I.O.S.

R. R. S. DISCOVERY

CRUISE 92

4 April – 23 May 1978

Midwater and benthic sampling in the Porcupine Sea Bight and midwater studies along 13°W and 17°W and around 42°N 17°W

CRUISE REPORT No. 70

1978

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences,
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Surrey GU8 5UB.

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SCIENTIFIC PERSONNEL

R.A. Aldred	IOS Wormley	Leg 1 only
M.V. Angel	IOS Wormley	PSO
J. Athersuch	University of Leicester	
S. Audley	IOS Barry	Leg 2 only
J.R. Badcock	IOS Wormely	
D.S.M. Billett	IOS Wormely	
J. Burnham	IOS Barry	Leg 1 only
P. Domanski	IOS Wormley	Leg 2 only
C. Durning	University of Lancaster	
M.J.R. Fasham	IOS Wormley	
B. Hansen	Copenhagen Museum	Leg 1 only
M.J. Harris	IOS Wormley	Leg 2 only
P.J. Herring	IOS Wormley	
Miss R. Larcombe	IOS Wormley	
N.R. Merrett	IOS Wormley	Leg 1 only
G.R. Phillips	IOS Wormley	Leg 1 only
P.R. Pugh	IOS Wormley	
A.L. Rice	IOS Wormley	Leg 1 only
Miss L. Rigby	IOS Wormley	Leg 2 only
H.S.J. Roe	IOS Wormley	
D.M. Shale	IOS Wormley	
J. Sherwood	IOS Barry	Leg 1 only
J. Smithers	IOS Wormley	Leg 1 only
Miss C. Taylor	IOS Wormley	
R.A. Wild	IOS Wormley	

SHIP'S OFFICERS AND PETTY OFFICERS

	Leg 1		Leg 2
Master		M. Harding	
Chief Officer	D. Noden		P. Moran
Second Officer	S. Jarvis		R. Coutts
Third Officer	J. Seymour		G. Harries
Catering Officer		R. Cridlan	
Chief Engineer		D. Warlow	
Second Engineer	N. de Rosa		T. Rees

	Leg 1		Leg 2
Third Engineer		R. Perriam	
Fourth Engineer	B. Entwhistle		P. Marsh
Fifth Engineer	(	A. Greenham	
	(A. Davies		R.M. Thomas
Chief Electrical Officer		F.P. Sharpe	
Boatswain		T. Leonard	
Netman		R.G. Burt	
Carpenter		L. Cromwell	

OBJECTIVES

Primary 1. To collect a comprehensive series of midwater samples throughout the total water column including samples from within 5-20 m of the sea bed at two stations at depths of about 2000 m and 4000 m respectively in the Porcupine Sea Bight region.

2. To collect benthic samples using a variety of samplers (i.e. the semi-balloon otter trawl, the epibenthic sledge and a fish trap fitted with a time lapse camera) at these same stations to complement the midwater sampling so an assessment of the total water column ecosystem could be attempted.

.3. Initial midwater studies at 42°N17°W to facilitate the designing of the joint biological and physical mesoscale experiment planned for 1980/1.

Secondary 1. To collect a series of oblique samples along 13°W and 17°W to investigate the possible existence of a zoogeographical boundary between 42°N and 50°N.

2. To make observations on the physical structure of the water in the Porcupine Sea Bight area

3. To make studies on the phytoplankton during the cruise by fluorometry, particle-counting and direct study of phytoplankton.

4. To develop the multiple RMT 1+8 system.

5. To use the in situ light meter mounted on the net monitor to study the relationship between light levels and the diurnal migration patterns of zooplankton and nekton.

6. To collect a repeat series of hauls at 1000 m to investigate a) the patchiness of organisms at such depth and b) whether these organisms undergo diurnal vertical migration.

7. To collect further benthic samples from as many depths as possible between the edge of the continental shelf and the abyssal plain in the Porcupine Sea Bight Area.

ITINERARY

The ship sailed at 1000 h./4. IV, on time in spite of the difficulties caused by the crane drivers industrial action. The ship's officers, crew, the scientists and particularly the IOS ship liaison personnel are to be congratulated on the efforts they made to achieve the scheduled sailing time. Radar calibrations were carried out off Portsmouth before the ship proceeded to Falmouth to pick up explosives for Cruise 93. She arrived off Falmouth at 0730/5.IV and sailed again at 1430. Two runs along the measured mile at Polperro were used to calibrate the E.M. log. The ship called into Falmouth Roads again to pick up a box of scientific equipment delayed in transit to IOS by British Road Services. The PES fish and TS profiler were streamed on the morning of 6th April and clocks were adjusted to GMT during the night. The ship arrived in the Porcupine Sea-bight area just after midnight/7.IV. Initially an otter trawl was fished at a depth of about 1000 m and this provided the bait for the fish trap (9752 / 2) which was set out at a 1000 m depth. The ship then steamed to a position where the sounding was 2000 m. A partially successful monitor test was conducted, followed by a fluorometer intercalibration, a CTD profile to 2000 m, and then another otter trawl. On 8.IV various monitor tests were mostly abortive, but a good benthic sledge sample was achieved. The ship then steamed back to a position where the sounding was 1500 m. A CTD and fluorescence profile to 110 m was followed by a short turbulence experiment at 25 m. A benthic sledge sample (9754 / 3) gave a good catch before the ship returned to the 1000 m position to pick up the fish trap. Once the fish trap had recovered (0830/9.m) the ship steamed back to the 2000 m position. Three midwater trawls sampled down to 1500 m, although the final haul showed that there were still problems with the monitors. Until then the weather conditions had been ideal but the wind had begun to freshen. A CTD dip with the *in situ* fluorometer to 100 m ended during a vicious 50 kt squall. With little hope of any sampling with the midwater trawls because of both the weatter conditions and the problems with the monitors, the ship steamed for the 4000 m position, arriving at 1930/10.IV. Working conditions were marginal in 25-35 kt wind conditions, but even so a good start was made both in the midwater and benthic sampling programmes. Work at the 4000 m station included midwater sampling, benthic sampling and fluorescence observations. The net monitors on the midwater trawls continued to be suspect but even so much of the total water column sampling was completed apart from the near bottom hauls. On the successful recovery of the fish trap at 9756/ 8 at 1730/15.IV conditions had deteriorated so much that it was decided to start the CTD survey. This was started at 1750/16.IV and after delays caused both by cable failures on the CTD and some bad weather the survey was finally terminated at 0640/21.IV.

The ship then made course for the 2000 m station taking an otter trawl sample at 1500 m and a test RMT 1+8 to 100 m on the way. A further RMT 1+8 at 1500-1900 m and a benthic sledge sample were accomplished before yet another depression caused the abandonement of further station work. The rather depressing weather forecasts encouraged the decision to move south, so the ship set course for the Goban Spur area. At 0800/23.IV an otter trawl was fished at 800 m, followed by a bottom sledge at a similar depth, and a chlorophyll profile. The ship then moved to a position at the edge of the shelf and made a CTD dip. Otter trawl samples and a sledge sample were taken down the gradual slope to the west of the spur. The sledge sample at 1400 m (9779/1) was noteably rich. The first of the series of obliques along 13°W was carried before the ship moved out into deep water to once again attempt a 3500 m near bottom tow with the RMT 1+8. Once again this attempt failed, the monitor failing to respond to any signals. The ship then steamed back towards the shelf and completed a line of three CTD in 2500 m, 2000 m, and 1500 m of water respectively to identify more clearly the possibly cascaded water observed during the main CTD survey.

The ship then continued with the series of oblique combination net samples along 13°W, with occasional further fluorometer observations and a further abortive attempt at a deep 4000-3500 m combination net tow. After monitor tests were conducted on a vertical wire at 42°N 13°W the vessel sailed for Vigo at 1610/29.IV, and arrived at 0830/30IV.

In Vigo M. Harris, S. Audley, P. Domanski and Miss L Rigby joined the cruise, and A.L. Rice, N.R. Merrett, R.G. Aldred, G. Phillips, J. Smithers, J. Sherwood, J.R. Burnham and B. Hansen left. On the 2nd May the ship was visited by 16 Spanish scientists from the Instituto Espanol de Oceanografia and the Instituto de Investigaciones Pesqueras, and by about 50 students from the University of Santiago. The British Naval Attaché in Madrid Commander J.M. Lee O.B.E. RN and the British Vice Consul in Vigo, Mr. J.M. Cogolludo also visited the ship.

The ship's departure on the 3 May was delayed initially by the eventual release of equipment brought out as hand luggage by the scientists joining and impounded by customs in Bilbao, and then by a hydraulics failure of the aft crane. She eventually sailed at 0800/4.V. The P.E.S. and TS fishes were streamed at 0900/5.V, and the vessel arrived at the 4000 m station position in the Porcupine Sea Bight area at 0500/6.V. After a CTD dip to 2000 m, a vertical miniseries of hauls was completed using the RMT 1+8 multinet system within 48 hours. The induced state of euphoria was immediately quelled by a further abortive attempt at a deep RMT 1+8 tow. Not only did the monitor fail to open the net but the final recovery in rapidly deteriorating weather conditions with wind gusts of up to 50 kts resulted in Dr. P.R. Pugh being bowled over into the A-frame by a wave breaking over the poop. Considerable damaged occurred to both nets and the top bar was hung up on the release gear.

