTD and fluorometer survey up the Spur to find and investigate any fronts present. No clear fronts were observed during these stations (10116#1 - 10119#1) and a benthic sledge was fished in 400m at 1954/13.IX. After a final CTD and fluorometer dip in 200m the frontal survey was abandoned and course was set south for a projected series of oblique RMT 1+8M hauls down the 17° meridian, commencing at 48°N. The trawl warp was laid out to 8564m with a drogue at 0900/14.IX in order to improve the lay of the wire and remove several 'birdcaged' regions around 8000m. Forecasts of up to force 12 in the eastern central zone (hurricane Gloria) caused the 48° station to be abandoned and heading made instead for the 46° position. During the night of 14/15.IX the recurrence of persistent refrigeration problems caused the scientific programme to be abandoned and Discovery returned to Barry for repairs, docking at 1500/17.IX.

In view of this unexpected return to Barry the changes in scientific personnel scheduled for Tenerife were brought forward where practicable. Dr. Campbell, Dr. Crescenzi, Mr. Darlington, Mr. Edge, Dr. Fasham, Mr. Hartland, Mr. Jenkins, Mr. Knudsen, Dr. Rice, Mr. Smithers and Miss Rigby left the ship while Mr. Billett, Mr. Domanski, Mr. Harris, Mr. Lewis, Dr. Morris, Mr. Roe and Mr. Thurston joined the scientific complement.

Refrigerator repairs continued in Barry until 21.IX when Discovery sailed at 1030 to clear the lock on a favourable tide. The vessel anchored outside the lock to await the completion of documentation formalities for a refrigeration engineer who was to sail with the ship to Tenerife. Passage for Santa Cruz, Tenerife was made at 1420/21.IX, arriving at 0824/27.IX.

Leg 2: Santa Cruz to South Shields

Dr. Bassot, Dr. Gibbs, Lieut. Cdr. Kelly, Dr. Kirkegaard, Dr. Land, Miss Rigby, Mr. Sherwood and Dr. Williamson were embarked at Santa Cruz and after an overnight stop Discovery sailed 0900/28.IX. Passage was made to a position on the continental shelf of what was formerly Spanish Sahara for a series of benthic sledge stations at depths aimed at filling in data gaps in the I.O.S. coverage of this area. The first of the series of benthic sledges commenced at 1342/29.IX at 23°36'N at a depth of 200m (10122#1). This was followed by a test with the I.O.S. gravity corer in 500m. No core was obtained, and the failure was attributed to the hard nature of the sandy sediment. Additional benthic sledge tows were made in depths of 460m and 410m and a second corer trial in 1105m (10127). Two RMT 1+8M hauls were subsequently made for physiological material and net monitor J19 calibrated against the CTD at 2034/30.IX. On 1.X.79 further sledges were fished at 1225, 1325 and 1775m, followed by a gravity core in 1915m. All the sledge hauls so far had utilised the BN1.5 net to prevent damage to the BN1.5/3M system on the hard bottoms that were expected at shallow depths. This multiple net system and camera was first used in 2520m on 2206/1.X (10134#1). Additional sledge tows were made with this net system in depths of 2750, 3460, 3780 and 4250m (10145#1, 4.X), interspersed with RMT 1+8 hauls for physiological material. A series of hauls with the RMT 1+8M system and low level photometer was then fished over two dawn-to-dusk periods sampling depth horizons which were associated with specific isolumes. The first of these hauls commenced 0613/5.X (10147#1-3) and the last ended 2052/6.X (10147#28-30). Additional physiological hauls were made with the multinet system overnight 6/7.X fishing 9 horizons from 10-640m. The series of benthic sledges was then continued using not the BN1.5/3M system but the BN1.5 as it seemed probable that there was insufficient main warp available to reach depths of ~4500m with the former gear. A successful tow at 4830m (10148#1) was achieved, but required 8124 m.w.o. The projected haul in 5200m was therefore abandoned as only 8500m of wire were available. A gravity core sample of almost 1m was obtained at 10149#1 in 4824m (0040/8.X), but during the hauling period the starboard traverse gear roller on the main winch seized. The scientific programme was therefore postponed to allow the engineers to replace the roller whose bearings proved to have been destroyed. Passage was then made south east about the Canaries for the U.K. in order to allow several days working time on the passage home. Several materials hauls with the RMT 1+8 were made en route including tests of a new closing cod-end. Two materials hauls with the BN1.5 were made in the Conception Bank area (10153#1 and 10154#1) with a final gravity core (10153#2) during the night of 10/11.X. Following two further closing cod end materials hauls passage was made to the 13°W meridian with the intention of working RMT 1+8M oblique hauls at 1° or 2° intervals between 31°N and 45°N. The depth horizons of the hauls were to be decided on the basis of a CTD profile at the start of each station, and divided into 1) surface to top of Mediterranean water; 2) Mediterranean water to 1000m (for comparison with previous 0-1000m oblique tows) and 3) 1000m to the 8° isotherm. Two such stations were successfully completed (10157 and 10158) but the onset of gale force winds and heavy seas required the vessel to heave to during the night of 12/13.X. This loss of passage time caused the RMTM/CTD station system to be abandoned in favour of the more rapid RMT 1+8 0-1000m oblique tows. Two of these were fished on 13.X and 14.X before continuing bad weather caused further work to be abandoned. The weather did not moderate until 17.X. At this point so little working time remained that the 13° meridian programme was abandoned altogether and two RMT 1+8 materials hauls were made on 17 and 18.X (10161 and 10162) followed by tests with the near-bottom echosounder system. No further work was possible and passage was made to South Shields pausing en route at Plymouth 1500/20.X to pick up a replacement radar scan motor. Discovery berthed in South Shields preparatory to her refit at 0800/23.X.

BENTHOS (R.G. Aldred, D.S.M. Billett, J.B. Kirkegaard, J. Knudsen, A.L. Rice, M.H. Thurston and R.A. Wild)

The two legs of this cruise were to different areas and had different objectives, so it is convenient to deal separately with the northern and southern programmes.

Leg 1

The benthic programme had the following main objectives: (a) to obtain epibenthic sledge and trawl samples at the S.M.B.A. repeat station in the Rockall Trough; (b) to extend the benthic sampling of the Porcupine Sea-Bight and particularly to obtain additional samples at about 2000m and 4000m for comparison with ones obtained previously at these depths during April 1978 (Discovery cruise 92) and July 1979 (Challenger cruise 9/79); (c) to get both the bottom camera and the meter wheel on the sledge to work at the same time to test the ability of the gear to sample the macrofauna quantitatively; and (d) to obtain a series of close-spaced samples at more or less the same depth to examine the size structure of the sampled populations of the dominant organisms.

Bad weather prevented benthic sampling at the SMBA station and the winch malfunction made the use of the trawl impossible because of the lack of wing drums, but otherwise the objectives were successfully achieved.

In all, eleven successful sledge hauls were made in depths ranging from 400m to a little over 4000m. These included one at about 2300m in the centre of the Bight, two at about 4000m, a series of close-spaced hauls at around 2700m, and a series of five samples from the Goban Spur in depths ranging from 1600m to 400m.

Problems were once again encountered with the camera system. In the early hauls the camera was triggered by the angle switch on the upper net (SBN) and operated in mid-water. From haul 10112#2 the angle switch was strapped to the front of the sledge frame to indicate roll and revealed that in mid-water the sledge was tipped at an angle of some 30° to the horizontal. This posture, together with the sensitivity of the pendulum in the angle switch, had apparently been responsible for the premature camera operation and this problem was obviated by triggering the camera from the monitor level switch.

The meter wheel also failed to work during the early hauls despite all efforts to make it do so. Finally, it was found that the magnetic coupling was misaligned and also possibly insufficiently powerful. Once these deficiences had been rectified (from 10112#2) the wheel worked well during all subsequent hauls and a total of six hauls were obtained with both the camera system and the meter wheel operating correctly. A small number of photographs were developed on board and indicate that their quality is good, so that comparisons should now be possible between the densities of megafaunal animals indicated by the camera on the one hand and the net catches on the other.

At first sight the catches generally seemed disappointingly small and, with the exception of 10111#8 in which the centre net contained more than 100 litres of mud, they were remarkably clean. Nevertheless, although fewer very large animals seem to have been taken than in previous catches within the Sea-Bight, a cursory examination of the residues indicates that they are extremely interesting, several of them containing very large numbers of individual species. For instance, although we encountered only a few individuals of the holothurian Kolga hyalina at around 3000m, as we did on Challenger cruise 9/79, very large numbers of small individuals were taken in one of the 4000m samples, as was the case both during the Challenger cruise and during Discovery cruise 92. Similarly, the three close-spaced samples at about 2600m (10112) contained large numbers of the asteroid Hymenaster and the small bivalve Kelliella. Interestingly, the sample from station 10113#1, which was not significantly deeper than those at 10112, and was only a few miles to the south-west, differed from them in containing Kolga and very few Hymenaster.

With the completion of this cruise we have now obtained 28 epibenthic sledge hauls in the Porcupine Sea-Bight region, including the southern slope of the Porcupine Bank and the Goban Spur.

Leg 2

The principal objectives of the benthic programme were to fill gaps in the depth coverage given by samples collected between latitudes 20°N and 27°N during the period 1968-1976, and to provide material for physiological and biochemical studies.

These objectives were successfully achieved, although lack of time precluded sampling at depths greater than 4850m.

In all, fifteen benthic hauls were completed, thirteen at depths of 200-4850m between latitudes 23°N and 26°N, and two near to 29°N 12 °W. Previous experience had shown the upper part of the continental slope south of the Canary Islands to be a high-risk environment in that flat, soft bottoms are at a premium. For this reason, the seven hauls fished shallower than 1800m were made with the BN1.5/5C fitted with a J-type monitor but no camera or odometer. This net was also used for the 4800m haul and the two northerly hauls. Five hauls from 2500-4300m were made with the BN1.5/3M+SBN fitted with J-type monitor, camera and odometer.

Most hauls were fished against the current, ie from south to north, but the scope : depth ratios were disappointingly high (1.47-2.03, average 1.82). These results suggest that a reversion to the fishing techniques used in 1974 might be beneficial. In that year samples were obtained from depths down to 6000m with scope : depth ratios of 1.3 and less.

An attempt was made to rectify the tilt of the net by adding weight to one skid. This made little or no difference, and it was subsequently found that the tilt was not constant. During paying out, when the drag is relatively low, the net tilted left side down, but during hauling the reverse was true. Two Corning glass spheres were used regularly during hauls with both nets on leg 2, and although tilting occurred, no problems were encountered. The old camera/flash bracket used on the BN1.5/5C was modified to accept the new type of flash unit.

In general samples were rather small, fairly clean, and contained few megabenthic organisms, despite some long tows. In terms of biomass, sponges and echinoderms, particularly echinoids, ophiuroids and holothurians dominated catches. Of particular note were large quantities of a strongly bioluminescent ophiuroid (Ophiacantha) found at Stn 10125 in depths similar to those at which huge quantities had been obtained in 1972. Stn. 10138 at 2750m was almost devoid of living macroscopic organisms, but contained large quantities of dead shells. It is possible that this represents evidence of slumping, a feature which echo-sounding surveys have shown to be of widespread occurrence on the slope in this region.

Residues of samples from Stn. 10134, 10153 and 10154 were sufficiently large to require subsampling at some stage in the sorting and sieving process. No attempt has been made to sort any residues but some at least are clearly rich in small macrofauna. Amphipoda were particularly abundant at Stn. 10124, and small crangonid decapods were found in large numbers on some of the coarser bottoms. Annelids were also evident in many residues.

It has been possible for one of us (J.B.K.) to examine annelids picked out during the initial sorting and sieving. At 200m depth the following families and genera were present: Sigalionidae (3 specimens), Euphrosynidae (4), Nephthyidae (3), Glyceridae (1), Eunicidae (1), Hyalinoecia (4), Spiochaetopterus (1), Owenia (1), Serpulidae (several on small rocks).

In the bathyal region (from 460-1790m) the following families and genera were represented: Aphroditidae (2 specimens), Macellicephala violacea (2), Macellicephala sp. (1), Sigalionidae (2species, 4 specimens) Nephthyidae (2), Polynoidae (1), Sphaeroduridae (1), Hyalinoecia (large numbers at 1790m), Eunicidae (1), Lumbrinereis (1), Sternaspis (1), Myriochele (1), Maldanidae (1), Serpulidae (several on rocks and bottles).

