I.O.S.

RRS DISCOVERY

CRUISE 148

21 MAY – 12 JUNE 1984

BIOLOGICAL STUDIES IN THE EASTERN NORTH ATLANTIC (48°N – 35°N) CENTRED AROUND THE KING'S TROUGH FLANK (42°00'N 21°30'W)

CRUISE REPORT NO. 163

1984

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

RRS DISCOVERY

Cruise 148

21 May - 12 June 1984

Biological studies in the eastern North Atlantic (48°N - 35°N) centred around the King's Trough Flank (42°00'N 21°30'W)

Principal Scientist

H.S.J. Roe

CRUISE REPORT NO. 163

1984

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ITINERARY

Depart Falmouth 1630H 21 May 1984

Arrive Funchal (Madeira) 2004H 11 June 1984

SCIENTIFIC PERSONNEL

R.G. Aldred	IOS Wormley
T. Araujo	" "
J.R. Badcock	" "
E. Bertelsen	Zoologisk Museum, Copenhagen
M.P. Burnham	IOS Wormley
P.A. Domanski	" "
D. Edge	" "
C.J. Ellis	" "
You Bong Go	Je Ju University, Korea
J.D.M. Gordon	SMBA, Oban
A.W. Gray	IOS Wormley
D. Grohmann	" "
P.J. Herring	" "
A. Moguilevsky	University College of Wales, Aberystwyth
N.R. Merrett	IOS Wormley
T. Pafort-van-Iersel	Zoological Museum, Amsterdam
H.S.J. Roe	IOS Wormley - Principal Scientist
M.A. Squires	" "
S. White	Queen Mary College, University of London
R.A. Wild	IOS Wormley

SHIP'S OFFICERS and CREW

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A.L. Moore	Chief Officer
S. Sykes	2nd Officer
A.J. Brigden	3rd Officer
I.R. Bennett	Chief Engineer
F.C. Hammond	2nd Engineer
D. Hornsby	3rd Engineer
T.J. Comley	4th Engineer
S.H.A. Tomas	Jr. Engineer
J.G.S. Bray	Jr. Engineer
B.J. Regan	Electrical Engineer
R. Overton	Purser
M. Taperell	Radio Officer
R. MacDonald	C.P.O. Deck
C.A. Hambly	Seaman
M.A. Harrison	"
W.D. Roberts	"
P.J. Rowett	"
D.J. Walker	"
V. Williams	"
C.F. Brown	"
K.L. King	"
M.D. Staunton	"
C.F. Fry	Motor Man
T.J. Taylor	"
D. Mawdsley	"
K. Peters	Chief Cook
C. Hubbard	2nd Cook
W. Ayres	Assistant Cook
W.F.G. Grinyer	2nd Steward
A.C.P. Whiteley	Steward
C.D. Chalkley	"
P.T. Congdon	"
P.H. Vincent	"

OBJECTIVES

1. To sample repeatedly at a depth >3000m in order to provide a statistical basis for future deep-sea sampling programmes.
1. To fish a transect of oblique midwater nets between 44°N and 36°N to study the latitudinal succession of different species and the effects of different water masses upon these.
3. To fish a transect of otter trawls between 48N and 35°N to study latitudinal differences in benthic fish populations.
4. To catch midwater and benthic animals for a variety of biochemical and experimental observations.
5. To test a new near-bottom echo sounder fitted to the midwater trawls.
6. To test a new linear release gear for midwater trawls.

NARRATIVE

Discovery sailed from Falmouth at 1630H on the 21st May; a short meeting was held to outline the proposed programme. The Precision Echo Sounder (PES) fish was deployed at 0925H on the 22 May and echo sounding watches started at 1600H. The weather deteriorated throughout the day and attempts to rig the various nets were abandoned during the afternoon. A planned near surface haul over the edge of the continental shelf was also abandoned. Heavy weather continued until the afternoon of the 23rd by which time it had moderated sufficiently to enable the otter trawl (OTSB14) to be rigged. Continuous surface bioluminescence profiling, using the non-toxic sea water supply was started and this continued throughout the cruise.

The first station was reached at 0530H on the 24 May and the OTSB14 shot at 0603H in a depth of 4800m. A good catch of fish, decapods and artifacts (including a French shoe) resulted. At 1500H XBT launches started and these continued on passage legs throughout the cruise; the data were telexed back to the Hydrographic Office in London. During the early evening of the 24 May a length of conducting cable was run through the winch system, payed out to a depth of 99m at a speed of 2 knots, and measurements made of electrical interference at various points.

The second OTSB station was reached at 1200H on the 25 May and after a preliminary PES survey a successful haul was made. During the recovery of the trawl one of the sweeps jammed down inside the block on the 'A' frame. The wire had to be cut and re-joined outside the block. This block was subsequently replaced with the one on the forward 'A' frame and no further problems of this type occurred. The midwater (RMT1+8M) transect began at 1800H but this was dogged by a failure of the conductivity cell in the CTD and a subsequent failure of the trawl due to a defective microswitch in the release gear. The second station of the midwater transect (Stn 11120# 1-3) was fished successfully but the depth of the Mediterranean water was estimated from the results obtained earlier on Cruise 146.

The Kings Trough flank area was reached at 1800H on 27 May and a PES survey made until 1515H the following day. A flat bottomed basin running approximately North-South between two submarine ridges was surveyed. The bottom depth varied around 4000m and the southern area, some 24 x 4 miles in size was earmarked for future near-bottom echo sounding. A series of repeat RMT1+8M hauls started at 1530H on the 28 May. The hauls were made at a near-constant depth of 3500m, keeping within the previously surveyed area. Four hauls, totalling 12 RMT1 samples and 12 RMT8 samples, were made until deteriorating weather during the night of the 30 May forced a halt. An annular eclipse of the sun was observed on the evening of the 30 May.

The weather had improved slightly by the following afternoon and an RMT 1+8 haul was made to catch experimental animals. The improvement was temporary however, the RMT1 cod end was completely torn from the net, and no further fishing was possible until the morning of the 2 June. During this break the conductivity cell of the CTD was successfully replaced.

The OTSB14 was shot at 0854 on June 2 and a successful haul made in the southerly basin of our PES survey. The catch included a quantity of Teredo - riddled timber. Unfortunately the weather again worsened and the proposed 3500m haul was abandoned in favour of a material haul using the RMT1+8 and the new linear release gear. The gear failed because of a defective lead, and no further work was possible that night. A scientific meeting was held to outline the remaining programme in view of the lost time.

