I.O.S.

RRS DISCOVERY

CRUISE 140

5 AUGUST - 13 SEPTEMBER 1983

BIOLOGICAL AND PHYSIOLOGICAL STUDIES IN THE EASTERN NORTH ATLANTIC (15° - 45°N)

CRUISE REPORT NO. 155

1983

INSTITUTE OF OCEANOGRAPHIC SCIENCES

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

RRS DISCOVERY

Cruise 140

Leg 1: 5 - 22 August 1983

Leg 2: 24 August - 13 September 1983

Biological and physiological studies in the eastern North Atlantic (15°N-45°N)

Principal Scientist

P.J. Herring

CRUISE REPORT NO. 155

1983

CONTENTS

CONTENTS continued

ITINERARY

Leg 1 Depart Dakar August 5
Arrive Funchal August 22

Leg 2 Depart Funchal August 24
Arrive South Shields September 13

Where lies the land to which the ship would go?
Far, far ahead, is all her seamen know,
And where the land she travels from? Away,
Far, far behind, is all that they can say.

ARTHUR HUGH CLOUGH (1819-1861)

PERSONNEL

SHIP'S OFFICERS AND P.O.s

P.H.P. Maw[1,2]	Master
S.D. Mayle[1,2]	First Officer
P.R. Oldfield[1,2]	Second "
T.C. Harrison[1,2]	Third "
H. Myhill[1,2]	Radio Officer
D.C. Rowlands[1,2]	Chief Engineer
T. Bennett[1]	Engineers
I.G. McGill	
A. Greenhorn[1,2]	
G. Parker[1,2]	
K.T. Sullivan[1]	
P.G. Parker[2]	
B. Davenport[1]	
T.J. Comley	
P.E. Edgill[1]	Electrical Engineers
B. Smith[2]	
P. Higginbottom[1,2]	Catering Officer
C. Hubbard[1,2]	Cook
R. MacDonald[1]	Bosun
F.S. Williams[2]	
L. Cromwell[1,2]	Deck P.O.s
M. Harrison[1,2]	

SCIENTIFIC PERSONNEL

P.J. Herring[1,2]	IOS Wormley	Principal Scientist
E.J. Darlington[1,2]	" "	
A. Gray[1,2]	" "	
G. Lake[1,2]	" "	
H.S.J. Roe[1,2]	" "	
R.A. Wild[1,2]	" "	
D.S.M. Billett[1]	" "	
M.P. Burnham[1]	" "	
R.H. Edge[1]	" "	
D. Edge[1]	" "	
N.R. Merrett[1]	" "	
R.J. Morris[1]	" "	
P.S. Ridout[1]	" "	
R.A. Russell[1]	" "	
R.G. Aldred[2]	" "	
P.A. Domanski[2]	" "	
C.J. Ellis[2]	" "	
C. Flewellen[2]	" "	
G.V. Lodge[2]	" "	
M. Beney[1]	Research Vessel Services	
P. Mason[2]	" " "	
A. Bebbington[2]	Bristol	
S. Burch[1]	Salford University	
A.K. Campbell[2]	Welsh National School of Medicine, Cardiff	
J. Davenport[1]	Marine Sciences Laboratory, Menai Bridge	
D. Dyball[1]	Southampton University	
I.A. Johnston[2]	St. Andrews University	
M.I. Latz[2]	University of California, Santa Barbara	
S.B. Matthews[2]	Welsh National School of Medicine, Cardiff	
M.P. Philpott[2]	AMTE, Portsmouth	
M. Sheader[2]	Southampton University	
E.R. Trueman[1]	Manchester University	
E.A. Widder[2]	University of California, Santa Barbara	

[1] Leg 1

[2] Leg 2

OBJECTIVES

1. To study the distribution of the benthopelagic fauna down to 4000m on appropriate slope areas between 15°N and 20°N.

2. To relate the vertical distribution of the pelagic fauna in the Cape Verde area to the ambient light intensities.

3 To investigate particular aspects of the physiology and biochemistry of oceanic animals.

4. To investigate the geochemistry of short sediment cores from slope regions.

NARRATIVE

Cruise 140 began in a state of some confusion. In the week prior to embarkation information was received that the mid-cruise port call at Tenerife presented no difficulties, yet only two days before the scientific party was due to depart instructions were received from the Foreign Office that Discovery was not to proceed to Tenerife. Other ports were investigated and it was found that Funchal was the most feasible alternative; however, it was not possible to effect the planned personnel change on the originally proposed dates (26-28 August) as flights to and from Funchal were already heavily booked. It was therefore necessary to bring forward the port call to August 22nd-24th. All these tentative arrangements, made on the morning of 3rd August, could not be confirmed until official agreement was reached. The scientific party for the first leg therefore flew out to Dakar the same day without any certainty of the vessel's destination. In Dakar equipment for the second leg of the cruise, sent from AMTE Portsmouth to the British Embassy, was loaded and the vessel sailed at 1225 on August 5th. The PES fish was launched at 1650 and echo-sounding watches commenced. The otter trawl (OTSB14) was rigged during the day, prior to a series of tows planned down the continental slope. During the day serious cooling problems were encountered in the engine room, resulting from a combination of high sea surface temperature and failure of a main cooling fan. These problems persisted throughout the first leg and restricted the vessel's speed, particularly in the southernmost working area.

The OTSB14 was shot 0924/6th in a depth of 3000m, and obtained a large catch of ooze containing some fish and echinoderms. In view of the excessive quantities of ooze the transect was postponed and passage made to the shelf edge for two box cores (Stations 10871 & 10872). The first produced a muddy sample but the second encountered a shelly deposit and failed to obtain a core. Two OTSB14 tows, in 1000m depth (10873) on 7th and in 1400m (10874) on the 8th, both obtained good catches with little mud, though the latter was on the bottom for only 26 minutes as a canyon was encountered during the tow. On the same day (8th August) official confirmation was received that Funchal was to be the mid-cruise port call, from 22-24th August. This reduction in the length of the first leg of 4 days, added to the additional day required to steam to Madeira instead of Tenerife, meant that the cruise programme centred largely to the west of the Cape Verde islands had to be abandoned and an alternative programme implemented. This was particularly unfortunate in that one of the main rationales for the original cruise proposal was the value of a western Cape Verdes working area. It was decided to concentrate the midwater work on a region to the east of the Cape Verdes in order to retain the planned epibenthic sledge station positions on the Mauretanian and Spanish Sahara shelf edge.

Multiple RMT tows were begun on 8th August to obtain experimental material and test the system prior to use in a series of light meter tows. Five hauls were made (10875-10879) up to 10th August. On 9th August the new experimental cooled container was tested but its motor burnt out the same day so it could not be used at all during the first leg. A request was made for a replacement motor to be sent out to Funchal. On the same day a brief scientific meeting was held to outline the plans for the rest of the first leg.

Information had been received that work on the Mauretanian and Spanish Sahara shelf edge was permitted (subject to minor distance restrictions) but on August 10th the vessel was instructed not to approach within 200 miles of the Spanish Sahara coastline. This restriction not only eliminated the two predetermined sledge positions but also added considerably to the steaming time necessary to circumnavigate the extensive 'box' now designated a no-go area.

Tows for experimental material with the RMT 1+8 and closing cod-end system were initiated on August 10th (10880) but experienced technical problems until 10881#4 on August 11th when a vertical wire test was carried out on monitor J3.

Particle sampling system tests were carried out during the nights of August 10th, 11th and 12th combined with squid fishing. A box core station (10883) was completed early on the 12th followed by an OTSB14 in 3000m depth. This yielded a good mixed catch with little mud. Later on the 12th a trial tow of the multinet and low level photometer was carried out. A series of successful light meter tows at the 85, 95 and 105 dB levels were made during the next two days (13th and 14th). During the night of August 12th, while the vessel was hove to, a 2m white tip shark was caught on a hand line and extensive blood samples taken.

On the morning of August 14th a short scientific meeting was held and the epibenthic sledge (BN 1.5/3m) rigged. A tow was made in 2000m for the echinoid Pourtalesia (10890#1), this being the nearest appropriate site to the original planned station about a degree further north off Spanish Sahara. Both Pourtalesia and Actinoscypha were obtained and a second photosledge run was made over the same area (10890#2). During the tow the weather deteriorated considerably with an offshore wind of 30 kts. Persistent heavy seas and strong winds forced the abandonment of the second projected sledge position (for the ophiuroid Ophiacantha) and on 16th August course was made westwards en route to Funchal. An RMT 1+8 tow (10891) on 17th was made successfully with an overheating cutout incorporated in monitor J3. RMT 1+8 hauls with the closing cod-end were begun p.m. on August 17th (10892) and continued during the passage to Funchal. Seven hauls were made (to 10898) up to 21st August with intermittent postponements when high winds were encountered just west of the Canary Islands. A summary scientific meeting was held on 21st and the vessel arrived at Funchal a.m. August 22nd.

Despite the last minute changes of port call and dates all the participants for the second leg were able to meet the revised schedule and all were embarked, along with the replacement container motor and the equipment air-freighted from California. N.R. Merrett, D.S.M. Billett, R.A. Russell, R.J. Morris, P.S. Ridout, R.H. Edge, M.P. Burnham, D. Edge, M. Beney, S. Burch, D. Dyball, E.R. Trueman and J. Davenport left the ship in Funchal and were replaced by R.G. Aldred, P.A. Domanski, C.J. Ellis, G. Lodge, C. Flewellen, P. Mason, A. Bebbington, I.A. Johnston, M. Sheader, M. Philpott, A. Campbell, S.B. Matthews, E. Widder and M. Latz.