On the abyssal plain (2750-3850m) the following were obtained: Aphroditidae (1 specimen with 2 parasitic copepods), Macellicephala violacea (4 + 4 proboscis), Eunicidae (14 in small flat tubes, covered with foraminiferans) Maldanidae (2), Sabellidae (3), Serpulidae (several).

Of special interest is the Macellicephala violacea, since the genus is a deep-sea genus with several species known from bathyal and abyssal depths. M. violacea is a violet-blue colour and one of the specimens was found on an echinothurian with just the same colour.

Clearly many more polychaetes will be found when the residues are sorted, since many of the species are small and difficult to see onboard the ship.

Close to Conception Bank, NE of the Canaries some other polychaetes were obtained with the BN1.5 at 1065-1610m. Of most interest was a specimen of Eunoe laetmogonensis recently described by D. Billett and J.B. Kirkegaard as a commensal on Laetmogone. Several Laetmogone with marks from the polychaete were also present. The species was previously found at the same locality. Also some large, branched sponges were collected here, which contained many specimens of a Polynoe species. Its scales showed luminescence according to Dr. J.-M. Bassot.

NEAR BOTTOM SAMPLING (M.V. Angel)

As a consequence to the near bottom RMT 1+8 sampling carried out on Challenger Cruise 9/79, it was decided to supplement and extend these observations using the multiple net (RMT 1+8M) working up the continental slope in the Goban Spur region. Four depths were samples 1600m (10111), 1450m (10108), 1200m (10109) and

900m (10110). At all but the last position two multiple net samples were taken, the first haul involving an oblique sample to within about 300m of the sea-bed, and the remaining samples from 300-200m, and 200-100m off the bottom respectively. The second haul generally subdivided the near bottom 100m. Height above the bottom was estimated from the average soundings taken during the course of the tow; the net was considered to be at a distance behind the vessel approximating to half the amount of wire paid out. Once the net came within 200m of the sea bed, bottom echoes of the monitor transmissions could be picked up under favourable conditions. During Challenger Cruise 9/79, considerable success was experienced in picking up these bottom echoes using the backward-looking single element receiver towed in a dolphin. During this cruise not only were sea states less condu ive to good reception, but also the noise generated by the ship tended to swamp signals picked up by the dolphin. The P.E.S. system with 60° beam-steering was used as the main receiving system, but the dolphin's backward-looking element was used as the transmitter. This made simultaneous soundings and monitor reception impossible, which made net control that little bit more difficult.

Once bottom echoes were received it was assumed that the height of the net was approximately equivalent to the separation of the direct pulse and the pulse reflected from the bottom. This is only strictly true for long lengths of warp out, where the warp out to net depth ratio is 2:1 and the net is very close to the bottom. Monitor depths were considered to be the true depth of net. There was an unaccounted discrepancy between the P.E.S. soundings and the monitor depths of about 20-30m or greater if Matthews tables for area 10 were used to correct the P.E.S. observations. Calculations of the mean sound velocity using the CTD data suggested that the Matthews table corrections were not correct.

Preliminary analysis of the near bottom samples taken at station 10111 suggests that within 30-15m of the bottom the nektonic biomass as sampled by the RMT 8 nearly doubled. This increase was the result of a large increase in gelatinous organisms mostly the medusa _Aglantha digitale_. Numbers of fish, decapods and mysids were highest in the sample taken 40-30m above the sea-bed. The catches were predominantly of typically midwater organisms, but the proportions of species changed quite markedly in the three samples. In the 30-15m sample _Eucopia hanseni_ dominated the mysid catch whereas in the shallowest sample _Gnathophausia zoea_, _Longithorax fuscus_ and _Boreomysis microps_ particularly occurred in greater abundance. Similarly of the decapods caught a _Gennadas_ species dominated the 30-15m sample and a _Sergia_ species occurred, whereas there were relatively fewer

Gennadas and more Hymenodora and Pasiphaea in the shallower sample. A euphausiid Thysanopoda sp. and an amphipod Megalanceola decreased noticeably in abundance closer to the sea bed.

Similar quantitative variations were noted for the 1200m station. However, the standing crop of biomass never reached the level observed at depths of 1200m and shallower on the northern edge of the Porcupine Sea Bight during Challenger Cruise 9/79.

LIGHT METERING HAULS (L. Rigby, H.S.J. Roe)

Two consecutive dawn to dusk periods were sampled with the multiple net and photometer. On the first day the nets were shot before dawn and the 105dB, 95dB and 85dB light levels fished throughout the day, finishing with the ascent of the 105dB level at dusk. The 105dB level reached a depth of 560m at midday. A full moon rose at the same time as sunset and hauls were continued until midnight fishing the 115, 105 and 95dB levels; a depth of 160m was reached. The following dawn to dusk series sampled the 115, 105 and 95dB levels, the 115dB reaching 625m at midday. The moon rose later on the second night and this, combined with cloud cover, rendered its effects less noticeable than previously.

None of the catches were very large, the 85dB level being particularly poor consisting mainly of chaetognaths and siphonophores. Euphausiids, mainly Thysanopoda sp., Nematoscelis megalops and Stylocheiron sp. were abundant in the 95 and 105 dB levels. Small Sergestes including Sergestes vigilax and S. sargassi and juvenile Oplophorus spinosus were frequent in the 105 and 115dB hauls. During the moonlight tows adult Systellaspis debilis were taken in the 115dB sample.

Large numbers of non migratory Cyclothone braueri were caught, Argyropelecus hemigymnus showed a size gradation with decreasing light - the smallest individuals being in the shallow (lighter) hauls. Benthosema suborbitale and small Chauliodus were common in the 105 and 115dB tows.

The gear worked without a hitch during this series and it seems possible that some of the euphausiids, decapods and fish were associated with particular light levels. There was also some indication that considerable mixing occurred at night however, with deeper living species migrating into light regimes which they did not inhabit during the day.

SAMPLING GEAR (E.J. Darlington, M.J. Harris, H.S.J. Roe & R. Wild)

RMT and BN system

The multiple net was fished 22 times on the first leg and 16 times on the second, producing 65 and 48 pairs of samples respectively (on one occasion on the first leg net 3 was not fished). The maximum depth fished was 1900m. The RMT 1+8 was only used on the second leg and was fished 19 times, of which 5 were with the closing cod end. The maximum depth sampled was 1220m. Apart from two occasions during Leg 1 when net bridles hung up there were no problems with either set of gear at any time.

Net Monitor J5 was used exclusively on the RMT system on the first leg and successfully completed a total of 65 hauls in conjunction with the multinet. This indicates that 260 separate successful acoustic command operations together with trouble free telemetry were achieved on this leg.

Net Monitor J18 was used on eleven benthic sledge hauls on leg 1 and provided trouble free telemetry. The intermittent fault which was present on the odometer wheel was diagnosed as misalignment of the magnetic coupling. When this fault had been rectified the instrumentation of the benthic sledge performed faultlessly. Activation of the camera system was changed over from the sensing system in the anglemeter to a mercury switch fitted internally in the monitor. This freed the anglemeter from net mouth opening indication for use as an indicator of horizontal gear stability in the athwartships plane.

Some troubles were experienced with the camera flash unit during the first leg but luckily this unit did not finally fail until it was recovered at the end of the last haul on which it was used.

Digital Flowmeter

This is a standard RMT flowmeter that has had the mechanical gearbox and electrical contacts replaced by integrated circuit dividers and an electronic switch.

The digital system has the advantages of:-

a) not having any mechanical moving parts;

b) a wide selection of impeller revs to output pulse ratios;

c) being cheaper to produce than the mechanical version.

The digital flowmeter was used with the RMT 1+8 system on an oblique net haul to a depth of 1000m. It operated correctly throughout the haul.

Towed Dolphin (with variable declination transducer)

This comprised a trainable 10kHz element mounted in a 'Dolphin' towed fish. The standard Nylotron 10kHz element is mounted on a platform pivoted to swing through 70° from the vertical; a motor gearbox unit moves the element through its arc, a potentiometer is used to indicate its position. The six core towing cable carries power to the motor, as well as the signal from the potentiometer and the transducer.

The Dolphin was tested and used extensively, on leg 2 of the cruise without any problems.

With the net monitor being towed well aft of the ship, giving a beam angle of approximately 20° to the horizontal, there was a 10dB improvement of signal strength when the Dolphin 10kHz transducer was swung from the vertical to looking 70° aft.

Direct comparison with the Dolphin and the P.E.S. fish with its beam steering showed the Dolphin to be approximately 3dB down in signal to noise when the monitor was directly aft of the ship. Prevailing sea conditions did not make it possible to compare the two systems with the net monitor on the beam of the ship. In this situation the wider beam angle of the Dolphin would have given it an advantage over the P.E.S. system.

32kHz Telemetry Echo Sounder

This instrument has been developed for incorporation in the net monitor system to enable the distance of the net off the sea bed to be acoustically telemetered back to the ship.

In order to check the performance of this E/S it was produced as a self contained system and tested on two occasions using the CTD winch.

On the first test it was lowered to a depth of 2500 metres and operated correctly over a range of 6 to 140 metres off the sea bed.

On the second test it was lowered to a depth of 4720 metres. Unfortunately lack of winch cable made it impossible to come closer than 195m off the sea bed. However, the echo sounder gave no indication of malfunctioning even though a bottom echo was not recorded.

Closing Cod End

For this cruise a ball valve was added to the top end of the existing hydrostatically controlled unit, a release operated from the bottom plate permitted the spring loaded ball to rotate shut.

Four experimental hauls were made with the system. None of these were totally successful and modifications were made including an acoustic beacon to indicate when the bottom diaphragm plate operated. On the last haul some of the catch was above the ball valve indicating that the ball closed prematurely; this was found to be due to deflection of the diaphragm by water surges. This fault can be cured by moving the release as close to the centre as practical though this modification could not be tested on the cruise because fishing time was limited by deteriorating weather.

COMPUTER OPERATIONS (P. Hartland, A. Lewis & J. Sherwood)

The 1800 computer system performed the usual navigation and data-logging operations quite satisfactorily throughout the cruise, despite one or two hardware problems resulting in unavoidable data gaps.

During the early hours of 5th October, a failure of the air-conditioning system caused the temperature in the computer room to rise to an unacceptable level, and the computer was turned off from 0930 to 1330h while the air-conditioning was repaired. On restarting the system, hardware errors soom became apparent, and the computer was again turned off between 1700 and 1915h to investigate and rectify the fault, which turned out to be a damaged logic circuit card. From 15th

October to the end of the cruise, the system was turned off each night when no scientific work was in progress.

Application of off-line navigation programs to these breaks in the data, which allow the computer to estimate course and speed over such periods, produced some clearly erroneous results due to program error. While it has been possible to correct the estimated course, some unacceptable jumps in speed remain during these periods. All estimated data are flagged as being of low status as a matter of course.

Noise in the analogue to digital converter has reduced the resolution of converted data from 14 to 8 bits throughout the cruise. This is unimportant in rapidly varying, relatively high voltage signals such as those received from the EM logs, but is noticeable in the slowly varying hull and air temperature data in particular, causing the profiles to appear rather discontinuous. It should be noted therefore, that all such data are accurate to only $\pm$ 0.3°C approximately. Pressure and solarimeter data are similarly affected, but to a lesser degree.

Several CTD dips were recorded and processed without any hitches, using the PDP11/04 computer as a buffer for the data being passed to the 1800.

During the cruise, as well as routine software maintenance, programs were developed to test the feasibility of storing raw EM log and Gyro data over extended periods, and using more data points than the customary two-minute sampling period provides, to accurately reproduce the ship's track in the event of bad calibrations being discovered some time after the event. A short series of 'extreme' ship's manoeuvres was recorded for testing purposes. Programs incorporating the new Sounding Correction Areas, which replace the Matthews Areas, were also developed and implemented.

CHEMISTRY (R.J. Morris)

Coring

The primary objective was to test the new IOS 15cm square box gravity corer. Good quality cores with a relatively undisturbed sediment-water interface were collected at a number of stations down the continental slope off N.W. Africa. Of particular interest were two cores collected near the top of the slope

($24^{\circ}23'$N, $17^{\circ}10'$W and $24^{\circ}34'$N, $18^{\circ}43'$W) which appeared to indicate that most of the overlying, unconsolidated sediment had been fairly recently lost, presumably by sliding or turbidite activity.