At 0900H on the 3 June the linear release was successfully tested on the midships winch and this was followed by a CTD cast to 3800m. By this time the weather was improving and at 1421H the last 3500m repeat haul was deployed.

The RMT1+8M was fished with the near-bottom echo sounder on the following morning (4 June). The winch was directly controlled from the plot by the Mufax operator. In a sounding of 4030m the fishing operation was a complete success; 3 pairs of samples were taken - between 10-25m, 25-40m and 40-55m off the sea bed respectively. The catches were similar to those taken at 3500m but there were conspicuously more animals in the samples taken nearest to the bottom. A second successful tow was made using the near-bottom echo sounder and all IOS personnel had at least one opportunity to fish the system.

A monitor belonging to the British Antarctic Survey was satisfactorally tested on the subsequent CTD cast, and after an oblique RMT1+8M haul Discovery left the King's Trough area at 1425H on 5 June en route for Madeira.

During the evening of 5 June a successful RMT1+8 haul was made with the linear release gear but on recovering the trawl the traction winch began to make a "hunting" noise. A fault was located in one of the pumps and trawling continued at slightly reduced hauling rates for the remainder of the cruise. Later that night the closing cod end was used for the first time on this cruise but after a successful haul the slewing mechanism of the after crane failed completely. Repairs on board were impossible and the crane was lashed fore and aft. Fortunately we were able to continue working in this mode until the end of the cruise.

A transect of midwater hauls, mostly with the closing cod end and several with the linear release gear, was made over the next 3 days. A summary scientific meeting was held during the evening of June 8 and the final station, an OTSB14 haul, was completed at 0940H on 10 June. Following this haul the defective winch pump was replaced with a new unit and eventually successfully tested during the afternoon of June 11. Discovery docked at Funchal at 2004H, 11 June; spare crane parts were waiting on our arrival and the after crane was successfully repaired over the next two days.

It is a pleasure to thank the Master, officers and crew for their help during this cruise; despite the indifferent weather and various equipment failures the main cruise objectives were all successfully accomplished.

SAMPLING GEAR OPERATION AND DEVELOPMENT

Midwater Sampling (R.G. Aldred)

Midwater sampling was done using two variations of the RMT1+8. The Multinet (RMT1+8M) for near bottom, oblique and repeat deep hauls and the standard combination net (RMT1+8) for material hauls with the closing cod-end on the RMT8.

Fourteen RMT1+8M hauls were made, giving 84 samples, and 15 RMT1+8s producing 30 samples. A single failure occurred with each trawl due, respectively, to defective switches in the release gear and a leaking lead. The RMT1 cod-end sieving system was used on all the multiple net tows.

The three lower RMT8 sliding bars were fitted with pairs of rollers to replace the usual eyebolts. These showed considerably less wear than the usual polypropylene inserts.

The RMT1+8 with the closing cod end was rigged with the new 8 jaw release gear for its first sea trials. Apart from a few minor problems this functioned well and promises to be a very useful piece of gear.

Near-bottom Echo Sounder (H.S.J. Roe)

A new 35kHz near-bottom echo sounder system was used on this cruise. The monitor is a combination of our standard net monitor and that used for the towed survey camera; the transducer is mounted below the monitor cross at such an angle that it points vertically downwards whilst the nets are open. The echo sounder responds between 10.5 and 90m from the sea bed. Prior to deep trawling the unit was fitted to the monitor cross and the subsequent surface echoes indicated that it would ultimately respond successfully near to the bottom.

A PES survey located a flat bottomed basin some 24 miles long by 4 miles wide at a depth of 4030m. Two tows were made over this ground, the first (11121# 20-22) fished between 10-25m, 25-40 and 40-55m off the bottom respectively, the second between 10-27 and 24-40m off the bottom. The second tow was limited to two nets because of the shortage of time and a planned third tow was not made. Nevertheless the system worked superbly and produced a very clear record. The winch was controlled from the plot via a hand lever fitted adjacent to the Mufax and it proved to be extremely simple to drive the net over the bottom. The response of the net to adjustments on the hand lever was impressively instantaneous, even with over 9500m of wire out.

The catches were generally similar to those taken in the 3500m repeat series. Animals were apparently most abundant in the hauls taken nearest to the bottom.

8 Jaw Linear Release Gear (D. Grohmann)

This new release gear has been developed as a future replacement for our existing rotary release gears. It consists essentially of two parallel banks of 4 jaws which open in sequence. Ultimately it should be possible to fish up to 7 pairs of midwater nets with mouth areas of up to $25m^2$. Cruise 148 provided the first opportunity to test this gear.

The initial net trial failed because of leaking electrical connections but on a subsequent wire test the release operated correctly. Four further deployments were made with the RMT1+8 and the release worked perfectly on each occasion.

Without a deck stand it was extremely difficult to load the release gear. A stand is required which will hold the release vertically, thereby allowing the internal levers to easily drop into place. Some distortion of the trigger arm return springs was noted; these require further development and tesing.

Electronics and Acoustics (D. Edge)

Fishing Gear

The RMT, OTSB and Closing Cod End monitor systems all worked very successfully with only a few minor problems. The near-bottom echo sounder worked very well, permitting accurate fishing just above the sea bed.

CTD

After initial problems with a faulty conductivity cell, 6 successful CTD casts were made. The Digidata system provided data storage and in the absence of the shipboard computer a BBC microcomputer system was used to provide real time profiles of temperature and salinity. This latter system worked extremely well.

XBT

A new Hewlett-Packard microbased system was used for XBT data logging. The system provides automatic data storage onto cassettes and gives a menu of options for graphical representation of the data. It worked very well and is a vast improvement on its predecessor.

Bioluminescence Spectral Analyser.

A Commodore "PET" microcomputer was used for the first time for measurements of bioluminescent spectra. This highlighted areas for improvement within the system and some initial faults seem to have been overcome.

Shipboard Gear

In general this performed satisfactorally. The beam steering of the Precision Echo Sounder provided good acoustic reception of all the telemetering gear at ranges of up to 10,000m of wire out.

Mechanical Instrumentation (R.A. Wild)

Gear used: Net Releases (4) Four Jaw
" " (2) Two Jaw
" " (8) Multiple (prototype)
" Flow Meters
Sieving Cod Ends on RMT1 Nets
Closing Cod End on RMT8 Net

It is disappointing to report two failures of the RMT multi and combination gear due to electrical microswitch malfunction.