Discovery sailed from Funchal in perfect weather conditions at 1218, 24th

August and at 1530 the PES fish was launched and echo sounding watches restarted. Attempts were made to obtain a continuous seawater supply for the AMTE bioluminescence sensor, employing a spar set into a shoe on the hull, but it proved ineffective at full speed as the spar continually came out of the water on the roll and was too insecure for safe deployment at this speed. A south-westerly course was set for the Grand Meteor Seamount and closing cod-end RMT 1+8 hauls initiated en route on August 25th (10899). Fourteen tows were made up to p.m. August 28th (10911) when the vessel reached the seamount. Two trials of the near-bottom echosounder were carried out in depths of about 300m over the seamount but in both cases the near-bottom echo sounder failed. A sledge was then fished at a depth of 320m and obtained a large number of long-spined echinoids. A search for a deeper sledge site was not successful and passage was made on p.m. August 29th across the line of the Irving and Cruiser seamounts with another near-bottom echo sounder trial (10915) in a depth of 600m. Course was then set for Galicia Bank.

Closing cod-end RMT 1+8 tows were begun on August 30th (10916) and nine tows completed up to p.m. September 1st (10924). On August 31st the Zodiac was put over the side to sample the barnacles on the vessel's hull. No Conchoderma auritum were found but specimens of Lepas were collected. A massive bloom of the dinoflagellate Pyrocystis was encountered that evening and the species persisted for several days. The PES fish was changed on September 1st following a deterioration in its performance.

On September 2nd a series of RMT 1+8 tows were made (10925-10926) to investigate the effect of a cod-end sieve system on the RMT 1. On September 3rd RMT 1+8 closing cod-end tows were begun again and 12 tows (10927-10938) completed by p.m. September 6th. During the last tow electrical problems necessitated hauling the net with the hydraulics powered by the separate 100kV alternator, but it was nevertheless successfully achieved. Dense aggregations of Meganyctiphanes blocked the engine room filters overnight September 6-7th and reduced the vessel's speed for 1½ hours.

A survey of the top of Galicia Bank was carried out on September 7th preceding two sledge hauls (10939, 10940) for luminous ophiuroids. Much coral was encountered and some ophiuroids were obtained. An RMT 1+8 CCE was fished during the night of 7/8th to catch Meganyctiphanes at the position of the previous night's encounter, but relatively few specimens were obtained.

A third BN 1.5/C was fished on the Bank (10942) and again obtained large amounts of coral. During the tow the net was badly torn. Passage was then made for the U.K. but no information concerning the refit port was received until p.m. September 9th when instructions were received to sail for the Tyne to arrive on the 13th, one day earlier than in the cruise programme. Consequently no time was left for further scientific stations and the only additional scientific task was that of collecting standard seawater. This was done between 1415 and 1515hr on September 9th. A scientific meeting to summarise the work done was held on September 10th. Passage was set for the Tyne in deteriorating weather conditions and gale force winds were experienced from Ushant to the North Sea. Discovery berthed in Middle Dock, South Shields 0800 September 13th.

P.J. Herring

SAMPLING GEAR OPERATION AND DEVELOPMENT

Main winch system: Leg 1

The traction winch and associated machinery aft was used extensively on this leg. Some 43 deployments were made pulling loads up to 4 tonnes when trawling with 8000m of warp out. The system ran virtually trouble free with only two minor hold-ups which did not affect scientific work.

The auxiliary winch was successfully used to deploy and recover the OTSB nets. A separate communication system was used between poop (crane davit) and winch at all times. This helped overcome the problem of not having hydraulic brakes on the winch. Due to the uneven amounts of wire on the drums much unnecessary clutching in and out was done. The line shackles passed through the winch rollers with difficulty. These problems will be put right during the coming ship refit.

M. Burnham, R.H. Edge

Leg 2

During this period the aft winch system and ancillary equipment was used extensively for a period of 140 hours running, with some 49 deployments.

No problems were encountered during this period and the winch system performed well. During a recovery of the RMT, the winch system had a power failure, a problem caused by the ship's 200 kVa alternator. The net was recovered by using only 2 hydraulic pumps powered from the ship's 100 kVa alternator.

G.V. Lodge

Epibenthic sledge

The epibenthic sledge was used on two occasions only during Leg 1, off the northern edge of the Mauretanian shelf in depths of around 2000m. On the first occasion it was rigged with three nets (BN 1.5/3M) and a suprabenthic net and reached a sounding of 2010m with only 2741m.w.o. A good catch of Pourtalesia and Actinoscypha was obtained as well as considerable mud. Particularly good specimens of Pourtalesia were obtained in the suprabenthic net. The trace indicated that only occasional photographs were taken on the bottom. The second deployment was without a net as a photosledge in the the same locality.

On Leg 2 the sledge was fished with a single coarse mesh net (BN 1.5/C) on four occasions. Once on the Great Meteor Bank at approximately 300m and three times on the Galicia Bank between 750 and 950m. The gear functioned successfully but unfortunately the net was badly torn on coral during the last haul.

Launching and recovering the sledge using the crane and davit proved to be relatively straight forward. The latter operation however, was severely hampered by the bolts, studs and various jagged projections from the deck, left after the removal of the rail. The net was easily torn on the projections and they prevented the sledge being brought inboard far enough for the catch to be recovered with safety.

D.S.M. Billett, R.G. Aldred

Closing cod-end on the RMT 8

Cruise 140 was only the second opportunity to use this gear and the first occasion on which it proved thoroughly reliable. Forty-four hauls were made, 37 of which were totally successful. There were three mechanical failures, one acoustic failure, and three hauls in which the valves did not close completely. The maximum fishing depth was 1700m (3234m.w.o.) and the minimum depth was 50m.

The temperature of water in the cod-end after retrieval was only 1-2°C higher than at the closing depth in most hauls, apart from one of the deepest ones in which a maximum differential of 6°C above the closing temperature was recorded. In all cases the catch was in excellent condition. The monitor reception was sufficiently good to move it to its original design position beneath the cod-end where it also acted as a keel and provided much more stability on launch and recovery. The use of a positively buoyant recovery line prevented it tangling round the fin or drogue.

R.A. Wild, E.J. Darlington, P.J. Herring

Neuston net

A new light-weight neuston net was used for the first time. This could easily be launched and recovered by two people and was made of marine ply. Its light weight presented stability problems in choppy water but with suitable trimming it proved very effective at low speeds (2kt). It was used on some 90 occasions, accumulating approximately 45hr fishing time.

R.A. Wild

Cod-end sieve

The experimental cod-end sieve system, which comprises three nested liners of mesh sizes 4mm, 1mm and 0.32mm separated by spacer rings, designed and built by R. Wild and R.G. Aldred, was fished on 10 RMT 1 and 3 RMT 1M hauls. For the multinet tows, the CES was put on RMT 1M-2 and all three hauls of a tow were taken in the same 50m band. The depths fished were 250-300m, 500-550m and 600-650m. A few of these samples were analysed on board and the condition of the animals in the CES fractions seemed better than in the comparable ordinary cod-end hauls. Hang-up of small organisms in the large mesh bags occurred to a variable extent, usually due to fragments of jelly and spinous Radiolaria catching on the mesh and entrapping small organisms, usually chaetognaths and copepods. However the amount of contamination of 4mm and 1mm fractions by small copepods, and other crustaceans and chaetognaths is probably not significant. Experimentation with different mesh types, mesh sizes and bag design would probably reduce this problem.

Electronics and acoustics

Mufax MkIII No. 12 was used without serious problems throughout the cruise. On the second leg P.E.S. fish No. 2 was swapped for No. 7 as the former began to get noisy. When No. 7 was recovered at the end of the cruise it was observed that the armouring at the strut was exposed and broken but fortunately only those wires returning from the pudding ring were in this condition.

The first leg was not a totally happy one from the electronic viewpoint; the satisfactory performance of the other units being marred by the failure of Net Monitor J3. This unit stopped pinging abruptly on several hauls although its receiver continued to operate normally. This fault proved difficult to eradicate as it would 'switch' itself on again usually shortly before being recovered. No amount of vibration testing coupled with thermal shocks could produce the fault in either the laboratory or the cold room. It would have been abandoned completely but for the fact that it was required for the deep-sea photometer series of hauls. After virtually every component in the Pulse Power Amplifier had been replaced the cause of the trouble proved to be a hairline crack in a printed circuit board.

The major disappointment of the cruise was the failure of the floppy disc unit on the second day, before a single sample had been analysed in the PET based bioluminescence spectra system.

The new mini suspended particle pumping system also proved to be disappointing due to the flooding at one time or another of all three containers, i.e. the timer case, the battery pack and the oil filled motor case.

On a happier note the photometer series of hauls was successfully completed using J3 and towards the end of the first leg the closing cod-end monitor was behaving impeccably and continued so to do throughout the remainder of the cruise. A temperature sensor was fitted close to the photo-multiplier port in the non-toxic sea water supply and the temperature data displayed on the second channel of the recorder used for logging the luminescence.

A circuit was also devised which effectively closes the receiver of the net monitor whenever the temperature of the pressure case exceeds 28°C. This was

fitted for safety purposes to prevent the unwanted operation of the release gear during deployment of the RMTs, after the monitors had been left cooking on deck for any length of time.

The second leg proved to be much more satisfactory - the only failures of the acoustic system were (a) during the only haul using an experimental net monitor which had been completed during the cruise and (b) when 2 trial hauls were made to fish the RMT using the Near Bottom Echo Sounder on a shallow bottom. This latter system would clearly benefit from some further work in this application.

E.J. Darlington, D. Edge

Digitising Net-monitor signals

A system is being developed to track and digitise telemetered signals in a manner similar to P.E.S.T. During leg 2 the construction of the micro-processor was completed, it was tested and most of the soft-ware put together. At the end of the cruise the system was capable of tracking up to eight channels and printing their positions on the Mufax. Due to lack of both program and read/write memory it was not possible to write the operator interface routine that would have virtually completed the system.