As it seemed pointless to throw good ship's time after bad, course was set, once the weather has moderated, for 50°N 17°W to start the second line of obliques southwards. This line was completed by 0500h/13.V at 42°N 17°W. A miniseries of tows to a depth of 1500 m was then completed during the following 48 hours.

At 1600/14.V a group of at least 3 rorqual whales were sighted that were almost certainly humpbacks judging by the black and white coloration of their flukes, their long flippers and the shape of their backs and dorsal fin.

At dawn on the 15th May a series of tows was begun to fish isolumes in an attempt to follow the movements of vertical migrants. During darkness on the 15th May chlorophyll profiles were measured using the CTD, the *in situ* fluorometer, the pump and the Turner fluorometer. The isolume chasing hauls were continued on the 16th, but were abandoned before dusk because of an apparent fault on the light meter card in the monitor. That evening a series of repeated tows were made at 1000 m. This series continued until midday on the 18th, with only a pause in the morning of the 18th while the engineers replaced the badly worn brake drums on the main winch. A final CTD dip to 2000 m was made during the break. During the afternoon of the 18th, the light meter for the monitors was lowered on a vertical wire, to provide a clean trace of its response under ideal conditions. A short multiple net tow was then conducted partly to provide a clean trace of the operation of the net, and partly to provide a quantity of euphausiids for deep freezing. A series of deep tows was started after a series of abortive attempts of launching the nets, with the monitor prematurely triggering at the surface. The deep series consisted of two hour tows down through strata 200 m thick, starting at 1500 m working down. On the morning of the 19th May an attempt to open the net at 2100 m failed as a result of the loss of sensitivity of the monitor at depth. The monitor was replaced but then one of the bars was seen to be bent and so the side-wires and towing bridles were replaced. Meanwhile an ugly little dispute over the opening of the ventilation hatch from the winch motor room behind the winch drivers head to reduce over-heating, threatened the continuation of the sampling programme. Although the dispute did not cause the loss of scientific time, it was an indication of how trivial problems may be increasingly difficult to resolve amicably now the ship is unionised.

A complete series down to 3800 m was achieved, but the final haul to 4500 m was only partially successful as a result of a further monitor failure. The work at 42°N 17°W was finally completed with a CTD dip to 4000 m at 1400/22.V. The ship set course for Lisbon arriving there at 1000h/24.V. The cruise's final sting in the tail was the delay in the stamping of the scientist's passports by Portuguese immigration officials until 1830 h. This curtailed the well-earned relaxation of the scientific party in Lisbon before returning to U.K.

I would like to thank all members of Captain Harding's crew for all their help and cooperation. The difficulties in achieving the scientific objectives were generally always eased by the forebearance and patience of both officers and crew.

1. GEAR REPORTS

a. Benthic samplers

The semi-balloon otter trawl (OTSB 14) was used unaltered from previous cruises (i.e. Cruises 75, 77, 79, 82 and 88). It has again proved to be a most effective and useful sampler, and has the great advantage in being relatively safe to operate in winds of up to force 9.

The epibenthic sledge (BN 1.5 3m) was used with two important modifications. Firstly the single net constructed of netting with a 4.5 mm mesh but with a 1.0 mm mesh cod-end was replaced by three smaller nets. The outer two of these nets were constructed throughout of the 4.5 mm mesh, and the central one of the 1.0 mm mesh throughout. This modification was an attempt to collect the smaller organisms more quantitatively without seriously reducing the overall filtering efficienty of the whole sampler. The use of three cod-ends complicated both the handling of the gear and the treatment of the samples. However, the modification was considered to be a success as the samples collected by the coarse nets were generally washed clean even from over very muddy bottoms, while the fine net apparently collected more small animals than the previous mixed-mesh nets.

The second modification was the attachment of a 1.5 m circumference odometer wheel to one skid of the BN 1.5. The revolutions of the odometer were indicated on the pinger transmissions recorded on the P.E.S. mufax during the course of the hauls. Two hundred revolutions of the wheel produced are complete sweeps of a trace through a time interval of $\frac{1}{2}$ second (i.e. 200 fms indications on the P.E.S.) relative to the reference 2 second pulse. Thus each revolution of the wheel which indicated a 1.5 m foreward movement of the sledge produced a one fathom (i.e. 1/400 second) deflection of the trace. Minor problems were encountered in using this system, but it worked well in making it possible to fish the gear for a known distance along the sea bed rather than for a standard time when the precise speed of the speed over the ground is not known. While no towed gear can be expected to be absolutely quantitative in its sampling, the BN 1.5

must now approach this ideal reasonable closely, at least for the larger epifaunal organisms and shallow infauna.

During BN 1.5 hauls soundings were taken at 10 min intervals. The depth range of fishing of the net was taken to be the range of soundings recorded from when shooting the net to the end of a period equal in duration to the interval between the first bottom contact and final lift-off.

The fish trap used was very similar to the one deployed (and still in place with the pinger functioning, but the release still failing to operate mechanically) during cruise 88. This cruise, however, a surface mooring was used rather than an acoustic release and pop-up system, also a fine mesh line was fitted beneath the bait to retain smaller animals during hauling. An interesting, though unsuccessful innovation was the use of a kite tethered to the dan-buoy to facilitate relocation during bad weather. Tests during passage out gave us every confidence that the kite would stay aloft in anything but dead calm weather. During the first cast the lower end of the polypropylene kite line chafed through on the radar reflector. In the event the weather was extremely clear during both retrievals of the trap (inspite of the 30-40 kt winds experienced when retrieving the second cast), and no problems were encountered relocating the dans. However, it is worth pursuing the technique as the kite could prove most useful in less fabourable conditions.

b. Midwater

Gear trials on Cruise 87 had revealed weaknesses in the construction and attachment of the release gears to the monitor cross. New body castings of both 2- and 4-jaw release gears were used on the cruise, with integral lugs for the attachment of the release strops. The attachment point to the monitor-cross had been rotated through 90° and a new coupling between the cross and the release gear had been incorporated, allowing limited movement of the gear in the fore and aft as well as lateral directions. All these modifications worked successfully and the release gears and their attachment points are now much more robust.

Cruise 87 demonstrated the feasibility of the multiple RMT 1+8 system, which was used seriously for the first time on this cruise. Slight modifications to the bridle lengths had been made since the initial trials, the orientation of the 4-jaw release gear had been changed and a shorter RMT 1 upper fixed bar had been incorporated to reduce the compression loads on the fixed bar.

The system using three pairs of sequentially opening RMT 1's and RMT 8's was used 38 times, producing 228 samples, without a single mechanical failure. The major advantage of the multiple system is to allow the nearly simultaneous sampling of different depth horizons. Both are achieved with a considerable saving in ship's time, since three pairs of samples are obtained with only a single paying out and hauling in period. Each of the vertical series in the upper 900 m were taken in under 24 hours and consisted of eighteen, one hour tows, less than 4½ hours being taken over paying out and hauling in. Fishing the remainder of the water column between 900 x 3900 m required only five hauls, each fishing three 200 m horizons for two hours each. This deep series took 49h 23 minutes fishing time, of which 19 h 23 minutes was spent hauling and paying out. These represent a major saving in ship's time when compared with similar series done with the conventional RMT 1+8.

The seals on the mouths of the RMT 1's were extremely good and there was very little evidence of contamination. The gaps between the bars of the first and second RMT 8 were small compared with the standard RMT 1+8, due to the weights of the nets above them, but the top RMT 8 had a gap of some six inches when closed. In an effort to reduce this, a heavy bar (50 lbs) replaced the aluminium top bar, for the deep hauls. This improved the seal, reducing the gap to 3" but it is clear there is still a slight problem here.

Handling on deck was not difficult, an average time of 15 minutes was taken to retrieve, re-rig and reshoot the net. The system was used in varying conditions up to 25 knots and a moderate swell without undue problems.

A potential problem with the multiple net was the condition of the animals in the first net, which would have been towed for several hours before retrieval. Tests on cruise 87 had shown that the multiple net was a much more stable system than the RMT 1+8. The condition of the catches, even in the deepest tows from 4500 m and 3900 m which were towed for 6 hours after closing, contained delicate polychaetes and planktonic holothurians in near perfect condition. Ctenophores and deep sea medusae were also taken intact in other hauls and the condition of catches generally was excellent.

Previously, deep samples have been taken from 500 m horizons, but with the multiple net narrower horizons (200 m) were sampled. These, certainly down to 3000 m showed marked differences in faunal composition to justify narrower sampling bands.