The sieving cod ends were first used experimentally on Cruises 140 and again on Cruise 146. All three of the RMT1 nets on the multi-net system were equipped with these for this cruise and proved to be a viable system. The sieving cod end consists of two rings made of 'Nylatron', each carrying a liner of different mesh size interposed between the two parts of the standard cod end collar, thus three liners are mounted in parallel with the large mesh first; 'in line' sorting is achieved.

The acoustic controlled closing cod end was again used successfully and can now be considered a standard method of fishing with the RMT8 net.

Permanent scientific engineering installations on the ship were a little more demanding than usual, requiring support time for their maintenance and repairs

Aft Hydraulics (M.P. Burnham, A.W. Gray, D. Grohmann, M.A. Squires)

The aft system was run for a period of 230hrs towing the midwater and bottom trawls. Deployment and recovery procedures were generally smooth; except for the one exception when an otter trawl 'sweep' caught in the side of the port 'A' frame sheave.

During the near bottom tows with the RMT1+8M the traction winch was driven from the 'Plot' to achieve the fast response and close control necessary for this operation.

Towards the end of the cruise one of the main pump sets on the power pack developed a fault, which reduced payout and haul speed of subsequent deployments. The fault was originally thought to be in the main pump which was found to be damaged. After this had been changed however, the fault persisted and was finally isolated to the 3 phase motor brushes. A repair was effected and the operation of the new pump set checked with a successful wire test.

E-M Cable Interference Test (M.P. Burnham)

To determine the effect of ship induced electrical interference picked up by an unscreened cable with a copper conducter covered by steel armour wires, a short length of 'CTD' cable was attached to the aft system and used to tow a small weight at 99m depth. Ship induced noise picked up by the streamed cable was then measured between 0.05kHz and 50kHz.

The results will be used to determine the feasibility of using an unscreened cable for the deep side scan sonar vehicle TOBI.

BIOLOGICAL INVESTIGATIONS

Deep Repeat Midwater Trawling (H.S.J. Roe)

To provide estimates of the repeatability of deep sampling and the length of tow required to catch statistically significant numbers of animals a series of RMT1+8M tows was made at a depth of 3500m. Five tows were made between 28 May and 3 June; there was a four day delay between the 4th (Stn 11121 # 10-12) and 5th (11121 # 17-19) tows due to bad weather.

The RMT8 catches, as expected, were small in volume and contained mainly decapods (Hymenodora spp), mysids (Eucopia spp) and assorted jellies. The RMT1's were relatively large consisting mostly of copepods and ostracods. Many of the copepods were merely exoskeletons of surface and shallow-living species and the numbers of deep-sea species may be fairly low. The RMT8 and RMT1 catches were very uniform throughout the series, indicating that the bathypelagic fauna is relatively evenly distributed and that the repeatability of sampling

is high. The numbers of some groups were also fairly consistent and future analysis at IOS should provide a good basis for future deep-sea sampling programmes.

Deep-Sea Demersal Fishes (N.R. Merrett, J.D.M. Gordon)

The cruise provided an opportunity to investigate the faunal composition of abyssal demersal fishes over 13° of latitude (34°-47°N), for comparison with the recently investigated area of the Porcupine abyssal plain (49°-51°N, 14°-16°W). Four operations of the semi-balloon otter trawl (OTSB14) in 4090-4835m soundings at 47°, 45°, 41° and 34°N yielded 199 fishes with a total weight of 92kg. Some 18 species in all were represented, of which 11 occurred in the 3 northerly samples. Five species were common to all collections (Histiobranchus bathybius, Bathypterois longipes, Coryphaenoides (Nematonurus) armatus, C. (Chalinura) leptolepis and C. (C.) profundicola), which are also typical of the Porcupine area. Indeed, all 3 northerly collections reflected the Porcupine abyssal demersal ichthyofauna. Indications of faunal change appeared in the 34°N sample, in which the chlorophthalmid, Bathymicrops regis, and at least 2 species of ophidioid fishes occurred. None of these are representative of OTSB14 samples in the north. The relative catch per unit effort was, however, similar from all stations, with a range of 0.1-0.4kg/1000m^2. This is consistent with other samples from abyssal depths from this trawl.

In addition, an interesting variety of juvenile demersal species were caught in the RMT8 pelagic trawling samples. Several species of macrourid were represented, including one possibly unique form from 3500m depth, about 500m above the sea floor.

Near Bottom Fishes (E. Bertelsen)

In connection with a study on the systematics and functional anatomy of the gulper eels (Lyomeri), families Saccopharyngidae and Monognathidae, and based on existing indications, it was hoped that some needed material and special preservations could be obtained in the series of abyssal hauls - especially in those from near-bottom. Unfortunately this failed.

More generally my object was to gain an impression of the distribution and

composition of the abysso-pelagic and near-bottom fauna based on the refined and exact methods used by 'Discovery' for comparison with material obtained from the same area by the large mid-water trawls of the German research vessel "Walther Herwig". The latter material differs greatly from the Discovery catches in quantity and in size distribution of specimens, and in being caught in open nets. In this respect the cruise was highly instructive and most useful for my evaluation of the ichthyological materials which I am working on.

In addition to this some material was obtained for various ichthyological studies by colleagues at the Zoological Museum of Copenhagen.

Oblique Fishes (J.R. Badcock)

The oblique series was intended as one being complementary to the series fished across 46°-40°N during Cr. 146 and consequently the sampling methods initiated then were maintained. The objectives were twofold; firstly, and at the broad level, to examine the latitudinal succession of species and compare these results with those obtained on more easterly but seasonally equivalent transects; secondly, to gain some insight into the geographic distributions of larval and adult Benthosema glaciale and hence into possible areas of expatriation. In the absence of any sharp physical gradients, the succession observed was probably more a function of changing species dominance than one of actual species succession. For example, although the lanternfishes B. glaciale and Lampanyctus pusillus show considerable geographic overlap, B. glaciale appeared to be the dominant form only north of about 41°N. Around 53°-60°N the larvae of B. glaciale first appear in the water column in May. Consequently, the dearth of such larvae in the transect collections made in both April (CR. 146) and early June (CR. 148) may add support to the contention that the eastern Atlantic population south of about 45°N is largely an expatriate one maintained by larval and juvenile overspill from more westerly and northerly areas; and this despite the species remaining the dominant lanternfish throughout much of the more southerly areas of the temperate region.