Biochemistry

A series of cell-free cultures were set up using decapod and myctophid samples from the day and night light experiment. The object was to measure enzyme activity at various stages of an organism's diurnal migration in order to test the hypothesis that there might be a biochemical rhythm associated with the migratory rhythm.

Natural product metals

A deep frozen collection of organisms from different trophic levels was made for subsequent analysis of their natural product metal chemistry. Particular care was taken to avoid any metal contamination during the sampling. Initially the object is to better understand the distribution of metals in marine organisms from uncontaminated environments and secondly to determine in what form the major component metals are associated.

PCB Work

A number of benthic animals and surface sediment samples were carefully taken and deep frozen for PCB analysis at the University of London (W. Courtney). Of special relevance will be the postulated existence of a rapid, particle dominated flux of PCB compounds from the surface layers to the deep ocean sediments.

MIDWATER FISHES (J.R. Badcock, R.H. Gibbs)

In some respects, for example in species composition per equivalent depth stratum, the collections from Rockall Trough and 49°N 14°W were very similar. Yet in others, they differed; there was a marked tendency for species to have their centres of abundance slightly deeper at the former position. Thus whilst the respective and overall diurnal vertical distributions of Argyropelecus hemigymnus, Cyclothone braueri and C. microdon were identical at these two stations, their centres of abundance were 100m shallower in the Porcupine Sea Bight in each instance. Similarly, the diurnal depth distributions of Benthosema glaciale were more or less coincidental, yet at 49°N 14°W its centre of abundance lay in 400-900m (with adults captured deepest) whilst at the Rockall Trough St. its abundance - depth relationship was bimodal, with juveniles and smaller adults centred in 300-800m and large adults in 900-1500m depth.

The catches taken south of the Canaries were fairly poor both in numbers and in species diversity, and few unexpected species were caught. One such, however, was a specimen of an undescribed species of Cyclothone. In its geographic distribution this species is similar to C. obscura and in its vertical distribution lies at depths intermediate between those of C. obscura and C. pallida. The capture of the present specimen is remarkable in that it is the northern-most record we have of the species.

PHYTOPLANKTON (P. Domanski)

Samples taken whilst steaming down to Tenerife in the region of the Bay of Biscay revealed a general scarcity of phytoplankton. Preliminary analysis has yielded only the smallest fragments of the chain forming Chaetoceros genus, diatoms in general being virtually absent. The main floral component appeared to be species of small dinoflagellates of the Peridinium and Gonyaulax genera.

In the main working area to the south of the Canary Islands, diatoms remained little in evidence , Chaetoceros atlanticum, Thalassiothrix longissima, Corethron criophilum and Thalassionema nitzschoides occurred infrequently. This southerly flora was again dominated by dinoflagellates, species of Peridinium and Gonyaulax being the most abundant. Oxytoxum scolopax, the paired Dinophysis caudata and a number of Ceratium species occurred in variable numbers. The silicoflagellate also Dictyocha fibula appeared occasionally. Numbers of the large bioluminescent Noctiluca were caught in the Oxfam and neuston nets.

Before returning to the U.K. storms in the N. Atlantic probably resulted in the introduction of nutrients into the surface waters. Sampling on the home run in the Biscay area yielded a more abundant flora. Species of Peridinium, Gonyaulax and Ceratium were the most common but the diatoms T. longissima, Rhizosolenia alata and various species of Chaetoceros also featured albeit in small numbers. Nauplii larvae and tintinnids seemed very much in evidence. It was interesting to note several bisaccate pollen grains typical of the conifer genus Pinus were found in one of the samples in this region, presumably blown out to sea from the

French coast.

BIOLUMINESCENCE INVESTIGATIONS (J.-M. Bassot, A.K. Campbell, P.J. Herring, J Kelly)

Biochemistry

Detailed examination of the luminescent system of the radiolarian Thalassicolla has shown that a photoprotein can be extracted with kinetics similar to that of obelin. Crude extracts are unstable even at -70°C, but after ammonium sulphate precipitation the preparation remains stable. The photoprotein is calcium activated, has a marked ionic specificity, a molecular weight estimated at 10-15000 and can be reactivated using native coelenterate luciferin.

Preliminary investigations of other luminous animals showed a peroxidase activity in the hatchetfish Argyropelecus and clear evidence for preferential red emission from the suborbital organ of the fish Malacosteus. Material from a number of species has been deep-frozen for subsequent laboratory examination.

Physiology

Observations on the response to stimuli and the physiological control of luminescence have been made on a number of animals with particular emphasis on the ophiuroid Ophiacantha, the medusa Atolla, and amphipod and decapod crustaceans. Image-intensifier records of Atolla and Ophiacantha have given an insight into the neural pathways involved in the bioluminescent responses to stimulation and have provided data on the response co-ordination that would not otherwise have been obtainable. In the Crustacea the variability in the photophore number of the amphipod Paraproноë has been examined as well as the pharmacological features of the luminescence of the amphipod Scina. Work on the decapod genera Oplophorus and Systellaspis has shown spectral differences in the secretory luminescence and the photophore emission but it has not yet proved possible to obtain responsive isolated preparations from either genus. Oplophorus is stimulated by 5-HT like euphausiids, but Systellaspis is not.

Photophore structure

The red fluorescence of stomiatoid photophores has been examined in more detail and is localised in the B cells. Those gonostomatids in which it is also present have a radial photophore structure similar to the stomiatoid type and are restricted to the family Photichthyidae. Fixed and embedded material of the photophores of a number of fishes (Margrethia, Ichthyococcus, Valenciennellus, Vinciguerria, Cyclothone, Sternoptyx, Argyropelecus, Chauliodus, Stomias, Eustomias, Melanocetus, Cryptopsaras and Euprotomicrus) cephalopods and crustaceans have been prepared for subsequent structural investigation.

Survey of Surface Bioluminescence

The purpose of this survey was to investigate the bioluminescence stimulated in front of and around the ships bow wave. The equipment consisted of a Marconi Isocon low level image intensifier mounted on the ship's side, approximately 20' from the bow, and looking down and forward to the bow wave. The camera was connected by a 100' cable to a 12" monitor and video tape recorder, sited in the plot.

Measurements were made on passage from the Canaries to Ushant, under varying conditions of moon and starlight illumination, and with varying ship's speed. Where possible neuston net samples were made in order to try to identify the main sources of bioluminescence.

It was found that, contrary to expectation, the ships steaming and special operations lights did not interfere with the measurements because the bow wave was well shielded by the flare of the ships bows. The survey was hampered by the weather conditions; for one week measurements were impossible due to gale force winds and a heavy swell; for another week the illumination from a full or near full moon dominated the situation.

However on several occasions fairly spectacular displays of bioluminescence were recorded, and attributed in turn to lantern fish, ctenophores and the medusa Pelagia.

AMPHIONIDES AND LARVAL CRABS (D.I. Williamson)

The aberrant eucaridan crustacean Amphionides reynaudii is known chiefly from its larvae ('amphion' stages). The relatively few adults which have been collected have been mostly from 2000-5000 metres, never in good condition, and, although a unique form of brood-pouch has been postulated, females have never been seen with eggs. During the cruise 65 late larvae and 2 adult females were collected in RMTs, NNs and surface plankton nets. The females were without eggs or ovaries and add nothing to our knowledge of the reproduction of the species. The following observations are however relevant to future work:

(1) In the region sampled, larvae occur mostly at 0-10m at night and at about 20-30m by day. A simple tow-net of mouth area 0.5-1 sq m, mesh 1.5mm, seems the best method of collecting reasonable numbers of late larvae in good condition.

(2) Undamaged specimens will live 24h in captivity.

(3) Metamorphosed specimens are not all abyssal: one was taken in a neuston net; the other in an oblique RMT 5-1035m.

There is a reasonable possibility of collecting metamorphosing specimens in the upper layers and of observing metamorphosis in captivity. Recently metamorphosed specimens, including females with ovaries or eggs, are likely to occur from time to time in RMT samples from the upper 1000m, and scientists sorting samples are supplicated to search for same.

Neuston samples contained several species of spectacular crab larvae which cannot at present be linked with adults. These live well in small containers, zoeas feeding on *Artemia* nauplii, megalopas on a range of foods from dead plankton to roast chicken (*Gallus* sp.). Zoeas of the larval genus *Pluteocaris* were kept alive for over a fortnight and some moults took place, but at the end of the cruise none had metamorphosed to the megalopa.

FIELDS OF VIEW OF DOUBLE-EYED AMPHIPODS (M.F. Land)

A number of hyperiid amphipods have two eyes on each side of the head, and this project was intended to map their respective fields of view. The method uses the fact that a pseudopupil, a black dot whose position shifts around the eye, is visible in those ommatidia that are actually looking at the observer. Rotating the animal until the pseudopupil is no longer visible in a particular eye, and measuring the angle turned, gives the field of view. The three species *Platyscelus ovoides*, *Phrosina semilunata* and *Phronima sedentaria*, form a series in which the separation of the eyes increases, and this is accompanied by a narrowing of the field of view of the dorsal eyes. In *Platyscelus* the field of view of the dorsal eyes extends to 58° laterally and is 42° in the antero-posterior direction. There is a 15° zone of binocular overlap. Corresponding figures for Phrosina are 45°, 17° and 4°, and Phronima 9°, 10° and 7°. Since in all three species the number of facets in the dorsal eyes is about the same, this presumably means that the resolution improves as the field of view decreases, with the potential resolution of Phronima eye being about 0.5°. In all three species the ventral eye covers the remainder of the forward-pointing hemisphere around the animal, but with very much lower resolution.

Cystisoma was also examined. In this animal the retina is very large and very flat, and there was the possibility that all it does is to detect light non-directionally. This turned out to be quite wrong. A clear, red pseudopupil is visible over an angle reaching only 8° laterally and covering 9° in the anterior-posterior direction. Pseudopupils are visible in both eyes throughout the field of view, indicating almost complete binocularity. This eye is seen as an extreme adaptation to the problem of getting reasonable resolution at very low light levels, the strategy being to devote a very large retinal area to a small area of visual field, as in "telescope-eyed" fishes.

EYE MOVEMENTS AND VERTICAL STEERING IN EUPHAUSIIDS (M.F. Land)

In several species of double-eyed euphausiid it was found that animals in good condition would follow a 5° light source with their upper eyes. In Nematoscelis megalops the eyes could be driven through a full 180°. The thoracic photophores followed the eye movements exactly.

Animals were restrained by allowing their legs to become entangled with a single pin, around which they could rotate, and their behaviour in response to a moving light was recorded on video-tape. It was found that some animals swam towards the light with their upper eyes pointing forward, and others swam away with eyes pointing backward. These directions were maintained by small movements of the tail. These were in the opposite direction to movements of the eyes; thus, if the light was moved forwards above the animal the eyes rotated forwards and the tail moved down. This directed the water stream from the pleopods down, pushing the tail up and rotating the animal forwards until the original angle between the light and body axis was restored, when the tail became straight again. Conversely, backward movement of the light causes the tail to move up, and the animal to rotate backwards.

These observations are interpreted to mean that these euphausiids have a sophisticated guidance system for maintaining a particular course with respect to the direction of light from the surface. It involves two feed back loops. One that keeps the eye pointing towards the light (and incidentally the photophores pointing down); and a second in which tail movements are driven by deviations from a pre-set positon of the eye in its orbit. If this position is in the anterior 90° of the orbit, the animal will have a stable upward course, and a downward course if the set position is in the posterior part of the orbit. This is presumably the guidance mechanism used during vertical migrations.

PIGMENT ANALYSIS (S. Crescenzi)

The pigments of a variety of oceanic animals have been either analysed on board or material retained for subsequent further laboratory investigations. A probable melanin has been identified in the mysid Longithorax fuscus, a zoanthoxanthin in Zoanthus sp. and porphyrins in the shell of the pteropod Diacria trispinosa. Unidentified pigments from several species of amphipod, the pteropod Cymbulia, the holothurian Stichopus, the cephalopod Vampyroteuthis and a number of other animals are currently under investigation in Naples.

ORNITHOLOGY (M.H. Thurston)

Regular observations were maintained throughout most of the second leg of the cruise, starting off the Isles of Scilly and terminating off Plymouth. An attempt was made to watch for birds for a ten minute period in every hour of daylight. This target was usually achieved unless the ship was on station when other work took precedence. About 280 observation periods were recorded together with over 60 casual sightings.

