Dr. M. ? Jones ?

I.O.S.

RRS DISCOVERY
CRUISE 121

5 – 26 JUNE 1981

BIOLOGICAL INVESTIGATIONS OF THE OCEANIC FRONT TO THE SOUTH-WEST OF THE AZORES

CRUISE REPORT NO 115
1981

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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RRS DISCOVERY

CRUISE 121

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Biological investigations of the oceanic front to the south-west of the Azores.

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Institute of Oceanographic Sciences,
Wormley, Godalming,
Surrey, GU8 5UB

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OBJECTIVES

The cruise was designed to provide the main set of biological samples of plankton and micronekton for the study of the meandering frontal system between Eastern Atlantic Water (i.e. water typical of the eastern Atlantic from south of around 42°N to at least the latitudes of the Azores) and the Western Atlantic Water (i.e. water with a broad band of 18°C Sargasso Sea Water which probably represents one arm of the Gulf Stream which crosses the Mid-Atlantic Ridge into the eastern Atlantic) to the south-west of the Azores. The cruise was a follow up of the joint physical and biological cruise undertaken in late autumn 1980 (Cruise 114), and the preceeding two cruises during which physical observations were made (Cruise 119) and when the distribution of nutrient and fluorescence were studied in relation to the front as well as mapping and some biological sampling (Cruise 120).

NARRATIVE

The ship sailed from Ponta Delgada, Sao Miguel, Azores at 1000/5.vi. The P.E.S. fish was streamed at 1100h and surface thermosalinograph readings were started soon after. Course was set for 33°N 27°W. Scientific watches began at 2000h with XBT launches every two hours. At 0600/6.vi the XBT dip showed that a front had been crossed from Eastern Atlantic Water (EAW) into Western Atlantic Water (WAW), and the thermosalinograph showed the usual surface salinity front. At 1400/6.vi a front was recrossed back into EAW. The position for the first station 33°N 27°W was reached at 1500/6.vi. An attempt to observe the hydrographic profile was thwarted by a burst in the flexible pipe in the high pressure line of the hydraulics supply. A short haul with the RMT 1+8M was made to test out the system, wash-out the nets and to provide fresh material for physiology. Since the position chosen to be typical of EAW was so close to a front it was abandoned as a main sampling position. It was uncertain as to whether these fronts were part of a meandering of the main boundary or if they were the edges of a detached eddy, but there was insufficient time to carry out enough mapping to determine what sort of feature they bounded. Course was set for 32°30'N, 30°W a position in the centre of the large meander to the west of the Cruiser Seamount; this was also a repeat of station 10222 carried out on Cruise 114. The boundary back into WAW was crossed at about 0400/7.vi, and the station position reached at

1212h, At each main station the vertical profiles of plankton and micronekton were sampled by both day and night with the RMT 1+8M in 100m strata down to depths of at least 1400m; a dip to 2000m with the CTD and oxygen probe gave the hydrographic structure of the water column and the oxygen profiles; a twenty-four hour series of two hourly filter samples from the ship's hydrant system were collected to study the variations in foraminiferan abundance at 5m, in conjunction with a vertical haul with a fine mesh net from 500-0m. The station work was completed at 0400h/10.vi and course set for 35°N 32°W. This position to the west of Atlantis Seamount was expected to be well into EAW. The XBT profile extended up the main axis of the meander and it was not until 2300/10.vi that the salinity front was crossed and 0100/11.vi that the XBT's showed evidence that the ship had crossed the front back into EAW water. Once again the position selected was too close to the main front and so the ship steamed due west to 35°N 33°W, and there the next main station was conducted. RMT 1+8M sampling was extended down to 1900m by day and 1700m by night. In addition during the day of 14.vi there was a test of the near bottom echo-sounder device attached to the net monitor. Station work was completed at 0400/15.vi and course set for 30°N 34°W, a station deep into WAW.

The ship arrived at the new position at 1200/16.vi and the net series was started immediately. However, during the night of the 16/17th nearly 6½ hours of time was lost to scientific work while essential repairs were carried out on the main engines. As a result no night-time sampling was achieved that night, but sampling restarted at 0800/17.vi. By 0500/20.vi a daytime vertical series had been completed to a depth of 2300m and a night-time series to 1300m. In a telephone call from IOS, Dr. J. Gould reported that the FGGE buoys set out during Cruise 119 showed an anticlockwise circulation centred at 32°30'N 32°W, so it was decided to complete the cruise sampling programme by working in this feature. So the ship steamed for this position, pausing only to make two hauls with the RMT 1+8 to test the closing cod-end system during the afternoon of 20th June.

The ship reached the centre position of the possible eddy at 0800/21.vi and observations started with a CTD dip to 2000m. Before leaving the position at 0630/24.vi a daytime vertical series was achieved to 1400m and a night-time series to 1200m. Three further trial hauls with the closing cod-end were made and the northern edge of the EAW feature located with two shallow CTD dips and a single XBT observation. Scientific watches were suspended as from 0800/24.vi and the P.E.S. fish brought inboard at 0900h. The ship arrived at Ponta Delgada at 0900/26.vi.

VERTICAL SERIES

The four vertical series of day and night samples taken from the surface to depths of at least 1200m or as much as 2300m formed the main framework of the biological sampling during this cruise. These series were positioned relative to the front as delineated during Cruise 119 and 120 together with the information derived from XBT's as to the temperature structure of the water column. The initial plan to sample Eastern Atlantic Water (EAW) at 33°N 27°W was thwarted by the unexpected presence of either an eddy or meander of Western Atlantic Water (WAW) occurring to the north of the position. Consequently the first main station worked (10378) was in the meander of WAW identified to the west of Cruiser Seamount both on cruises 119 and 120 and during the late autumn of 1980 on Cruise 114. In fact this series was a repeat of station 10222 worked on Cruise 114. The second station (10379) was positioned in EAW to the west of Atlantis Seamount. It had been hoped to work EAW at least 100nm from the front. However, considerable movements in the position of the front appear to have occurred and the position selected was only about 60nm from the front. The samples were noticeably larger than at the previous station and the 'look' of the catches was quite distinct. The third main station was deep into WAW, and there the catches were very noticeably smaller than at the previous two. The fourth station was worked in the centre of an anticlockwise circulation that could have been an eddy of EAW that had become detached since the last survey had been carried out on Cruise 120. The circulation was identified from the trajectories of satellite tracked FGGE buoys deployed in the front during Cruise 119. This is the first time that remote sensing techniques have been used to give a real time feed back into the sampling programme of Discovery. On Cruise 122 a batfish survey showed that this feature was separated to a depth of 280m, but at that depth it was still attached to the EAW water mass.

At each station 100m strata were sampled from 100m to depths of at least 1200m and in most cases 1700m both by day and by night. The surface 100m was subdivided into two 50m bands, the lower of which probably included the chlorophyll maximum at most positions. The hydrographic profiles were determined with CTD dips to 2000m. The sampler used almost exclusively was the RMT 1+8M which gives three consecutive samples with a fine mesh macroplankton net RMT 1 (0.33mm mesh) and a larger coarse mesh micronekton net RMT 8 (5mm mesh). Usually each stratum was sampled for 1½ hours during daylight hours and 1 hour after dark. No sampling was carried out one hour either side of both sunrise and sunset.

RMT 1 VOLUMES M.V. Angel

All the RMT 1 samples (macroplankton) for the four vertical series sampled during this cruise and for the series collected during Cruise 120 were volumed onboard and the data are tabulated below. When the data are standardised to the volume caught per hour per 100m stratum sampled, they can be summed for the top 1400m of the water column sampled to give a rough approximation of the standing crop at each position. The data will eventually be standardised for flow as well. These integrated results are as follows:-

			Day	Night
Station	10376	Frontal region	850	1159
	10378	WAW in meander	604	664
	10379	EAW ~ 60nm from front	841	1024
	10380	WAW ~ 180nm from front	465	467*
	10382	EAW eddy (~60 x 120nm)	896	797**

* to 1300m only ** to 1200m only.

At three of the stations the difference between day and night estimates were ≤10%. Only the frontal station gave poor agreement between the day and night samples, however, adjustment for flow may improve the results since there was a current shear of 1kt or more between the surface and a depth of around 450m. At the WAW station the standing crop was clearly much lower than at any of the other positions, and this was quite obvious from the size of the samples as they were collected. The standing crop at the other WAW station situated in the meander was intermediate between the other impoverished WAW station and the three EAW stations, all of which were very similar despite the first and last being separated by about a month. Thus initial results suggest that the front does not have a significant effect on the standing crop of macroplankton despite the higher standing crop of phytoplankton observed in the frontal region during Cruise 120. The position of the front is possibly too transient for it to influence the macroplankton standing crop. The enrichment of the meander region may be the result of mixing at the front particularly as it curved at the western

RMT 1 DISPLACEMENT VOLUMES

	10376		10378		10379		10380		10382	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
0-50	40	155(+40)	60*	100	120*	315(+140)	85*	120	145*	175
50-100	163	400	165*	165	200*	235	210*	134	175*	280
100-200	250	66	85*	85	100*	115	106*	97	185*	125
200-300	80*	85	30*	45	105*	80	32*	25	75*	39
300-400	125*	96	55*	40	120*	75	54*	26	120*	65
400-500	120*	65	45*	35	140*	75	67*	25	115*	55
500-600	100*	57	60*	50	90*	40	43(+28)*	36	125*	35
600-700	137*	50(+40)	75*	85	115*	55	52*	22	120*	45
700-800	75*	82	50*	35	100*	45	50*	25	90*	35
800-900	60(+40)*	44	75*	35	85*	50	32*	19	80*	45
900-1000	95*	43	45*	25	50*	30	44*	26	100*	45
1000-1100	50*	52	45*	30(+10)	60*	35	30*	15	65*	35
1100-1200	41*	45	35*	35	34*	35	10*	20	55*	70
1200-1300	45*	55	40*	40	45*	30	19*	18(+86)	50*	
1300-1400	33*	33	35*	35	45*	35	18*		40*	
1400-1500	28*	48			20*	30(+14)*	12*			
1500-1600	35*	22			30*	30*	20*			
1600-1700	22*				25*	20*	25*			
1700-1900							23+			
1900-2100							15+			
2100-2300							7+			

* 1½h tows + 1h 55min tows

corner of the meander or of diffusion. Specific analysis of the samples will be needed to explore further the influence of the front on the macroplanktonic populations. Comparisons with the Cruise 114 data show that in the EAW and the frontal area the macroplankton standing crop had approximately doubled, but in WAW there had been little if an increase.