An effort to improve the reception of the monitor by reducing obstructions infront of the transducer was made by **cutting off the upper 8 inches of the cross.** Eyebolts with nylon inverts were fixed to the flowmeter arms and the cross was towed on a pair of 8 mm bridles, each passing through one of the eyebolts to a shackle on the forward edge of the triangular plate of the cross. The towing bridles were joined to the swivel, eighteen inches in front of the monitor. The modified cross worked well, towed at the same angle as the original cross and showed no signs of vibration. The validity of the modification has not, however, been proved.

The standard RMT 1+8, as usual, functioned well but the dinoflagellate net was torn or damaged on a number of occasions and was finally removed for the remainder of the cruise.

On one occasion when conditions had deteriorated with a steep, short swell, the bottom RMT 1 fixed bar (8ft) was hooked over the release gear and badly bent. One RMT 1 cod-end and bucket were torn aft and lost, a second RMT 1 was torn, the RMT 1 side wires were almost cut through and an RMT 8 was split along its whole length.

Contamination of deep hauls with animals from the upper layers has been a problem for some time. A simple method to overcome this was by throttling the RMT 8 at closure. A drogue was released from the upper RMT 8 sliding bar on closure, the force of which throttled the RMT 8 about $1\frac{1}{2}$ metres from the cod-end. The force produced by the drogue was about 50 lbs but this turned out to be excessive, straining the seams on the net. The drogue was reduced in size but still produced too much pull. The method was successful in reducing contamination, but a much smaller drogue and less complicated release mechanism are necessary to reduce gear damage and facilitate easier rigging. The problem of contamination therefore still remains as one of the major tasks to be solved especially if deep tows are to be relied upon.

In agreement with conventional oblique tows, which are opened at the surface and fished downwards, most of the multiple net hauls were opened at the upper depth and fished down, adjusting the ship's speed accordingly.

c) Monitors

The net monitors used with the RMT 1+8 and RMT 1+8 m net systems were of two types, the MkH and MkJ. The H type (blue and red) being the earlier version.

The blue H type was used successfully on a number of deep hauls to a depth of 3900 m and a slant range of 7900 m. The only failure was due to a defective battery pack in the release gear.

The sensors and sensor telemetry system in J3 and J6 operated without fault during the cruise, but the depth sensor on J3 had to be recalibrated because of a scale shift. While both J type monitors were capable of opening and closing the nets upon acoustic command at slant ranges of up to 3000 m it was apparent that their receivers were less sensitive than the H type. Apart from this lack of sensitivity several factors contributed to the malfunction of the J6 system. In the early part of the cruise a defective magnetic latching relay caused the net to operate on noise. This was followed by a battery pack failure in the release gear giving the impression that the monitor was not switching correctly. Towards the end of the cruise after a period of correct operation J6 began switching on noise. This fault was due to an inadequate mechanical earthing system of the electronics. Some of these faults masked the reduced sensitivity of the receiver, and it was only at the end of the cruise that the receiver was set to a sensitivity that enabled it to operate at a range of 8500 m. Even then it was apparent that one of the channels was temperature sensitive and would not operate below approximately 3°C.

Because of the difficulties encountered in obtaining the necessary depth range with J6, it was thought that the support frame (cross) might be acoustically masking the transcucer on the monitor. To overcome this problem, initially the monitor case was extended to place the transducer beyond the end of the cross. Later the cross was modified to provide this facility while using a standard length monitor case. It was difficult to check the usefulness of this modification but it seemed that the monitor was no longer so sensitive to its vertical elevation relative to the ship.

2. BENTHIC RESULTS

a) General

A total of 9 otter-trawl hauls, 7 epibenthic sledge hauls and 2 fish-trap casts were made.

The primary benthic objectives of the cruise were almost completely achieved in that two samples with the otter-trawl and two with the epibenthic sledge were obtained both at the 2000 m station in the centre of the Bight and at the 4000 m station at its mouth. This success was marred only by the loss of the fine net catch from the epibenthic sledge when the weak link parted during retrieval from one of the 2000 m hauls (9775 / 3) and a malfunction of the camera system during the same haul. A superficial examination of these two sets of samples reveals some interesting differences besides those to be expected from the difference in depth. First, the catches from the deeper area were all remarkably mud free, indicating an unexpectedly firm bottom and confirming the results obtained with the otter trawl in the same area during cruise 88. In contrast, the 2000 m samples, and particularly those obtained with the epibenthic sledge, all contained large quantities of fine globigerina ooze, presumably indicating little water movement in the central Bight region. Second, the duplicated hauls, separated by only a few kilometres, indicate considerable patchiness, at least for some groups. Third, and perhaps most interestingly, the 4000 m sledge samples contain very large numbers of small echinoderms, particularly holothurians and ophiuroids. We do not yet know whether these animals are juveniles, but if they are their presence perhaps indicates a reproductive seasonality making further samples from the same stations at other times of the year very desirable.

In addition to these 2000 m and 4000 m samples, a good series of benthic samples was obtained within and below the coral massif in the north-eastern part of the Bight, and a second series from the edge of the shelf to about 1500 m down the Goban Spur to the south-east of the Bight. These two series indicate a fairly widespread firm sea-bed in the 500-1000 m depth range, indicative of relatively high water movement, with a very much finer sediment below this depth. It would clearly be very interesting to obtain samples at similar depths from the northern and western areas, though the most serious gaps in the bathymetric coverage are obviously between about 2000 and 4000 m.

The two fish trap casts, one in the coral zone at about 1000 m and the other at 3800 m at the mouth of the Bight, caught disappointingly few fish, though the small number of photographs developed on board indicate that more entered the trap than were ultimately brought to the surface! However, large numbers of amphipods were obtained, particularly during the shallow cast and the remainder of the photographic record will perhaps provide further interesting information.

Further general comments about most of the benthic taxa taken during the cruise would be inappropriate before the samples have been examined in greater detail, but the dominant large invertebrates, the holothurians, and also the fishes, warrant the following separate short reports.

b) Fish

More than 700 bottom-living fishes, comprising about 50 species from 21 families, were collected from the 9 otter trawl and 7 epibenthic sledge hauls. The broad sounding range sampled (200-4100 m) provided preliminary information on the faunal assemblages present on the continental slope of the Porcupine Sea Bight. Peak biomass and species diversity were found at mid-slope depths (700-1500 m). While poor catches were made over the fine sediments encountered around soundings of 2000 m, some of the deep tows (c. 4000 m) yielded surprisingly good results.

The most abundant species collected was the eel, Synaphobranchus, of the mid-slope fauna, where Notacanthus, Alepocephalus, Lepidion, Trachyrhynchus, Coelorhynchus, Coryphaenoides rupestris, Nezumia and Hoplostethus mediterraneus also dominated. A further assemblage could be identified from somewhat deeper (1400-2000 m) composed of Bathyraja, Conocara macroptera, Coryphaenoides güntheri and Hoplostethus atlanticus. Finally, among the deepest samples collected (3600-4100 m), Histiobranchus, Nomoctes koefoedi, Rinoctes, Bathypterois, Coryphaenoides annatus, C. leptolepis and C. carapinus were characteristic.

Of particular interest were an unusual species of Rhinochimaera, specimens of the rare alepocephalid Rinoctes, juveniles of Antimora and a female of a bythitid genus (? Calamopteryx) in a running ripe condition. This last specimen shed many thousands of larvae (<10 mm overall), whose reduced yolk sacs were a conspicuous pink colour. Otolith samples were taken from selected specimens of the more abundant species for use in growth studies.

c) Holothurians

The twelve samples taken between 200-2000 m permitted the approximate bathymetric distribution of the bathyal holothurians in the Porcupine Bight to be established. Stichopus tremulus occurred to a depth of 1000 m where Laetmogone violacea became common. A specimen of S. tremulus was kept alive for several days during which time its methods of locomotion and righting were observed. Although the intestine and respiratory trees were eviscerated on the first day, it was not until the third day that the gonads were shed. Commensal polychaetes were found on several specimens of L. violacea. Benthogone rosea occurred with L. violacea between 1000-1500 m and then with Paelopatides gigantea from 1500 m to 2000 m. Mesothuria sp. and Echinocucumis sp. were present in the samples taken at about 1500 m. It was unfortunate that the camera failed to function during a sledge trawl when the density of P. gigantea approached 1 per 10 m^2.

The abyssal holothurians taken between 3600-4000 m were similar to those sampled in the same area on Cruise 88 (November 1977). Psychropotes longicauda, Oneirophanta mutabilis mutabilis, Peniagone diaphana, and Benthodytes lingua were particularly prominent. Deima validum validum and Paroriza sp. were also present. Molpadia blakeii and Achlyonice ecalcarea were notable by their absence since both of these holothurians occurred in significant numbers on Cruise 88 (Station 9638/2). Benthothuria sp. was once again taken at 3700 m and photographed fresh owing to difficulties encountered with its preservation. Ovarian brood

brood protection that has been demonstrated in Oneirophanta m. affinis could not be found in Oneirophanta m. mutabilis.