The second leg of the cruise falls conveniently into three parts: Barry to Tenerife, south of the Canary Islands, and the passage north from 31°N 13°W.

Barry to Tenerife (22-27 September). Fulmars (Fulmarus glacialis), gannets (Sula bassana) and great skuas (Catharacta skua) were seen regularly across the mouth of the Channel and into northern Biscay. Thereafter bird numbers were low, with occasional gannets and Wilson's storm petrels (Oceanites oceanicus) making up most of the sightings. A single Cory's shearwater (Calonectris diomedea) was seen at 39°N but the species was commonly met with only within sight of Tenerife

South of the Canary Islands (28 September - 11 October). Just off the continental shelf in 24°N, Wilson's storm petrels were seen regularly with a few Cory's shearwaters. At the end of the period, south and east of Fuertaventura and Lanzarote, the latter species was seen at most observations but never in large numbers. To the south-west of the Canary Islands, very few birds were seen, only one observation in seven producing a sighting. Wilson's storm petrels, Lesser black-backed gulls (Larus fuscus) and Leach's storm petrels (Oceanodroma leucorhoa) made up most of the records.

Canary Islands to Plymouth (12-20 October). As had been the case during the last week of September, very few birds were seen on this passage. A few Cory's shearwaters, Wilson's storm petrels and Leach's storm petrels were seen south of 38°N and occasional kittiwakes (Rissa tridactyla) from 41°N into Biscay. Not until the northern part of the Bay of Biscay was reached did bird numbers increase. Here, close to the edge of the continental shelf, many greater shearwaters (Puffinus gravis) were encountered. At the mouth of the Channel gannets were abundant and great skuas and kittiwakes present in smaller numbers.

Fourteen species of land bird, mostly passerines, were seen on or around the ship at various times during the second leg of the cruise.

One Leach's storm petrel found on board was ringed prior to release.

WHALE OBSERVATIONS (M.H. Thurston)

In all 19 sightings of Cetacea were reported during the second leg of the cruise. Common dolphin (Delphinus delphis) were identified on six occasions and sperm whale (Physeter macrocephalus) twice. Pilot whales (Globicephala sp.) were seen on two occasions while rorquals (Balaenoptera sp.) and spinner dolphins (Stenella sp.) were recorded once each.

Dolphins were twice seen associated with concentrations of birds. Off Finisterre, unidentified dolphins were seen leaping under flocks of feeding gannets (Sula bassana). As several D. delphis were seen close to the ship, at the same time, it is possible that the more distant individuals also belonged to this species. Close to the edge of the continental shelf in north Biscay large numbers of D. delphis were seen together with numerous greater shearwaters (Puffinus gravis).

GEAR ABBREVIATIONS IN THE STATION LIST

BN1.5/5C	Bottom net 1.5m² (closing) 5mm mesh.
BN1.5/3M	Bottom net 1.5m² (closing) with 3 nets and camera
CTD	Conductivity/temperature/depth probe
GRAV. CORER	IOS Gravity corer
LLP	Low level photometer (on net monitor)
MS	Rosette multisampler
RMT 1	Rectangular midwater trawl $1m^2$)fished in combination
RMT 8	Rectangular midwater trawl $8m^2$
RMT 1M-1,2,3	Rectangular midwater trawl $1m^2$ multiple - nets 1, 2 & 3)in combin-
RMT 8M-1,2,3	Rectangular midwater trawl $8m^2$ multiple - nets 1, 2 & 3)ation
SBN 0.5	Suprabenthic net $0.5m^2$ (On BN1.5/3M)
UFL	Underwater fluorometer (mounted on CTD)
WB	Water bottle

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10105	31/ 8	54 37.7N	12 22.1W	RMT1M-1	900-1100	1953-2153		2841
# 1		54 34.7N	12 28.8W	RMT8M-1		DUSK	FLOW DIST. 6.61 KM.	
10105	31/ 8	54 34.7N	12 28.8W	RMT1M-2	1090-1290	2153-2353		2864
# 2		54 31.6N	12 35.7W	RMT8M-2		NIGHT	FLOW DIST. 6.81 KM.	
10105	31/ 8	54 31.6N	12 35.7W	RMT1M-3	1290-1500	2353-0153		2875
# 3	1/ 9	54 28.3N	12 42.7W	RMT8M-3		NIGHT	FLOW DIST. 7.39 KM.	
10105	1/ 9	54 37.3N	12 25.8W	CTD	0-2945	0744-0952	W.B. AT 2945 AND 0 M.	2982
# 4		54 37.9N	12 26.0W	MS		DAWN		
10105	1/ 9	54 35.5N	12 25.1W	RMT1M-1	600- 700	1051-1151		2866
# 5		54 33.5N	12 23.5W	RMT8M-1		DAY	FLOW DIST. 3.51 KM.	
10105	1/ 9	54 33.5N	12 23.5W	RMT1M-2	700- 810	1151-1255		
# 6		54 31.6N	12 21.7W	RMT8M-2		DAY	FLOW DIST. 3.82 KM.	
10105	1/ 9	54 31.6N	12 21.7W	RMT1M-3	800- 900	1255-1355		
# 7		54 29.6N	12 20.8W	RMT8M-3		DAY	FLOW DIST. 3.64 KM.	
10105	1/ 9	54 28.1N	12 19.2W	RMT1M-1	300- 410	1529-1629		2883
# 8		54 26.0N	12 18.2W	RMT8M-1		DAY	FLOW DIST. 4.04 KM.	
10105	1/ 9	54 26.0N	12 18.2W	RMT1M-2	405- 500	1629-1729		2883
# 9		54 24.2N	12 16.7W	RMT8M-2		DAY	FLOW DIST. 3.78 KM.	
10105	1/ 9	54 24.2N	12 16.7W	RMT1M-3	500- 600	1729-1829		2884
# 10		54 22.4N	12 15.1W	RMT8M-3		DAY	FLOW DIST. 3.82 KM.	
10105	1/ 9	54 35.0N	12 27.8W	RMT1M-1	600- 700	2302-0002		
# 11	2/ 9	54 35.3N	12 32.9W	RMT8M-1		NIGHT	FLOW DIST. 3.73 KM.	
10105	2/ 9	54 35.3N	12 32.7W	RMT1M-2	700- 810	0002-0141	DELAY IN CLOSING NET	
# 12		54 36.4N	12 40.7W	RMT8M-2		NIGHT	FLOW DIST. 6.71 KM.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10105	2/ 9	54 36.4N	12 40.7W	RMT1M-3	770- 900	0141-0241		
# 13		54 37.5N	12 45.0W	RMT8M-3		NIGHT	FLOW DIST. 3.46 KM.	
10105	2/ 9	54 38.9N	12 17.8W	RMT1M-1	10- 100	0716-0816		2913
# 14		54 37.5N	12 21.5W	RMT8M-1		DAY	FLOW DIST. 3.73 KM.	
10105	2/ 9	54 37.5N	12 21.4W	RMT1M-2	100- 195	0816-0916		2927
# 15		54 36.6N	12 26.3W	RMT8M-2		DAY	FLOW DIST. 3.87 KM.	
10105	2/ 9	54 36.6N	12 26.1W	RMT1M-3	195- 300	0916-1016		2932
# 16		54 36.0N	12 31.3W	RMT8M-3		DAY	FLOW DIST. 4.00 KM.	
10105	2/ 9	54 38.9N	12 31.2W	RMT1M-1	1500-1700	1329-1529		2929
# 17		54 39.7N	12 39.7W	RMT8M-1		DAY	FLOW DIST. 8.13 KM.	
10105	2/ 9	54 39.7N	12 39.7W	RMT1M-2	1700-1900	1529-1729	NET 3 NOT FISHED	
# 18		54 41.2N	12 47.7W	RMT8M-2		DAY	FLOW DIST. 8.53 KM.	
10105	2/ 9	54 43.5N	12 55.2W	RMT1M-1	500- 600	2056-2156		2918
# 19		54 44.9N	12 57.6W	RMT8M-1		NIGHT	FLOW DIST. 3.20 KM.	
10105	2/ 9	54 44.9N	12 57.5W	RMT1M-2	400- 500	2156-2256		2920
# 20		54 46.3N	13 0.2W	RMT8M-2		NIGHT	FLOW DIST. 3.55 KM.	
10105	2/ 9	54 46.2N	13 0.1W	RMT1M-3	300- 400	2256-2356	RMT8 NOT COMPLETELY CLOSED	2915
# 21		54 47.6N	13 3.0W	RMT8M-3		NIGHT	FLOW DIST. 3.64 KM.	
10105	3/ 9	54 49.6N	13 6.6W	RMT1M-1	200- 300	0119-0219	VERY SMALL CATCH	
# 22		54 51.3N	13 9.5W	RMT8M-1		NIGHT	FLOW DIST. 4.08 KM.	
10105	3/ 9	54 51.3N	13 9.5W	RMT1M-2	100- 200	0219-0319		
# 23		54 52.8N	13 12.7W	RMT8M-2		NIGHT	FLOW DIST. 4.26 KM.	
10105	3/ 9	54 52.8N	13 12.7W	RMT1M-3	10- 100	0319-0419		2890
# 24		54 54.4N	13 15.8W	RMT8M-3		NIGHT	FLOW DIST. 4.17 KM.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10106	4/ 9	50 41.7N	12 50.7W	SBN 0.5	2300-2315	0831-0917		
# 1		50 41.0N	12 48.4W	BN 1.5/3M		DAY		
10107	5/ 9	49 3.3N	12 54.0W	CTD	0-2079	1639-1819	W.B. AT 2079,1000,600 AND 10M	2098
# 1		49 3.8N	12 54.6W	MS				
10108	5/ 9	49 20.6N	12 49.2W	SBN 0.5	1385-1390	2233-2310	SBN 0.5 TURNED INSIDE OUT	
# 1		49 19.6N	12 48.7W	BN 1.5/3M		NIGHT		
10108	5/ 9	50 35.5N	13 13.8W	CTD	0-1326	0015-0145	W.B. AT 1326 AND 10M.	
# 2	6/ 9	49 17.4N	12 46.9W	MS				
10108	6/ 9	49 16.5N	12 47.7W	RMT1M-1	10-1100	0319-0456		1325
# 3		49 13.2N	12 51.1W	RMT8M-1		NIGHT	FLOW DIST. 5.14 KM.	
10108	6/ 9	49 13.3N	12 51.0W	RMT1M-2	1100-1230	0456-0556		1432
# 4		49 11.1N	12 52.4W	RMT8M-2		DAWN	FLOW DIST. 4.44 KM.	
10108	6/ 9	49 11.2N	12 52.3W	RMT1M-3	1230-1300	0556-0656	ESTIMATED TO WITHIN 125M OF BOTTOM	1584
# 5		49 9.0N	12 55.1W	RMT8M-3		DAWN	FLOW DIST. 4.44 KM.	
10108	6/ 9	49 27.8N	12 47.8W	RMT1M-1	1210-1350	1147-1247	ESTIMATED TO WITHIN 90M OF BOTTOM	1415
# 6		49 25.4N	12 49.1W	RMT8M-1		DAY	FLOW DIST. 3.51 KM.	
10108	6/ 9	49 25.4N	12 49.1W	RMT1M-2	1350-1410	1247-1347	ESTIMATED 90-30M OFF BOTTOM	1414
# 7		49 23.6N	12 49.6W	RMT8M-2		DAY	FLOW DIST. 3.73 KM.	
10108	6/ 9	49 23.6N	12 49.6W	RMT1M-3	1410-1425	1347-1420	ESTIMATED 30-15M OFF BOTTOM	1411
# 8		49 22.6N	12 49.9W	RMT8M-3		DAY	FLOW DIST. 1.39 KM.	
10109	6/ 9	49 19.9N	12 24.7W	RMT1M-1	1000-1100	1814-1914	ESTIMATED TO WITHIN 60M OF BOTTOM	1196
# 1		49 18.6N	12 27.5W	RMT8M-1		DUSK	FLOW DIST. 3.28 KM.	
10109	6/ 9	49 18.6N	12 27.4W	RMT1M-2	1110-1155	1914-2014	ESTIMATED 25-60M OFF BOTTOM	1180
# 2		49 17.4N	12 30.4W	RMT8M-2		DUSK	FLOW DIST. 3.15 KM.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10109 # 3	6/ 9	49 17.4N 49 16.1N	12 30.3W 12 33.2W	RMT1M-3 RMT8M-3	1140-1155	2014-2114 NIGHT	ESTIMATED 25-15M OFF BOTTOM FLOW DIST. 5.75 KM.	1175
10109 # 4	6/ 9	49 14.7N 49 13.6N	12 37.2W 12 41.6W	RMT1M-1 RMT8M-1	10- 900	2237-2357 NIGHT	FLOW DIST. 4.08 KM.	1192
10109 # 5	6/ 9 7/ 9	49 13.6N 49 13.1N	12 41.6W 12 45.0W	RMT1M-2 RMT8M-2	700- 940	2357-0057 NIGHT	ESTIMATED 200-310M OFF BOTTOM FLOW DIST. 4.08 KM.	1227
10109 # 6	7/ 9	49 13.1N 49 12.6N	12 45.0W 12 48.5W	RMT1M-3 RMT8M-3	910-1150	0057-0157 NIGHT	NET 3 DID NOT FISH FLOW DIST. 4.22 KM.	1276
10109 # 7	7/ 9	49 16.9N 49 17.0N	12 20.9W 12 19.8W	CTD MS	0-1139	0602-0705	W.B. AT 1139 AND 10M	1162
10109 # 8	7/ 9	49 11.7N 49 10.0N	12 19.4W 12 18.5W	SBN 0.5 BN 1.5/3M	1120-1130	1005-1100 DAY		
10110 # 1	7/ 9	49 10.8N 49 10.3N	11 42.8W 11 44.0W	SBN 0.5 BN 1.5/3M	920- 930	1602-1645 DAY		
10110 # 2	7/ 9	49 10.2N 49 10.3N	11 44.3W 11 43.6W	CTD MS	0- 896	1754-1847	W.B. AT 896 AND 10M	921
10110 # 3	7/ 9	49 16.8N 49 16.5N	11 45.4W 11 48.3W	RMT1M-1 RMT8M-1	10- 810	2029-2124 NIGHT	ESTIMATED TO WITHIN 120M OF BOTTOM FLOW DIST. 2.65 KM.	985
10110 # 4	7/ 9	49 16.5N 49 17.0N	11 48.2W 11 50.9W	RMT1M-2 RMT8M-2	800- 950	2124-2224 NIGHT	ESTIMATED 120-35M OFF BOTTOM FLOW DIST. 2.79 KM.	950
10110 # 5	7/ 9	49 17.0N 49 17.4N	11 50.8W 11 53.2W	RMT1M-3 RMT8M-3	935-1000	2224-2324 NIGHT	ESTIMATED 40-15M OFF BOTTOM FLOW DIST. 2.37 KM.	1005
10111 # 1	8/ 9	49 36.8N 49 37.8N	13 3.1W 13 9.0W	RMT1M-1 RMT8M-1	10-1500	0634-0809 DAY	FLOW DIST. 4.23 KM.	1760