RMT 8 DISPLACEMENT VOLUMES D. Crawford

The volumes of all the RMT 8 samples taken during this cruise and at station 10376 on cruise 120 were measured onboard. Pyrosomas were generally counted, volumed and discarded prior to preservation, and this data has not been included in the table below. A series of measurements were made on the catches from a materials and showed that most shrinkage occurred within six hours of preservation. Measurements were made 2-3 days after preservation when most shrinkage would have been completed. Integrating the data standardised to hour tows per 100m stratum gave the following results:-

			Day	Night
Station	10376	Frontal region	3510	5730
	10378	WAW in meander	2770	2850
	10379	EAW ~ 60nm from front	2780	3530
	10380	WAW ~ 180nm from front	1300	1720
	10382	EAW eddy	3070	3050

The night/day disparity tended to be more marked than for the RMT 1 volumes, with the frontal station yielding the greatest discrepancy. The WAW station gave half the standing crop observed at the two EAW stations and the meander, all of which were fairly similar. The maximum standing crop occurred at the frontal station. This difference between the RMT 1 macroplankton data and these RMT 8 data may prove to be the result of the micronekton having the ability to concentrate within the frontal region, despite its oscillating geographical position. When allowance is made for the larger mouth-area of the RMT 8 the micronekton standing crop is about one third to one quarter of the macroplankton standing crop. In comparison with the integrated data from the same region collected on Cruise 114, micronekton standing crop was about 50% higher on this cruise except for the levels at station 10380, the WAW station, where the standing crop was similar to those observed during the early winter months.

RMT 8 DISPLACEMENT VOLUMES STANDARDISED TO ONE HOUR TOWS

	10376		10378		10379		10380		10382	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
0-50			50	200	150	600	40	110	130	330
50-100	320	910	110	440	180	456	70	70	170	540
100-200			120	390	150	270	60	350	240	300
200-300	200	290	90	160	160	290	70	120	220	290
300-400	150	420	90	180	170	180	60	70	110	160
400-500	280	310	90	100	180	170	60	110	160	130
500-600	270	230	130	140	190	180	110	140	150	180
600-700	250	190	150	120	200	190	90	110	190	120
700-800	230	320	350	120	310	180	110	180	220	200
800-900	280	150	230	220	300	170	110	130	310	220
900-1000	220	210	230	140	180	260	110	100	330	200
1000-1100	200	190	220	140	150	140	160	80	310	220
1100-1200	150	200	260	160	170	150	120	120	240	160
1200-1300	210	320	220	150	170	180	70	30	150	
1300-1400	110	170	430	190	120	120	50		140	
1400-1500	130	190					30			
1500-1600	150	140					40			
1600-1700	150						50			
1700-1900							30			
1900-2100							30			
2100-2300							20			

SHIPBOARD SAMPLE SORTING C. Ellis

During Cruise 121, thirty-six RMT 8M catches were sorted. Effort was concentrated on the material collected at station 10376. This station was fished in frontal water on cruise 120 to 1700m by day and 1600m by night. The eighteen day and seventeen night macroplankton samples of the vertical profile were volumed and sorted into major groups, viz: chaetognaths, fish, decapods, euphausiids, mysids and cephalopods. Polychaetes, heteropods, pteropods, ostracods and ctenophores were also sorted and counted.

Since the vertical profiling went deeper than on Cruise 114, the total numbers to 1100m are given so that a direct comparison can be made with the autumn data. Also, to account for the difference in towing time (tow times per net were 1½ hours in the day and 1 hour at night) the daytime numbers have been corrected to a 1 hour standard.

All the groups showed a numerical increase compared with samples from intermediate water taken in the autumn (Station 10222). Fish, decapod and mysid numbers were doubled and euphausiid and chaetognath numbers quadrupled. Cephalopods were slightly more numerous. The depth of the fish zone of maximum abundance was between 400-800m, broader and deeper than in the autumn with Cyclothone braueri and C. microdon the dominant species. The depth at which mysids became abundant, the top of the Eucopia unguiculata zone remained at 700m.

A few unusual animals were caught in this series, including a fish Saccopharynx, two siphonophores a physophoran and a specimen of Erenna richardi, and several Nebaliopsis were taken in the deeper hauls below 1300m.

	Number of Mysids		Number of Cephalopods		Number of Chaetognaths	
	Day	Night	Day	Night	Day	Night
5-25m	2	1	6	6	738	960
25-130m	-	-	11	26	1198	1302
130-200m	10	-	32	6	5589	1435
200-300m	-	3	11	9	3461	3116
300-400m	2	1	4	92	4022	3239
400-500m	-	-	5	3	3519	2945
500-600m	5	18	12	2	2807	2402
600-700m	-	29	8	3	1704	1143
700-800m	63	70	9	2	921	1168
800-900m	316	126	5	3	1291	1352
900-1000m	233	233	6	8	960	873
1000-1100m	210	106	3	3	1284	649
Total Number to 1100m (Day samples x .66)	580	587	74	163	18147	20584
1100-1200m	38	110	4	2	467	639
1200-1300m	27	38	8	-	416	320
1300-1400m	28	32	1	3	270	424
1400-1500m	29	16	-	1	304	199
1500-1600m	7	23	-	1	104	318
1600-1700m	14		-		273	
Total	984	806	125	170	29328	22484
Total numbers in intermediate water Stn 10222 Cruise 114	69	261	121	117	4100	5773

	Number of Fish		Number of Decapods		Number of Euphausiids	
	Day	Night	Day	Night	Day	Night
5-25m	60	1212	43	120	56	1121
25-130m	158	995	235	301	75	1471
130-200m	256	78	78	87	537	1821
200-300m	56	158	-	146	351	1060
300-400m	123	303	6	79	548	230
400-500m	1690	855	135	63	2004	511
500-600m	1706	873	180	175	598	253
600-700m	1006	577	302	41	533	286
700-800m	931	466	233	82	1313	608
800-900m	466	285	301	81	374	459
900-1000m	245	252	291	39	137	269
1000-1100m	284	306	79	44	263	231
Total Number to 1100m (Day samples x .66)	4607	6360	1243	1258	4480	8320
1100-1200m	266	278	77	83	308	240
1200-1300m	270	235	62	46	320	187
1300-1400m	110	237	110	82	369	310
1400-1500m	180	128	76	89	365	219
1500-1600m	169	117	71	48	252	363
1600-1700m	125		57		236	
Total	8101	7355	2336	1606	8639	9639
Total numbers in intermediate water Stn 10222 Cruise 114	1834	3574	461	776	1270	2016

RMT CONTROL GEAR R.A. Wild

During the midwater fishing programme only four hauls were affected by gear malfunction. During two, *Pyrosoma* got wrapped round the external temperature probe, which on the second occasion broke the wires on the thermistor, although this was not obvious until the following haul.

When using the new Hall effect flowmeter with built-in thermistor, the wires to the thermistor broke again; as this was not a quantitative haul it did not affect the value of the haul.

A monitor was used for the non-quantitative hauls modified to gain experience with the Hall effect or digital flowmeter. This performed well and gave enough confidence for the system to be adopted as a cheaper, easier to produce unit.

Oceanic connectors were fitted to this monitor and flowmeter to evaluate them against the Marsh and Marine plugs and sockets which are no longer produced. There is no reason to doubt their suitability.

All in all the system worked well as an established system should.

A number of trials with a closing cod-end device with a hydrostatic trigger mechanism resulted in some success. However, the reliability and accuracy of the system needs to be improved and the acoustic trigger needs to be developed. Undoubtedly the calmness of the weather conditions made a major contribution to the reliability of the net system.

NEAR BOTTOM ECHO-SOUNDER TEST M.V. Angel

A single trial of the near bottom echo-sounder mounted on the RMT 1+8M was carried out at station 10379; the only position occupied where the sounding was sufficiently shallow (~2980m) and 'apparently' flat enough to conduct a trial. The device functioned well for the first two nets although there was more noise than during the tests conducted on Cruise 120. During the third net tow when fishing 12-30m off the bottom the sea bed rose sharply about 150m. The echo-sounder suddenly locked on to a distant object and indicated that the net had suddenly risen about 100m off the sea bed. Despite being hauled in, the net hit the sea bed and was towed along the bottom for about eight minutes. Fortunately no damage occurred to the gear, and the catches although contaminated with bottom sediment still contained specimens of interest (see Copepod report). Clearly the echo-sounder has considerable potential, but more experience is needed in its use during sampling.