3. TOTAL WATER COLUMN SAMPLING

The ordinary combination net was fished down to 1900 m at the 2000 m station, and to 3500 m at the 4000 m station in the Porcupine Sea Bight, by fishing 500 m strata. The combination of frequent storms and the persistent malfunctioning of the J-type monitors prevented the attainment of a complete series. The only near-bottom tow that appeared to function successfully was spoilt by the dinoflagellate net hanging up the other two nets. Near bottom sampling is only possible in good weather conditons with the present system of sampling as the ship's speed has to be maintained extremely accurately. In gusting winds greater than force 5 or in sea states where the conditions cause significant variations in the ship's speed, the nets are too likely to be trawled into the sea-bed.

At 42°N 17°W a deep series of nets to depths of 4500 m was accomplished using the multiple net. This is an area of soundings often well in excess of 4500 m, so the influence of the proximity of the sea-bed was not evident in the samples.

The lack of success of the deep midwater sampling in linking up with the benthic sampling in the Porcupine Sea Bight was a major failure in the overall scientific programme of the cruise.

4. OBLIQUE SERIES

One of the main problems in the interpretation of previous sampling programmes, noteably the results of the seasonal sampling at 44°N 13°W in 1974/5, has been the knowledge of the precise location of a possible zoogeographical boundary in the vicinity of 43-45°N. The boundary seems to have gone unnoticed in other zoogeographical studies and seems to be associated with the latitude at which the winter storms fail to turn over the water column. This could be considered to be the subtropical convergence which is generally not considered to be identifiable in the N.E. Atlantic. Many aspects of the ecology and zoogeography of planktonic organisms, such as the regular occurrence of many of the species of the so-called Lusitanian fauna may be resolved by an understanding of what occurs across this boundary.

Two series of 0-1000 m oblique RMT 1+8 tows were conducted along 13°W (on leg 1) and along 17°W (on leg 2), from about 50°N to 42°N. The spacing of the tows was for the most part 1° of latitude. A CTD dip to 2000 m was made prior to each oblique. The 13°W series showed a maximum faunal change between 44° and 43°N, which was mostly clearly seen onboard in the change in the midwater fish fauna. Subjectively the boundary was less clearly defined in the 17°W series.

5. MINISERIES

Two miniseries were accomplished using the multiple net at the 4000 m station in the Porcupine Sea Bight and at 42°N 17°W. 100 m strata were fished for one hour both by day and by night down to 900 m, and 200 m strata for two hours from 900-1500 m. Each series was completed in less than 48 hours, and is a good example of how the multiple net increases our sampling power. The series in the Porcupine Sea Bight was designed to be part of the total water column sampling. The series at 42°N 17°W was a preliminary look at the area in which a joint biological/physical mesoscale experiment is planned for 1980/1. Both series were complimentary to the earlier zoogeographical and vertical distribution studies carried out by the IOS Biology Group.

6. BIOLUMINESCENCE

The benthic sampling programme provided the opportunity to examine further the luminous systems of a number of echinoderms. The large numbers of Plutonaster bifrons obtained at several stations allowed a particularly thorough examination and localisation of the phenomenon in this species. Specimens of Pectinaster and Benthopecten were also examined and the luminescence of the ovaries of these animals, and of the ophiuroid Ophiomusium, was confirmed. A number of luminous holothurians were also obtained, notable Laetmogone, Paroriza and Benthogone, though Oneirophauta was not luminous. The capture of two specimens of the luminous shark Etmopterus provided the opportunity to compare its photophores with those of the midwater genera Isistius and Euprotomicrus obtained previously.

Among the midwater fauna attention has been concentrated upon the cephalopods, particularly the cranchiid Taonius, the decapod Sergestes and the medusa Atolla. The complex responses of the latter animal are particularly intense, with rhythmic responses to individual stimuli. The abundant medusa Pelagia has also been examined in some detail and found to have complex luminescent responses involving a flickering over the general body and manubrium surface, as well as brighter sources round the umbrellar margin. Considerable numbers of the animals have been deep-frozen whole, and extracts prepared, in order to investigate the kinetics of of their luminescent material.

The luminous system of several radiolarians has been studied and found to exhibit a close similarity to that of many coelenterates in that calcium activated luminescent extracts can be prepared. The animals themselves give rhythmic post-stimulus flashes when in good condition.

Continued work on the bioluminescence spectral analysis system has improved the methods and the software, reducing the noise inherent in low intensity spectra. Previous suggestions concerning the role of the filter pigments in hatchetfish, photophores have been clearly demonstrated, and spectra recorded from a variety of other species.

Trials with an image intensifier/videotape system have shown that the present lens combination is inadequate for some work, but have nevertheless demonstrated that the system can provide data unobtainable by any other system.

In addition to the experimental work photophores from several species have been fixed and embedded for subsequent study of their comparative ultrastructure.

7. OSMOTIC PRESSURE OF CRUSTACEAN HAEMOLYMPH

A survey of the osmotic pressures of the haemolymph of various planktonic animals was undertaken with the aid of a Ramsay-type micro-freezing point determination apparatus. Animals from the surface water were collected both by day and night in either the Neuston or Oxfam net or by filtering the non-toxic sea water supply. Some midwater organisms were also studied, particularly those reportedly able to regulate their buoyancy or species which appeared buoyant in the RMT 1+8 catches, such as certain copepods, e.g. *Euaugaptilus magnus*.

Blood samples were obtained by micropipette under liquid paraffin and their osmolarities calculated by comparing their freezing points (taken as the temperature, to within 0.005°C, at which the last ice crystal in the sample thawed) to those of distilled water and a one osmolar sucrose standard. Of the animals sampled, including a range of calanoid copepods, cyclopoids of the genus *Corycaeus* (the only cyclopoids large enough to yield blood samples by this technique) (*Gigantocypris mulleri* and *Conchoecia* species, some isopods and euphausids and goose barnacles, all proved to be roughly isosmotic with the surrounding sea water except *Evadne nordmanni*. This cladoceran hypo-osmoregulates, being found to maintain a blood concentration some 600 m osmoles below that of sea water ($\Delta \approx 0.75°C$). Attempts at silver straining to locate areas of the cuticle permeable to chloride were inconclusive. This reduction in blood concentration was observed to render the animal neutrally or positively bouyant.

Relative density measurements were made on blood from a few specimens of *Gigantocypris*, an ostracod which is positively buoyant on capture. A density gradient column was prepared by layering a mixture of xylene and carbontetrachloride of density c 0.98 $g.ml^{-1}$ onto another mixture of the two with a density of c 1.03 $g.ml^{-1}$. The interface between the two layers was gently broken and the mixture left for a day to allow diffusion to establish a gradient of increasing density down the column. Gigantocypris blood was found to have a density equivalent to about 90% SW.

8. PARTICLE COUNTING AND PHYTOPLANKTON FLUORESCENCE

The Turner fluorometer was used throughout the cruise to measure the near-surface levels of fluorescence, or, during the occasional pump station, to look at the vertical distribution of this fluorescence. Comparisons were made between the readings of this fluorometer and those of the Chelsea instrument and the results are discussed elsewhere in this report. Calibration measurements were made at frequent intervals. Expecially during the vertical profiling stations, and the results exemplify the extreme variability in the relationship between *in vivo* fluorescence and the actual concentration of chlorophyll A. This was especially noticeable, during the second leg of the cruise where the levels of fluorescence were very similar at the two major positions worked. The Porcupine Sea Bight and 42°N, 17°W, but the actual concentrations of chlorophyll A differed by a factor of three. At the latter position there was also an interesting diurnal variation in the fluorescence levels. To see whether this variation was due to a vertical migration of the phytoplankton, was a function of diurnal variations in the levels of fluorescence of individual cells, or had some other cause, calibration and concentrated phytoplankton samples were taken at frequent intervals during two 24 hour periods and particle counting, in the 1.35 to 600 µm size range, was carried out on a semi-continuous basis. These results remain to be analysed in detail, but it does appear that, although there was a five-fold variation in the fluorescence levels, the actual chlorophyll A concentration varied to a much smaller extent. Distinct changes in the concentrations of particles in various size ranges were, however, noted.

Particle counting was not very successful during the cruise due to the fact that early in the first leg one of the printed circuit boards was inadvertantly blown up! Attempts to rectify the situation met with a singular lack of success, but much was learned concerning the workings of the machine! A new board eventually reached us in Vigo and so, after some initial checks, particle counting was possible for most of the second leg. Three new innovations to the system were tried out during the cruise. Firstly, a flow integrator had been built so that the volume of water which passed through the larger sensor

(CMB 600 - 18-600μm sizing range) during each count cycle could be assessed. This worked extremely well and the integrated flow was displayed by the printer along with the channel counts. Secondly, a self-cleaning filter, with a slit size of 75 μm, was introduced into the line leading to the smaller sensor (CMB 60 - 10 - 60 μm. Sizing range). It was hoped that this would considerably reduce the rate at which this sensor tended to become blocked, and, although the situation was not ideal, counting periods of up to 6 hours were achieved before blockages occurred. However, it is not known as yet what effect this filter has on the concentration and size distribution of particles within the sizing range of the sensor.