Decapoda (P.A. Domanski)

The series of 0-1000m oblique RMT hauls at 1° intervals from 43° to 36°N at approximately 20°W, was an extension to the sampling programme undertaken during

Cruise 146 in April. The purpose was to investigate a faunal discontinuity believed to be in the region of 40°N. Shipboard examination of adult animals revealed an increase in sub-tropical species such as Ephyrina spp. and Pasiphaeids toward the southern end of the series. Conversely Acanthephyra pelagica, which was a prominant species in the north, had disappeared (submerged below 1000m) from the obliques by 39°N.

The 3500m repeat series yielded similar numbers of Hymenodora spp. in most hauls, this species probably comprised the largest faunal component at this depth. Several hauls contained a few other species including Benthyscymus (hjorti?), Acanthephyra brevirostris and Systellaspis cristata. Several other species occurred which are normally distributed at much shallower depths (<2000m), these include Acanthephyra pelagica and Gennadas valens and so must be regarded as contaminants.

An exceptionally fine specimen of Notostomus gibbosus was taken at Stn. 11132#3 (730-920m) using the closing cod end. The animal, which was still alive when brought to the surface, was a very gravid female with a carapace length of 55mm.

Oblique Pteropoda (C.J. Ellis)

Seven species of Pteropoda were found in the preliminary sorting of the oblique series RMT1 material. Three were comparatively common and showed distinct distributional differences with latitude. Diacria trispinosa was common at four stations from 43°N to 39°N. Clio pyramidata was common at only one station, the most northerly (43°N) and Cavolinia inflexa was very abundant at most of the southerly stations, 40°N, 39°N and 36°N. Very few pteropods were taken at 38°N. The greatest diversity in pteropod species was seen at the most southerly station 36°N where all seven species were present, the above three species and also Cavolinia gibbosa, Styliola subula, Diacria quadridentata and Peraclis triacantha.

Pteropoda. Clio pyramidata (T. Pafort-van-Iersel)

In some populations of the euthecosomatous pteropod Clio pyramidata so-called 'aberrant' stages occur. The function of these stages is unknown. These aberrants seem to develop from the gonads of adult specimens when circumstances are unfavourable.

At stations 11120 and 11124 respectively, 15 and 6 aberrant specimens and 112 and 59 normal adult specimens were collected and kept alive in sea-water at a temperature of 6°C. Nineteen of the 21 aberrants left their shells some time (5 hours - 2 days) after capture and started swimming actively. One of the normal adult specimens developed into an aberrant stage and also left its shell after a few hours. The aberrants could be kept alive for days, one specimen survived for 14 days before it had to be preserved. The normal stages proved to be less strong, rarely surviving for more than six days.

Apart from the two wings and a small alimentary system, the most developed aberrant specimens had a big sack filled with what seemed to be eggs which were gradually released into the sea-water. Specimens of several stages have been preserved in formalin for histological purposes. Subsequent histological investigations may possibly affirm that the aberrant stages represent a secondary reproduction system in this pteropod.

Ostracoda (A. Moguilevsky)

I had intended during Cruise 148 to collect live specimens of different myodocopid species for further cytogenetic studies. Some 44 specimens of Gigantocypris dracontovalis were recovered from 11 RMT1+8M samples taken between 3465 and 3640m, and another 7 from 3 near-bottom hauls. Out of the total of 51 individuals, 17 were females, 6 males, and the remainder were different juvenile stages. Since none of these specimens was recovered alive, they were immediately fixed and subsequently preserved in acetic alcohol (3:1) for future study of their karyotype and meiotic stages. Five RMT1+8 samples taken between 350 and 1530m yielded 9 live specimens (3 females, 3 males, 3 juveniles) of Macrocypridina castanea. Those individuals that appeared to be most active, were kept in the cool room for 24 to 36 hours during which time a solution of Colchicine in sea water was added periodically in order to obtain an accumulation of mitotic

metaphase stages of the dividing cells. The material was then fixed and preserved in a similar way to G. dracontovalis. A preliminary observation of the chromosomes of both M. castanea and G. dracontovalis carried out on board ship confirmed the adequacy of the techniques employed during the Colchicine treatment as well as the method of preservation.

Although the karyotype of Gigantocypris muelleri has already been described from material collected during cruises 121 and 146, further live specimens were needed for chromosome banding techniques.

Some 34 individuals were recovered from 11 RMT1+8 oblique tows and closing cod end samples taken between 0 and 1530m. Out of this total, 13 were large, non-gravid adult females, 6 were adult males and the remainder were juveniles in different stages of development. Some species of halocyprids, also included in these cytogenetic studies, such as Halocypria globosa, Conchoecia ametra, C. haddoni and others not as yet identified were recovered from oblique tows and material hauls. These specimens as well as those of G. muelleri, were Colchicine treated and preserved in the same way as described above.

Attempts to assess the motility characteristics of sperms recovered from female spermathecae of G. muelleri were inconclusive because excessive vibration of the ship during bad weather precluded accurate microscopic examination.

Bioluminescence and Visual Pigment (P.J. Herring)

Cruise 148 provided the first opportunity to test the modified spectral measuring system at sea. The hardware has performed well but some software problems have been identified during the course of spectral measurements on a number of bioluminescent species. Despite these problems, interesting and extensive data have been obtained on animals such as the cephalopod Taningia, the holothurian Benthodytes and the fishes Opisthoproctus, Searsia and Benthalbella. Fixed material from Atolla, Taningia and Searsia has been processed for future morphological investigations on the photogenic tissues.

A particularly interesting phenomenon in the earlier part of the cruise was the appearance of numerous luminous 'patches' in the area worked adjacent to the Kings Trough. These coincided with massive catches of Meganyctiphanes in the

engine room filters and in neuston nets fished very briefly in the patches. Associated with the dense patches of euphausiids were numerous larvaceans whose contribution to surface luminescence has not previously been recognised in the Atlantic.

Frozen samples of Meganyctiphanes, and of the blue- and red- emitting photophores of the fish Malacosteus, have been obtained for biochemical analysis of the system involved.

In an attempt to identify the cellular distribution of the visual pigments of several fishes, samples of dark-adapted retinas of five genera of deep-sea fishes have been prepared for microspectrophotometric investigations of single rods by Dr. J. Bowmaker at QMC.