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10111	8/ 9	49 37.8N	13 9.0W	RMT1M-2	1500-1610	0809-0910	ESTIMATED 200-500M OFF BOTTOM	1755
# 2		49 38.2N	13 12.6W	RMT8M-2		DAY	FLOW DIST. 3.73 KM.	
10111	8/ 9	49 38.2N	13 12.5W	RMT1M-3	1610-1670	0910-0943	ESTIMATED 100-40M OFF BOTTOM	1735
# 3		49 38.2N	13 14.4W	RMT8M-3		DAY	FLOW DIST. 2.03 KM.	
10111	8/ 9	49 34.5N	13 7.9W	RMT1M-1	1480-1570	1405-1505	ESTIMATED 40-90M OFF BOTTOM	1660
# 4		49 34.7N	13 12.5W	RMT8M-1		DAY	FLOW DIST. 3.96 KM.	
10111	8/ 9	49 34.7N	13 12.5W	RMT1M-2	1555-1570	1505-1605	ESTIMATED 25-30M OFF BOTTOM	1647
# 5		49 34.9N	13 16.7W	RMT8M-2		DAY	FLOW DIST. 4.76 KM.	
10111	8/ 9	49 34.9N	13 16.7W	RMT1M-3	1580-1650	1605-1705	ESTIMATED 10-25M OFF BOTTOM	1685
# 6		49 35.2N	13 21.0W	RMT8M-3		DAY	FLOW DIST. 4.40 KM.	
10111	8/ 9	49 36.7N	13 2.2W	CTD	0-1805	2050-2209	W.B. AT 1805 AND 10M	2124
# 7		49 36.7N	13 3.6W	MS				
10111	9/ 9	49 32.6N	13 7.1W	SBN 0.5	1630-1640	0203-0252		
# 8		49 33.5N	13 5.9W	BN 1.5/3M		NIGHT	ROLLER DIST. 665 M.	
10112	9/ 9	50 25.0N	13 19.1W	SBN 0.5	2640-2660	1233-1322		
# 1		50 26.4N	13 17.6W	BN 1.5/3M		DAY		
10112	9/ 9	50 25.2N	13 20.3W	SBN 0.5	2640-2650	2055-2119		
# 2		50 25.7N	13 20.4W	BN 1.5/3M		NIGHT	ROLLER DIST. 310 M.	
10112	10/ 9	50 19.1N	13 25.8W	SBN 0.5	2740-2755	0301-0337		
# 3		50 19.9N	13 26.9W	BN 1.5/3M		NIGHT	ROLLER DIST. 570 M.	
10113	10/ 9	50 16.1N	13 31.6W	SBN 0.5	2755-2760	1132-1155		
# 1		50 16.3N	13 32.3W	BN 1.5/3M		DAY	ROLLER DIST. 550 M.	
10114	10/ 9	49 45.6N	14 8.2W	SBN 0.5	4040-4060	2129-2147		
# 1		49 45.0N	14 8.0W	BN 1.5/3M		NIGHT	ROLLER DIST. 485 M.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10115	11/ 9	49 46.3N	13 56.0W	SBN 0.5	3900-3950	0521-0609		
# 1		49 45.6N	13 56.6W	BN 1.5/3M		DAWN	ROLLER DIST. 595 M.	
10115	11/ 9	49 44.6N	13 59.2W	RMT1M-1	600- 700	1013-1113		4030
# 2		49 45.8N	14 2.0W	RMT8M-1		DAY	FLOW DIST. 3.15 KM.	
10115	11/ 9	49 45.8N	14 2.0W	RMT1M-2	700- 800	1113-1213		4022
# 3		49 47.0N	14 5.0W	RMT8M-2		DAY	FLOW DIST. 3.37 KM.	
10115	11/ 9	49 47.0N	14 5.0W	RMT1M-3	800- 900	1213-1313		
# 4		49 48.1N	14 8.0W	RMT8M-3		DAY	FLOW DIST. 3.28 KM.	
10115	11/ 9	49 47.8N	14 9.1W	RMT1M-1	300- 400	1420-1520		4052
# 5		49 45.6N	14 7.4W	RMT8M-1		DAY	FLOW DIST. 3.51 KM.	
10115	11/ 9	49 45.7N	14 7.4W	RMT1M-2	400- 500	1520-1620		4075
# 6		49 43.7N	14 5.9W	RMT8M-2		DAY	FLOW DIST. 3.46 KM.	
10115	11/ 9	49 43.8N	14 5.9W	RMT1M-3	500- 600	1620-1720		4095
# 7		49 41.9N	14 4.2W	RMT8M-3		DAY	FLOW DIST. 3.33 KM.	
10115	11/ 9	49 40.2N	14 2.7W	CTD	0-1982	1826-1952	W.B. AT 1982 AND 10M	4045
# 8		49 39.9N	14 1.7W	MS				
10115	11/ 9	49 42.0N	14 3.3W	RMT1M-1	600- 700	2102-2202		4135
# 9		49 44.2N	14 4.9W	RMT8M-1		NIGHT	FLOW DIST. 3.46 KM.	
10115	11/ 9	49 44.2N	14 4.8W	RMT1M-2	700- 800	2202-2302		
# 10		49 46.3N	14 6.5W	RMT8M-2		NIGHT	FLOW DIST. 3.64 KM.	
10115	11/ 9	49 46.3N	14 6.5W	RMT1M-3	800- 900	2302-0002		
# 11	12/ 9	49 48.4N	14 8.0W	RMT8M-3		NIGHT	FLOW DIST. 3.64 KM.	
10115	12/ 9	49 51.9N	14 10.5W	RMT1M-1	295- 400	0148-0248		3995
# 12		49 53.9N	14 11.5W	RMT8M-1		NIGHT	FLOW DIST. 3.69 KM.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10115	12/ 9	49 53.8N	14 11.5W	RMT1M-2	400- 500	0248-0348		3985
# 13		49 55.9N	14 12.3W	RMT8M-2		NIGHT	FLOW DIST. 3.51 KM.	
10115	12/ 9	49 55.8N	14 12.3W	RMT1M-3	500- 600	0348-0448		3930
# 14		49 57.8N	14 12.7W	RMT8M-3		NIGHT	FLOW DIST. 3.28 KM.	
10115	12/ 9	49 45.4N	13 58.9W	RMT1M-1	10- 100	0804-0904		
# 15		49 43.4N	13 57.6W	RMT8M-1		DAY	FLOW DIST. 3.64 KM.	
10115	12/ 9	49 43.5N	13 57.6W	RMT1M-2	100- 200	0904-1004		
# 16		49 41.6N	13 56.5W	RMT8M-2		DAY	FLOW DIST. 3.73 KM.	
10115	12/ 9	49 41.7N	13 56.5W	RMT1M-3	200- 300	1004-1104		4028
# 17		49 39.8N	13 55.6W	RMT8M-3		DAY	FLOW DIST. 3.64 KM.	
10115	12/ 9	49 38.5N	13 57.8W	RMT1M-1	910-1100	1212-1414		
# 18		49 36.6N	14 4.0W	RMT8M-1		DAY	FLOW DIST. 6.56 KM.	
10115	12/ 9	49 36.7N	14 3.9W	RMT1M-2	1100-1300	1414-1615		
# 19		49 38.1N	14 9.5W	RMT8M-2		DAY	FLOW DIST. 7.82 KM.	
10115	12/ 9	49 38.1N	14 9.5W	RMT1M-3	1300-1505	1615-1816		
# 20		49 42.4N	14 11.3W	RMT8M-3		DAY	FLOW DIST. 7.19 KM.	
10115	12/ 9	49 46.1N	14 9.9W	RMT1M-1	10- 100	2053-2153		
# 21		49 47.8N	14 8.3W	RMT8M-1		NIGHT	FLOW DIST. 3.96 KM.	
10115	12/ 9	49 47.8N	14 8.3W	RMT1M-2	100- 200	2153-2253		
# 22		49 49.5N	14 7.0W	RMT8M-2		NIGHT	FLOW DIST. 3.87 KM.	
10115	12/ 9	49 49.5N	14 7.0W	RMT1M-3	195- 300	2253-2353		
# 23		49 51.2N	14 5.5W	RMT8M-3		NIGHT	FLOW DIST. 2.65 KM.	
10116	13/ 9	49 10.8N	12 59.5W	CTD	0- 303	0625-0719	W.B. AT 50 AND 5M	1975
# 1		49 11.0N	12 59.7W	UFL				
				WB 1				

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10117	13/ 9	49 8.7N	12 10.6W	CTD	0- 297	1125-1203	W.B. AT 20M	955
# 1		49 8.7N	12 10.8W	UFL				
				WB 1				
10118	13/ 9	49 13.5N	11 28.5W	CTD	0- 295	1511-1547	W.B. AT 20M	500
# 1		49 13.3N	11 28.9W	UFL				
				WB 1				
10119	13/ 9	49 15.5N	11 14.3W	CTD	0- 150	1658-1734	W.B. AT 10M	200
# 1		49 16.0N	11 14.7W	UFL				
				LMD				
				WB 1				
10120	13/ 9	49 27.5N	11 21.7W	SBN 0.5	400- 400	2017-2033		
# 1		49 27.9N	11 21.2W	BN 1.5/3M		NIGHT	ROLLER DIST. 440 M.	
10121	13/ 9	49 23.2N	11 13.3W	CTD	0- 170	2222-2255	W.B. AT 70M	200
# 1		49 23.3N	11 13.1W	UFL				
				WB 1				