FISHES J.R. Badcock

The fish collections from the five series (St. 10376. 10378, 10379, 10380,10382) made during Cruises 120-121 were, as expected, very similar in many ways. The abundant species were the same and showed little, if any, intra-specific variations in depth distribution at the different sampling positions. As was the case with the eastern and western water collections made during Cruise 114, mesopelagic fishes occurred by day from 200m (again centred below 400m) to the lower sampling depth, and no individual species could be regarded as signaling faunal changes between the various sampling sites. Nevertheless, differences in relative abundances between the areas were apparent. The eastern water collections (St. 10379) were numerically richer than those from western water (St. 10380), where catch numbers were particularly low, but undoubtedly those from the front area (St. 10376) and eddy (St. 10382) were the richest in animal numbers and, possibly, species diversity. That such differences were obvious is encouraging and whilst it can be argued that the sampling methods employed produced only spot samples subject to considerable variation, the consistent collection of rich samples in apparent rich areas and poor samples in apparent oceanic deserts was impressive enough to diminish the force of this criticism.

Throughout the sampling reasonable numbers of the lanternfish Ceratoscopelus warmingi were taken by day. It is known that this species makes extensive vertical migrations in excess of 900m but the present collections provide the best confirmatory evidence to date. Juveniles and adults occurred in 900-1700m depth by day, with larger animals apparently residing deepest, and at night in the upper 100m, the whole population apparently migrating into this layer. The present collections, together with those from Cruise 114, should provide good insights into the migratory behaviour and life cycle of this remarkable species.

A number of curiosities - the anglerfishes Lasiognathus, Neoceratius and an Edriolychnus female bearing two dwarf males, as well as a couple of megalomycterids and aphyonids - make welcome additions to I.O.S. collections.

DECAPOD CRUSTACEA P. Domanski

On board sorting of material collected during the previous cruise (120) permitted an initial analysis of decapod species from the frontal region vertical series 10376. Stratification of species could clearly be seen with a pronounced faunal change occurring between 800 and 1000m. Diurnal migrations apparently occurred from well below 1000m in several species. Acanthephyra purpurea whose night-time distribution tailed out between 1100 and 1200m extended down to between 1300 and 1400m during the day. Gennadas valens which was taken from the near surface to 1000m during the night was found between 700m and 1400 during daytime hauls.

Candidates for possible reverse diurnal migrations are the deeper living species A. stylorostratis and Hymenodora gracilis whose distributions extended down to at least 1600-1700m (the greatest depth fished). Both these species were caught at shallower depths during the day than at night.

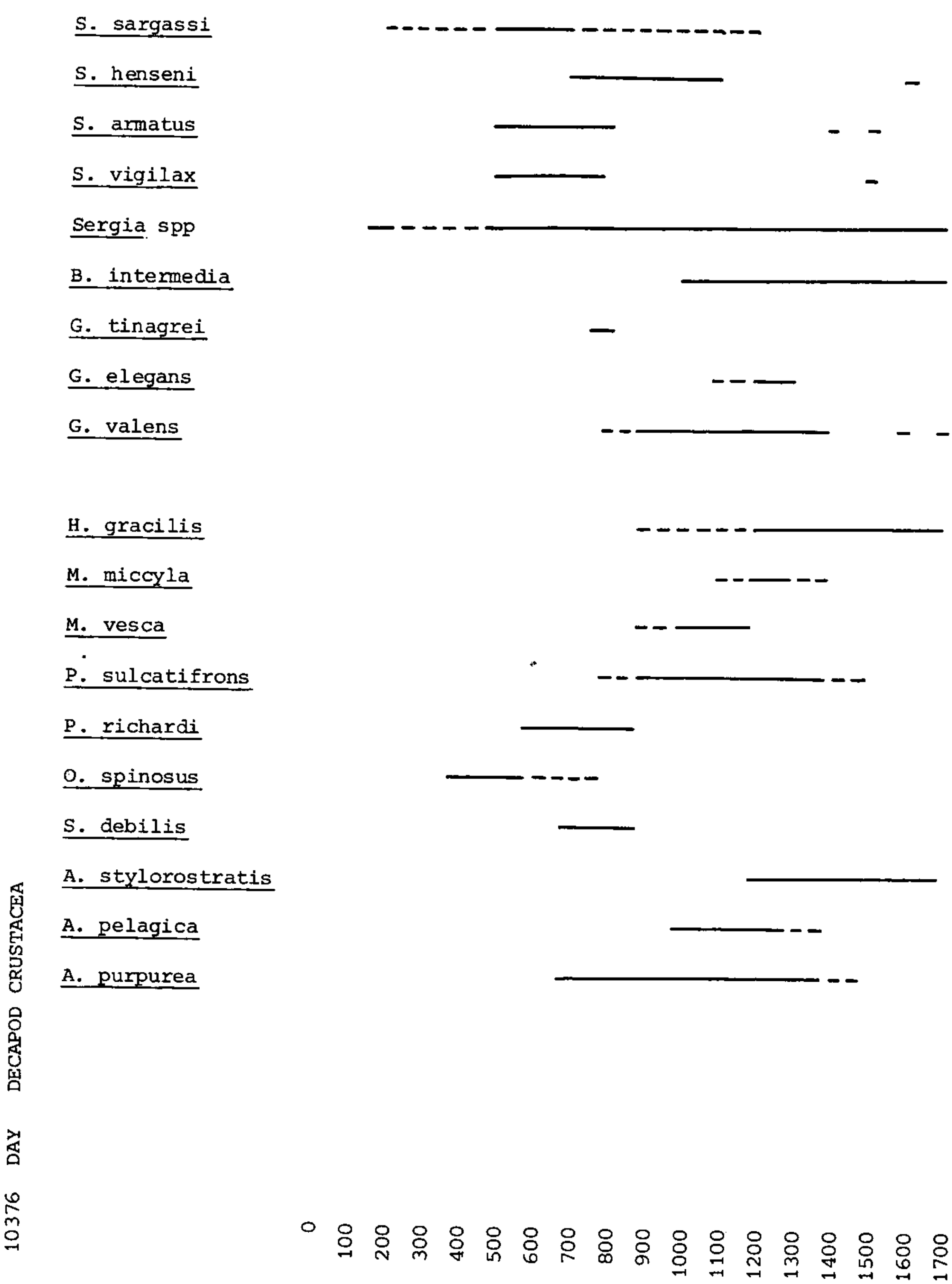
Among the more unusual species was a single specimen of Physetocaris microphthalma taken between 1100 and 1200m although this species subsequently appeared again in later series.

Cursory examination of catches taken during this cruise revealed a trend in accordance with other groups. Western Atlantic Water hauls generally yielded poorer numbers of animals than those from EAW. Species richness on the other hand appeared to be as much or even slightly greater in WAW where a number of single occurrences of animals were noted.

AMPHIPODA M. Sheader

Material was collected to study the development of hyperiid marsupial and free larval stages.

Hyperiid species are associated with gelatinous zooplankton to a varying extent. In the species studied to date, those that are more free-living, feeding on a wide range of zooplankton, produce relatively fewer, larger eggs in comparison with those species relying completely on gelatinous host/prey as a food source.


10376 DAY DECAPOD CRUSTACEA
S. sargassi
S. henseni
S. armatus
S. vigilax
Sergia spp
B. intermedia
G. tinagrei
G. elegans
G. valens
H. gracilis
M. miccyla
M. vesca
P. sulcatifrons
P. richardi
O. spinosus
S. debilis
A. stylorostratis
A. pelagica
A. purpurea
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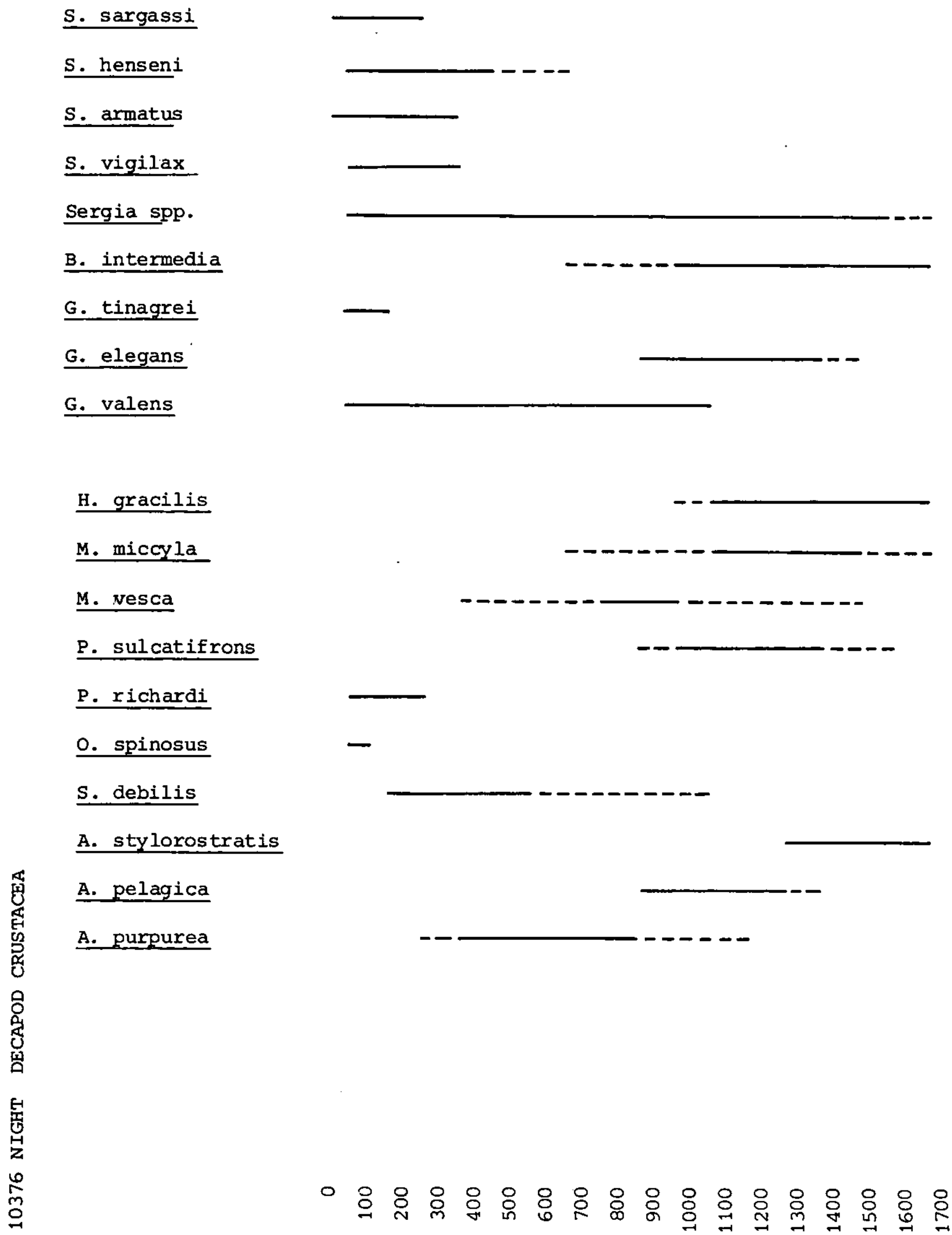
1700