C.G. Flewellen

BIOLOGICAL AND CHEMICAL STUDIES

Geochemistry

Interfacial and near surface sediment samples were taken on the continental shelf and slope off Dakar, the Cape Verde Terrace and the continental slope off Cape Blanc. The samples will be analysed for their mineralogical, inorganic and organic chemical composition. The results should enable the major sources of sedimentary input in these areas to be determined. In addition they may provide a clue as to the origin of the thick, organic-rich turbidites found recently in deep water sediments over 800 miles to the west near the Great Meteor Rise.

R.J. Morris, P.S. Ridout

Biochemistry

Samples of the gills from a number of meso- and bathypelagic crustaceans have been collected for subsequent lipid analysis. The results should provide an interesting comparison with data from euryhaline and freshwater crustaceans and it is hoped may allow a better understanding of the composition and function of gill membranes in general.

A number of specimens of the decapod Sergestes sp., which had either internal or external parasites, were found in the net hauls. Both the host and the parasite were sampled and their detailed biochemistry will be examined. The objective will be to determine the type of metabolic relationship which exists between the parasite and Sergestes.

Good quality specimens of a variety of midwater and benthic organisms were collected from the net hauls for subsequent trace metal analysis. The main objective will be to establish the natural product levels for biologically essential metals in a range of oceanic fauna.

R.J. Morris, P.S. Ridout

Flux studies.

A vertical wire, messenger-operated particle sampler was used to sample the water column over the Cape Verde Terrace. After successful samples were collected at depths of 50m and 3100m, serious problems were encountered with leaking pump and battery units. These difficulties could not be overcome during the cruise and no further samples were taken.

R.J. Morris, P.S. Ridout

Semi-balloon otter trawl fishing

The 4 OTSB14 operations spanned mid-tow sounding ranges of 925-3120m (6.0-1.7°C in temperature). A total of 969 fish were sampled. They weighed 98kg and represented at least 58 species. Peak values of relative density on the upper slope (1.3 gm/m^2 and 0.2 fish/m^2 at 925m; 2.4 gm/m^2 and 0.2 fish/m^2 at 1430m) correspond with earlier findings somewhat to the north of the area. Assuming these few samples to be representative of the prevailing fauna, the catch composition contrasts with that found in more temperate parts of the eastern North Atlantic. Generally species richness is higher in these samples (e.g. 30 spp. at 925m and 12 spp. at 3120m) than in similar samples at corresponding soundings at ca 50°N. There is also a change among the dominant families. At 925m, as expected, macrourids dominate in abundance (60%) but at mid-slope levels (1430m) this dominance is replaced by Synaphobranchus kaufi, alepocephalids and ophidioids (79%). Likewise at 3120m synaphobranchids, alepocephalids and ophidioids dominate numerically (72%). A possible explanation for the variation in dominance down the slope, where macrourids could be expected to dominate to lower slope levels, is suggested by the shallower occurrence of certain species with broad latitudinal distributions.

The most noteworthy captures among the samples were 9 specimens of the rattail Coryphaenoides paramarshalli, to more than double the total number hitherto reported, and a single specimen of the unusual lycodid, Pachycara obesum.

As a result of earlier requests, fish specimens were collected for Q. Bone (Marine Biological Association), and K. Sulak and T. Monroe (both of the Virginia Institute of Marine Sciences).

N.R. Merrett, R.A. Russell

Light Meter Series

Two consecutive dawn to dusk periods were sampled with the RMT 1+8M fitted with the low light level photometer. Three light levels, $3.2x10^{-3}$, $3.2x10^{-4}$ and $3.2x10^{-5}$ $\mu W/cm^2$ were fished sequentially at a position centred ca 18°N 20°W. The series fills a geographical hole in the transect of light meter stations which now extends from ca 45°N to ca 3°S. The water was opaque and the maximum depth reached was only 420m. None of the sampled populations were restricted to a single isolume and the catches on the two consecutive days were markedly different - euphausiids predominating at $3.2x10^{-4}$ and $3.2x10^{-5}$ $\mu W/cm^2$ on the first day, pteropods on the second. The results agree with our previous observations: on a population level isolume following seems dead.

H.S.J. Roe

Conchoderma project

The programme of investigations into the geographic distributions and the settlement of Conchoderma auritum cyprids, on behalf of ROSCM, was hampered by the almost total absence of the species. A total of 7 Conchoderma-type cyprids were positively identified during the cruise. Some 90 neuston net hauls were examined and only two Conchoderma cyprids found; both were dead. The other five were found in RMT 1 hauls, 3 (all dead) in 10925#1 which was fished between 250-300m and 2 (living) 10901#1 325-430m. These two were kept alive in settlement chambers made on board by R. Wild and G. Lake but did not metamorphose. Numerous cyprids and adults of several Lepas species were obtained from the neuston net hauls and cyprids of L. pectinata and L. anatifera were kept alive in the settlement chambers through metamorphosis. A short report will be written for ROSCM.

D.S.M. Billett, C. Ellis

Energetics of invertebrate locomotion

Two aspects were investigated (a) the jet performance of some oceanic cephalopods and (b) the oxygen consumption of certain planktonic and nektonic invertibrates. Both investigations were designed to assess the energy cost of

locomotion (unit locomotory cost) (a) by mechanical analysis and (b) by respirometry.

(a) Jet performance

Only a limited range of species became available and the results for single specimens, satisfactorily investigated in good condition, are summarised in Table 1. With the exception of Ommastrephes all exhibit low jet pressures, the octopods with pulses of long duration but low pressure are probably the most economical of energy. By contrast Ommastrephes produces a short pulse, generally 200msec, at high pressure and its use in escape or attack is likely to be very much more costly. The ratio between body and mantle cavity volumes summarises the capacity of an animal for jet swimming. Ratios of less than 4:1 generally indicate sufficient mass of carried water for rapid acceleration. The squid Histioteuthis in marked contrast to this, having a relatively reduced mantle cavity.

On returning to England further analysis of the recordings together with the estimation of dry tissue weight will allow the determination of unit locomotory cost in different swimming modes.

(b) Oxygen consumption

Experiments were carried out to determine the energetic cost of locomotion in a range of tropical planktonic or nektonic invertibrates. Oxygen uptake measurements were performed (using Radiometer Clark-type electrodes) first upon active animals and subsequently after they had been anaesthetised with low concentrations of methanol. The difference between active and anaesthetised values was attributed to the energy required for locomotion (Table 2). Where feasible, estimates of climbing and sinking speeds were obtained in an aquarium tank. Animals were also placed in a respirometer chanber and left until death or until the available oxygen was exhausted in order to establish the nature of responses to falling oxygen tension.

Full analysis will require much further work in the U.K. e.g. identification, dry weight and organic matter estimates, but some preliminary comments may be made. Only megalopae, which are meroplanktonic, have the ability to regulate their oxygen uptake as oxygen tensions fall. Probably this ability is not required by the larva but may be of importance to adult crabs living in low

oxygen tension environments. Sinking rates, as might be expected, show the more muscular heavy animals sinking more quickly than gelatinous ones. Euphausiids are an exception probably because they fall with appendages protruding. It was also noted that the euphausiid species and Phrosina sp. had hydrophobic body surfaces and could easily live in the surface film without sinking; this may be to their energetic advantage. Heavy pteropods fell some 25% less quickly with parapodia extended; again this presumably conserves energy.

Interpretation of the active/anaesthetised oxygen uptake data is difficult at this stage but there is a tendency for heavier, active animals to have a much reduced oxygen uptake under anaesthesia, while lighter forms show much smaller differences. Some species do not fit this pattern however, particularly the cranchiid squid, which appeared to use a great deal of oxygen when active (despite ion-based buoyancy mechanisms) and the megalopae which seemed to require little extra oxygen for climbing although the climb rate is slow.

In addition one of us (J.D.) made collections of material for teaching purposes at U.C.N.W. Bangor, and also collected flying fish for later morpho-/metric structural analysis.

J. Davenport, E.R. Trueman

Table 1 Jet Performance of oceanic cephalopods

	Volume (cm^3)		Ratio	Pressure (K Pa)		Pulse Duration
	Body	Man. cavity	Body /m.c.	Resp.	Jet pulse	msec
Large octopod	375	180	2:1	-	0.5-1.6	1000-2000
Japetella sp.	26	6	4.3:1	0.05-0.16	1.4	600
Cranchia scabra	24	9	2.6:1	0.1-0.15	1-2	120
Histioteuthis sp.	14	1.4	10:1	0.1	1-1.6	300
Ommastrephes pteropus	310	100	3.1:1	1.2-1.6	4-42	2-400
Argonauta sp.	1.2	-	-	0.15-0.4	1.7	200
Spirula sp.	mantle L =0.5cm	-	-	0.08-0.09	1.2	180

Table 2

Species	No. Studied	Climbing rate (cm sec^{-1})	Sinking rate (cm sec^{-1})	Anaesthetised oxygen uptake as % active uptake	Category of response to low p02
Pelagia noctiluca	5	-	0.33	45.0%	-
Cranchia scabra	1	-	-	15.2%	-
Heteropods	4	-	2.6	57.7%	-
Large pteropods	3	-	10.7*, 8.2**	17.1%	-
Small pteropods	4	-	5.1*	83.8%	-
Euphausiids	6	4.5	2.1	64.6%	Oxygen conformer
Phrosina	4	-	6.1	19.6%	Oxygen conformer
Systellaspis debilis	5	-	5.8	19.4%	Oxygen conformer
Crab megalopae	5	0.67	-	85.5%	Oxygen regulator