Trace Metals in Crustacea (S. White)

Rationale

Compared with coastal environments the deep sea might be expected to be relatively free of anthropogenic metal input and as a result indigenous organisms would be expected to have lower or "background" concentrations of various metals than their near-shore or littoral counterparts. Preliminary work however, has shown that for some crustaceans this is not necessarily the case, particularly for the "toxic" metal cadmium.

The concentrations of metals such as cadmium, copper, manganese, silver and zinc in crustacean species may vary with the size (dry weight) of individual animals. To detect the nature of this variation it is necessary to analyse a large number of individual animals over a wide size range. As the relationship between size and the various metal concentrations may vary between sampling sites animals used for this analysis should be taken from one area.

Objective

In the light of the above my objective for the cruise was to collect a number of species of crustaceans, in particular decapods, amphipods and euphausiids for subsequent trace metal analysis by atomic absorption spectrophotometry at

Queen Mary College, London. In order to determine relationships between size and various metal concentrations more than 30 individuals per species were required, ideally from single hauls.

Material Collected

Crustaceans were collected throughout the cruise from various nets (RMT1+8 M, RMT1+8CCE and neuston net), and at a variety of depths (surface - 1500m) to accommodate the different vertical distribution patterns of the species sampled.

All animals were removed from the plastic bowls and sorted according to species, avoiding contact with metal at any stage. All animals were put into individually labelled plastic bags, adult decapods having previously been sexed and in some instances measured. Animals were then frozen at -20°C, stored in plastic boxes and will remain aboard ship until Discovery returns to the U.K. Animals were frozen individually as past experience has shown that animals frozen together tend to stick to one another and then break up on thawing.

Species (numbers) collected

DECAPODS

CARIDEA

Systellaspis debilis (124)
Acanthephyra purpurea (105)
Acanthephyra pelagica (14)

PENAEIDEA

Gennadas valens (38)
Parapasiphae sulcatifrons (6)
Sergestes robustus (15)
Sergestes japonicus (2)

EUPHAUSIIDS

Meganyctiphanes norvegica (35)

MYSIDS

Eucopia sculpticauda (28)

AMPHIPODS

Phronima seticaudata (8)

ISOPODS

Idotea metallica (12)

Achievement of objectives

More than 30 individuals of 5 species were collected; S. debilis, A. purpurea, G. valens, M. norvegica and E. sculpticauda. Of these more than 30 S. debilis and M. norvegica were taken in single hauls (twice for S. debilis). Although for the other 3 species it will be necessary to pool catches for complete size-metal content analysis some stations at which these animals were taken are probably sufficiently close to be considered from the same population. The five large collections will allow comparisons of both absolute concentrations and size-metal concentration relationships for various metals (including Ag, Al, Cd, Cu, Fe, Mn and Zn) and, by combinations of samples; between samples of the same species from different sites i.e. the two large S. debilis samples; between related species, S. debilis and A. purpurea; between caridean and penaeid decapods; and between decapods, euphausiids and mysids.

The species for which less than 30 individuals were collected will probably be analysed for a number of metals and concentrations compared with the data for the large samples

Many thanks to Peter Herring and Peter Domanski for identifying the animals collected and to everyone for being patient with their spoons and allowing me to take my samples first.

Postcript

It is perhaps ironic that as the person interested in trace metals I should have launched so many XBTs. Rough calculations show that each XBT puts about 2-2½Km of copper wire into the water, weighing approximately 100g. As the copper concentration of open ocean waters is about $0.1\mu gl^{-1}$ each XBT launch is potentially enough to double the copper concentration of 10^6M^3 of seawater!

Whale and Krill Observations (H.S.J. Roe)

Remarkable numbers of baleen whales were seen in the King's Trough flank area. Whales seen throughout the cruise were:-

Date	Position	
23 May	49°03'N 3°12'W	5-6 Common Dolphins (Delphinus delphis)
27 "		7-8 Pilot Whales (Globicephala melaena)
28 "		12 Rorquals inc. 2 Fin Whales (Balaenoptera physalus) and 3 Sei Whales (B. borealis)
	42°25' - 41°20'N	
29 "	21°30' - 22°0'W	8 Rorquals, inc. 6 Fin, one of which was a calf.
30 "		3 Rorquals
31 "		1 Rorqual, 12 Common Dolphin
1 June		12 Pilot Whales + ?Common Dolphins
5 "		8 Sei Whales
	ca $\leq$	31 Rorquals, 19 Pilot Whales, 17+ Dolphins

The numbers of rorquals seen were probably underestimates of the numbers present especially as the weather was very poor between 30 May and 3 June with high winds and swell precluding accurate observations. No rorquals were seen north or south of the King's Trough area, although several were observed to be swimming north.

Between the nights of 28 May and 4 June luminous blue/green patches were frequently seen on the surface; one of these was estimated to be some 400x10m in size and was sufficiently bright to be seen after the onset of sunrise. On these nights the engine room filters were blocked with krill (Meganyctiphanes norvegica) and a neuston net fished within a patch caught very large numbers of the same animal. Like the whales these patches were not seen in other areas; presumably the whales were feeding upon krill in the King's Trough area.

GEAR ABBREVIATIONS IN STATION LIST

OTSB14	Semi-baloon Otter Trawl
RMT1+8	Rectangular Midwater Trawl with a nominal $1m^2$ mouth net (RMT1) combined with an $8m^2$ mouth area net (RMT8)
RMT1+8M	As above but a multiple version with three pairs of nets
CCE	Closing Cod End (used on RMT8)
CTD	Conductivity Temperature Depth Probe
EM	Electro-Mechanical