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10122	29/ 9	23 36.6N	16 55.9W	*BN1.5/5C	195- 210	1351-1424	* LARGE SAMPLE SAND SHELL DEBRIS	
# 1		23 36.8N	16 54.9W			DAY		
10123	29/ 9	23 38.4N	16 58.0W	*GRAV CORER	500- 500	1608-	* 3-4 INS OF MUDDY SAND	500
# 1						DAY		
10124	29/ 9	23 40.5N	17 4.0W	BN1.5/5C	660- 665	2201-2221		
# 1		23 40.9N	17 3.8W			NIGHT		
10125	30/ 9	23 42.4N	16 54.2W	*BN1.5/5C	410- 420	0114-0129	* FISHED BOTTOM ECHO - SEE BIO LOG	
# 1		23 42.7N	16 54.0W			NIGHT		
10126	30/ 9	23 44.9N	16 52.6W	*BN1.5/5C	355- 362	0400-0419	* FISHED BOTTOM ECHO - SEE BIO LOG	
# 1		23 45.3N	16 52.5W			NIGHT		
10127	30/ 9	23 48.0N	17 12.5W	*GRAV CORER	1105-1105	0811-	* HARD BOTTOM 10CM CORE OBTAINED	1105
# 1						DAY		
10128	30/ 9	23 55.6N	17 15.7W	*RMT 1	5-1200	1247-1425	* MATERIAL HAUL NONE RETAINED	
# 1		24 0.3N	17 17.7W	RMT 8		DAY	FLOW DIST. 5.71 KM.	
10129	30/ 9	24 6.0N	17 19.0W	*RMT 1	20- 400	1843-2005	* MATERIAL HAUL NONE RETAINED	
# 1		24 8.9N	17 18.4W	RMT 8		DUSK	FLOW DIST. 5.94 KM.	
10129	30/ 9	24 9.3N	17 18.5W	*CTD	0-1790	2034-2322	* MONITOR CALIBRATION	1810
# 2		24 9.1N	17 20.5W			NIGHT		
10130	1/10	24 11.5N	16 58.0W	BN1.5/5C	1225-1250	0326-0346		
# 1		24 12.1N	16 57.9W			NIGHT		
10131	1/10	24 17.4N	16 59.1W	*BN1.5/5C	1320-1325	0755-0820	* NET TORN SLIGHTLY	
# 1		24 18.0N	16 59.5W			DAY		
10132	1/10	24 20.5N	17 9.4W	*BN1.5/5C	1775-1790	1237-1303	* VERY MUDDY	
# 1		24 21.1N	17 9.4W			DAY		

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10133	1/10	24 23.3N	17 10.3W	*GRAV CORER	1915-1915	1605-	* HARD MUD BELOW SURFACE	1915
# 1						DUSK		
10134	2/10	24 22.7N	17 57.2W	*SBN 0.5	2510-2520	0012-0136	* WEAK LINK BROKE, MASSIVE MUD CATCH	
# 1		24 24.7N	17 57.6W	BN 1.5/3M		NIGHT		
10135	2/10	24 16.9N	18 6.5W	*RMT 1	20- 110	0622-0752	* MATERIAL HAUL, NONE RETAINED	
# 1		24 20.0N	18 7.3W	RMT 8		DAWN		
10136	2/10	24 22.7N	18 19.8W	*RMT 1	5- 855	1002-1303	* MATERIAL HAUL, MON. INTERMITTANT	
# 1		24 29.9N	18 19.7W	RMT 8		DAY		
10137	2/10	24 31.3N	18 19.7W	*RMT 1	5- 200	1400-1555	* MATERIAL HAUL, NONE RETAINED	2730
# 1		24 35.4N	18 19.9W	RMT 8		DAY		
10138	2/10	24 29.9N	18 21.0W	*SBN 0.5	2750-2750	1959-2021	* SPARSE CATCH, ROLLER DIST. 515M	
# 1		24 30.4N	18 21.4W	BN 1.5/3M		NIGHT		
10139	3/10	24 33.9N	18 43.5W	GRAV CORER	2923-2923	0140-		2923
# 1						NIGHT		
10139	3/10	24 35.0N	18 47.5W	RMT 1	975-1030	0346-0447		2925
# 2		24 35.2N	18 49.0W	RMT 8		NIGHT	FLOW DIST. 3.82 KM.	
10140	3/10	24 36.5N	19 30.7W	*RMT 1	5-1220	0919-1150	* MATERIAL HAUL, NONE RETAINED	
# 1		24 42.5N	19 31.0W	RMT 8		DAY		
10141	3/10	24 33.8N	19 40.6W	*SBN 0.5	3460-3470	1816-1856	* SPARSE CATCH, ROLLER DIST. 990M	
# 1		24 34.8N	19 40.7W	BN 1.5/3M		DUSK		
10142	3/10	24 39.8N	19 48.9W	*RMT 1	50- 200	2302-0102	* MATERIAL HAUL, NONE RETAINED	3600
# 1	4/10	24 41.4N	19 53.3W	RMT 8		NIGHT	FLOW DIST. 8.04 KM.	
10143	4/10	24 43.6N	20 3.7W	*SBN 0.5	3780-3810	0643-0727	* ROLLER DIST. 1200M	
# 1		24 44.5N	20 4.5W	BN 1.5/3M		DAWN		

STN.	DATE 1979	POSITION LAT	 LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10144 # 1	4/10	24 47.8N 24 47.6N	20 31.4W 20 37.9W	*RMT 1 RMT 8	9- 210	1258-1508 DAY	* MATERIAL HAUL, NONE RETAINED	
10145 # 1	4/10	24 51.5N 24 53.2N	20 44.4W 20 43.5W	*SBN 0.5 BN 1.5/3M	4250-4260	2131-2238 NIGHT	* ROLLER DIST. 2180M	
10146 # 1	5/10	24 59.4N 25 0.0N	20 47.4W 20 47.4W	*RMT1M-1 RMT8M-1	230- 320	0346-0402 NIGHT	* MATERIAL HAUL, NONE RETAINED FLOW DIST. 0.85 KM.	
10146 # 2	5/10	24 59.9N 25 0.6N	20 47.4W 20 47.3W	*RMT1M-2 RMT8M-2	225- 245	0402-0420 NIGHT	* MATERIAL HAUL, NONE RETAINED FLOW DIST. 0.94 KM.	
10146 # 3	5/10	25 0.5N 25 1.2N	20 47.3W 20 47.3W	*RMT1M-3 RMT8M-3	245- 250	0420-0438 NIGHT	* MATERIAL HAUL, NONE RETAINED FLOW DIST. 0.94 KM.	
10147 # 1	5/10	25 2.9N 25 5.7N	21 0.8W 21 0.8W	*RMT1M-1 RMT8M-1 LLP	90- 430	0620-0729 DAWN	* SUNRISE 0704HRS FLOW DIST. 3.78 KM.	
10147 # 2	5/10	25 5.7N 25 8.3N	21 0.8W 21 0.4W	RMT1M-2 RMT8M-2 LLP	375- 420	0729-0832 DAWN	FLOW DIST. 3.96 KM.	
10147 # 3	5/10	25 8.2N 25 10.7N	21 0.5W 21 0.0W	RMT1M-3 RMT8M-3 LLP	350- 390	0832-0932 DAY	FLOW DIST. 3.96 KM.	
10147 # 4	5/10	25 13.0N 25 14.8N	20 59.4W 20 59.8W	RMT1M-1 RMT8M-1 LLP	440- 500	1029-1129 DAY	FLOW DIST. 4.00 KM.	
10147 # 5	5/10	25 14.8N 25 16.3N	20 59.8W 20 59.7W	RMT1M-2 RMT8M-2 LLP	490- 560	1129-1230 DAY	FLOW DIST. 4.23 KM.	
10147 # 6	5/10	25 16.3N 25 20.4N	20 59 7W 20 58.2W	RMT1M-3 RMT8M-3 LLP	440- 490	1230-1330 DAY	FLOW DIST. 3.31 KM.	

STN.	DATE 1979	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10147 # 7	5/10	25 21.9N 25 24.0N	20 57.5W 20 57.0W	RMT1M-1 RMT8M-1 LLP	380- 420	1430-1529 DAY	FLOW DIST. 3.64 KM.	
10147 # 8	5/10	25 24.0N 25 26.2N	20 57.0W 20 56.6W	RMT1M-2 RMT8M-2 LLP	395- 500	1529-1629 DAY	FLOW DIST. 3.69 KM.	
10147 # 9	5/10	25 26.2N 25 28.4N	20 56.6W 20 56.3W	RMT1M-3 RMT8M-3 LLP	495- 550	1629-1730 DAY	FLOW DIST. 3.87 KM.	
10147 # 10	5/10	25 32.0N 25 32.6N	20 55.7W 20 55.6W	RMT1M-1 RMT8M-1 LLP	280- 540	1829-1926 DUSK	FLOW DIST. 3.82 KM.	
10147 # 11	5/10	25 32.6N 25 34.1N	20 55.6W 20 55.4W	RMT1M-2 RMT8M-2 LLP	80- 280	1926-2014 DUSK	FLOW DIST. 3.30 KM.	
10147 # 12	5/10	25 34.1N 25 35.5N	20 55.4W 20 55.1W	RMT1M-3 RMT8M-3 LLP	70- 85	2014-2100 NIGHT	FLOW DIST. 2.33 KM.	
10147 # 13	5/10	25 36.5N 25 37.5N	20 55.0W 20 55.0W	RMT1M-1 RMT8M-1 LLP	70- 90	2141-2211 NIGHT	FLOW DIST. 1.66 KM.	
10147 # 14	5/10	25 37.5N 25 38.5N	20 55.0W 20 54.9W	RMT1M-2 RMT8M-2 LLP	90- 140	2211-2242 NIGHT	FLOW DIST. 1.57 KM.	
10147 # 15	5/10	25 38.4N 25 39.2N	20 54.9W 20 54.9W	RMT1M-3 RMT8M-3 LLP	140- 160	2242-2312 NIGHT	FLOW DIST. 1.48 KM.	

STH.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10147	6/10	25 40.6N	20 54.9W	RMT1M-1	600- 700	0021-0121		
# 16		25 42.0N	20 54.9W	RMT8M-1		NIGHT	FLOW DIST. 3.24 KM.	
10147	6/10	25 42.9N	20 54.9W	RMT1M-2	700- 800	0121-0251		
# 17		25 47.6N	20 54.0W	RMT8M-2		NIGHT	FLOW DIST. 5.53 KM.	
10147	6/10	25 47.6N	20 54.0W	RMT1M-3	800- 925	0251-0421		
# 18		25 50.7N	20 54.1W	RMT8M-3		NIGHT	FLOW DIST. 5.80 KM.	
10147	6/10	25 51.1N	20 56.1W	RMT1M-1	135- 430	0608-0706		
# 19		25 49.1N	20 56.9W	RMT8M-1		DAWN	FLOW DIST. 2.83 KM.	
				LLP				
10147	6/10	25 49.2N	20 56.9W	RMT1M-2	360- 500	0706-0810		
# 20		25 46.8N	20 58.1W	RMT8M-2		DAWN	FLOW DIST. 4.13 KM.	
				LLP				
10147	6/10	25 46.8N	20 58.1W	RMT1M-3	420- 470	0810-0909		
# 21		25 44.8N	20 59.2W	RMT8M-3		DAY	FLOW DIST. 3.96 KM.	
				LLP				
10147	6/10	25 42.5N	21 0.5W	RMT1M-1	535- 570	1017-1117		
# 22		25 40.7N	21 1.7W	RMT8M-1		DAY	FLOW DIST. 3.62 KM.	
				LLP				
10147	6/10	25 40.7N	21 1.7W	RMT1M-2	570- 625	1117-1218		
# 23		25 38.9N	21 2.9W	RMT8M-2		DAY	FLOW DIST. 3.96 KM.	
				LLP				
10147	6/10	25 39.0N	21 2.9W	RMT1M-3	500- 580	1218-1318		
# 24		25 37.1N	21 4.1W	RMT8M-3		DAY	FLOW DIST. 3.82 KM.	
				LLP				
10147	6/10	25 35.8N	21 5.1W	RMT1M-1	410- 495	1406-1507		
# 25		25 33.9N	21 6.3W	RMT8M-1		DAY	FLOW DIST. 3.17 KM.	
				LLP				