* parapodia retracted

** parapodia extended

Properties of skeletal and cardiac muscle from mid-water fishes

Samples of skeletal and cardiac muscle were collected from the following species, fixed, and embedded in Araldite resin: Gonichthys coccoi, Gonostoma elongatum, Gonostoma bathyphilum, Valenciennellus tripunctulatus, Sternoptyx diaphana, Eurypharynx pelecanoides, Serrivomer sp. Chauliodus sp. and Benthalbella sp. The species were chosen to include both examples that are thought to undertake vertical migration and those that are probably non-migratory. Sustained swimming ability is correlated both with the proportion of red muscle fibres and their capillary supply and mitochondrial volume density. Whole fish will be sectioned to determine the proportion of red and white trunk muscles. The dimensions of muscle cells and capillaries will be determined by light microscopy (semi-thin sections) using a digitiser interfaced to a mini-computer. An estimate of the degree of capillary anisotropy will be obtained from point-counts of capillaries sectioned transversely and longitudinally to the fibre axis. This will allow the surface and volume densities of the capillary bed to be determined. These morphological parameters provide indices of the potential surface area available for gas/metabolite exchange between capillaries and muscle cells and the maximum volume of capillary blood. Electron microscopy and stereological techniques will be used to determine the following ultrastructural characteristics: volume density of mitochondria and myofibrils, surface and volume density of the T-system and sarcoplasmic reticulum, nature and location of energy stores. The data obtained will be compared with that from previous studies on shallow water fishes with a range of different life-styles. One aim of this project is to gain an insight into the mode of locomotion and activity patterns of the various mid-water fishes. Preliminary observations indicate that the trunk muscle of non-migratory bathypelagic species such as Eurypharynx is almost entirely composed of white muscle fibres with a high water content. Of the species examined Gonichthys coccoi had the most red muscle. These were caught in large numbers at night on the surface with a Neuston net and were not found in RMT 1+8 trawls. Another interesting observation is the relatively well developed red muscle of Sternoptyx, a species considered to have a restricted vertical migration range.

Other material collected will be used for studies of the anatomy and ultra-structure of the heart and innervation of skeletal muscle.

A second aim of this cruise was to determine the feasibility of undertaking

muscle physiology experiments at sea. Most of the benthic species obtained would appear to offer suitable preparations. However, amongst the mid-water fishes short fibre lengths would appear to restrict the species available for study. The longest fibres found were 6mm from a large Gonostoma elongatum. It was considered that in calm weather Discovery could provide a stable platform for fibre isolation and various design modifications necessary to existing apparatus were noted.

I.A. Johnston

Comparative study of planktonic Amphipods

The Amphipoda are an interesting and diverse group. Many of the oceanic species are parasitoids on gelatinous zooplankton. The specificity and nature of the association varies between species, but, to date, details of only a few such associations are well documented. Basic biological information is lacking for the majority of species, and the aim during Cruise 140 was to collect as much comparative data on as many species as possible. Particular attention was paid to reproductive and developmental biology, feeding and gut structure, and amphipod-host associations.

Analysis of material collected is as yet incomplete; however, during the cruise, 7 species of gammarid and 37 species of hyperiid were identified from RMT and neuston net samples. Of these, 10 species - Phronima sedentaria, Streetsia challengeri, Primno johnsoni, Eupronoe maculata, Eupronoe sp., Hyperioides longipes, Oxycephalum piscator and Themisto gaudichaudii, together with two gammarids, were present in sufficient numbers to permit egg and larval development within the marsupium to be followed. A number of amphipod-gelatinous zooplankton associations were noted in catches.

Predictably, southern sampling stations had the highest diversity of species, with Themisto gaudichaudii bispinosa dominating at the more northerly stations.

In addition to the amphipods, isopods were collected when present (total 5 species), with large numbers of Idotea metallica taken in the neuston net, especially at the more southerly stations. A parasitic Cryptoniscid isopod

was found at a high level of infestation within a population of surface-living mysids (Siriella sp.) and specimens were collected for further study.

M. Sheader

Magnesium metabolism in mesopelagic decapods

Midwater decapods plus some amphipods were obtained using the Rectangular Mid-water Trawl. By virtue of this net being opened and closed remotely animals of distinct depth bands were sampled. The use of a closing cod end on this net ensured the specimens being in good physical condition. Even in the absence of the closing cod end, animals were obtained suitably active for sampling purposes.

Animals were required still living for blood sampling. It was important that live specimens were used because the ionic constitution of the blood alters when these animals die. From the blood samples measured aliquots were diluted with deionised water and stored frozen in small vials. The blood samples will be analysed later for magnesium, sodium, potassium and if the samples are large enough, copper will also be analysed. Blood was sampled from at least eight species of decapod and four genera of amphipod. A total of 150 animals were sampled. The volumes of blood obtained from individuals varied between 10µl (some of the decapods) and 4ml (Cystisoma). The depths sampled varied between 65 metres and 800 metres.

The animals once sampled were also stored frozen for later shore based analysis of lipid, protein and carbohydrate.

The data from these measurements will be compared with those obtained on a previous Discovery cruise and used to determine whether a relationship exists between activity (exemplified by vertical migration patterns) and blood magnesium concentrations.

D. Dyball

Mollusca other than Cephalopoda

Some 500 specimens of Pteropoda : Thecosomata, over half of which were

Limacina sp., were collected from the RMT 1+8 CCE and neuston nets. Nine genera were represented in the samples: Limacina, Creseis, Styliola, Hyalocylis, Clio, Cuvierina, Diacria, Cavolinia, and Peraclis. Material was observed, drawn and preserved for future study of shells, radulae, and reproductive structures.

Only empty shells were collected by BN amongst the corals. At St. 10914 there was a mixed assemblage whilst at St. 10942 Diacria was well represented.

Small numbers of Pteropoda : Gymnosomata and Heteropoda were collected for future identification and study including Clione, Pterotrachea and Oxygyrus.

Two other Opisthobranchia Phyllirhoë and Glaucus were collected, the latter in large numbers. Reproduction was observed in Glaucus including egg-laying and development to hatching. A growth series was preserved for future study.

Other molluscs collected included several prosobranch larvae and the bivalve Spondylus. Spondylus was found attached to the coral samples collected from the BN.

A. Bebbington

Cephalopoda (Leg 2)

Although cephalopods were disappointingly most noticeable by their absence, the catches did contain some rare species including Cycloteuthis serventi, Discoteuthis and Lepidoteuthis. Several large Bathothauma lyromma were also taken but none were mature enough to have totally lost their eye-stalks.

The most common species was Japetella diaphana. Four adult specimens were caught in the 1700-1300m depth range. Three females from the same haul all displayed yellow circumoral light organs and a male from a different haul could be distinguished by three enlarged suckers on the third right arm.

All the cephalopods taken with the closing cod-end were in remarkably good condition.

R.G. Aldred

Protein studies of cartilaginous fish

The evolutionary position of the chimaeras (Holocephali) is uncertain. Recent biochemical evidence based upon the immunological distance of serum transferrins suggests that the Holocephali may well be more closely related to sharks than was hitherto supposed. It was the aim on Cruise 140 to collect blood samples from a variety of cartilaginous fishes to broaden the range available for study and so clarify this theory. In all, blood of 5 species not investigated previously was collected (Raja ?doutrei, Centroscymnus coelolepis, Centroscyllium fabricii, Deania calceus and the white tip shark, Carcharhinus longimanus). The first four species were caught in the OTSB14 the fifth by hand lining with flying fish as bait. The blood was taken by simple insertion into the pericardium with cardiac puncture. The samples were then frozen to -20°C for transportation from the ship.

S. Burch

Constant temperature container

The new biological container was used on the second leg and efforts were made to keep various species of decapod Crustacea and mysids alive for feeding experiments. After early mishaps with the motor the container worked well, the temperature cycled between 10 and 15°C with the water in the aquaria remaining at ca 11.5-12.5°C. A number of modifications are obviously needed : the motor unit needs isolating as vibration is a severe drawback at present, a system of dim red lighting is needed, reservoir facilities for topping up with cold water are desirable, and higher splash guards around the sink top would cut down a lot of water spillage.

The feeding experiments met with limited success. Most individuals lived for 24 hours after capture but none for more than 3 days; most ate various fish or Crustacea once but only a few specimens of Systellaspis debilis and Gennadas valens fed more than once before dying. The longevity of the specimens was disappointing, perhaps oxygenated water is necessary or a shorter towing time in the net.

H.S.J. Roe

Photography

In all more than 100 species of neuston, midwater and benthic animals were photographed during the cruise. Many specimens recorded were in pristine condition due largely to the closing cod end used on the RMT 8. In particular several angler fish and their lures were photographed including a fine specimen of Linophryne sp. Other interesting animals included scopelarchid fish with pigmented, upward-looking eyes and the squids Bathothauma and Discoteuthis.

P. Domanski, H.S.J. Roe

BIOLUMINESCENCE INVESTIGATIONS

Sea surface monitoring

Continuous monitoring of surface bioluminescence was carried out using two systems. One, employed for both legs of the cruise, used an EMI photomultiplier monitoring bioluminescence in the outboard side of the non-toxic seawater system. This performed very reliably and was supplemented on the second leg by a thermistor located in the system close to the photomultiplier port. No major correlations of luminescence with temperature were observed but few frontal regions were encountered. Installation of a turbulence-generating probe had a negligible effect on the levels of luminescence recorded.

The second system, operating only on the second leg from Madeira to the U.K. used a Prototype Oriel Bioluminescence sensor (POBs). This sensor consists of an Oriel Model 7070 Photomultiplier detection system that was used to scan a light tight chamber through which sea water was passed.

The original aim had been to draw a sea water supply through the sensor by means of a centrifugal pump, this necessitated finding an alternative water source to the shipboard non-toxic sea water supply. A metal spar to which black reinforced tubing was tied was attached to the side of the ship; this enabled a constant sea water supply to be drawn through the sensor. This system functioned perfectly at reduced ships speed but once underway the ship's movement resulted in the bottom of the spar being lifted clear of the water thus affecting the flow through the sensor. An alternative water

source was sought by placing the sensor in the ASDIC trunk and drawing water from the well of the ship. This proved unsatisfactory due to excessive background noise, the cause of which has yet to be determined. Sea water samples were taken from the sensor outlet to be analysed at a later date.