S. sargassi
S. henseni
S. armatus
S. vigilax
Sergia spp.
B. intermedia
G. tinagrei
G. elegans
G. valens
H. gracilis
M. miccyla
M. vesca
P. sulcatifrons
P. richardi
O. spinosus
S. debilis
A. stylorostratis
A. pelagica
A. purpurea
10376 NIGHT DECAPOD CRUSTACEA
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700

These larger eggs increase in size during development and, after hatching, pass through two moults in the marsupium, before being released as swimming juveniles. In contrast, those species relying entirely on gelatinous zooplankton as a food source tend to produce large numbers of small eggs which increase in size only slightly during development, and on hatching are released from the marsupium as 'protopleon' larvae, with reduced pleopods and uropods. These larvae are incapable of swimming and are presumably placed in or on the host by the female. Juvenile hyperiids are not infrequently found in gelatinous zooplankton, but the lack of detailed descriptions of juvenile stages usually prevents identification.

During the present cruise several species of hyperiid (Cystisoma, Phronima, Phrosina, Primno, Streetsia, Platyscelus, Parapronoe, Vibilia, Hyperoche) with eggs or juveniles in the marsupium have been collected, permitting a comparative study to be made of egg and larval developmental stages, with additional information on fecundity.

COPEPODS (G.A. Boxshall)

The near-bottom hauls (10379 hauls 36-38) contained large numbers of non-calanoid copepods. In addition to the two known species of Benthomisophria a new species of misophrioid was found, readily distinguishable from all known species by the presence of a large anteriorly-directed rostrum. The non-calanoid component was dominated by harpacticoids of the genera Aegisthus and Volkmannia and by poecilostomatoids of the genus Oncaea. These hauls also contained large numbers of siphonostomatoid copepods which live as parasites or associates of invertebrate hosts. Several of these species are new. The two species of Mormonilla were common in both near-bottom and midwater hauls and observations were made on the feeding movements of live specimens of M. phasma. Specimens of Mormonilla (Mormonilloida), Oncaea (Poecilostomatoida) and Euaugaptilus (Calanoida) were fixed for later use in a comparative study of skeletomusculature systems in copepods.

SIPHONOPHORES P.R. Pugh

Most of the siphonophores from a series of hauls made at the "front" station (St. 10376, Cr. 120) were identified. This station may be comparable with St. 10222 (Cr. 114) although the latter probably was sited to one side of the front, in Western Atlantic Water. The initial results indicate that the siphonophores at St. 10376 were reduced in numbers in comparison with those collections made last Oct./Nov., although the shallowest and probably richest samples remain to be investigated. Unfortunately it was not possible to examine the siphonophores from the other series, carried out during Cruise 121, in detail and so the influence of the front on the specific distributions could not be assessed. This applies particularly to Hippopodius hippopus, a species which appeared to be a clear indicator, during Cruise 114, of the influence of Eastern Atlantic Water. In the "front" samples (St. 10376) this was not one of the commonest species and its close relative Vogtia glabra was more abundant. Of particular note were the very low numbers of hippopodiid larval nectophores in comparison with the Cruise 114 results, without a concomitant increase in adult numbers. It would appear that there is a definite seasonality in the abundance and life history of these species. Amongst the samples only a few of the rarer siphonophore species were noted, the most conspicuous of these being the physonect Erenna richardi. On several occasions the large nectophores with black radial canals were noted.

GIGANTOCYPRIS A. Moguilevsky

Some 140 specimens of Gigantocypris muelleri were separated from 45 RMT 1+8M samples taken between 700-1500m. All were measured on board ship to avoid problems arising from distortion of the carapace during preservation. Adult males represented 22.38% of the specimens caught. They occurred in the 800-1300m hauls but mainly between 1000-1200m. Juvenile specimens (41.95%) were taken in the 800-1200m hauls being more numerous in the 1000-1100m samples. Brooding females and pre-adult females with developing ovaries represented the remaining 35.66%. Immature females were caught between 700-1400m, although in low numbers below 1200m. Gravid females occurred mainly in the 1100-1300m hauls; a single specimen was retrieved from the 1400-1500m hauls and only 5 from the hauls between 800-1100m.

A preliminary analysis of the gut contents of most specimens was carried out on board ship. Chaetognaths, fish remains, calanoid copepods, eucopid mysid and decapod limbs were the most frequent items encountered.

Only 6 specimens of G. dracontovalis were retrieved from the 2840-2985m haul.

A single pre-adult male of an as yet unidentified *Gigantocypris* species was caught in the 1900-2100m haul at Station 10380.

An adult female, two adult males and two young instars of *Gigantocypris muelleri* were kept alive for 15 days in a 20ℓ white plastic bucket of sea water at about 10°C in the Constant Temperature Room. Despite the lack of constant flow of sea water, the specimens swam actively although with a tendancy to favour a circular orbit both in the horizontal and vertical planes. This behaviour is not thought to be natural.

Some 6 specimens of *G. muelleri* were also kept alive for about 5 days in a solution of colchicine in sea water and then preserved in absolute ethanol/ glaciel acetic acid (3/1) for future chromosome studies.

PLANKTONIC FORAMINIFERA   A. Moguilevsky

The aim of this work was to obtain live planktonic foraminifera to establish and compare species distribution. Two methods were followed:-

1) A 24 h continuous sampling programme was carried out at stations 10378, 10379 and 10380. Sea water from a depth of 5m was pumped at a flow rate of approx. 14000 ℓ/h using the hydrant pump, and filtered through a flask-shaped net with a mesh of 148μ. While in operation the net was supported by being immersed in a 60ℓ bucket. Every two hours the net was removed and immediately replaced with a clean and identical net to continue the filtering until a 24h recording was completed. The material collected in the nets was washed and concentrated through a 90μ mesh sieve and consequently preserved in 10% buffered formalin.

2) Three vertical hauls from 500m to the surface were made at the same stations, using a conventional plankton net.

This material is currently being studied by Mr. N. Holmes (U.C.W., Aberystwyth) who will compare the results with those that he obtained during Cruise 8/1980 of RRS Challenger in the N.E. Atlantic (continental shelf west of Scotland, Rockall Trough, Abyssal Plain and Porcupine Seabight).

BIOLUMINESCENCE P.J. Herring

Luminescence investigations were directed largely at a comparative study of the phenomenon in copepods. Species from all the known luminous families were examined and considerable differences noted in the position and appearance of the effector glands as well as in the characteristics of the responses. All the calanoid species studied emit light as an extracellular secretion but the cyclopoid Oncaea has internal photocytes spread over the dorsal surface of the whole body. Each photocyte can flash repetitively and photomultiplier records of the flash characteristics were obtained. Electrically stimulated flashing was recorded on image intensified videotape and subsequent analysis of the tapes will provide detailed information about the co-ordination of the responses. Fluorescence microscopy was used extensively for examination of the luminous tissue in Oncaea and the calanoid species.

Spectral analysis of Oncaea luminescence showed it to peak at shorter wavelengths than that of other copepods and spectra from a large variety of luminous animals demonstrated how wide the interspecific variation may be. Short wavelength emission characterizes, for example, Oncaea, Scina and Ctenopteryx while longer wavelength spectral peaks are typical of the cranchiid squids. The spectra from the esca of three species of anglerfish were identical to that of Photobacterium phosphoreum, providing further support for the baterial nature of the luminescence of these fishes.

Extensive use was made of the ability to videotape image intensified luminescent responses and specimens of the scyphozoan Atolla were examined in particular detail. Preliminary assessment of the rapid conduction pathways involved in their propagated responses to a variety of stimuli suggests that epithelial conduction systems are involved.

PHYSIOLOGICAL OBSERVATIONS M. Dawson

Haemolymph samples were taken from various species of decapod, an amphipod and an ostracod. Whole haemolymph samples and dilutions were taken. Samples will be analysed for sodium concentration as an indicator of the osmotic relationship between haemolymph and sea water. Magnesium concention will be determined in a preliminary attempt to investigate the possibility of an inverse relationship between the concentration of this ion and the range of vertical diurnal migration. The decapod crustaceans Acanthephyra pelagica, A. purpurea and A. stylorostratis were specifically selected for this experiment.