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10147 # 26	6/10	25 33.9N 25 32.2N	21 6.3W 21 7.3W	RMT1M-2 RMT8M-2 LLP	495- 560	1507-1605 DAY	FLOW DIST. 3.33 KM.	
10147 # 27	6/10	25 32.2N 25 30.4N	21 7.3W 21 8.5W	RMT1M-3 RMT8M-3 LLP	545- 590	1605-1705 DAY	FLOW DIST. 3.64 KM.	
10147 # 28	6/10	25 28.6N 25 27.1N	21 9.7W 21 10.9W	RMT1M-1 RMT8M-1 LLP	360- 420	1805-1903 DUSK	FLOW DIST. 2.95 KM.	
10147 # 29	6/10	25 27.1N 25 25.9N	21 10.9W 21 12.2W	RMT1M-2 RMT8M-2 LLP	80- 435	1903-2000 DUSK	FLOW DIST. 3.82 KM.	
10147 # 30	6/10	25 26.0N 25 24.9N	21 12.2W 21 13.1W	RMT1M-3 RMT8M-3 LLP	95- 120	2000-2041 NIGHT	FLOW DIST. 2.65 KM.	
10147 # 31	6/10	25 23.6N 25 22.1N	21 14.1W 21 15.5W	RMT1M-1 RMT8M-1	10- 100	2141-2242 NIGHT	FLOW DIST. 2.80 KM.	
10147 # 32	6/10	25 22.1N 25 20.6N	21 15.4W 21 16.7W	RMT1M-2 RMT8M-2	100- 200	2242-2341 NIGHT	FLOW DIST. 3.67 KM.	
10147 # 33	6/10 7/10	25 20.6N 25 18.8N	21 16.7W 21 18.2W	*RMT1M-3 RMT8M-3	15- 200	2341-0048 NIGHT	* MAINLY ABOVE 55M THERMOCLINE FLOW DIST. 4.44 KM.	
10147 # 34	7/10	25 17.8N 25 15.7N	21 18.6W 21 18.5W	RMT1M-1 RMT8M-1	200- 305	0131-0231 NIGHT	FLOW DIST. 3.84 KM.	
10147 # 35	7/10	25 15.7N 25 13.2N	21 18.5W 21 17.9W	RMT1M-2 RMT8M-2	305- 400	0231-0331 NIGHT	FLOW DIST. 4.33 KM.	
10147 # 36	7/10	25 13.2N 25 10.9N	21 17.9W 21 17.4W	RMT1M-3 RMT8M-3	400- 515	0331-0431 NIGHT	FLOW DIST. 4.17 KM.	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10147 # 37	7/10	25 8.5N 25 6.1N	21 17.4W 21 17.4W	RMT1M-1 RMT8M-1	500- 605	0532-0632 DAWN	FLOW DIST. 3.46 KM.	
10147 # 38	7/10	25 6.1N 25 4.1N	21 17.4W 21 17.5W	RMT1M-2 RMT8M-2	595- 625	0632-0732 DAWN	FLOW DIST. 3.64 KM.	
10147 # 39	7/10	25 4.1N 25 2.1N	21 17.5W 21 17.6W	RMT1M-3 RMT8M-3	610- 640	0732-0832 DAWN	FLOW DIST. 3.44 KM.	
10148 # 1	7/10	25 16.9N 25 17.4N	22 21.3W 22 24.5W	*BN1.5/5C	4830-4850	1847-2125 DUSK	* WITH CAMERA	
10149 # 1	8/10	25 16.6N	22 27.7W	*GRAV CORER	4879-4879	0208- NIGHT	* ALMOST 1M CORE OBTAINED	4879
10150 # 1	8/10	26 1.3N 26 1.9N	20 25.5W 20 15.9W	RMT 1 RMT 8	5-1035	1553-1925 DAY	FLOW DIST. 14.44 KM.	
10151 # 1	9/10	26 59.3N 26 56.7N	17 16.7W 17 15.8W	*RMT 1 RMT 8	5- 800	1136-1240 DAY	* CLOSING COD END TEST FLOW DIST. 3.42 KM.	
10151 # 2	9/10	26 51.4N 26 49.4N	17 13.5W 17 12.7W	*RMT 1 RMT 8	5- 510	1447-1530 DAY	* CLOSING COD END TEST, DEPTH EST.	
10152 # 1	9/10	27 0.3N 27 1.9N	16 38.9W 16 37.1W	*RMT 1 RMT 8	5- 510	1924-2039 DUSK	* CLOSING COD END TEST FLOW DIST. 3.82 KM.	
10153 # 1	10/10 11/10	29 6.3N 29 6.9N	12 29.0W 12 25.3W	*BN1.5/5C	1065-1090	2356-0132 NIGHT	* WITH CAMERA, LARGE MUD CATCH	
10153 # 2	11/10	29 7.2N	12 22.9W	*GRAV CORER	1043-1043	0404- NIGHT	* NO CORE ENTERED BARREL	1043
10154 # 1	11/10	29 23.9N 29 25.1N	12 12.3W 12 11.5W	*BN1.5/5C	1585-1610	0820-0917 DAY	* WITH CAMERA	

STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10155	11/10	30 7.5N	12 30.2W	*RMT 1	5- 500	1556-1714	* CLOSING COD END TEST	
# 1		30 10.7N	12 31.4W	RMT 8		DAY	FLOW DIST. 4.58 KM.	
10156	11/10	30 24.2N	12 36.0W	*RMT 1	5- 640	1924-2100	* CLOSING COD END TEST	
# 1		30 27.9N	12 34.3W	RMT 8		DUSK	FLOW DIST. 6.16 KM.	
10157	12/10	30 59.5N	13 0.8W	CTD	0-2000	0247-0424		
# 1		30 59.2N	13 0.6W			NIGHT		
10157	12/10	31 1.0N	13 0.4W	RMT1M-1	5- 650	0512-0614		
# 2		31 3.7N	13 0.0W	RMT8M-1		DAWN	FLOW DIST. 3.60 KM.	
10157	12/10	31 3.6N	13 0.0W	RMT1M-2	650-1000	0614-0708		
# 3		31 6.1N	12 59.6W	RMT8M-2		DAWN	FLOW DIST. 3.48 KM.	
10157	12/10	31 6.0N	12 59.6W	RMT1M-3	1000-1360	0708-0815		
# 4		31 9.3N	12 58.9W	RMT8M-3		DAWN	FLOW DIST. 4.40 KM.	
10158	12/10	32 0.4N	12 59.6W	CTD	0-2000	1514-1647		
# 1		32 0.1N	12 59.6W			DAY		
10158	12/10	32 1.1N	12 59.7W	RMT1M-1	5- 700	1714-1819		
# 2		32 4.1N	13 0.3W	RMT8M-1		DUSK	FLOW DIST. 3.75 KM.	
10158	12/10	32 4.1N	13 0.3W	RMT1M-2	700-1000	1819-1857		
# 3		32 5.9N	13 0.7W	RMT8M-2		DUSK	FLOW DIST. 2.20 KM.	
10158	12/10	32 5.9N	13 0.7W	RMT1M-3	1000-1340	1857-2009		
# 4		32 9.3N	13 1.5W	RMT8M-3		DUSK	FLOW DIST. 4.62 KM.	
10159	13/10	33 22.2N	12 55.2W	RMT 1	10-1000	1614-1752		
# 1		33 25.3N	12 55.8W	RMT 8		DAY	FLOW DIST. 5.22 KM.	
10160	14/10	34 30.5N	13 25.7W	RMT 1	10-1000	0746-0955		
# 1		34 35.4N	13 28.2W	RMT 8		DAY	FLOW DIST. 8.31 KM.	

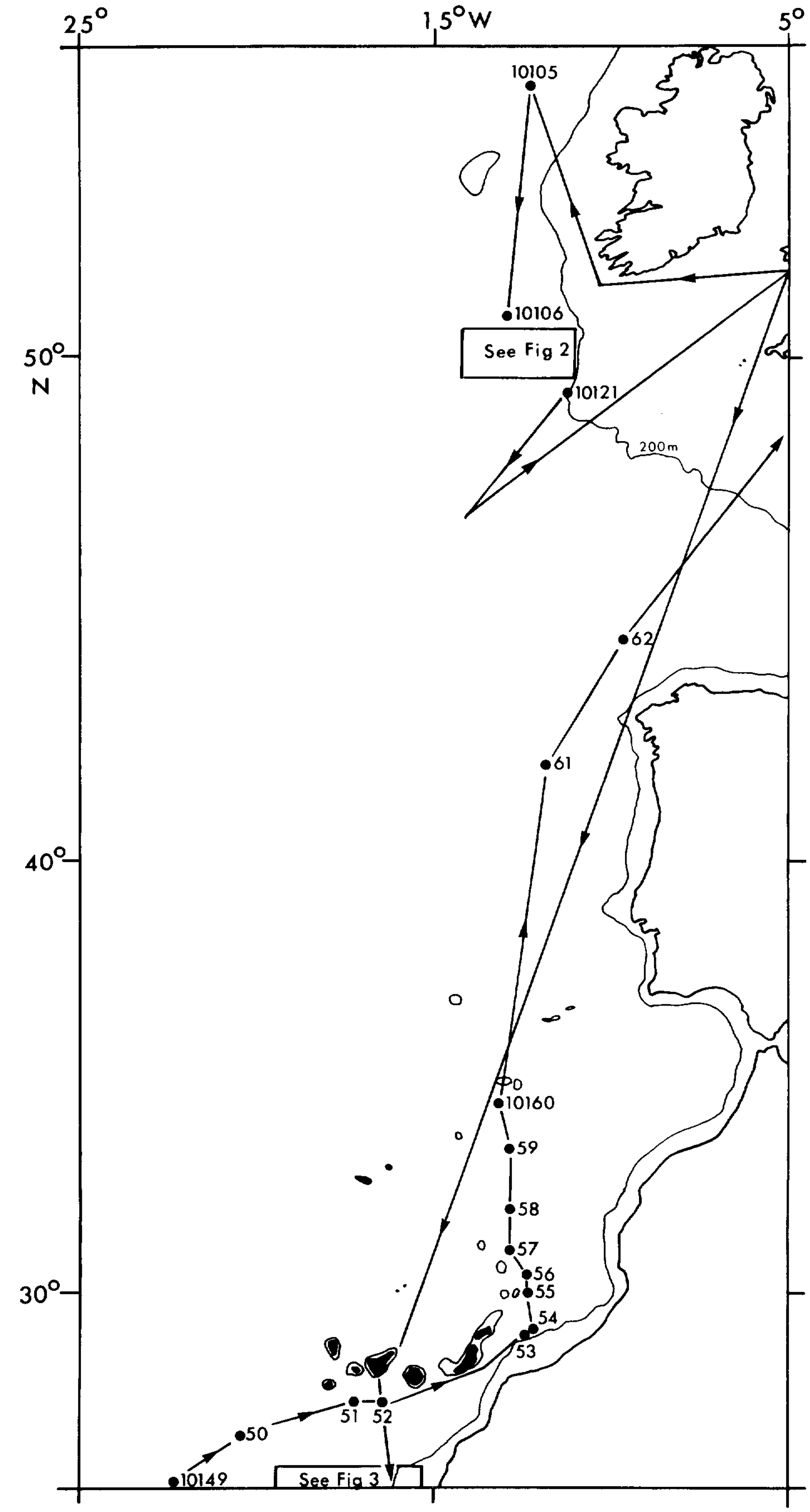
STN.	DATE 1979	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10161	17/10	42 0.5N	11 52.2W	RMT 1	5-1000	1418-1750		
# 1		42 6.0N	11 43.4W	RMT 8		DAY	FLOW DIST. 13.00 KM.	
10162	18/10	44 35.3N	9 48.4W	*RMT 1	5-1000	1419-1755	* MATERIAL HAUL NONE RETAINED	
# 1		44 47.4N	9 45.4W	RMT 8		DAY	FLOW DIST. 12.46 KM.	