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11116	24/ 5	47 46.7N	15 23.3W	OTSB14	4800-4800	1028-1302		4800
# 1		47 43.0N	15 27.5W			DAY	LOG DIST. 12.23 KM.	
11117	24/ 5	47 23.3N	15 51.6W	XX	0- 99	1916-2019	E-M CABLE TEST	
# 1		47 23.3N	15 51.6W			DUSK		
11118	25/ 5	45 32.1N	18 31.4W	OTSB14	4450-4680	1942-2142		4565
# 1		45 28.7N	18 36.1W			NIGHT	LOG DIST. 12.04 KM.	
11119	26/ 5	44 0.2N	19 56.9W	CTD	0- 520	1800-1825		
# 1		44 0.2N	19 56.9W			DUSK	SALINITY NOT WORKING	
11119	26/ 5	43 57.4N	19 54.8W	RMT1M/1	10- 100	1850-1953		
# 2		43 57.8N	19 56.0W	RMT8M/1		DUSK	FLOW DIST. 4.36 KM.	
11119	26/ 5	43 57.8N	19 56.0W	RMT1M/2	100- 700	1953-2105	RELEASE FAILED; NO CATCH	
# 3		44 3.2N	19 57.3W	RMT8M/2		NIGHT	FLOW DIST. 4.45 KM.	
11119	26/ 5	44 3.2N	19 57.3W	RMT1M/3	700-1000	2105-2156	RELEASE FAILED; NO CATCH	
# 4		44 6.2N	19 58.8W	RMT8M/3		NIGHT	FLOW DIST. 3.55 KM.	
11119	26/ 5	44 9.1N	19 59.7W	CTD	0-1000	2314-0005		
# 5	27/ 5	44 9.1N	19 59.7W			NIGHT	SALINITY NOT WORKING	
11120	27/ 5	42 59.9N	20 54.0W	RMT1M/1	15- 100	0857-0957		
# 1		43 0.6N	20 56.6W	RMT8M/1		DAY	FLOW DIST. 3.59 KM.	
11120	27/ 5	43 0.6N	20 56.6W	RMT1M/2	100- 550	0957-1101		
# 2		43 2.0N	20 59.0W	RMT8M/2		DAY	FLOW DIST. 3.46 KM.	
11120	27/ 5	43 0.2N	20 59.0W	RMT1M/3	550-1000	1101-1205		
# 3		43 4.4N	21 2.7W	RMT8M/3		DAY	FLOW DIST. 4.18 KM.	

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11121	28/ 5	41 28.4N	21 53.5W	RMT1M/1	3470-3580	1942-2142		
# 1		41 33.1N	21 52.7W	RMT8M/1		DUSK	FLOW DIST. 7.60 KM.	
11121	28/ 5	41 33.1N	21 52.7W	RMT1M/2	3470-3565	2142-2342		
# 2		41 37.3N	21 52.1W	RMT8M/2		NIGHT	FLOW DIST. 8.41 KM.	
11121	28/ 5	41 37.3N	21 52.1W	RMT1M/3	3475-3505	2342-0142		
# 3	29/ 5	41 42.0N	21 51.4W	RMT8M/3		NIGHT	FLOW DIST. 8.05 KM.	
11121	29/ 5	42 0.8N	21 48.5W	RMT1M/1	3500-3625	1140-1340		
# 4		42 3.7N	21 47.1W	RMT8M/1		DAY	FLOW DIST. 8.05 KM.	
11121	29/ 5	42 3.7N	21 47.1W	RMT1M/2	3480-3520	1340-1540		
# 5		42 7.4N	21 47.3W	RMT8M/2		DAY	FLOW DIST. 6.54 KM.	
11121	29/ 5	42 7.4N	21 47.3W	RMT1M/3	3480-3520	1540-1740		
# 6		42 11.0N	21 44.1W	RMT8M/3		DAY	FLOW DIST. 7.03 KM.	
11121	30/ 5	41 59.6N	21 45.7W	RMT1M/1	3465-3530	0054-0254		
# 7		41 54.6N	21 44.5W	RMT8M/1		NIGHT	FLOW DIST. 8.77 KM.	
11121	30/ 5	41 54.6N	21 44.5W	RMT1M/2	3490-3530	0254-0455		
# 8		41 50.3N	21 44.2W	RMT8M/2		NIGHT	FLOW DIST. 8.45 KM.	
11121	30/ 5	41 50.3N	21 44.2W	RMT1M/3	3485-3640	0455-0654		
# 9		41 45.9N	21 45.1W	RMT8M/3		NIGHT	FLOW DIST. 7.87 KM.	
11121	30/ 5	41 41.7N	21 45.9W	RMT1M/1	3485-3515	1423-1623		
#10		41 47.1N	21 46.0W	RMT8M/1		DAY	FLOW DIST. 7.87 KM.	
11121	30/ 5	41 47.1N	21 46.0W	RMT1M/2	3480-3515	1623-1823		
#11		41 51.9N	21 44.7W	RMT8M/2		DAY	FLOW DIST. 8.68 KM.	