Various transparent animals were collected for Professor Potts at Lancaster University.

COMPUTING J. Sherwood, T. Colvin

The IBM computer was used to record, plot and list navigation and meteorological data, echo soundings and biological station data.

The PDP 11/34 "Batfish" system was also run, recording and plotting CTD dip data, and incidentally recording navigation for most of the cruise.

Both systems ran very reliably with few equipment problems; these were a failure of the computer room D5200 terminal due to a blown rectifier, a fault on the HP7221A flatbed plotter due to a loose internal connector, and a long standing over-heating problem on the Dri line printer.

The Viking air conditioner units only just maintained the computer and clean rooms at a workable temperature, with no spare capacity in hand, and temperatures did not fall below 22°C during the cruise.

The ship's AC supply has a tendency for the voltage to creep upwards and on one occasion was measured at 249 volts, causing the computers to run hot, and very near their maximum voltage rating.

XBT DATA

No.	Day	Time	Position °N	Position °W	Isotherm depths 16 °C	Isotherm depths 15 °C
1	156	2002	36°08.4'	26°07.1'	177	229
2		2200	35°49.2'	26°14.0'	96	153
3		2358	35°31.1'	26°20.7'	175	210
4	157	0204	35°11.1'	26°25.6'	164	213
5		0358	34°52.9'	26°29.6'	205	251
6		0559	34°33.7'	26°33.8'	230	295
7		0759	34°14.3'	26°38.0'	261	322
8		1000	33°54.8'	26°43.1'	276	340
9		1205	33°34.6'	26°48.2'	284	340
10		1400	33°16.2'	26°54.2'	216	259
11		2120	32°55.3'	27°30.7'	205	254
12	158	0000	32°51.6'	28°00.4'	178	230
13		0202	32°47.8'	28°22.3'	172	243
14		0403	32°44,6'	28°43.6'	198	282
15		0505	32°42.5'	28°53.5'	190	265
16		0600	32°41.3'	29°03.1'	193	308
17		0800	32°38.3'	29°22.4'	222	280
18		1819	32°34.3'	29°54.5'	250	305
19	161	0408	32°15.2'	29°46.6'	268	331
20		0600	32°30.7'	29°57.7'	236	344
21		0800	32°47.3'	30°09.4'	260	330
22		1000	33°03.0'	30°20.6'	262	312
23		1200	33°18.1'	30°31.7'	278	338
24		1420	33°35.3'	30°45.5'	231	270
25		1600	33°47.5'	30°55.0'	266	358
26		1800	34°01.8'	31°06.3'	255	338
27		2000	34°16.1'	31°17.4'	290	347
28		2215	34°32.7'	31°29.5'	269	325
29	162	0001	34°46.1'	31°39.7'	218	284
30		0200	34°57.1'	31°56.0'	178	250
31		0300	34°59.9'	32°06.1'	162	238
32		0400	35°01.1'	32°17.3'	127	212
33		0610	35°00.9'	32°41.3'	149	204
34		0800	35°01.9'	33°00.9'	130	189

No.	Day	Time	°N	°W	16 °C	15 °C
35	166	0503	34°51.0'	32°46.7'	134	220
36		0701	34°32.9'	32°52.1'	151	255
37		0908	34°13.5'	32°58.1'	267	335
38		1201	33°48.5'	33°04.6'	272	323
39		1406	33°30.2'	33°08.9'	269	333
40		1602	33°12.6'	33°13.4'	241	318
41		0800	33°02.9'	31°56.6'	260	312

CRUISE STATISTICS

RMT 1+8M hauls	44
ie (Macroplankton samples	121
(Micronekton samples	121
RMT 1+8 closing cod end trials	5
XBTS	41
CTD observations to 2000m	4
" " " 300m	2
Vertical fine mesh net hauls	3
24h pump samples	3

Steaming time	176.7h
Station time	316.3h
Lost time (engine repairs)	7.0h

STATION LIST

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10377	6/ 6	32 59.3N	27 3.5W	RMT1M-1	240- 625	1718-1905	MATERIALS HAUL	
# 1		32 58.1N	27 8.9W	RMT8M-1		DAY	FLOW DIST. 7.92 KM.	
10378	7/ 6	32 29.6N	30 0.3W	RMT1M-1	0- 50	1229-1416		
# 1		32 27.4N	29 57.4W	RMT8M-1		DAY	FLOW DIST. 7.12 KM.	
10378	7/ 6	32 27.4N	29 57.5W	RMT1M-2	50- 100	1416-1546		
# 2		32 30.5N	29 56.3W	RMT8M-2		DAY	FLOW DIST. 5.60 KM.	
10378	7/ 6	32 30.4N	29 56.3W	RMT1M-3	100- 200	1546-1716		
# 3		32 33.9N	29 55.0W	RMT8M-3		DAY	FLOW DIST. 5.91 KM.	
10378	7/ 6	32 34.3N	29 54.4W	CTD	0-2000	1826-2037	WB @ STANDARD DEPTHS	
# 4		32 32.7N	29 53.6W	MS				
10378	7/ 6	32 29.1N	29 52.3W	RMT1M-1	800- 902	2206-2306		
# 5		32 26.6N	29 51.7W	RMT8M-1		NIGHT	FLOW DIST. 3.69 KM.	
10378	7/ 6	32 26.7N	29 51.7W	RMT1M-2	902-1000	2306-0006		
# 6	8/ 6	32 24.8N	29 50.9W	RMT8M-2		NIGHT	FLOW DIST. 3.64 KM.	
10378	8/ 6	32 24.8N	29 50.9W	RMT1M-3	1000-1100	0006-0106		
# 7		32 22.9N	29 50.2W	RMT8M-3		NIGHT	FLOW DIST. 3.24 KM.	
10378	8/ 6	32 20.9N	29 50.4W	RMT1M-1	500- 602	0223-0323		
# 8		32 18.7N	29 49.9W	RMT8M-1		NIGHT	FLOW DIST. 3.01 KM.	
10378	8/ 6	32 18.7N	29 49.9W	RMT1M-2	602- 700	0323-0424		
# 9		32 16.5N	29 49.7W	RMT8M-2		NIGHT	FLOW DIST. 3.80 KM.	
10378	8/ 6	32 16.6N	29 49.7W	RMT1M-3	700- 800	0424-0524		
# 10		32 14.4N	29 49.6W	RMT8M-3		NIGHT	FLOW DIST. 3.51 KM.	
10378	8/ 6	32 14.5N	29 50.0W	RMT1M-1	800- 900	0752-0922		
# 11		32 17.7N	29 51.7W	RMT8M-1		DAY	FLOW DIST. 5.33 KM.	