A compromise was finally reached whereby at reduced ship's speeds when RMTs were being fished a sea water supply was drawn through the sensor by means of the metal spar that could be lowered over the side of the ship. Once under way the spar was raised and the sensor connected to the onboard non-toxic seawater supply.

Both systems recorded regular day/night cycles of intensity change and in all the periods of intense bioluminescence encountered dinoflagellates (Pyrocystis sp.) were found to be the main causative organism.

P.J. Herring, M.P. Philpott

Measurements of emission spectra

The emission spectra of 60 bioluminescent species were measured with a computer controlled optical multichannel analyzer (OMA). The OMA simultaneously measures a 350 nm spectral window using a linear array of 700 silicon photodiodes coupled by fibre optics to a microchannel plate image intensifier upon which a polychromator generated spectrum is focused. High sensitivity and spatial resolution and essentially instantaneous light collection by this system made it possible to acquire spectra of transient luminescent events such as the flashing of myctophid caudal organs, copepods and the amphipod Scina.

Time dependent changes in the spectral distributions of the exudate from searsiid fishes were examined in some detail. The initial emission spectrum was unimodal (peak at 488 nm) but gradually the presence of a short wavelength component (peak at 405 nm) resulted in a bimodal spectral distribution. This process was accelerated by hydrogen peroxide and partially reversed by the reducing agent sodium dithionite.

Of particular interest was the role of optical filtering in altering the emission spectrum. In the hatchetfish Argyropelecus, filters narrowed the bandwidth of the luminescent emission, while in Opisthoproctus the emission of the bacterial light organ was shifted to shorter wavelengths and narrowed

in bandwidth. The in vivo emission of the suborbital organ of Malacosteus niger, which peaked at 706 nm, was broadened and shorter wavelength peaks became evident upon removal of the overlying filters.

E.A. Widder, M.I. Latz

Biochemistry of bioluminescent systems

Background

A major aim of our work is to establish the role of oxygen radicals in the pathogenesis of inflammatory diseases, in particular rheumatoid arthritis and certain heart diseases. A key feature in our studies is the elucidation of the mechanisms underlaying activation of phagocytes, such as polymorphonuclear leukocytes, to produce oxygen radicals. All bioluminescence requires oxygen in some form and one of our objectives was to search for new indicators of oxygen radicals.

The underlying philosophy of our work with mammalian cells is to study chemical events in intact single cells. We have developed a homogeneous immunoassay based on chemiluminescence energy transfer and also methods for incorporating the components of this assay system into living mammalian cells. A further objective of our work on Discovery was to search for better chemiluminescent labels and fluors to improve this energy transfer system.

Aims

1. To search for new indicators of oxygen radicals, particularly in these luminous organisms where "peroxides" may be involved in the luminescent reaction.

2 To search for new chemiluminescent labels, particularly photoprotein systems where no additional catalysts are required.

3. To investigate energy transfer in bioluminescence.

It is further hoped that an understanding of the chemistry of oxygen in bioluminescence may help to clarify the chemistry of toxic oxygen species in pathological conditions in man.

Experimental

1. Extraction procedures

Work on the chemistry of bioluminescence has often been hampered by lack of knowledge of how to maintain active chemiluminescence in stored material. A series of extraction procedures was therefore established. These will be compared with frozen and freeze-dried organisms assayed in our home laboratory. The following extracts have been prepared:

a) Tris homogenate
b) Tris homogenate saturated with ammonium sulphate
c) Methanol: 5%H_2SO_4, to extract active luciferin
d) Acetone powder
e) Homogenates + oxygen radical scavengers, e.g. ascorbate.

More than 90 extracts from 30 species have been prepared from seven phyla (Protozoa, Cnidaria, Ctenophora, Echinodermata, Mollusca, Arthropoda and Chordata). Particular attention was focussed on penaeids, oplophorids and euphausiids, as well as the hatchet fish Sternoptyx and Argyropelecus, and the dinoflagellate Pyrocystis.

2. Thin layer chromatography (t.l.c.)

Micro t.l.c. was carried out and showed that blue fluorescent spots could be isolated from extracts of several species. t.l.c. combined with h.p.l.c. should now provide a rapid and highly sensitive method of isolating and identifying luciferins and their oxidation products.

3. Malacosteus

An homogenate of the "blue" light organ produced detectable chemiluminescence. The "red" organ was more difficult to study because of phosphorescence. However, working with fresh material showed that changes in the fluorescence properties occur under certain conditions, for example ammonium sulphate precipitation. The fresh material has for the first time enabled a red fluorescent chromophore to be isolated on t.l.c.

4. Searsiid fish

Chemiluminescence in extracts of cells released by these fish continued for

many hours. A large proportion (ca >80%) could be centrifuged down at 10,000g within 30 seconds; however, the supernatant still retained a considerable amount of chemiluminescence and fluorescence. H_2O_2 stimulated the luminescence, Triton X-100 virtually abolished within one minute detectable chemiluminescence and the green fluorescence. A blue fluorescent spot was identified on t.l.c. after acid/methanol and chloroform extraction.

Conclusions

We are optimistic that we have sufficient material to:

a) isolate the components of hitherto poorly understood bioluminescent reactions.
b) use for studies of the intracellular biochemistry of mammalian cells.
c) reconstitute luciferin and luciferase systems.
d) develop a new approach to the identification of luciferins using high performance liquid chromatography (h.p.l.c.).

Coda

The identification of species was greatly helped by the generous cooperation of I.O.S. personnel. Biochemical studies require quantities of active material and this has been particularly well supplied to us on this cruise, thanks to the efficient organisation of the Principal Scientist, Dr. Peter Herring, and the efficient working of the gear. We anticipate some exciting results in the future with material obtained from this rewarding cruise.

A.K. Campbell, S.B Matthews

Experimental work

The complex luminous responses of the medusa Atolla have been recorded on videotape under various stimulus conditions. The condition of the specimens is critical, for the responses of animals obtained in the closing cod-end and maintained in the dark at low temperature for a period are far more complex than those of specimens subject to more damage during capture. The conduction pathways and rates suggest that epithelial conduction is involved in the responses.

Further video data on the position of the photocytes of Oncaea conifera, and its luminous responses will enable a detailed analysis of the correlation

between fluorescence and luminescence to be made. Similar data on the fluorescence and luminescence of two species of ophiuroid will help to clarify some of the conduction processes involved in these animals.

The presence of numerous specimens of Cyclosalpa in the surface waters has permitted an investigation of its reported luminescence. On no occasion has luminescence been observed and it is concluded that this species is not luminescent. An investigation into the morphology of the "luminous" organs is in progress. Material from a number of other bioluminescent species has been prepared for light and electron microscopy, including searsiid fishes, Saccopharynx, cephalopods and copepods.

Dark-adapted eyes of the red-emitting fishes Pachystomias and Malacosteus have been frozen for retinal extracts and some retinal material prepared for micro-spectrophotometry.

P.J. Herring

STATION LIST

GEAR ABBREVIATIONS IN THE STATION LIST

OTSB14	Semi-balloon otter trawl
RMT8	Rectangular mid-water trawl; $8m^2$ mouth area
RMT1	" " " $1m^2$ " "
RMT8M	" " " $8m^2$ " " ; multiple net
RMT1M	" " " $1m^2$ " " ; " "
CCE	Closing cod end (used on RMT8)
BN1.5/3M	Epibenthic sledge with triple net
BN1.5/C	" " " single coarse mesh net
BN1.5/P	" " used as a photosledge
BC	IOS box corer
LLP	Low light photometer (used on RMTM system)
PS	Particle sampler

STN	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10870	6/ 8	15 9.93N	18 34.05W	OTSB 14	2970- 2990	1120-1440		3020
#001		15 10.25N	18 33.89W				FLOW DIST. 10006	
10871	7/ 8	14 10.29N	17 24.74W	BC	84- 84	0615-0615		84
#001		14 10.29N	17 24.74W				FLOW DIST.	
10872	7/ 8	14 15.96N	17 31.29W	BC	132- 132	1021-1021		132
#001		14 15.96N	17 31.29W				FLOW DIST.	
10873	7/ 8	14 49.40N	17 43.69W	OTSB 14	860- 990	1854-1954		915
#001		14 47.49N	17 42.90W				FLOW DIST. 3891	
10874	8/ 8	14 50.81N	17 50.58W	OTSB 14	1420- 1440	0549-0615		1436
#001		14 49.81N	17 50.65W				FLOW DIST. 1853	
10875	8/ 8	14 50.08N	18 48.22W	RMT 1M	380- 560	1710-1735	Catch not retained	3067
#001		14 50.02N	18 49.12W	RMT 8M		DAY	FLOW DIST.	
10875	8/ 8	14 50.02N	18 49.12W	RMT 1M	450- 470	1735-1800	Catch not retained	3067
#002		14 49.98N	18 50.01W	RMT 8M		DAY	FLOW DIST.	
10875	8/ 8	14 49.98N	18 50.01W	RMT 1M	445- 450	1800-1828	Catch not retained	3067
#003		14 49.99N	18 51.09W	RMT 8M		DAY	FLOW DIST.	
10876	8/ 8	14 50.36N	19 6.99W	RMT 1M	80- 100	2245-2305	Catch not retained	3361
#001		14 50.30N	19 7.71W	RMT 8M		NIGHT	FLOW DIST.	
10876	8/ 8	14 50.30N	19 7.71W	RMT 1M	73- 80	2305-2325	Catch not retained	3361
#002		14 50.24N	19 8.46W	RMT 8M		NIGHT	FLOW DIST.	
10876	8/ 8	14 50.24N	19 8.46W	RMT 1M	65- 73	2325-2345	Catch not retained	3361
#003		14 50.19N	19 9.22W	RMT 8M		NIGHT	FLOW DIST.	
10877	9/ 8	14 49.95N	20 31.45W	RMT 1M	250- 300	0932-1000	Catch not retained	4050
#001		14 50.89N	20 30.93W	RMT 8M		DAY	FLOW DIST.	
10877	9/ 8	14 50.89N	20 30.93W	RMT 1M	260- 275	1000-1029	Catch not retained	4050
#002		14 51.94N	20 30.48W	RMT 8M		DAY	FLOW DIST	
10877	9/ 8	14 51.94N	20 30.48W	RMT 1M	260- 310	1029-1059	Catch not retained	4050
#003		14 53.07N	20 30.06W	RMT 8M		DAY	FLOW DIST.	