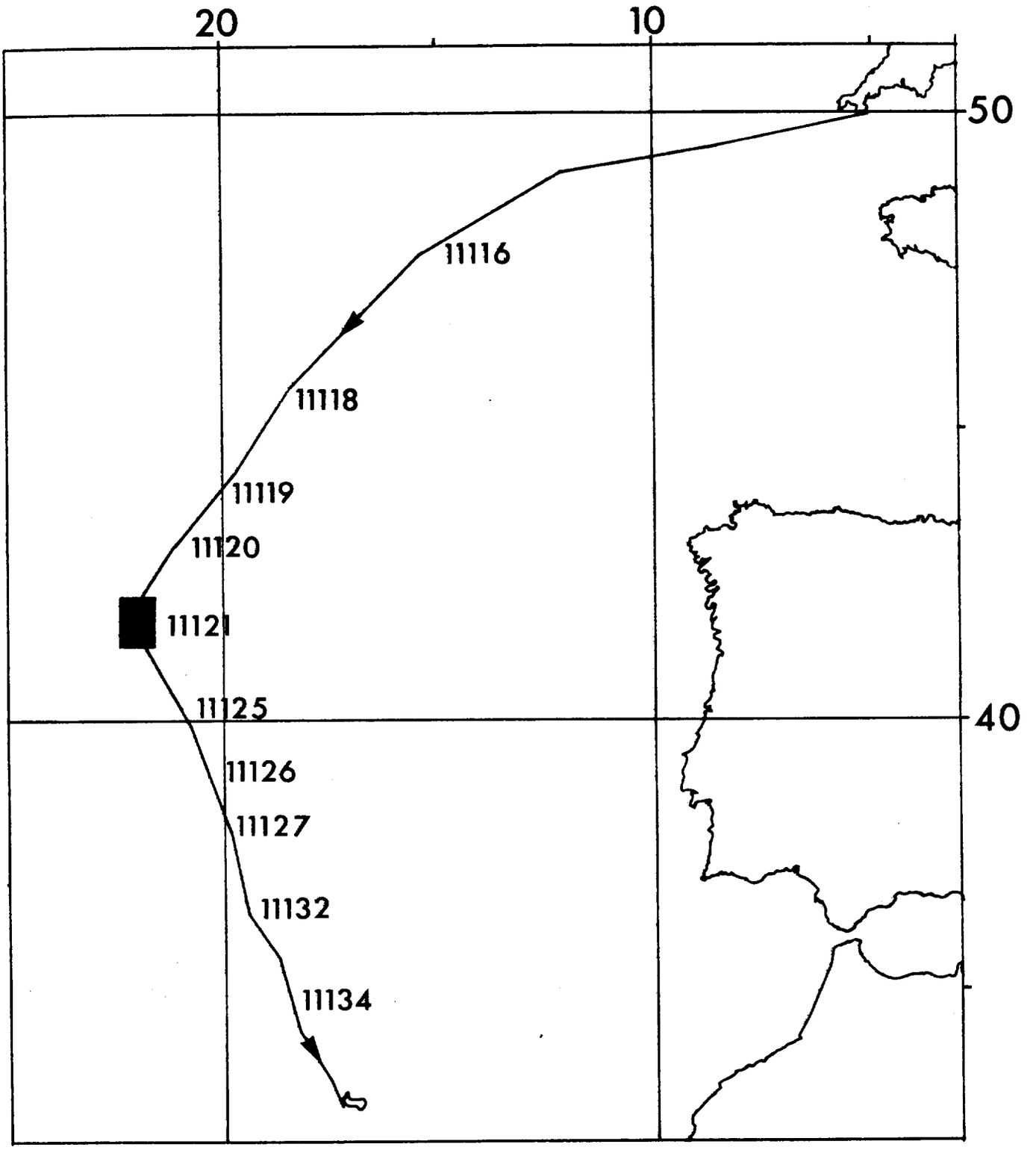
STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11121	30/ 5	41 51.9N	21 44.7W	RMT1M/3	3490-3510	1823-2023		
#12		41 56.9N	21 45.4W	RMT8M/3		NIGHT	FLOW DIST. 8.05 KM.	
11121	31/ 5	41 20.2N	21 50.2W	RMT1	200-1180	1436-1755		
#13		41 24.4N	21 54.1W	RMT8		DAY	NO FLOWMETER	
11121	2/ 6	41 30.1N	21 49.6W	OTSB14	4080-4100	1300-1520		4090
#14		41 34.0N	21 45.3W			DAY	LOG DIST. 10.01 KM.	
11121	2/ 6	41 38.2N	21 47.3W	RMT1	0- 100	2000-2025	NO FLOWMETER. LINEAR	
#15		41 38.2N	21 47.3W	RMT8		NIGHT	RELEASE GEAR TEST	
11121	2/ 6	41 36.6N	21 47.1W	CTD	0-3800	0906-1235	LINEAR RELEASE GEAR	
#16		41 36.6N	21 47.1W	XX		DAY	TEST	
11121	3/ 6	41 48.2N	21 40.4W	RMT1M/1	3520-3490	1820-2024		
#17		41 52.1N	21 43.2W	RMT8M/1		DUSK	FLOW DIST. 6.59 KM.	
11121	3/ 6	41 52.1N	21 43.2W	RMT1M/2	3480-3520	2024-2240		
#18		41 56.1N	21 47.0W	RMT8M/2		NIGHT	FLOW DIST. 8.05 KM.	
11121	4/ 6	41 56.1N	21 47.0W	RMT1M/3	3485-3530	2240-0040		
#19		42 0.5N	21 47.5W	RMT8M/3		NIGHT	FLOW DIST. 7.55 KM.	
11121	4/ 6	41 33.0N	21 44.1W	RMT1M/1	4006-4021	1136-1336	10-25M OFF BOTTOM	4031
#20		41 36.0N	21 43.9W	RMT8M/1		DAY	FLOW DIST. 6.76 KM.	
				NBES				
11121	4/ 6	41 36.0N	21 43.9W	RMT1M/2	3988-4008	1336-1536	23-43M OFF BOTTOM	4031
#21		41 38.9N	21 43.8W	RMT8M/2		DAY	FLOW DIST. 6.04 KM.	
				NBES				

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11121	4/ 6	41 38.9N	21 43.8W	RMT1M/3	3976-3991	1536-1736	40-55M OFF BOTTOM	4031
#22		41 42.1N	21 47.7W	RMT8M/3		DAY	FLOW DIST. 5.38 KM.	
				NBES				
11121	5/ 6	41 26.1N	21 47 6W	RMT1M/1	4004-4021	0124-0324	10-27M OFF BOTTOM	4031
#23		41 22.5N	21 44.3W	RMT8M/1		NIGHT	FLOW DIST. 8.50 KM.	
				NBES				
11121	5/ 6	41 22.5N	21 44 3W	RMT1M/2	3991-4007	0324-0523	24-40M OFF BOTTOM	4031
#24		41 18.2N	21 40.9W	RMT8M/2		NIGHT	FLOW DIST. 8.95 KM.	
				NBES				
11121	5/ 6	41 18.2N	21 40.9W	RMT1M/3	3941-3991	0523-0530	40-90M OFF BOTTOM. NO	4031
#25		41 17.9N	21 40.7W	RMT8M/3		NIGHT	FLOW, NET NOT FISHED	
				NBES				
11121	5/ 6	41 11.5N	21 36.9W	CTD	0-1500	0830-1000		
#26		41 11.5N	21 36.9W			DAY		
11121	5/ 6	41 10.0N	21 35.0W	RMT1M/1	10- 100	1027-1127		
#27		41 7.9N	21 33.4W	RMT8M/1		DAY	FLOW DIST. 4.09 KM.	
11121	5/ 6	41 7.9N	21 33.4W	RMT1M/2	100- 650	1127-1252		
#28		41 5.0N	21 30.0W	RMT8M/2		DAY	FLOW DIST. 6.20 KM.	
11121	5/ 6	41 5.0N	21 30 0W	RMT1M/3	650-1000	1252-1338		
#29		41 3.0N	21 28.9W	RMT8M/3		DAY	FLOW DIST. 3.10 KM.	
11122	5/ 6	40 48.0N	21 21.6W	RMT1	400- 510	1604-1815	NO FLOWMETER. LINEAR	
# 1		40 43.2N	21 19.1W	RMT8		DAY	RELEASE GEAR	
11123	5/ 6	40 21.7N	21 1.5W	RMT1	350- 390	2204-2255	NO FLOWMETER. LINEAR	
# 1		40 20.5N	21 0.5W	RMT8		NIGHT	RELEASE GEAR	
				CCE				