STN.	DATE 1981	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10378	8/ 6	32 17.7N	29 51.7W	RMT1M-2	900-1000	0922-1052		
# 12		32 20.9N	29 53.2W	RMT8M-2		DAY	FLOW DIST. 5.24 KM.	
10378	8/ 6	32 20.8N	29 53.2W	RMT1M-3	1000-1100	1052-1222		
# 13		32 24.1N	29 54.7W	RMT8M-3		DAY	FLOW DIST. 5.56 KM.	
10378	8/ 6	32 24.6N	29 53.7W	RMT1M-1	500- 600	1358-1528		
# 14		32 22.2N	29 50.7W	RMT8M-1		DAY	FLOW DIST. 5.87 KM.	
10378	8/ 6	32 22.2N	29 50.7W	RMT1M-2	600- 705	1528-1658		
# 15		32 19.5N	29 47.5W	RMT8M-2		DAY	FLOW DIST. 5.96 KM.	
10378	8/ 6	32 19.6N	29 47.6W	RMT1M-3	705- 800	1658-1828		
# 16		32 16.6N	29 44.9W	RMT8M-3		DAY	FLOW DIST. 6.14 KM.	
10378	8/ 6	32 14.7N	29 43.8W	XX	0- 500	2040-2102	FINE MESH NET - VERTICAL HAUL	
# 17		32 14.7N	29 43.8W			DUSK		
10378	8/ 6	32 15.7N	29 44.7W	RMT1M-1	200- 310	2207-2307		
# 18		32 17.4N	29 46.0W	RMT8M-1		NIGHT	FLOW DIST. 3.28 KM.	
10378	8/ 6	32 17.4N	29 46.0W	RMT1M-2	300- 405	2307-0007		
# 19	9/ 6	32 19.4N	29 47.4W	RMT8M-2		NIGHT	FLOW DIST. 3.24 KM.	
10378	9/ 6	32 19.4N	29 47.4W	RMT1M-3	400- 498	0007-0107		
# 20		32 21.5N	29 48.6W	RMT8M-3		NIGHT	FLOW DIST. 3.98 KM.	
10378	9/ 6	32 23.0N	29 49.4W	RMT1M-1	0- 52	0148-0248		
# 21		32 25.2N	29 50.7W	RMT8M-1		NIGHT	FLOW DIST. 4.08 KM.	
10378	9/ 6	32 25.1N	29 50.7W	RMT1M-2	52- 105	0248-0348		
# 22		32 27.0N	29 52.3W	RMT8M-2		NIGHT	FLOW DIST. 3.64 KM.	
10378	9/ 6	32 26.9N	29 52.2W	RMT1M-3	105- 200	0348-0448		
# 23		32 28.6N	29 53.9W	RMT8M-3		NIGHT	FLOW DIST. 3.64 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10378	9/ 6	32 25.2N	29 52.5W	RMT1M-1	1100-1202	0901-1031		
# 24		32 22.2N	29 50.7W	RMT8M-1		DAY	FLOW DIST. 5.55 KM.	
10378	9/ 6	32 22.2N	29 50.7W	RMT1M-2	1200-1305	1031-1201		
# 25		32 19.1N	29 48.6W	RMT8M-2		DAY	FLOW DIST. 5.96 KM.	
10378	9/ 6	32 19.1N	29 48.6W	RMT1M-3	1300-1400	1201-1331		
# 26		32 16 4N	29 46.2W	RMT8M-3		DAY	FLOW DIST. 5.55 KM.	
10378	9/ 6	32 14.4N	29 43.8W	RMT1M-1	200- 300	1453-1623		
# 27		32 11.8N	29 41.3W	RMT8M-1		DAY	FLOW DIST. 5.52 KM.	
10378	9/ 6	32 11.8N	29 41.3W	RMT1M-2	300- 400	1623-1753		
# 28		32 9.0N	29 38.7W	RMT8M-2		DAY	FLOW DIST. 5.65 KM.	
10378	9/ 6	32 9.0N	29 38.7W	RMT1M-3	400- 500	1753-1923		
# 29		32 5.7N	29 36.5W	RMT8M-3		DAY	FLOW DIST. 6.14 KM.	
10378	9/ 6	32 4 7N	29 36.8W	RMT1M-1	1097-1200	2219-2349		
# 30		32 6 8N	29 40.4W	RMT8M-1		NIGHT	FLOW DIST. 5.51 KM.	
10378	9/ 6	32 6.8N	29 40.4W	RMT1M-2	1200-1295	2349-0119		
# 31	10/ 6	32 9 3N	29 42.9W	RMT8M-2		NIGHT	FLOW DIST. 5.55 KM.	
10378	10/ 6	32 9.3N	29 42.9W	RMT1M-3	1290-1415	0119-0249		
# 32		32 12.2N	29 45.3W	RMT8M-3		NIGHT	FLOW DIST. 5.28 KM.	
10379	11/ 6	35 2.1N	33 3 7W	RMT1M-1	5- 50	0830-1000		
# 1		35 2 9N	33 7.9W	RMT8M-1		DAY	FLOW DIST. 6.07 KM.	
10379	11/ 6	35 2 9N	33 7.8W	RMT1M-2	50- 100	1000-1130		
# 2		35 3 3N	33 12 3W	RMT8M-2		DAY	FLOW DIST. 5.44 KM.	
10379	11/ 6	35 3 3N	33 12.2W	RMT1M-3	98- 200	1130-1300		
# 3		35 3.6N	33 16.7W	RMT8M-3		DAY	FLOW DIST. 6.14 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10379	11/ 6	35 3.2N	33 15.9W	RMT1M-1	200- 300	1351-1521		
# 4		35 2.9N	33 12.1W	RMT8M-1		DAY	FLOW DIST. 5.57 KM.	
10379	11/ 6	35 2.9N	33 12.1W	RMT1M-2	300- 400	1521-1651		
# 5		35 2.8N	33 8.3W	RMT8M-2		DAY	FLOW DIST. 5.49 KM.	
10379	11/ 6	35 2.8N	33 8.3W	RMT1M-3	400- 500	1651-1821		
# 6		35 3.3N	33 4.7W	RMT8M-3		DAY	FLOW DIST. 4.66 KM.	
10379	11/ 6	35 3.2N	33 3.8W	CTD	0-2000	1904-2025	WB @ STANDARD DEPTHS	3061
# 7		35 3.2N	33 3.9W	MS				
10379	11/ 6	35 0.5N	33 3.2W	RMT1M-1	800- 900	2228-2328		
# 8		34 58.3N	33 2.3W	RMT8M-1		NIGHT	FLOW DIST. 2.90 KM.	
10379	11/ 6	34 58.4N	33 2.3W	RMT1M-2	900-1000	2328-0028		
# 9	12/ 6	34 56.1N	33 1.7W	RMT8M-2		NIGHT	FLOW DIST. 3.66 KM.	
10379	12/ 6	34 56.2N	33 1.7W	RMT1M-3	1000-1100	0028-0128		
# 10		34 54.1N	33 1.2W	RMT8M-3		NIGHT	FLOW DIST. 3.39 KM.	
10379	12/ 6	34 52.8N	33 0.9W	RMT1M-1	0- 50	0227-0327		
# 11		34 50.8N	33 0.8W	RMT8M-1		NIGHT	FLOW DIST. 3.42 KM.	
10379	12/ 6	34 50 8N	33 0.8W	RMT1M-2	50- 100	0327-0427		
# 12		34 48.7N	33 0.7W	RMT8M-2		NIGHT	FLOW DIST. 3.39 KM.	
10379	12/ 6	34 48.7N	33 0.7W	RMT1M-3	100- 205	0427-0527		
# 13		34 46.7N	33 0 7W	RMT8M-3		NIGHT	FLOW DIST. 3 09 KM.	
10379	12/ 6	34 48.4N	33 4.3W	RMT1M-1	1100-1200	0758-0928		
# 14		34 50.9N	33 6.9W	RMT8M-1		DAY	FLOW DIST. 5.62 KM.	
10379	12/ 6	34 50.8N	33 6 9W	RMT1M-2	1200-1300	0928-1058		
# 15		34 52.9N	33 10.3W	RMT8M-2		DAY	FLOW DIST. 5.60 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10379	12/ 6	34 52.9N	33 10.2W	RMT1M-3	1300-1410	1058-1228		
# 16		34 55.0N	33 13.7W	RMT8M-3		DAY	FLOW DIST. 5.91 KM.	
10379	12/ 6	34 56 2N	33 16.2W	XX	0- 500	1402-1420	FINE MESH NET - VERTICAL HAUL	
# 17		34 56.3N	33 16.1W			DAY		
10379	12/ 6	34 58.6N	33 15.8W	RMT1M-1	800- 900	1540-1710		
# 18		35 2 1N	33 15.2W	RMT8M-1		DAY	FLOW DIST. 5.17 KM.	
10379	12/ 6	35 2 0N	33 15.2W	RMT1M-2	900- 995	1710-1840		
# 19		35 5.5N	33 14.5W	RMT8M-2		DAY	FLOW DIST. 5.81 KM.	
10379	12/ 6	35 5 5N	33 14.5W	RMT1M-3	995-1100	1840-2010		
# 20		35 9 0N	33 13.8W	RMT8M-3		DAY	FLOW DIST. 5.72 KM.	
10379	12/ 6	35 9.1N	33 12.0W	RMT1M-1	495- 600	2227-2327		
# 21		35 7 5N	33 9.9W	RMT8M-1		NIGHT	FLOW DIST. 3.60 KM.	
10379	12/ 6	35 7.5N	33 9.9W	RMT1M-2	600- 700	2327-0027		
# 22	13/ 6	35 6 1N	33 8.0W	RMT8M-2		NIGHT	FLOW DIST. 3.73 KM.	
10379	13/ 6	35 6.1N	33 8.0W	RMT1M-3	700- 792	0027-0127		
# 23		35 4.8N	33 5.7W	RMT8M-3		NIGHT	FLOW DIST. 3.31 KM.	
10379	13/ 6	35 3.2N	33 3.6W	RMT1M-1	200- 298	0232-0332		
# 24		35 1.8N	33 1.5W	RMT8M-1		NIGHT	FLOW DIST. 4.01 KM.	
10379	13/ 6	35 1.8N	33 1 6W	RMT1M-2	298- 400	0332-0432		
# 25		35 0.4N	32 59 5W	RMT8M-2		NIGHT	FLOW DIST. 3.55 KM.	
10379	13/ 6	35 0.5N	32 59.6W	RMT1M-3	400- 500	0432-0532		
# 26		34 59.2N	32 57 6W	RMT8M-3		NIGHT	FLOW DIST. 3.09 KM.	
10379	13/ 6	35 1.4N	33 0.8W	RMT1M-1	1400-1500	0803-0933		
# 27		35 3.8N	33 4.0W	RMT8M-1		DAY	FLOW DIST. 5.79 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10379	13/ 6	35 3.8N	33 4.0W	RMT1M-2	1500-1600	0933-1103		
# 28		35 6.0N	33 7.5W	RMT8M-2		DAY	FLOW DIST. 6.08 KM.	
10379	13/ 6	35 6.0N	33 7.5W	RMT1M-3	1600-1700	1103-1233		
# 29		35 7.8N	33 11.4W	RMT8M-3		DAY	FLOW DIST. 5.75 KM.	
10379	13/ 6	35 8.1N	33 13.9W	RMT1M-1	500- 600	1452-1622		
# 30		35 6.6N	33 10.7W	RMT8M-1		DAY	FLOW DIST. 4.72 KM.	
10379	13/ 6	35 6.6N	33 10.8W	RMT1M-2	600- 700	1622-1752		
# 31		35 5.0N	33 6.9W	RMT8M-2		DAY	FLOW DIST. 5.78 KM.	
10379	13/ 6	35 5.1N	33 7.0W	RMT1M-3	700- 800	1752-1922		
# 32		35 3.6N	33 3.3W	RMT8M-3		DAY	FLOW DIST. 5.91 KM.	
10379	13/ 6	35 5.6N	33 6.6W	RMT1M-1	1100-1200	2230-0000		
# 33	14/ 6	35 3.5N	33 2.6W	RMT8M-1		NIGHT	FLOW DIST. 5.19 KM.	
10379	14/ 6	35 3.5N	33 2.7W	RMT1M-2	1200-1295	0000-0130		
# 34		35 1.3N	32 59.3W	RMT8M-2		NIGHT	FLOW DIST. 6.23 KM.	
10379	14/ 6	35 1.3N	32 59.4W	RMT1M-3	1295-1400	0130-0300		
# 35		34 59.1N	32 56.3W	RMT8M-3		NIGHT	FLOW DIST. 5.64 KM.	
10379	14/ 6	35 0.3N	33 1.3W	RMT1M-1	2840-2980	0850-1046	175-45 M. OFF THE BOTTOM	
# 36		34 58.1N	32 56.5W	RMT8M-1		DAY	FLOW DIST. 5.53 KM.	
10379	14/ 6	34 58.1N	32 56.5W	RMT1M-2	2960-2985	1046-1216	23-56 M. OFF THE BOTTOM	
# 37		34 56.9N	32 53.2W	RMT8M-2		DAY	FLOW DIST. 5.30 KM.	
10379	14/ 6	34 57.0N	32 53.3W	RMT1M-3	2840-2980	1216-1303	01-32 M. OFF THE BOTTOM	
# 38		34 56.3N	32 51.5W	RMT8M-3		DAY	FLOW DIST. 2.64 KM.	
10379	14/ 6	34 59.1N	32 51.8W	RMT1M-1	1700-1800	1650-1820		
# 39		35 2.3N	32 54.9W	RMT8M-1		DAY	FLOW DIST. 4.96 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10379	14/ 6	35 2.2N	32 54.8W	RMT1M-2	1800-1900	1820-1950		
# 40		35 5.1N	32 57.3W	RMT8M-2		DAY	FLOW DIST. 5.87 KM.	
10379	14/ 6	35 5.9N	32 56.6W	RMT1M-1	1400-1495	2240-0010		
# 41	15/ 6	35 3.5N	32 53.1W	RMT8M-1		NIGHT	FLOW DIST. 4.89 KM.	
10379	15/ 6	35 3.6N	32 53.2W	RMT1M-2	1495-1600	0010-0140		
# 42		35 1.4N	32 49.8W	RMT8M-2		NIGHT	FLOW DIST. 5.78 KM.	
10379	15/ 6	35 1.4N	32 49.9W	RMT1M-3	1600-1700	0140-0310		
# 43		34 59.2N	32 46.8W	RMT8M-3		NIGHT	FLOW DIST. 5.51 KM.	
10380	16/ 6	30 0.4N	33 58.8W	RMT1M-1	5- 50	1252-1422		
# 1		30 1.3N	33 54.8W	RMT8M-1		DAY	FLOW DIST. 5.75 KM.	
10380	16/ 6	30 1.3N	33 54.9W	RMT1M-2	50- 100	1422-1553		
# 2		30 2.0N	33 51.0W	RMT8M-2		DAY	FLOW DIST. 5.99 KM.	
10380	16/ 6	30 2.0N	33 51.0W	RMT1M-3	100- 200	1553-1723		
# 3		30 2.6N	33 47.3W	RMT8M-3		DAY	FLOW DIST. 5.96 KM.	
10380	16/ 6	30 2.7N	33 46.0W	CTD	0-2000	1808-1925	WB @ STANDARD DEPTHS	
# 4		30 2.9N	33 45.7W	MS				
10380	17/ 6	30 2.5N	33 57.5W	RMT1M-1	1100-1200	0815-0945		
# 5		30 5.0N	33 54.5W	RMT8M-1		DAY	FLOW DIST. 4.96 KM.	
10380	17/ 6	30 5.0N	33 54.5W	RMT1M-2	1200-1300	0945-1115		
# 6		30 7.6N	33 51.4W	RMT8M-2		DAY	FLOW DIST. 5.93 KM.	
10380	17/ 6	30 7.6N	33 51.4W	RMT1M-3	1300-1400	1115-1245		
# 7		30 9.9N	33 47.9W	RMT8M-3		DAY	FLOW DIST. 6.00 KM.	
10380	17/ 6	30 10.8N	33 47.7W	RMT1M-1	800- 900	1458-1628		
# 8		30 9.0N	33 51.0W	RMT8M-1		DAY	FLOW DIST. 5.37 KM.	