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10878	9/ 8	15 1.88N	21 6.40W	RMT 1M	330- 440	1938-2019	Catch not retained	4135
#001		15 3.04N	21 5.54W	RMT 8M		DUSK	FLOW DIST.	
10878	9/ 8	15 3.04N	21 5.54W	RMT 1M	250- 330	2019-2038	Catch not retained	4135
#002		15 3.56N	21 5.14W	RMT 8M		DUSK	FLOW DIST.	
10878	9/ 8	15 3.56N	21 5.14W	RMT 1M	140- 250	2038-2108	Catch not retained	4135
#003		15 4.42N	21 4.49W	RMT 8M		NIGHT	FLOW DIST.	
10879	10/ 8	16 25.56N	20 23.83W	RMT 1M	890- 1000	1157-1257	Catch not retained	3548
#001		16 27.53N	20 23.52W	RMT 8M		DAY	FLOW DIST.	
10879	10/ 8	16 27.53N	20 23.52W	RMT 1M	800- 900	1257-1357	Catch not retained	3546
#002		16 29.47N	20 23.36W	RMT 8M		DAY	FLOW DIST.	
10879	10/ 8	16 29.47N	20 23.36W	RMT 1M	690- 800	1357-1458	Catch not retained	3546
#003		16 31.39N	20 23.56W	RMT 8M		DAY	FLOW DIST.	
10880	10/ 8	16 53.37N	20 14.41W	RMT 1	230- 330	2034-2105	Cod-end twisted, Catch not retained	3448
#001		16 54.33N	20 14.30W	RMT 8		NIGHT	FLOW DIST.	
				CCE				
10881	11/ 8	17 56.49N	19 43.30W	RMT 1	500- 600	1015-1059	CCE failed to work, Catch discarded	3222
#001		17 56.19N	19 44.86W	RMT 8		DAY	FLOW DIST.	
				CCE				
10881	11/ 8	17 56.98N	19 57.48W	RMT 1	500- 600	1346-1431	CCE failed to work, Catch discarded	3222
#002		17 56.84N	19 59.06W	RMT 8		DAY	FLOW DIST.	
				CCE				
10881	11/ 8	17 56.91N	20 3.17W	RMT 1	110- 240	1637-1722	CCE failed to work, Catch discarded	3222
#003		17 57.11N	20 4.60W	RMT 8		DAY	FLOW DIST.	
				CCE				
10881	11/ 8	17 58.41N	20 9.88W	RMT 1	120- 210	2110-2155	Catch not retained	3175
#004		17 58.18N	20 11.42W	RMT 8		NIGHT	FLOW DIST.	
				CCE				
10882	11/ 8	17 58.28N	20 11.90W	PS	50- 50	2242-2317		3170
#001		17 58.42N	20 11.78W				FLOW DIST.	

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10883 #001	12/ 8 12/ 8	17 56.69N 17 57.01N	20 12.77W 20 12.77W	BC	3170- 3170	0318-0642	FLOW DIST.	3170
10884 #001	12/ 8 12/ 8	18 8.65N 18 13.96N	20 11.76W 20 10.97W	OTSB 14	3120- 3120	1226-1426	FLOW DIST. 9820	3170
10885 #001	12/ 8 12/ 8	18 20.13N 18 20.73N	20 9.56W 20 9.49W	RMT 1M RMT 8M LLP	300- 350	1927-1947 DUSK	Catch not retained FLOW DIST	3185
10885 #002	12/ 8 12/ 8	18 20.73N 18 21.28N	20 9.49W 20 9.41W	RMT 1M RMT 8M LLP	300- 330	1947-2007 DUSK	Catch not retained FLOW DIST.	3185
10885 #003	12/ 8 12/ 8	18 21.28N 18 21.82N	20 9.41W 20 9.35W	RMT 1M RMT 8M LLP	310- 350	2007-2027 NIGHT	Catch not retained FLOW DIST.	3185
10886 #001	12/ 8 13/ 8	18 23.67N 18 23.56N	20 9.25W 20 10.48W	PS	3100- 3100	2145-0000	FLOW DIST.	3189
10886 #002	13/ 8 13/ 8	18 23.49N 18 23.48N	20 10.95W 20 12.23W	PS	1500- 1500	0100-0300	Instrument failure, no sample FLOW DIST.	3189
10886 #003	13/ 8 13/ 8	18 23.47N 18 23.44N	20 12.52W 20 13.04W	PS	500- 500	0330-0520	Instrument failure, no sample FLOW DIST.	3189
10887 #001	13/ 8 13/ 8	18 25.08N 18 27.25N	20 13.46W 20 14.13W	RMT 1M RMT 8M LLP	50- 250	0629-0733 DAWN	Flowmeter damaged FLOW DIST.	3200
10887 #002	13/ 8 13/ 8	18 27.25N 18 28.82N	20 14.13W 20 14.66W	RMT 1M RMT 8M LLP	250- 330	0733-0820 DAWN	Flowmeter damaged FLOW DIST.	3200
10887 #003	13/ 8 13/ 8	18 28.82N 18 29.96N	20 14.66W 20 15.10W	RMT 1M RMT 8M LLP	330- 345	0820-0859 DAY	Flowmeter damaged, no catch FLOW DIST.	3200
10887 #004	13/ 8 13/ 8	18 32.62N 18 34.40N	20 16.81W 20 18.92W	RMT 1M RMT 8M LLP	280- 310	1022-1124 DAY	FLOW DIST. 4902	3200

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10887	13/ 8	18 34.40N	20 18.92W	RMT 1M	240- 285	1124-1230		3200
#005		18 36.51N	20 21.12W	RMT 8M		DAY	FLOW DIST. 5344	
				LLP				
10887	13/ 8	18 36.51N	20 21.12W	RMT 1M	285- 325	1230-1330		3200
#006		18 38.52N	20 23.11W	RMT 8M		DAY	FLOW DIST. 4770	
				LLP				
10887	13/ 8	18 40.93N	20 25.52W	RMT 1M	310- 370	1438-1537		3200
#007		18 42.83N	20 27.61W	RMT 8M		DAY	FLOW DIST. 4196	
				LLP				
10887	13/ 8	18 42.83N	20 27.61W	RMT 1M	250- 310	1537-1636		3200
#008		18 44.41N	20 29.58W	RMT 8M		DAY	FLOW DIST. 4151	
				LLP				
10887	13/ 8	18 44.41N	20 29.58W	RMT 1M	205- 250	1636-1736		3200
#009		18 46.32N	20 31.27W	RMT 8M		DAY	FLOW DIST. 4372	
				LLP				
10887	13/ 8	18 47.58N	20 32.58W	RMT 1M	245- 280	1820-1920		3200
#010		18 49.31N	20 34.45W	RMT 8M		DUSK	FLOW DIST. 4196	
				LLP				
10887	13/ 8	18 49.31N	20 34.45W	RMT 1M	50- 290	1920-2030		3200
#011		18 51.46N	20 36.35W	RMT 8M		DUSK	FLOW DIST. 5035	
				LLP				
10887	13/ 8	18 51.46N	20 36.35W	RMT 1M	50- 50	2030-2031	Catch not retained	3200
#012		18 51.49N	20 36.37W	RMT 8M		NIGHT	FLOW DIST.	
				LLP				
10888	13/ 8	18 52.03N	20 36.74W	PS	-	2110-2300	Instrument failed, no sample	3200
#001		18 52.08N	20 37.17W				FLOW DIST.	
10889	14/ 8	18 56.21N	20 31.57W	RMT 1M	125- 300	0649-0750		3400
#001		18 57.34N	20 31.97W	RMT 8M		DAWN	FLOW DIST. 3268	
				LLP				
10889	14/ 8	18 57.34N	20 31.97W	RMT 1M	300- 375	0750-0849		3400
#002		18 57.81N	20 32.69W	RMT 8M		DAWN	FLOW DIST. 2915	

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS		MEAN SOUND(m)
10889 #003	14/ 8	18 57.81N	20 32.69W	RMT 1M RMT 8M LLP	290- 320	0849-0950 DAY	FLOW DIST.	3268	3400
10889 #004	14/ 8	19 1.07N	20 29.50W	RMT 1M RMT 8M LLP	285- 320	1105-1215 DAY	Sat. nav. error. D.R. position FLOW DIST.	2606	3400
10889 #005	14/ 8	19 13.02N	20 28.03W	RMT 1M RMT 8M LLP	345- 370	1215-1315 DAY	FLOW DIST.	2871	3400
10889 #006	14/ 8	19 13.02N 19 13.47N	20 28.03W 20 28.66W	RMT 1M RMT 8M LLP	370- 420	1315-1415 DAY	FLOW DIST.	3003	3400
10889 #007	14/ 8	19 13.88N 19 14.30N	20 29.00W 20 29.62W	RMT 1M RMT 8M LLP	310- 370	1500-1601 DAY	FLOW DIST.	3356	3400
10889 #008	14/ 8	19 14.30N 19 14.83N	20 29.62W 20 30.20W	RMT 1M RMT 8M LLP	260- 310	1601-1702 DAY	FLOW DIST.	3754	3400
10889 #009	14/ 8	19 14.83N 19 16.36N	20 30.20W 20 29.81W	RMT 1M RMT 8M LLP	290- 340	1702-1802 DAY	FLOW DIST.	4019	3400
10889 #010	14/ 8	19 18.62N 19 19.74N	20 28.91W 20 28.49W	RMT 1M RMT 8M LLP	220- 320	1910-1945 DUSK	FLOW DIST.	2341	3400
10889 #011	14/ 8	19 19.74N 19 20.77N	20 28.49W 20 28.09W	RMT 1M RMT 8M LLP	50- 220	1945-2018 DUSK	FLOW DIST.	2561	3400
10890 #001	15/ 8	19 20.95N 19 21.24N	17 41.63W 17 42.15W	BN 1.5/3M	2020- 2030	1733-1801	FLOW DIST.	613	2030
10890 #002	16/ 8	19 20.70N 19 21.92N	17 48.37W 17 51.61W	BN 1.5/P	2140- 2200	0026-0155	FLOW DIST.	1589	2170