Thirdly, some last minute modifications were made in an attempt to enable the ship-borne computer to sample the count data. This proved to be more complicated than was at first suspected and, because of the demise of the particle counter during the first leg of the cruise, little was achieved. However, Steve Audley spent some time during the second leg trying to iron out the faults and eventually succeeded in convincing the PDP11/04 to sample the data and to dump it out onto paper tape.

Particle counting was carried out during the vertical profiling and "turbulence" experiments on the second leg. Both sensors were brought into use and interesting variations in the particle concentrations were noted and were mainly correlated with the changes in the fluorescence levels. A plethora of data was again collected and will have to await further analysis!

9. PHYTOPLANKTON SAMPLING

Surface water samples were taken on a fairly regular basis with special attention being paid to areas where fluorometer readings were high. Advantage was taken at CTD stations where the multisampler was used to collect water samples from the top 120 m of the water column. At the pumping station (9801/43) samples were obtained at 10 m intervals to a depth of 110 m.

Initial analysis of phytoplankton filtered through a 10 μm mesh indicated a substantial (but not unexpected) change in the floral composition from North to South. In the North, in the region at the mouth of the Porcupine Bight and over the Porcupine Abyssal plain, the dominant diatom species included several *Chaeotoceros* spp. with variable numbers of *Thalassionema nitzschiodes*, *Nitzschia delicatissima* and *Rhizosolenia* spp. Moving southwards *Chaetoceros* became less abundant and less species rich, with the diatoms generally becoming less diverse but more abundant. The dominant forms were several species of *Rhizosolenia* and *Nitzschia delicatissima*.

10. CTD OBSERVATIONS

A new system of sampling the CTD has initiated using the IBM 1800 and the PDP 11/04 front-end computer. This proved capable of logging at rates uo to 5 scans per second and was found to be 100% reliable. Further development was carried out on the 1800 CTD software package and all the known faults and omissions have been corrected.

A CTD survey was made of the Porcupine Bight consisting 2 east-west lines from the shelf edge out to 4000 m, and one north-south line across the mouth of the Bight. At a number of stations, bottle samples were also taken for the analysis of silicate, nitrate, phosphate and oxygen. There was evidence of high salinity water, lying above the Gulf of Gibraltar Water, which had probably cascaded off the Continental Shelf. It is hoped that this can be confirmed when the oxygen analyses become available.

CTD dips down to 2000 m were also made of each station of the two lines of oblique nets down 13°W and 17°W.

11. CHELSEA FLUOROMETER

The newly designed underwater fluorometer designed by Chelsea Instruments was tested for the first time. On the first leg the instrument was fitted to the CTD and run in conjunction with P. Pugh's pumping system. This enabled the results from the Chelsea instrument (CIF) to be compared with the Turner Fluorometer. This showed that the CIF was basically working up to specification, and could detect chlorophyll levels down to c.0.3 μg /litre. However a problem was found with noise spikes when the CIF was sampling at the low fluorescence end of its range. This is thought to be due to noise being picked up by the log amplifier in the detector circuit and can probably be overcome. It was also found that the instrument was sensitive to ambient light in the top few metres of water, and so a light proof plastic hood was built to cover the sensor head. This was connected by tube to the pumps inlet so that water could be drawn through the hood by the pump action. This served to ensure that a smooth flow of water passed the sensor heads.

On the second leg the CIF was connected up, in series with Turner fluorometer, to the pumped sea water supply. CIF signal was connected to the IBM 1800 enabling 2 minute averages to be stored on disk. When these averages were compared with the Turner values it was again found that, bearing in mind the greater sensitivity of the Turner, the output of the two instruments agreed well. There was some indication though that the sensitivity of the CIF was slightly unstable and this will need further investigation before the instrument can be used routinely.

12. 1000 m REPEAT SERIES

On the second leg seven tows with the multiple net were made over a period of 36 hours (i.e. a total of 21 samples) and supplemented with an earlier tow over a dusk period. The aim of this series was to establish whether or not their is any clear evidence of cyclic changes in the fauna that may be the result of diurnal vertical migrations, and some idea of the variability in the catches that may be attributable to patchiness. The fauna in the RMT 8 was not particularly rich in species, but included decapod species (e.g. Gennadas, Pasiphaea and Acanthephyra, mysids (e.g. Eucopia, Boreomysis, and a few Gnathophausia) euphausiids (Thysanopoda and Bentheuphausia) medusae (Atolla etc.), Beroë, Gigantocypris and about half a dozen fish species. There were many species that occurred in every haul without obvious systematic variations in abundance, one or two species such as Eucopia sculpticauda fluctuated in being present in fair numbers to being totally absent. The analysis of these hauls should provide a most useful insight into the movement of biomass within the water column which will be particularly relevent to possible biological influence on the flux or chemical compounds and elements in the deep water column.

13. DEEP SEA PHOTOMETER

The deep sea photometer (LLP) had its most extensive use so far on this cruise; two dips on a vertical wire and 17 net hauls - of which 12 were on the RMT 1+8M. All except 2 hauls were successful, once a battery lead was punched inside the photometer and once the light card in the monitor failed to operate satisfactorally - probably due to high tempereatures whilst waiting on deck. This card was subsequently modified by M.J. Harris and is now much improved. Light penetration in the sea was fairly poor throughout the cruise, the maximum depth attained with the photometer was 450 m - some 300 m shallower than the water south of Tenerife.

A series was fished with the photometer on the multiple net sampling 3 light horizons between sunrise and sunset on two consecutive days. Seven hauls were successful, producing 21 samples with each net, fishing light of around $5x10^{-3}$, $5x10^{-4}$ $\mu w/cm^2$. The final haul was abandoned since the monitor end of the system was faulty. Faunal differences were marked between the $5x10^{-2}$ abd $5x19^{-4}$ hauls, the former consisting mainly of pteropods with a few tiny Argyropelecus hemigymnus, Nansenia and a few Beroe cucumis. The $5x10^{-4}$ tows contained large numbers of euphausiids, A. hemigymnus, B cucumis and Notoscopelus. The $5x10^{-5}$ hauls were not strikingly different to the $5x10^{-4}$, but contained fewer euphausiids, more A. hemigymnus, Cymbulia and a few Benthosema.

The most interesting tows were those on the two days where the depth horizons fished were virtually identical but the light levels were not. When this occurred for the 10^{-3} and 10^{-4} light levels the fauna corresponded to the prevailing light conditions irrespective of depth. The euphausiids centred on the $5x10^{-4}$ level throughout the period and Notoscopelus apparently did likewise. The pteropods remained concentrated on the brighter $5x10^{-3}$ level.

One interesting aspect of these tows were the effects of clouds on the prevailing light levels. Large thick clouds rapidly changed the light by over 2 decades, and changes of one order of magnitude were very common. It seems extremely unlikely that animals can respond to these continuous, very rapid changes in light intensity.

14. MIDWATER FISHES

Four species, Cyclothone braueri, C. microdon, Argyropelecus hemigymnus and Benthosema glaciale predominated in the catches at each station of the oblique sampling series along 13°W and 17°W. As a consequence of this, impressions of faunal change between 50°N and 42°N are at present hard to formulate without more detailed catch analyses. Certainly the southerly samples showed some differences from the more northerly ones and some gradual faunal change is implied south of about 44°N. Even so, overall the fish catches made along these two meridians were all faunally more akin to those made in previous years at 53°N 20°W and 44°W than to those taken at 40°N 20°W during 1970. In the same way the vertical distributions of species in the Porcupine Sea Bight area and at 42°N 17°W appear to be more similar to those observed at 53°N and 44°N than at 40°N (where mesopelagic subarctic temperate species showed either a marked submergence or were absent). In both the Sea Bight area and at 42°N 17°W midwater fishes did not occur in depths greater than about 3000 m, which is similar to the lower limit found previously at 20°N 21°W.

At least 27 species were captured during the 1000 m series at 42°N 17°W, but of these only two, Cyclothone microdon and the juveniles of Poromitra, were caught with any measure of consistency. Among the remaining species there seemed no obvious relationship between their appearance in a sample and the sampling time; diel vertical migrations are probably not characteristic of the species encountered at this depth in this area.

Rare species taken and worthy of note were Parabrotula, Leucobrotula and Monognathus, the last mentioned being captured in 2100-2300 m depth at 42°N 17°W.