STN.	DATE 1981	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10380	17/ 6	30 9.1N	33 50.9W	RMT1M-2	900-1000	1628-1758		
# 9		30 6.9N	33 54.0W	RMT8M-2		DAY	FLOW DIST. 5.24 KM.	
10380	17/ 6	30 6.9N	33 53.9W	RMT1M-3	995-1100	1758-1928		
# 10		30 4.5N	33 57.0W	RMT8M-3		DAY	FLOW DIST. 5.82 KM.	
10380	17/ 6	30 3.2N	33 58.5W	XX	0- 500	2039-2056	FINE MESH NET - VERTICAL HAUL	
# 11		30 3.0N	33 58.6W			DUSK		
10380	17/ 6	30 1.2N	34 0.9W	RMT1M-1	800- 900	2220-2320		
# 12		29 59.7N	34 2.5W	RMT8M-1		NIGHT	FLOW DIST. 3.34 KM.	
10380	17/ 6	29 59.8N	34 2.5W	RMT1M-2	900-1000	2320-0020		
# 13	18/ 6	29 58.2N	34 4.6W	RMT8M-2		NIGHT	FLOW DIST. 3.64 KM.	
10380	18/ 6	29 58.2N	34 4.5W	RMT1M-3	1000-1100	0020-0120		
# 14		29 56.5N	34 7.0W	RMT8M-3		NIGHT	FLOW DIST. 4.02 KM.	
10380	18/ 6	29 54.5N	34 9.8W	RMT1M-1	200- 300	0235-0336		
# 15		29 52.9N	34 12.1W	RMT8M-1		NIGHT	FLOW DIST. 4.08 KM.	
10380	18/ 6	29 52.9N	34 12.0W	RMT1M-2	300- 400	0336-0435		
# 16		29 51.6N	34 14.3W	RMT8M-2		NIGHT	FLOW DIST. 3.46 KM.	
10380	18/ 6	29 51.6N	34 14.3W	RMT1M-3	400- 505	0435-0535		
# 17		29 51.1N	34 16.5W	RMT8M-3		NIGHT	FLOW DIST. 3.73 KM.	
10380	18/ 6	29 53.0N	34 15.5W	RMT1M-1	1400-1498	0834-1004		
# 18		29 55.2N	34 12.5W	RMT8M-1		DAY	FLOW DIST. 5.87 KM.	
10380	18/ 6	29 55.1N	34 12.6W	RMT1M-2	1498-1600	1004-1134		
# 19		29 57.7N	34 9.0W	RMT8M-2		DAY	FLOW DIST. 6.11 KM.	
10380	18/ 6	29 57.6N	34 9.1W	RMT1M-3	1600-1700	1134-1304		
# 20		30 0.4N	34 5.5W	RMT8M-3		DAY	FLOW DIST. 6.38 KM.	