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10891	17/ 8	20 59.71N	20 41.00W	RMT 1	180- 410	1518-1618	Catch not retained	4065
#001		21 1.43N	20 39.83W	RMT 8		DAY	FLOW DIST.	
10892	17/ 8	21 21.01N	20 34.41W	RMT 1	290- 410	2015-2115	Catch not retained	4090
#001		21 23.20N	20 34.17W	RMT 8		NIGHT	FLOW DIST.	
				CCE				
10893	18/ 8	23 40 02N	19 55.93W	RMT 1	200- 420	1922-2022	Catch not retained	3725
#001		23 42.30N	19 55.56W	RMT 8		DUSK	FLOW DIST.	
				CCE				
10894	19/ 8	25 19.00N	19 18.50W	RMT 1	0- 200	0916-1016	Catch not retained	2185
#001		25 20 76N	19 17.57W	RMT 8		DAY	FLOW DIST.	
				CCE				
10895	19/ 8	25 41.82N	19 10.77W	RMT 1	0- 800	1352-1450	Catch discarded,Monitor failure	3425
#001		25 43.92N	19 10.60W	RMT 8		DAY	FLOW DIST.	
				CCE				
10896	19/ 8	26 12.35N	19 2.38W	RMT 1	30- 400	1904-2004	Catch not retained	3501
#001		26 14.61N	19 1.68W	RMT 8		DUSK	FLOW DIST.	
				CCE				
10897	20/ 8	28 8.25N	18 30.45W	RMT 1	510- 590	1410-1510	Catch not retained	3963
#001		28 10.71N	18 30.31W	RMT 8		DAY	FLOW DIST.	
				CCE				
10898	21/ 8	30 5.80N	17 47.73W	RMT 1	560- 700	0729-0829	Catch not retained	4420
#001		30 8.17N	17 47.37W	RMT 8		DAWN	FLOW DIST.	
				CCE				

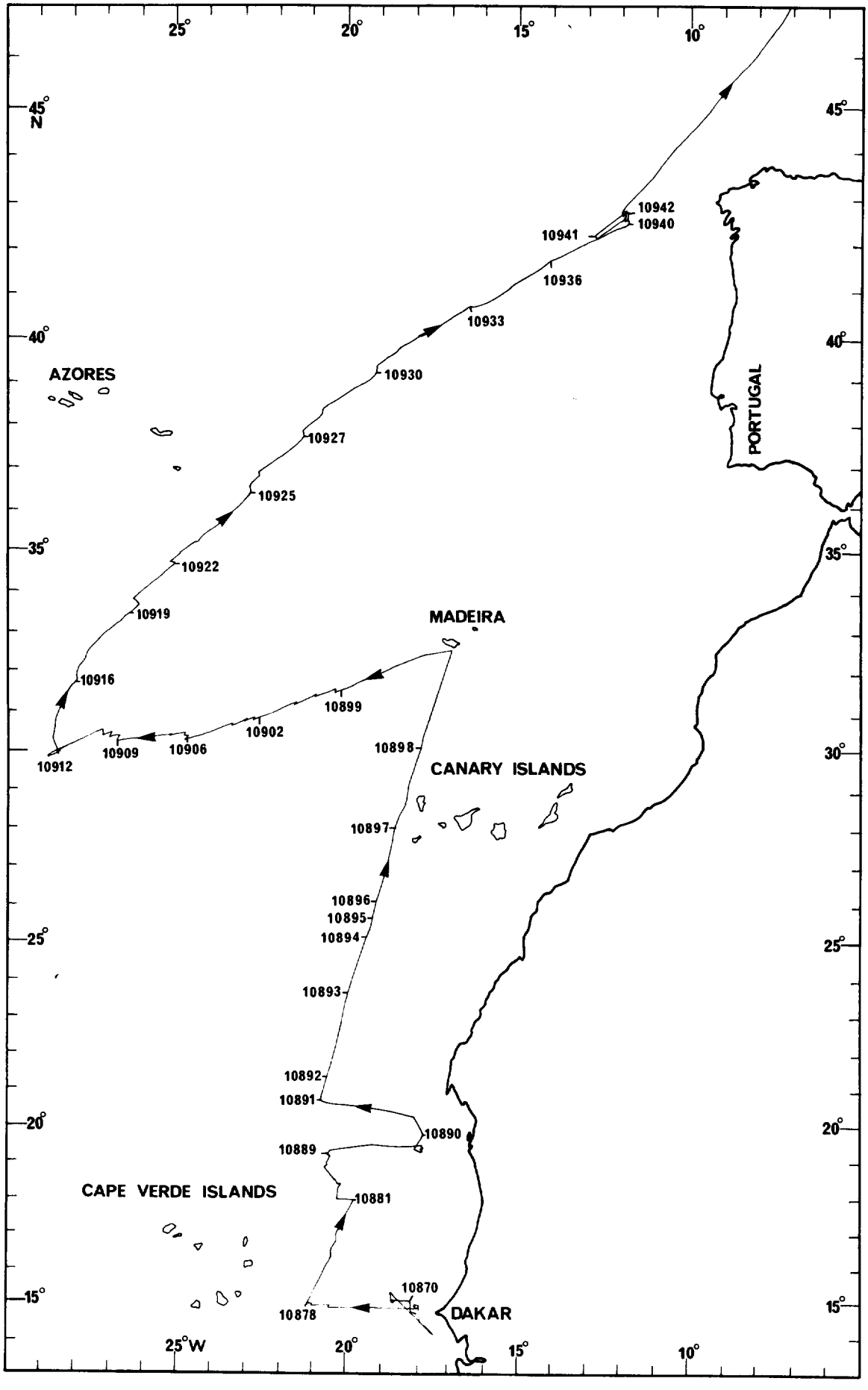
STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10899	25/ 8	31 34.73N	20 15.71W	RMT 1	490- 600	0849-0949	Catch not retained	4778
#001		31 36.87N	20 15.39W	RMT 8		DAY	FLOW DIST. 3267	
				CCE				
10900	25/ 8	31 25.91N	20 50.23W	RMT 1	740- 990	1445-1545	Catch not retained	4898
#001		31 26.79N	20 48.19W	RMT 8		DAY	FLOW DIST. 2737	
				CCE				
10901	25/ 8	31 15.09N	21 23.36W	RMT 1	290- 430	2022-2122	Catch not retained	4947
#001		31 16.39N	21 21.60W	RMT 8		NIGHT	FLOW DIST. 3002	
				CCE				
10901	25/ 8	31 17.15N	21 20.27W	RMT 1	65- 110	2219-2249	Catch not retained	4947
#002		31 17.53N	21 19.39W	RMT 8		NIGHT	FLOW DIST. 1501	
				CCE				
10902	26/ 8	30 51.31N	22 42.05W	RMT 1	920- 1200	0849-1019	Catch not retained	5185
#001		30 53.31N	22 39.07W	RMT 8		DAY	FLOW DIST. 5298	
				CCE				
10903	26/ 8	30 50.34N	22 52.89W	RMT 1	900- 1180	1359-1524	Catch not retained	5216
#001		30 51.85N	22 49.94W	RMT 8		DAY	FLOW DIST. 4503	
				CCE				
10904	26/ 8	30 44.21N	23 16.39W	RMT 1	450- 700	1936-2106	Catch not retained	5309
#001		30 45.86N	23 13.38W	RMT 8		NIGHT	FLOW DIST. 5254	
				CCE				
10905	26/ 8	30 46.51N	23 11.77W	RMT 1	30- 100	2225-2254	Catch not retained	5309
#001		30 46.95N	23 10.71W	RMT 8		NIGHT	FLOW DIST. 1589	
				CCE				
10906	27/ 8	30 22.36N	24 41.60W	RMT 1	1120- 1505	0903-1103	Catch not retained	5319
#001		30 25.61N	24 38.25W	RMT 8		DAY	FLOW DIST. 7594	
				CCE				
10907	27/ 8	30 27.76N	24 41.86W	RMT 1	780- 1000	1355-1525	Catch not retained	5412
#001		30 29.36N	24 38.77W	RMT 8		DAY	FLOW DIST. 5032	
				CCE				
10908	27/ 8	30 28.41N	25 6.68W	RMT 1	580- 800	1954-2154	Catch not retained	5428
#001		30 29.35N	25 2.16W	RMT 8		NIGHT	FLOW DIST. 7152	
				CCE				