GEAR USED	ABBREVIATION IN STATION LIST
Batfish	BATFISH
Bottom Camera	BCAM
Bottom Net 1.5m² closing with 3 nets 1 net fine	BN1.5/3M
Bottom trap	TRAP B
Conductivity/Temperature/Depth Probe	CTD
Dinoflagellate Net (attached to RMT 1+8)	DN
Fluorometer deck mounted	FL
Fluorometer submersible (mounted in Batfish)	UFL
Light meter on net monitor	LLP
Light meter, photo-diode profiler	LMD
Otter Trawl, semi-balloon 14m headline	OTSB 14
Rectangular midwater trawl 1m² Rectangular midwater trawl 8m²	RMT 1 RMT 8) fished in combination
Rectangular midwater trawl with three 1m² and three 8m² nets fished in succession	RMT 1M RMT 8M
Rosette multi sampler	MS
Submersible pump	PUMP

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9752 # 1	7/ 4	51 16.3N 51 18.6N	11 42.5W 11 42.8W	OTSB 14	1007-1042	0121-0220 NIGHT	BELLY TORN	
9752 # 2	7/ 4 9/ 4	51 18.2N 51 18.6N	11 43.7W 11 43.2W	TRAP B BCAM	1017-1017	0804-0650		1017
9753 # 1	7/ 4	50 55.0N 50 55.1N	12 19.0W 12 16.9W	RMT 1 RMT 8	10- 110	1308-1345 DAY	MONITOR TEST - DIFFICULTY IN CLOSING	1985
9753 # 2	7/ 4	50 55.0N 50 55.0N	12 16.3W 12 16.1W	CTD UFL FL LMD	3- 110	1413-1447 DAY	NEW UFL TRIALS	
9753 # 3	7/ 4	50 54.9N 50 54.8N	12 15.6W 12 15.8W	CTD MS	0-1976	1544-1745	WB @ 1976, 1500, 1000, 500 & 5 M.	1983
9753 # 4	7/ 4	50 54.9N 50 56.5N	12 12.0W 12 14.8W	OTSB 14	1942-1947	2034-2218 NIGHT	DOORS INTERMESHED	
9753 # 5	8/ 4	50 58.8N 50 59.8N	12 17.6W 12 16.8W	RMT 1 RMT 8	0- 0	0129-0206 NIGHT	MONITOR TEST - NO DEPTHS	
9753 # 6	8/ 4	50 59.4N 50 52.5N	12 15.6W 12 4.4W	RMT 1 RMT 8 DN	10-1000	0231-0537 NIGHT	HAUL TO 550M. TO CLOSE - NO FLOW	1915
9753 # 7	8/ 4	50 54.5N 50 54.8N	12 10.9W 12 11.4W	BN 1.5/3M BCAM	1942-1942	1120-1202 DAY		
9753 # 8	8/ 4	50 54.6N 50 55.6N	12 11.1W 12 12.7W	OTSB 14	1942-1942	1512-1612 DAY		
9754 # 1	8/ 4	51 7.4N 51 7.2N	12 1.4W 12 1.3W	CTD UFL FL PUMP	5- 110	2138-2232 NIGHT		

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9754	8/ 4	51 7.2N	12 1 3W	CTD	20- 25	2234-2309		
# 2		51 7.0N	12 1.2W	UFL		NIGHT		
				FL				
				PUMP				
9754	9/ 4	51 8.4N	12 1.5W	BN 1.5/3M	1484-1484	0023-0127		
# 3		51 9.5N	12 1.8W	BCAM		NIGHT		
9755	9/ 4	50 54.6N	12 21.4W	RMT 1	50- 500	1129-1329		2010
# 1		50 58.1N	12 24.1W	RMT 8		DAY	FLOW DIST. 6.51 KM.	
9755	9/ 4	50 59.0N	12 20.9W	RMT 1	500-1000	1613-1813		1995
# 2		51 1.0N	12 15.0W	RMT 8		DAY	FLOW DIST. 7.81 KM.	
				DN				
9755	9/ 4	50 59.7N	12 10.6W	RMT 1	1000-1525	2124-0228	DIFFICULT TO CLOSE - HAUL TO 1050 M.	1850
# 3	10/ 4	51 8.4N	12 0.7W	RMT 8		NIGHT	FLOW DIST. 19.45 KM.	
9755	10/ 4	50 50.2N	12 17.1W	CTD	5- 100	0923-0944		2089
# 4		50 50.3N	12 17.5W	UFL		DAY		
				LMD				
9756	10/ 4	49 48.4N	14 0.8W	RMT 1	10-1000	1950-2105	OBLIQUE	3989
# 1		49 50.6N	14 5.1W	RMT 8		NIGHT	FLOW DIST. 4.18 KM.	
				DN				
9756	10/ 4	49 52.8N	14 10.3W	RMT 1	1000-1500	2306-0306		4008
# 2	11/ 4	49 56.1N	14 22.3W	RMT 8		NIGHT	FLOW DIST. 14.38 KM.	
				DN				
9756	11/ 4	49 48.0N	14 14.8W	OTSB 14	4080-4156	1137-1310		
# 3		49 48.8N	14 19.3W			DAY		
9756	11/ 4	49 41.6N	14 10.1W	RMT 1	1500-2000	2033-0033	NO DN CATCH	4043
# 4	12/ 4	49 50.1N	14 7.4W	RMT 8		NIGHT	FLOW DIST. 14.70 KM.	
				DN				

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9756	12/ 4	49 49.3N	14 5.7W	OTSB 14	4012-4020	0728-0928		
# 5		49 52.3N	14 10.7W			DAY		
9756	12/ 4	49 44.2N	14 1.4W	RMT 1	2000-2500	1706-2106		4071
# 6		49 47.1N	14 14.8W	RMT 8		DUSK	FLOW DIST. 12.63 KM.	
				DN				
9756	13/ 4	49 45.9N	14 4.1W	RMT 1	2500-3000	0237-0637	FLOW EST. - DN MOUTH TORN	4062
# 7		49 53.0N	14 14.0W	RMT 8		NIGHT	FLOW DIST. 13.48 KM.	
				DN				
9756	13/ 4	49 53.6N	13 57.9W	TRAP B	3852-3852	1315-1730		3852
# 8	15/ 4	49 55.2N	13 54.7W	BCAM				
9756	13/ 4	49 47.1N	14 1.5W	BN 1.5/3M	4039-4069	2030-2125		4054
# 9		49 48.5N	14 2.0W	BCAM		NIGHT	ROLLER DIST. 546 M.	
9756	14/ 4	49 47.0N	14 4.4W	RMT 1	3000-3500	0723-1123		4062
# 10		49 52.6N	14 15.3W	RMT 8		DAY	FLOW DIST. 14.11 KM.	
				DN				
9756	14/ 4	49 49.7N	14 4 7W	RMT 1	4100-4200	1813-2143	4000-4012M.-FOR COMMENT SEE BIO LOG	4006
# 11		49 54 6N	14 11.0W	RMT 8		DUSK	FLOW DIST. 11.98 KM.	
				DN				
9756	15/ 4	49 57.0N	14 14.7W	CTD	5- 100	0118-0147		
# 12		49 57.0N	14 14.5W	UFL		NIGHT		
				FL				
				PUMP				
9756	15/ 4	49 57.1N	14 14.3W	CTD	3- 60	0217-0455	132 MINS @ 20 M.	
# 13		49 57.6N	14 12.9W	UFL		NIGHT		
				FL				
				CM				
9756	15/ 4	50 4 0N	13 55.6W	BN 1.5/3M	3680-3697	0834-0934		3688
# 14		50 4.3N	13 53.2W	BCAM		DAY	ROLLER DIST. 631 M.	

STN	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9757	16/ 4	49 12.2N	11 35.1W	CTD	3- 615	1751-1904	WB @ 615,500,375,250,125,100 & 3M.	637
# 1		49 12.2N	11 34.8W	MS				
9758	16/ 4	49 8.8N	12 9.7W	CTD	3- 962	2207-2251	WB @ 962 & 6M.	983
# 1		49 8.6N	12 9.8W	MS				
9759	17/ 4	49 31.4N	12 38.0W	CTD	3-1492	0222-0339	WB @ 1200,1300 & 6M.	1509
# 1		49 32.2N	12 35.6W	MS				
9760	17/ 4	49 40.1N	12 52.3W	CTD	3-1984	0540-0656	WB @ 1984 & 6M.	2010
# 1		49 39.4N	12 50.9W	MS				
9761	17/ 4	49 50.3N	13 7.2W	CTD	3-2416	0855-1038	WB @ 2416 & 6M.	2429
# 1		49 50.3N	13 7.6W	MS				
9762	17/ 4	50 9.7N	13 35.1W	CTD	6-2883	1338-1555	WB @ 11 DEPTHS - SEE LOG	2890
# 1		50 10.4N	13 35.0W	MS				
9763	17/ 4	50 23.8N	13 53.1W	CTD	3-2400	1837-2015	WB @ 2400 & 6 M.	2423
# 1		50 24.4N	13 53.8W	MS				
9764	17/ 4	50 26.8N	13 56.9W	CTD	3-1964	2049-2155	NO BOTTLES FIRED	1983
# 1		50 27.1N	13 57.2W	MS				
9765	17/ 4	50 35.2N	14 8.4W	CTD	3-1469	2324-0026	WB @ 1469 & 6 M.	1490
# 1	18/ 4	50 35.5N	14 8.6W	MS				
9766	18/ 4	50 43.0N	14 19.1W	CTD	3- 923	0149-0225	CTD FAILURE - STATION ABORTED	1014
# 1		50 42.8N	14 19.0W	MS				
9767	18/ 4	51 3.7N	14 21.1W	CTD	3- 681	0736-0819	WB @ 681,500,375,250,175,100 & 6 M.	705
# 1		51 3.6N	14 21.5W	MS				
9768	18/ 4	50 43.5N	14 19.1W	CTD	3- 996	1059-1147	WB @ 996 & 6 M.	1002
# 1		50 43.2N	14 19.4W	MS				