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11124 # 1	6/ 6	40 12.6N 40 10.7N	20 29.6W 20 51.3W	RMT1 RMT8 CCE	915- 960	0128-0228 NIGHT	NO FLOWMETER. LINEAR RELEASE GEAR	
11124 # 2	6/ 6	40 7.2N 40 3.7N	20 40.2W 20 44.5W	RMT1 RMT8 CCE	40- 250	0432-0618 NIGHT	NO FLOWMETER. LINEAR RELEASE GEAR	
11125 # 1	6/ 6	40 0.0N 40 0.0N	20 43.1W 20 43.1W	CTD	0-1500	0724-0832 DAY		
11125 # 2	6/ 6	39 59.5N 39 56.3N	20 41.6W 20 41.0W	RMT1M/1 RMT8M/1	10- 105	1111-1211 DAY	FLOW DIST. 3.91 KM.	
11125 # 3	6/ 6	39 56.3N 39 53.0N	20 41.0W 20 40.0W	RMT1M/2 RMT8M/2	100- 600	1211-1313 DAY	FLOW DIST. 3.66 KM.	
11125 # 4	6/ 6	39 53.0N 39 51.7N	20 40.0W 20 38.3W	RMT1M/3 RMT8M/3	600-1000	1313-1401 DAY	FLOW DIST. 3.01 KM.	
11126 # 1	6/ 6	39 0.0N 39 0.0N	20 16.2W 20 16.2W	CTD	0-1500	2026-2150 DAY		
11126 # 2	6/ 6	38 58.9N 38 56.4N	20 15.9W 20 14.7W	RMT1M/1 RMT8M/1	20- 100	2210-2310 NIGHT	FLOW DIST. 4.81 KM.	
11126 # 3	6/ 6 7/ 6	38 56.4N 38 53.0N	20 14.7W 20 13 3W	RMT1M/2 RMT8M/2	100- 550	2310-0034 NIGHT	FLOW DIST. 5.93 KM.	
11126 # 4	7/ 6	38 53.0N 38 49.3N	20 13.3W 20 11.7W	RMT1M/3 RMT8M/3	550-1000	0034-0202 NIGHT	FLOW DIST. 6.34 KM.	

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	SOUNDING(M)
11127	7/ 6	38 0.0N	19 51.4W	CTD	0-1500	0816-0936		
# 1		38 0.0N	19 51.4W			DAY		
11127	7/ 6	37 59.4N	19 52.7W	RMT1M/1	10- 100	1001-1101		
# 2		37 57.4N	19 52.3W	RMT8M/1		DAY	FLOW DIST. 3.73 KM.	
11127	7/ 6	37 57.4N	19 52.3W	RMT1M/2	100- 550	1101-1202		
# 3		37 55.1N	19 51.7W	RMT8M/2		DAY	FLOW DIST. 3.52 KM.	
11127	7/ 6	37 55.1N	19 51.7W	RMT1M/3	550-1000	1202-1308		
# 4		37 52.5N	19 51.2W	RMT8M/3		DAY	FLOW DIST. 4.25 KM.	
11128	7/ 6	37 39.1N	19 46.1W	RMT1	1030-1500	1658-1858		
# 1		37 34.3N	19 44.9W	RMT8 CCE		DAY	NO FLOWMETER	
11129	7/ 6	37 12.8N	19 35.6W	RMT1	770- 880	2307-0107		
# 1	8/ 6	37 7.9N	19 35.9W	RMT8 CCE		NIGHT	FLOW DIST. 8.14 KM.	
11130	8/ 6	37 4.8N	19 34.1W	RMT1	70- 300	0239-0339		
# 1		37 2.8N	19 33.5W	RMT8 CCE		NIGHT	FLOW DIST. 4.04 KM.	
11131	8/ 6	36 33.3N	19 21.0W	RMT1	500- 700	0812-1012		
# 1		36 21.1N	19 21.1W	RMT8 CCE		DAY	FLOW DIST. 8.63 KM.	
11132	8/ 6	36 28.5N	19 21.2W	CTD	0-1500	1100-1212		
# 1		36 28.5N	19 21.2W			DAY		
11132	8/ 6	36 22.0N	19 19.8W	RMT1M/1	0- 100	1420-1520		
# 2		36 18.8N	19 17.3W	RMT8M/1		DAY	FLOW DIST. 3.59 KM.	

STN.	DATE 1984	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS		SOUNDING(M)
11132	8/ 6	36 18.8N	19 17.3W	RMT1M/2	100- 600	1520-1630			
# 3		36 17.0N	19 15.5W	RMT8M/2		DAY	FLOW DIST.	4.07 KM.	
11132	8/ 6	36 17.0N	19 15.5W	RMT1M/3	600-1000	1630-1737			
# 4		36 15.1N	19 13.1W	RMT8M/3		DAY	FLOW DIST.	3.80 KM.	
11133	8/ 6	36 2.8N	19 5.0W	RMT1	6- 15	2022-2122			
# 1		36 1.4N	19 3.0W	RMT8 CCE		NIGHT	FLOW DIST.	4.22 KM.	
11133	8/ 6	36 0.2N	19 2.9W	RMT1	730- 920	2253-0057			
# 2	9/ 6	35 55.8N	18 57.7W	RMT8 CCE		NIGHT	FLOW DIST.	8.09 KM.	
11133	9/ 6	35 53.7N	18 55.7W	RMT1	60- 90	0224-0324			
# 3		35 52.1N	18 55.1W	RMT8 CCE		NIGHT	FLOW DIST.	3.64 KM.	
11133	9/ 6	35 48.6N	18 51.7W	RMT1	590- 700	0530-0730	NO FLOWMETER		
# 4		35 45.4N	18 47.9W	RMT8 CCE		DAWN			
11133	9/ 6	35 42.5N	18 44.9W	RMT1	760-1530	0958-1215			
# 5		35 37.1N	18 41.4W	RMT8 CCE		DAY	FLOW DIST.	9.40 KM.	
11134	10/ 6	34 45.7N	18 30.0W	OTSB14	4790-4880	0047-0251			4835
# 1		34 40.3N	18 30.0W			NIGHT	LOG DIST.	9.08 KM.	



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