FIGURE CAPTIONS

Fig. 1. Overall track chart

Fig. 2. Start positions of stations in the Porcupine Sea Bight

Fig. 3. Start positions of stations south of the Canary Islands


25°
15°W
5°
50°
N
40°
30°
10105
10106
See Fig 2
10121
200m
62
61
10160
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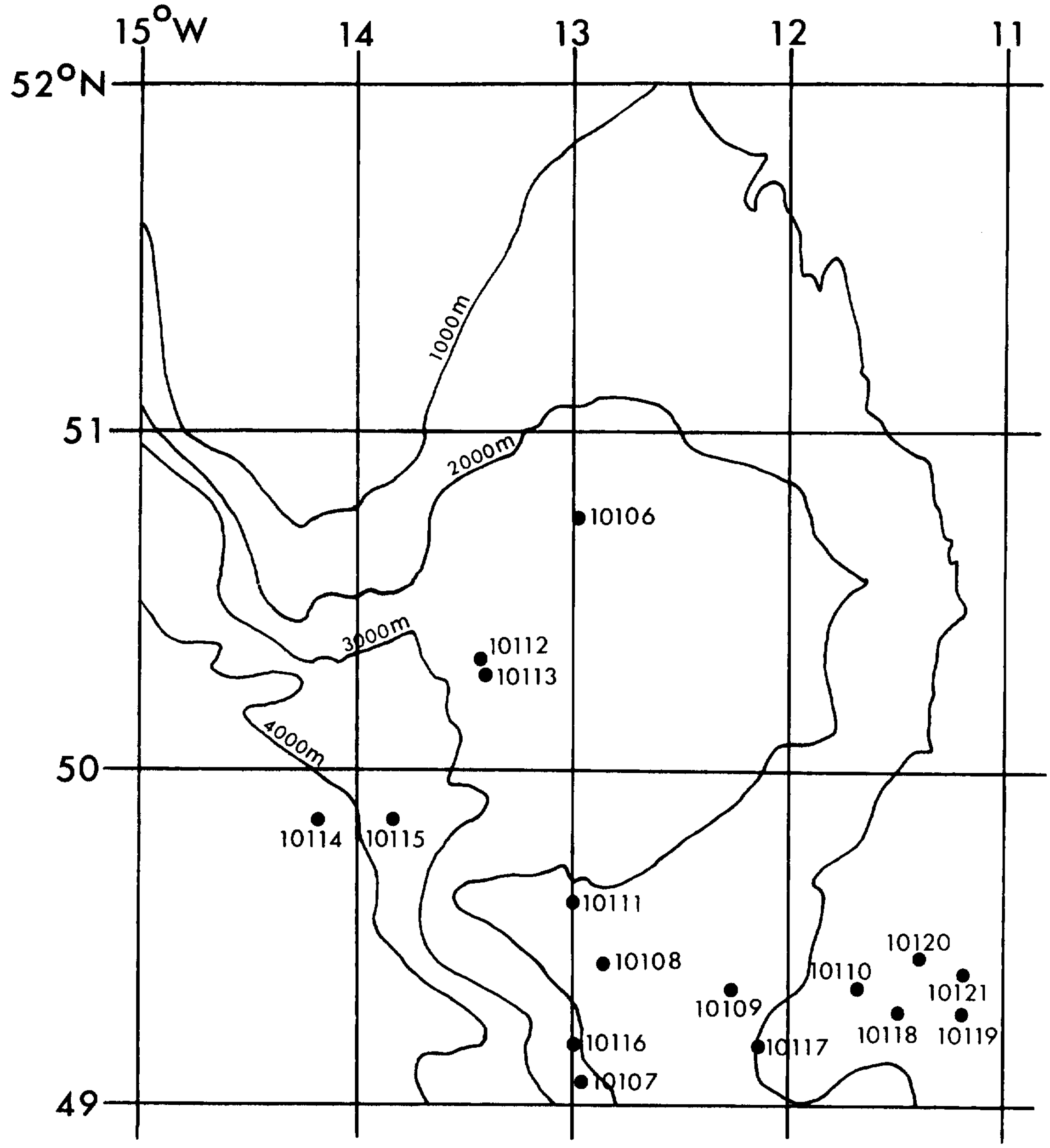
10149
See Fig 3

Figure 1.


15°W
14
13
12
11
52°N
51
50
49
1000m
2000m
3000m
4000m
10106
10112
10113
10114
10115
10111
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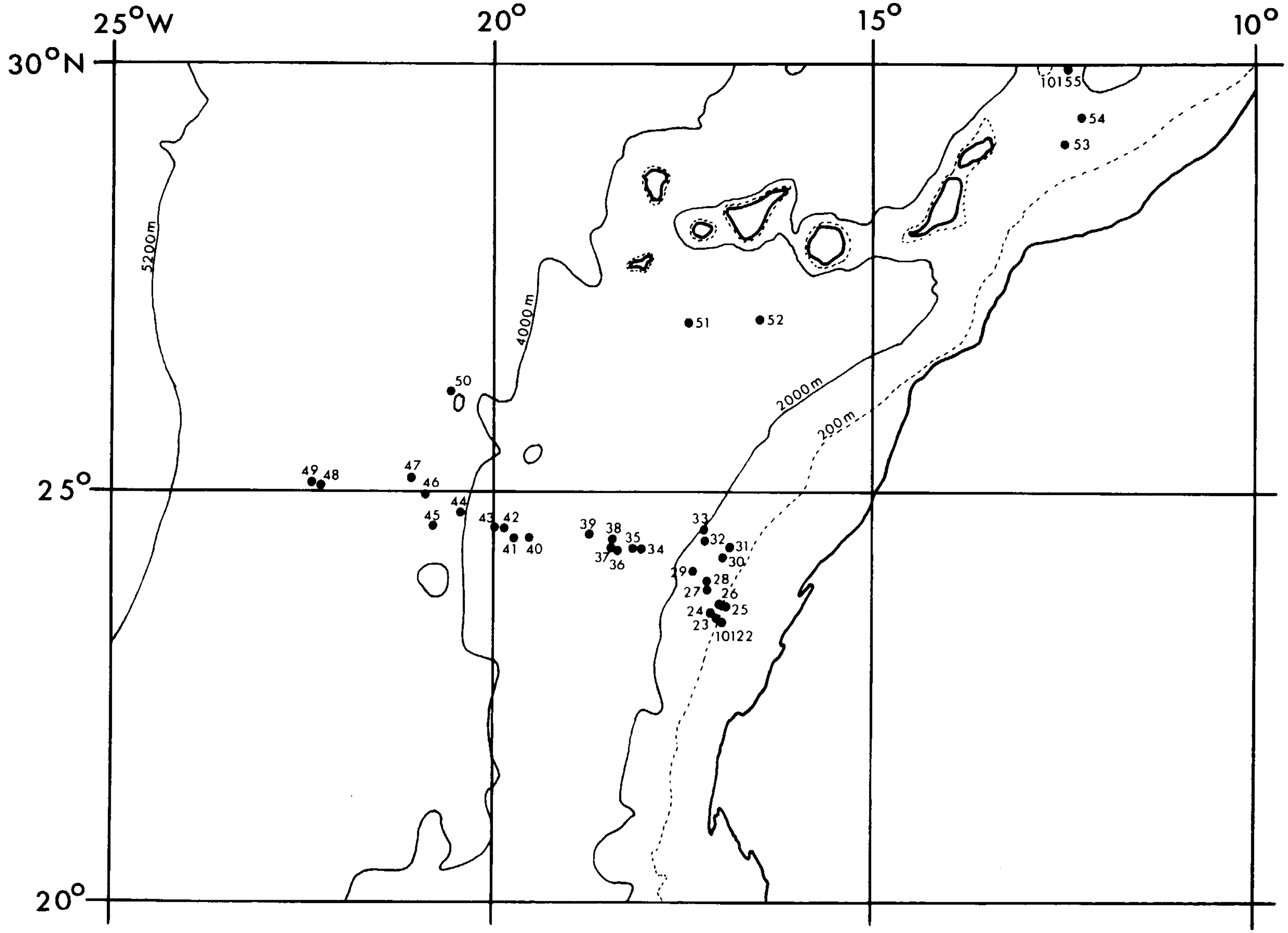
10119

Figure 2.


25°W
20°
15°
10°
30°N
25°
20°
5200m
4000m
2000m
200m
10155
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10122

Figure 3.

CRUISE REPORTS

RRS "DISCOVERY"

CRUISE NO.		REPORT NO.
1	JUN — AUG 1963	1*
2	AUG — DEC 1963	2*
3	DEC 1963 — SEP 1964	3*
		NIO CR**
4	FEB — MAR 1965	4
TO	TO	TO
37	NOV — DEC 1970	37
38	JAN — APR 1971	41
39	APR — JUN 1971	40
40	JUN — JUL 1971	48
41	AUG — SEP 1971	45
42	SEP 1971	49
43	OCT — NOV 1971	47
44	DEC 1971	46
45	FEB — APR 1972	50
46	APR — MAY 1972	55
47	JUN — JUL 1972	52
48	JUL — AUG 1972	53
49	AUG — OCT 1972	57
50	OCT 1972	56
51	NOV — DEC 1972	54
52	FEB — MAR 1973	59
53	APR — JUN 1973	58
		IOS CR***
54	JUN — AUG 1973	2
55	SEP — OCT 1973	5
56	OCT — NOV 1973	4
57	NOV — DEC 1973	6
58	DEC 1973	4
59	FEB 1974	14
60	FEB — MAR 1974	8
61	MAR — MAY 1974	10
62	MAY — JUN 1974	11
63	JUN — JUL 1974	12
64	JUL — AUG 1974	13
65	AUG 1974	17
66	AUG — SEP 1974	20
68	NOV — DEC 1974	16
69	JAN — MAR 1975	51
73	JUL — AUG 1975	34
74/1 + 3	SEP — OCT 1975	35
74/2	SEP 1975	33
75	OCT — NOV 1975	43
77	JUL — AUG 1976	46
78	SEP — OCT 1976	52
79	OCT — NOV 1976	54
82	MAR — MAY 1977	59
83	MAY — JUN 1977	61
84	JUN — JUL 1977	60
86	SEP 1977	57
87	OCT 1977	58
88	OCT — NOV 1977	65
89	NOV — DEC 1977	67
90	JAN — MAR 1978	68
91	MAR 1978	69
92	APR — MAY 1978	70
93	MAY — JUL 1978	71
94	JUL — SEP 1978	74
95	OCT — NOV 1978	77
96	NOV — DEC 1978	79
97	DEC 1978	77
98	DEC 1978 — JAN 1979	75
99	JAN 1979	78

CRUISE DATES	REPORT NO.
RRS "CHALLENGER"	
AUG — SEP 1974	IOS CR 22
MAR — APR 1976	IOS CR 47
MAR — MAY 1978	IOS CR 72
APR — 1979	IOS CR 81
MV "CRISCILLA"	
NOV — DEC 1978	IOS CR 73
RV "EDWARD FORBES"	
OCT 1974	IOS CR 15 X
JAN — FEB 1975	IOS CR 19
APR 1975	IOS CR 23
MAY 1975	IOS CR 32
MAY — JUN 1975	IOS CR 28
JUL 1975	IOS CR 31
JUL — AUG 1975	IOS CR 36
AUG — SEP 1975	IOS CR 41
FEB — APR 1976	IOS CR 48
APR — JUN 1976	IOS CR 50
MAY 1976	IOS CR 53
AUG — SEP 1977	IOS CR 64
RRS "JOHN MURRAY"	
APR — MAY 1972	NIO CR 51
SEP 1973	IOS CR 7
MAY — APR 1974	IOS CR 9
OCT — NOV & DEC 1974	IOS CR 21
APR — MAY 1975	IOS CR 25
APR 1975	IOS CR 39
OCT — NOV 1975	IOS CR 40
AUG — OCT 1975	IOS CR 42
OCT — NOV 1976	IOS CR 53
MAR — APR 1977	IOS CR 66
JUL — SEP 1978	IOS CR 76
NC "MARCEL BAYARD"	
FEB — APR 1971	NIO CR 44
MV "RESEARCHER"	
AUG — SEP 1972	NIO CR 60
RV "SARSIA"	
MAY — JUN 1975	IOS CR 30
AUG — SEP 1975	IOS CR 38
MAR — APR 1976	IOS CR 44
MAR 1977	IOS CR 63
RRS "SHACKLETON"	
AUG — SEP 1973	IOS CR 3
JAN — FEB 1975	IOS CR 18
MAR — MAY 1975	IOS CR 24
FEB — MAR 1975	IOS CR 29
JUL — AUG 1975	IOS CR 37
JUN — JUL 1976	IOS CR 45
OCT — NOV 1976	IOS CR 49
JUL 1977	IOS CR 62
JUL 1979	IOS CR 80
MV "SURVEYOR"	
FEB — APR 1971	NIO CR 38
JUN 1971	NIO CR 39 X
AUG 1971	NIO CR 42 X
DE "VICKERS VOYAGER" AND "PISCES III"	
JUN — JUL 1973	IOS CR 1

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** NIO CR: National Institute of Oceanography, Cruise Report.

*** IOS CR: Institute of Oceanographic Sciences, Cruise Report.

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