STN.	DATE 1978	POSITION LAT	LONG	GEAR.	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9769	18/ 4	49 53.6N	14 1.1W	CTD	3-3906	1734-2031	WB @ 11 DEPTHS - SEE LOG	3917
# 1		49 53.0N	14 0.8W	MS				
9770	19/ 4	50 29.7N	13 7.4W	CTD	3-2440	0141-0337	WB @ 2440 & 6 M.	2481
# 1		50 30.6N	13 5.0W	MS				
9771	19/ 4	50 56.2N	12 20.0W	CTD	3-1976	1108-1255	WB @ 11 DEPTHS - SEE LOG	1989
# 1		50 56.0N	12 19.6W	MS				
9772	21/ 4	51 8.4N	12 1.6W	CTD	3-1453	0201-0254	WB @ 1453 & 6 M	1483
# 1		51 8.1N	12 1.3W	MS				
9773	21/ 4	51 18.7N	11 44.1W	CTD	5- 400	0442-0504	CTD FAILURE - DIP ABORTED	1008
# 1		51 18.8N	11 44.2W	MS				
9773	21/ 4	51 19.1N	11 45.2W	CTD	5- 856	0621-0700	CTD FAILED AT 856 MWO.	1113
# 2		51 19.1N	11 45.6W	MS				
9774	21/ 4	51 4.4N	11 59.3W	OTSB 14	1494-1572	1032-1148		1533
# 1		51 5.2N	12 3.4W			DAY		
9775	21/ 4	51 2.5N	12 11.7W	RMT 1	10- 100	1455-1655	DROGUE USED TO STRANGLE RMT8 COD-END	1850
# 1		51 0.2N	12 17.3W	RMT 8		DAY	FLOW DIST. 7.12 KM.	
9775	21/ 4	50 58.9N	12 21.8W	RMT 1	1500-1900	1833-2316	DID NOT CLOSE 'TIL HAUL TO 1500 M.	2010
# 2		50 48.3N	12 29.1W	RMT 8		NIGHT	FLOW DIST. 17.95 KM.	
9775	22/ 4	50 56.8N	12 22.4W	BN 1.5/3M	2012-2019	0332-0442	WEAK LINK PARTED-FINE NET CATCH LOST	2016
# 3		50 55.7N	12 19.2W	BCAM		NIGHT	ROLLER DIST. 400 M.	
9776	23/ 4	49 29.4N	11 38.4W	OTSB 14	800- 808	0917-1017		
# 1		49 27.8N	11 37.7W			DAY		
9776	23/ 4	49 22.7N	11 36.0W	BN 1.5/3M	770- 785	1223-1309	WEAK LINK PARTED - CAMERA FAILED	777
# 2		49 21.5N	11 35.6W	BCAM		DAY	ROLLER DIST. 805 M.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9776 # 3	23/ 4	49 20.5N 49 20.6N	11 36.1W 11 36.0W	CTD UFL FL LMD	3- 110	1443-1542 DAY		748
9777 # 1	23/ 4	49 15.6N 49 15.5N	11 12.9W 11 12.8W	CTD MS UFL LMD	3- 189	1755-1810 DAY	WB @ 189,150,100 & 6 M.	196
9777 # 2	23/ 4	49 15.1N 49 14.5N	11 14.9W 11 21.1W	OTSB 14	205- 280	1910-2047 DUSK		240
9777 # 3	23/ 4 24/ 4	49 14.4N 49 13.6N	11 23.8W 11 24.0W	CTD UFL FL PUMP	3- 110	2146-0006 NIGHT	60 MINS. @ 15 M.	384
9778 # 1	24/ 4	49 14.6N 49 17.1N	12 7.1W 12 6.3W	OTSB 14	1016-1055	0436-0538 NIGHT		1030
9779 # 1	24/ 4	49 22.3N 49 20.7N	12 49.1W 12 49.5W	BN 1.5/3M BCAM	1398-1404	1130-1227 DAY	 ROLLER DIST. 837 M.	1401
9780 # 1	24/ 4	49 11.8N 49 11.9N	12 59.0W 12 58.2W	CTD MS	4-1892	1546-1722	WB @ 1397,1392 & 1390M.-CTD FAILURE	1903
9780 # 2	24/ 4	49 11.5N 49 8.0N	12 58.6W 13 3.6W	RMT 1 RMT 8	10-1000	1745-1929 DAY	OBLIQUE FLOW DIST. 5.88 KM.	1888
9781 # 1	25/ 4	49 8.8N 49 9.5N	13 30.6W 13 30.6W	RMT 1 RMT 8	1200-1430	0134-0150 NIGHT	FAILED TO OPEN AT REQUIRED DEPTHS	3626
9782 # 1	25/ 4	49 3.8N 49 3.7N	13 3.1W 13 3.6W	CTD MS	4-2511	0840-1042	WB @ 11 DEPTHS - SEE LOG	2524

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9783	25/ 4	49 3.9N	12 53.0W	CTD	4-1978	1311-1428	WB @ 1978 & 6 M.	1989
# 1		49 3.8N	12 53.4W	MS				
9784	25/ 4	49 4.8N	12 43.8W	CTD	4-1464	1532-1636	WB @ 1464 & 6 M.	1479
# 1		49 4.6N	12 43.2W	MS				
9785	25/ 4	48 0.2N	13 0.5W	CTD	3-2000	2352-0103	WB @ 2000 & 6 M.	4526
# 1	26/ 4	48 0.0N	13 0.3W	MS				
9785	26/ 4	47 59.8N	12 59.5W	RMT 1	10-1000	0135-0302	OBLIQUE	4526
# 2		47 59.3N	12 53.2W	RMT 8		NIGHT	FLOW DIST. 4.60 KM.	
9786	26/ 4	46 31.4N	12 59.0W	CTD	3-2000	1317-1455	WB @ 2000 & 6 M. - MONITOR CALIB.	4308
# 1		46 31.4N	12 58.7W	MS				
9786	26/ 4	46 31.9N	12 59.0W	RMT 1	10-1000	1516-1654	OBLIQUE	4308
# 2		46 36.0N	13 1.1W	RMT 8		DAY	FLOW DIST. 5.14 KM.	
9786	26/ 4	46 37.4N	13 3.5W	CTD	3- 110	1812-1936	2 DIPS	
# 3		46 37.6N	13 3.2W	UFL		DAY		
				FL				
				LMD				
9787	27/ 4	45 0.1N	13 0.7W	CTD	3- 31	1304-1428	65 MINS. AT 27 M.	3719
# 1		44 59.2N	13 2.3W	UFL		DAY		
				FL				
				LMD				
9787	27/ 4	44 59.0N	13 2.6W	CTD	3-2000	1446-1604	WB @ 2000 & 6 M.	3747
# 2		44 58.5N	13 3.6W	MS				
9787	27/ 4	44 58.7N	13 4.4W	RMT 1	10-1000	1645-1820	OBLIQUE	3747
# 3		44 59.2N	13 9.8W	RMT 8		DAY	FLOW DIST. 5.09 KM.	
9788	28/ 4	44 0.1N	13 2.2W	CTD	3-2000	0130-0255	WB @ 2000 & 6 M.	4748
# 1		43 59.9N	13 2.2W	MS				