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10909	28/ 8	30 18.41N	26 43.01W	RMT 1	1110- 1500	0918-1118	Catch not retained	4793
#001		30 22.29N	26 39.95W	RMT 8		DAY	FLOW DIST. 7506	
				CCE				
10910	28/ 8	30 24.35N	26 54.19W	RMT 1	830- 1000	1452-1652	Catch not retained	4875
#001		30 28.31N	26 52.87W	RMT 8		DAY	FLOW DIST. 6181	
				CCE				
10911	28/ 8	30 27.43N	27 7.12W	RMT 1	630- 830	1941-2143	Catch not retained	4814
#001		30 31.10N	27 8.68W	RMT 8		NIGHT	FLOW DIST. 5916	
				CCE				
10912	29/ 8	30 1.38N	28 27.20W	RMT 1	250- 290	1103-1200	NBES malfunction. Catch not retained	307
#001		30 0.19N	28 28.69W	RMT 8		DAY	FLOW DIST. 2914	
				CCE				
				NBES				
10913	29/ 8	30 60.00N	28 29.86W	RMT 1	250- 280	1313-1412	NBES malfunction. RMT 1 retained	307
#001		29 58.75N	28 31.11W	RMT 8		DAY	FLOW DIST.	
				CCE				
				NBES				
10914	29/ 8	29 55.26N	28 28.86W	BN 1.5/P	305- 320	1606-1646		312
#001		29 55.97N	28 28.50W			DAY	FLOW DIST.	
10915	29/ 8	30 18.33N	28 37.14W	RMT 1	560- 700	2109-2236	NBES malfunction.Cod End Sieve on RMT 1	517
#001		30 20.71N	28 36.16W	RMT 8		NIGHT	FLOW DIST. 3885	
				CCE				
				NBES				
10916	30/ 8	31 44.25N	28 4.16W	RMT 1	1250- 1500	0954-1154	Cod End Sieve on RMT 1	1909
#001		31 46.18N	27 58.80W	RMT 8		DAY	FLOW DIST. 7682	
				CCE				
10917	30/ 8	32 6.86N	27 55.68W	RMT 1	540- 735	1557-1657	Cod End Sieve on RMT 1	1005
#001		32 8.94N	27 53.61W	RMT 8		DAY	FLOW DIST. 3664	
				CCE				
10918	30/ 8	32 25.52N	27 42.20W	RMT 1	605- 800	2020-2220	Cod End Sieve on RMT 1	2009
#001		32 30.06N	27 42.04W	RMT 8		NIGHT	FLOW DIST. 7108	
				CCE				

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10919	31/ 8	33 31.79N	26 22.42W	RMT 1	1525- 1700	1004-1204	Cod End Sieve on RMT 1	4742
#001		33 34.43N	26 17.95W	RMT 8		DAY	FLOW DIST. 7594	
				CCE				
10920	31/ 8	33 42.18N	26 9.12W	RMT 1	705- 840	1626-1756	Cod End Sieve on RMT 1	4536
#001		33 43.90N	26 12.02W	RMT 8		DAY	FLOW DIST. 4680	
				CCE				
10921	31/ 8	33 46.32N	26 15.60W	RMT 1	790- 900	1956-2156	Cod End Sieve on RMT 1	4536
#001		33 48.40N	26 18.79W	RMT 8		NIGHT	FLOW DIST. 5916	
				CCE				
10922	1/ 9	34 43.97N	25 5.80W	RMT 1	1330- 1760	0905-1105	Catch not retained	4742
#001		34 44.82N	25 10.33W	RMT 8		DAY	FLOW DIST. 5740	
				CCE				
10923	1/ 9	35 13.81N	24 30.11W	RMT 1	570- 790	1813-1913	Catch not retained	4793
#001		35 13.81N	24 27.20W	RMT 8		DUSK	FLOW DIST. 3709	
				CCE				
10924	1/ 9	35 14.13N	24 22.68W	RMT 1	670- 930	2055-2255	Catch not retained	4793
#001		35 19.54N	24 19.87W	RMT 8		NIGHT	FLOW DIST. 5210	
				CCE				
10925	2/ 9	36 19.21N	22 52.41W	RMT 1M	250- 300	0915-1015	Only RMT 1 catch retained (RMT 1M/1)	4240
#001		36 20.64N	22 50.32W	RMT 8M		DAY	FLOW DIST. 3400	
10925	2/ 9	36 20.64N	22 50.32W	RMT 1M	250- 300	1015-1115	Cod End Sieve on RMT 1 (RMT 1M/2)	4240
#002		36 22.66N	22 49.69W	RMT 8M		DAY	FLOW DIST. 4238	
10925	2/ 9	36 22.66N	22 49.69W	RMT 1M	250- 300	1115-1215	Only RMT 1 catch retained (RMT 1M/3)	4240
#003		36 24.75N	22 49.35W	RMT 8M		DAY	FLOW DIST. 4018	
10925	2/ 9	36 27.77N	22 50.80W	RMT 1M	495- 550	1334-1434	Only RMT 1 catch retained (RMT 1M/1)	4240
#004		36 29.82N	22 51.97W	RMT 8M		DAY	FLOW DIST. 3863	
10925	2/ 9	36 29.82N	22 51.97W	RMT 1M	500- 550	1434-1534	Cod End Sieve on RMT 1 (RMT 1M/2)	4240
#005		36 31.65N	22 53.15W	RMT 8M		DAY	FLOW DIST. 3664	
10925	2/ 9	36 31.65N	22 53.15W	RMT 1M	505- 545	1534-1634	Only RMT 1 catch retained (RMT 1M/3)	4240
#006		36 33.44N	22 53.66W	RMT 8M		DAY	FLOW DIST. 3642	

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10926	2/ 9	36 49.40N	22 33.43W	RMT 1M	600- 655	2010-2110	Only RMT 1 catch retained (RMT 1M/1)	4230
#001		36 51.05N	22 34.93W	RMT 8M		NIGHT	FLOW DIST. 3620	
10926	2/ 9	36 51.05N	22 34.93W	RMT 1M	610- 650	2110-2210	Cod End Sieve on RMT 1 (RMT 1M/2)	4230
#002		36 52.72N	22 36.37W	RMT 8M		NIGHT	FLOW DIST. 3532	
10926	2/ 9	36 52.72N	22 36.37W	RMT 1M	600- 650	2210-2310	Only RMT 1 catch retained (RMT 1M/3)	4230
#003		36 54.13N	22 37.30W	RMT 8M		NIGHT	FLOW DIST. 3620	
10927	3/ 9	37 47.44N	21 14.77W	RMT 1	1430- 1750	1025-1226	Catch not retained	4378
#001		37 51.59N	21 16.57W	RMT 8		DAY	FLOW DIST. 6446	
				CCE				
10928	3/ 9	38 15.79N	20 42.45W	RMT 1	630- 910	1816-1946	Catch not retained	4020
#001		38 18.10N	20 41.43W	RMT 8		DUSK	FLOW DIST. 4371	
				CCE				
10929	3/ 9	38 20.55N	20 40.82W	RMT 1	410- 600	2114-2214	Catch not retained	4020
#001		38 22.38N	20 41.12W	RMT 8		NIGHT	FLOW DIST. 3267	
				CCE				
10930	4/ 9	39 16.71N	19 6.08W	RMT 1	1490- 1750	0942-1142	Catch not retained	5045
#001		39 21.21N	19 6.52W	RMT 8		DAY	FLOW DIST. 7130	
				CCE				
10931	4/ 9	39 29.79N	18 54.76W	RMT 1	800- 1000	1457-1657	Cod End Sieve on RMT 1	4530
#001		39 32.49N	18 50.74W	RMT 8		DAY	FLOW DIST. 6490	
				CCE				
10932	4/ 9	39 40.11N	18 36.44W	RMT 1	400- 795	1926-2119	Experimental monitor error Aborted	4820
#001		39 43.66N	18 33.41W	RMT 8		NIGHT	FLOW DIST.	
				CCE				
10933	5/ 9	40 37.79N	16 38.36W	RMT 1	1220- 1600	0922-1122	Catch not retained	4824
#001		40 39.04N	16 33.85W	RMT 8		DAY	FLOW DIST. 5784	
				CCE				
10934	5/ 9	40 47.45N	16 10.87W	RMT 1	850- 1000	1514-1714	Catch not retained	4434
#001		40 48.23N	16 5.02W	RMT 8		DAY	FLOW DIST. 6954	
				CCE				

STN.	DATE	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND(m)
10935	5/ 9	40 53.24N	15 50.85W	RMT 1	685- 920	1950-2150	Cod End Sieve on RMT1	5000
#001		40 54.42N	15 45.25W	RMT 8		NIGHT	FLOW DIST. 6976	
				CCE				
10936	6/ 9	41 40.05N	14 9.00W	RMT 1	1220- 1700	0906-1112	Cod End Sieve on RMT 1	5257
#001		41 43.20N	14 5.23W	RMT 8		DAY	FLOW DIST. 6976	
				CCE				
10937	6/ 9	41 52.62N	13 44.30W	RMT 1	790- 1000	1457-1657	Cod End Sieve on RMTno flow data	5340
#001		41 53.94N	13 39.48W	RMT 8		DAY	FLOW DIST.	
				CCE				
10938	6/ 9	41 58.70N	13 25.12W	RMT 1	150- 400	1930-2142	Cod End Sieve on RMT 1	5340
#001		42 0.08N	13 20.69W	RMT 8		NIGHT	FLOW DIST. 6799	
				CCE				
10939	7/ 9	42 49.01N	11 47.61W	BN 1.5/C	910- 955	1331-1414	Only representative catch retained	
#001		42 50.28N	11 47.50W			DAY	FLOW DIST.	
10940	7/ 9	42 40.30N	11 41.81W	BN 1.5/C	760- 770	1803-1843	Only representative catch retained	
#001		42 41.26N	11 41.88W			DUSK	FLOW DIST.	
10941	8/ 9	42 16.30N	12 33.85W	RMT 1	20- 50	0116-0206	Catch not retained	5000
#001		42 16.85N	12 35.52W	RMT 8		NIGHT	FLOW DIST. 2914	
				CCE				
10942	8/ 9	42 45.80N	11 51.46W	BN 1.5/C	850- 880	1030-1058	Net badly torn by coral	
#001		42 46.58N	11 51.23W			DAY	FLOW DIST.	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