STN.	DATE 1981	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10380	18/ 6	30 3.1N	33 59.7W	RMT1M-1	200- 300	1536-1706		
# 21		30 3.8N	33 56.5W	RMT8M-1		DAY	FLOW DIST. 5.91 KM.	
10380	18/ 6	30 3.8N	33 56.6W	RMT1M-2	300- 400	1706-1836		
# 22		30 4.6N	33 52.8W	RMT8M-2		DAY	FLOW DIST. 5.28 KM.	
10380	18/ 6	30 4.5N	33 52.9W	RMT1M-3	400- 500	1836-2006		
# 23		30 5.4N	33 49.3W	RMT8M-3		DAY	FLOW DIST. 5.37 KM.	
10380	18/ 6	30 4.0N	33 48.8W	RMT1M-1	500- 600	2226-2326		
# 24		30 2.4N	33 50.9W	RMT8M-1		NIGHT	FLOW DIST. 3.62 KM.	
10380	18/ 6	30 2.5N	33 50.8W	RMT1M-2	600- 710	2326-0026		
# 25	19/ 6	30 1.1N	33 53.1W	RMT8M-2		NIGHT	FLOW DIST. 3.82 KM.	
10380	19/ 6	30 1.1N	33 53.0W	RMT1M-3	705- 800	0026-0126		
# 26		29 59.8N	33 55.5W	RMT8M-3		NIGHT	FLOW DIST. 4.00 KM.	
10380	19/ 6	29 58.9N	33 57.2W	RMT1M-1	0- 50	0216-0316		
# 27		29 57.6N	33 59.9W	RMT8M-1		NIGHT	FLOW DIST. 4.22 KM.	
10380	19/ 6	29 57.6N	33 59.8W	RMT1M-2	50- 100	0316-0416		
# 28		29 56.3N	34 2.6W	RMT8M-2		NIGHT	FLOW DIST. 4.42 KM.	
10380	19/ 6	29 56.3N	34 2.5W	RMT1M-3	100- 205	0416-0516		
# 29		29 55.2N	34 4.9W	RMT8M-3		NIGHT	FLOW DIST. 3.73 KM.	
10380	19/ 6	30 0.6N	33 56.0W	RMT1M-1	500- 600	0835-1005		
# 30		29 59.6N	33 59.6W	RMT8M-1		DAY	FLOW DIST. 5.44 KM.	
10380	19/ 6	29 59.6N	33 59.6W	RMT1M-2	600- 700	1005-1135		
# 31		29 58.6N	34 3.2W	RMT8M-2		DAY	FLOW DIST. 5.60 KM.	
10380	19/ 6	29 58.6N	34 3.2W	RMT1M-3	700- 805	1135-1305		
# 32		29 57.5N	34 6.4W	RMT8M-3		DAY	FLOW DIST. 4.90 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10380	19/ 6	29 55.5N	34 10.4W	RMT1M-1	1700-1900	1515-1710		
# 33		29 53.1N	34 15.1W	RMT8M-1		DAY	FLOW DIST. 6.19 KM.	
10380	19/ 6	29 53.1N	34 15.0W	RMT1M-2	1900-2100	1710-1905		
# 34		29 50.5N	34 19.1W	RMT8M-2		DAY	FLOW DIST. 7.28 KM.	
10380	19/ 6	29 50.5N	34 19.1W	RMT1M-3	2100-2300	1905-2100		
# 35		29 47.2N	34 23.0W	RMT8M-3		DAY	FLOW DIST. 6.88 KM.	
10380	19/ 6	29 45.5N	34 21.0W	RMT1M-1	1102-1120	2356-0018	CLOSED PREMATURELY	
# 36	20/ 6	29 45.5N	34 20.1W	RMT8M-1		NIGHT	FLOW DIST. 1.35 KM.	
10380	20/ 6	29 45.5N	34 20.2W	RMT1M-2	1120-1200	0018-0148		
# 37		29 45.9N	34 16.8W	RMT8M-2		NIGHT	FLOW DIST. 4.91 KM.	
10380	20/ 6	29 45.9N	34 16.9W	RMT1M-3	1200-1300	0148-0318		
# 38		29 46.8N	34 14.4W	RMT8M-3		NIGHT	FLOW DIST. 4.60 KM.	
10381	20/ 6	30 59.4N	33 13.2W	RMT 1	610- 800	1639-1736	CLOSING COD-END AND FLOW METER TRIAL	
# 1		31 0.6N	33 10.8W	RMT 8		DAY		
10381	20/ 6	31 1.7N	33 8.1W	RMT 1	300- 450	1854-1930	CLOSING COD-END AND FLOW METER TRIAL	
# 2		31 2.2N	33 6.7W	RMT 8		DAY		
10382	21/ 6	32 30.2N	32 0.1W	CTD	0-2000	0810-0929	WB @ STANDARD DEPTHS	
# 1		32 31.0N	32 0.1W	MS				
10382	21/ 6	32 31.8N	31 56.9W	RMT1M-1	1100-1200	1106-1306		
# 2		32 33.2N	31 51.3W	RMT8M-1		DAY	FLOW DIST. 6.94 KM.	
10382	21/ 6	32 33.2N	31 51.4W	RMT1M-2	1200-1300	1306-1506		
# 3		32 35.3N	31 46.2W	RMT8M-2		DAY	FLOW DIST. 8.13 KM.	
10382	21/ 6	32 35.3N	31 46.3W	RMT1M-3	1300-1400	1506-1706		
# 4		32 38.0N	31 41.4W	RMT8M-3		DAY	FLOW DIST. 8.42 KM.	

STN.	DATE 1981	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10382	21/ 6	32 38.3N	31 39.5W	RMT1M-1	800- 900	2221-2321		
# 5		32 37.3N	31 42.3W	RMT8M-1		NIGHT	FLOW DIST. 3.42 KM.	
10382	21/ 6	32 37.3N	31 42.3W	RMT1M-2	900-1000	2321-0021		
# 6	22/ 6	32 36.3N	31 44.9W	RMT8M-2		NIGHT	FLOW DIST. 3.98 KM.	
10382	22/ 6	32 36.3N	31 44.9W	RMT1M-3	1000-1100	0021-0121		
# 7		32 35.3N	31 47.4W	RMT8M-3		NIGHT	FLOW DIST. 3.57 KM.	
10382	22/ 6	32 34.9N	31 50.5W	RMT1M-1	500- 605	0248-0348		
# 8		32 34.6N	31 53.2W	RMT8M-1		NIGHT	FLOW DIST. 3.46 KM.	
10382	22/ 6	32 34.6N	31 53.1W	RMT1M-2	605- 700	0348-0448		
# 9		32 34.3N	31 55.7W	RMT8M-2		NIGHT	FLOW DIST. 3.48 KM.	
10382	22/ 6	32 34.3N	31 55.6W	RMT1M-3	700- 800	0448-0548		
# 10		32 34.0N	31 58.2W	RMT8M-3		NIGHT	FLOW DIST. 3.51 KM.	
10382	22/ 6	32 33.8N	32 3.3W	RMT1M-1	800- 900	0801-0932		
# 11		32 33.5N	32 7.0W	RMT8M-1		DAY	FLOW DIST. 5.35 KM.	
10382	22/ 6	32 33.5N	32 6.9W	RMT1M-2	900-1000	0932-1102		
# 12		32 33.2N	32 11.0W	RMT8M-2		DAY	FLOW DIST. 4.89 KM.	
10382	22/ 6	32 33.2N	32 10.9W	RMT1M-3	1000-1100	1102-1232	NO FLOW	
# 13		32 32.8N	32 15.2W	RMT8M-3		DAY		
10382	22/ 6	32 32.8N	32 15.0W	RMT1M-1	500- 600	1426-1556		
# 14		32 33.0N	32 11.2W	RMT8M-1		DAY	FLOW DIST. 5.15 KM.	
10382	22/ 6	32 33.0N	32 11.3W	RMT1M-2	600- 700	1556-1726		
# 15		32 33.4N	32 7.2W	RMT8M-2		DAY	FLOW DIST. 5.64 KM.	
10382	22/ 6	32 33.4N	32 7.3W	RMT1M-3	700- 800	1726-1856		
# 16		32 33.9N	32 3.5W	RMT8M-3		DAY	FLOW DIST. 5.53 KM.	

STN.	DATE 1981	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10382	22/ 6	32 35.8N	32 1.0W	RMT1M-1	0- 50	2230-2330		
# 17		32 35.8N	31 59.0W	RMT8M-1		NIGHT	FLOW DIST. 3.51 KM.	
10382	22/ 6	32 35.8N	31 59.1W	RMT1M-2	50- 105	2330-0030		
# 18	23/ 6	32 35.6N	31 57.1W	RMT8M-2		NIGHT	FLOW DIST. 3.84 KM.	
10382	23/ 6	32 35.6N	31 57.2W	RMT1M-3	100- 200	0030-0130		
# 19		32 35.3N	31 55.2W	RMT8M-3		NIGHT	FLOW DIST. 3.46 KM.	
10382	23/ 6	32 35.2N	31 54.2W	RMT1M-1	200- 300	0203-0303		
# 20		32 35.2N	31 52.0W	RMT8M-1		NIGHT	FLOW DIST. 3.33 KM.	
10382	23/ 6	32 35.2N	31 52.0W	RMT1M-2	300- 420	0303-0412		
# 21		32 35.1N	31 49.3W	RMT8M-2		NIGHT	FLOW DIST. 3.88 KM.	
10382	23/ 6	32 35.1N	31 49.4W	RMT1M-3	405- 500	0412-0512		
# 22		32 35.0N	31 47.0W	RMT8M-3		NIGHT	FLOW DIST. 3.26 KM.	
10382	23/ 6	32 33.7N	31 50.2W	RMT1M-1	200- 300	0854-1024		
# 23		32 32.8N	31 54.0W	RMT8M-1		DAY	FLOW DIST. 5.53 KM.	
10382	23/ 6	32 32.8N	31 53.9W	RMT1M-2	300- 400	1024-1155		
# 24		32 31.4N	31 57.5W	RMT8M-2		DAY	FLOW DIST. 5.73 KM.	
10382	23/ 6	32 31.4N	31 57.5W	RMT1M-3	400- 500	1155-1325		
# 25		32 31.1N	32 1.6W	RMT8M-3		DAY	FLOW DIST. 5.60 KM.	
10382	23/ 6	32 31.1N	32 3.2W	RMT1M-1	5- 50	1408-1538		
# 26		32 31.1N	32 7.0W	RMT8M-1		DAY	FLOW DIST. 5.71 KM.	
10382	23/ 6	32 31.1N	32 6.9W	RMT1M-2	50- 99	1538-1708		
# 27		32 30.9N	32 10.7W	RMT8M-2		DAY	FLOW DIST. 5.42 KM.	
10382	23/ 6	32 30.9N	32 10.6W	RMT1M-3	97- 200	1708-1838		
# 28		32 30.6N	32 14.6W	RMT8M-3		DAY	FLOW DIST. 5.73 KM.	

STN.	DATE 1981	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
10382	23/ 6	32 32.0N	32 14.5W	CTD	0- 300	2036-2051		
# 29		32 32.2N	32 14.5W					
10382	23/ 6	32 34.6N	32 13.2W	RMT 1	850-1000	2158-2258	CLOSING COD-END AND FLOW METER TRIAL	
# 30		32 37.0N	32 11.8W	RMT 8		DUSK		
10382	24/ 6	32 42.1N	32 9.5W	RMT 1	1080-1210	0119-0249	CLOSING COD-END AND FLOW METER TRIAL	
# 31		32 45.8N	32 7.8W	RMT 8		NIGHT		
10382	24/ 6	32 48.7N	32 7.4W	CTD	0- 370	0425-0448		
# 32		32 49.0N	32 7.6W					
10382	24/ 6	32 50.7N	32 7.1W	RMT 1	600- 900	0535-0603	CLOSING COD-END AND FLOW METER TRIAL	
# 33		32 51.8N	32 6.7W	RMT 8		NIGHT		