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9788	28/ 4	43 59.5N	13 2.0W	RMT 1	10-1000	0315-0431	OBLIQUE	4739
# 2		43 55.3N	13 1.9W	RMT 8		NIGHT	FLOW DIST. 4.52 KM.	
9789	28/ 4	42 59.8N	13 1.9W	CTD	3-2000	1122-1237	WB @ 2000 & 6 M.	5166
# 1		42 59.8N	13 1.9W	MS				
9789	28/ 4	42 59.5N	13 2.1W	RMT 1	10-1000	1254-1430	OBLIQUE	5200
# 2		42 55.3N	13 3.0W	RMT 8		DAY	FLOW DIST. 4.95 KM.	
9790	28/ 4	42 0.4N	12 59.8W	CTD	3-2000	2044-2157	WB @ 2000 & 6 M.	5321
# 1		42 0.2N	12 59.9W	MS				
9790	28/ 4	41 59.8N	12 58.6W	RMT 1	10-1000	2221-0003	OBLIQUE	
# 2	29/ 4	41 58.4N	12 51.8W	RMT 8		NIGHT	FLOW DIST. 6.31 KM.	
9790	29/ 4	42 3.6N	12 41.1W	RMT 1	10-1000	0533-0702	OBLIQUE 1000 TO 10 M.	
# 3		42 5.2N	12 38.2W	RMT 8		DAWN	FLOW DIST. 5.71 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9791 # 1	6/ 5	49 39.8N 49 39.8N	13 59.1W 13 56.9W	CTD MS	3-2000	0509-0713	WB @ 8 DEPTHS - MONITOR CALIBRATION	4108
9791 # 2	6/ 5	49 38.5N 49 36 2N	13 51.1W 13 50.3W	RMT1M RMT8M	600- 705	1138-1238 DAY	NET 1 FLOW DIST. 3.42 KM.	
9791 # 3	6/ 5	49 36.3N 49 33 9N	13 50.3W 13 49.4W	RMT1M RMT8M	700- 800	1238-1340 DAY	NET 2 FLOW DIST. 3.95 KM.	
9791 # 4	6/ 5	49 34.0N 49 31.8N	13 49.4W 13 48.6W	RMT1M RMT8M	800- 905	1340-1440 DAY	NET 3 FLOW DIST. 3.87 KM.	
9791 # 5	6/ 5	49 30.4N 49 30.9N	13 50.5W 13 53.0W	RMT1M RMT8M LLP	10- 100	1631-1720 DAY	NET 1 FLOW DIST. 2.73 KM.	
9791 # 6	6/ 5	49 30.9N 49 31.8N	13 52.9W 13 56.5W	RMT1M RMT8M LLP	100- 200	1720-1834 DAY	NET 2 FLOW DIST. 4 61 KM.	
9791 # 7	6/ 5	49 31.7N 49 32.3N	13 56.4W 13 58.9W	RMT1M RMT8M LLP	200- 300	1834-1920 DAY	NET 3 FLOW DIST. 2.86 KM.	
9791 # 8	6/ 5	49 32.2N 49 30.4N	14 4.6W 14 2.5W	RMT1M RMT8M	300- 400	2120-2220 NIGHT	NET 1 FLOW DIST. 3.28 KM.	
9791 # 9	6/ 5	49 30 4N 49 28.4N	14 2.5W 14 0.7W	RMT1M RMT8M	400- 500	2220-2320 NIGHT	NET 2 FLOW DIST. 3.82 KM.	
9791 # 10	6/ 5 7/ 5	49 28.5N 49 26.8N	14 0.8W 13 58.5W	RMT1M RMT8M	500- 600	2320-0021 NIGHT	NET 3 FLOW DIST. 3.55 KM.	
9791 # 11	7/ 5	49 26.2N 49 25.4N	13 55.9W 13 52.6W	RMT1M RMT8M	10- 100	0118-0218 NIGHT	NET 1 FLOW DIST. 3.71 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS		MEAN SOUND M.
9791	7/ 5	49 25.4N	13 52.7W	RMT1M	100- 200	0218-0318	NET 2		
# 12		49 24.5N	13 49.5W	RMT8M		NIGHT	FLOW DIST.	3.55 KM.	
9791	7/ 5	49 24.6N	13 49.6W	RMT1M	200- 300	0318-0418	NET 3		
# 13		49 23.8N	13 46.4W	RMT8M		NIGHT	FLOW DIST.	3.34 KM.	
9791	7/ 5	49 26.0N	13 37.1W	RMT1M	300- 400	0747-0847	NET 1		
# 14		49 26.6N	13 39.7W	RMT8M		DAY	FLOW DIST.	3.42 KM.	
				LLP					
9791	7/ 5	49 26.6N	13 39.7W	RMT1M	400- 500	0847-0947	NET 2		
# 15		49 27.1N	13 42.3W	RMT8M		DAY	FLOW DIST.	3.55 KM.	
				LLP					
9791	7/ 5	49 27.1N	13 42.3W	RMT1M	500- 600	0947-1047	NET 3		
# 16		49 27.8N	13 44.9W	RMT8M		DAY	FLOW DIST.	3.64 KM.	
				LLP					
9791	7/ 5	49 30.1N	13 44.5W	RMT1M	895-1100	1226-1426	NET 1		
# 17		49 31.9N	13 50.5W	RMT8M		DAY	FLOW DIST.	6.38 KM.	
9791	7/ 5	49 31.8N	13 50.4W	RMT1M	1095-1300	1426-1626	NET 2		
# 18		49 33.2N	13 56.5W	RMT8M		DAY	FLOW DIST.	6.87 KM.	
9791	7/ 5	49 33.2N	13 56.4W	RMT1M	1300-1505	1626-1826	NET 3		
# 19		49 34.5N	14 2.5W	RMT8M		DAY	FLOW DIST.	7.28 KM.	
9791	7/ 5	49 42.8N	14 3.1W	RMT1M	590- 700	2123-2223	NET 1		
# 20		49 43.4N	13 59.4W	RMT8M		NIGHT	FLOW DIST.	3.57 KM.	
9791	7/ 5	49 43.4N	13 59.4W	RMT1M	700- 800	2223-2323	NET 2		
# 21		49 44.4N	13 55.8W	RMT8M		NIGHT	FLOW DIST.	3.71 KM.	
9791	7/ 5	49 44.4N	13 55.8W	RMT1M	800- 900	2323-0023	NET 3		
# 22	8/ 5	49 45.3N	13 52.3W	RMT8M		NIGHT	FLOW DIST.	4.00 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9792	9/ 5	50 0.1N	17 0.3W	CTD	3-2000	0249-0413	WB @ 2000 & 6 M.	4835
# 1		50 0.4N	16 58.9W	MS				
9792	9/ 5	50 0.5N	16 58.0W	RMT 1	0-1000	0438-0807	0-1000-0 M. - NET DID NOT CLOSE	
# 2		50 2.7N	16 44.1W	RMT 8		DAWN		
9792	9/ 5	50 3.6N	16 42.0W	RMT 1	10-1000	0957-1114	OBLIQUE	
# 3		50 3.9N	16 46.7W	RMT 8		DAY	FLOW DIST. 3.67 KM.	
				LLP				
9793	9/ 5	49 0.9N	17 0.9W	CTD	3-2000	1918-2039	WB @ 2000,80,50,30,20 & 6 M.	4837
# 1		49 1.2N	17 0.1W	MS				
9793	9/ 5	49 1.0N	17 0.7W	RMT 1	10-1000	2058-2239	OBLIQUE	4835
# 2		48 58.6N	17 6.4W	RMT 8		NIGHT	FLOW DIST. 5.36 KM.	
9794	10/ 5	47 58.9N	17 0.7W	CTD	3-2000	0538-0659	WB @ 2000 & 3M.	4807
# 1		47 59.0N	17 0.0W	MS				
9794	10/ 5	47 59.1N	17 1.1W	RMT 1	10-1000	0725-0918	OBLIQUE	
# 2		47 59.1N	17 0.9W	RMT 8		DAY	FLOW DIST. 6.36 KM.	
				LLP				
9795	10/ 5	46 59.5N	16 59.9W	CTD	6-2000	1638-1755	WB @ 2000 & 6 M.	4713
# 1		46 59.7N	16 59.6W	MS				
9795	10/ 5	46 59.3N	17 0.3W	RMT 1	10-1000	1813-1945	OBLIQUE - LLP FAILED	
# 2		46 56.9N	17 6.0W	RMT 8		DAY	FLOW DIST. 5.30 KM.	
				LLP				
9796	11/ 5	46 0.0N	16 59.6W	CTD	3-2000	0227-0346	WB @ 2000,80,40,20 & 6 M.	4692
# 1		46 0.7N	16 59.8W	MS				
9796	11/ 5	46 0.5N	16 59.8W	RMT 1	10-1000	0415-0606	OBLIQUE	
# 2		45 56.0N	16 59.9W	RMT 8		NIGHT	FLOW DIST. 5.94 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9797 # 1	11/ 5	44 59.8N 45 0.2N	16 59.9W 17 0.0W	CTD MS	6-2000	1356-1515	WB @ 2000,30,20 & 6 M.	4154
9797 # 2	11/ 5	44 59.7N 44 56.2N	16 59.3W 16 53.4W	RMT 1 RMT 8 LLP	10-1000	1535-1727 DAY	OBLIQUE FLOW DIST. 6.77 KM.	
9798 # 1	12/ 5	43 59.9N 43 59.9N	17 0.4W 17 0.8W	CTD MS	3-2000	0021-0143	WB @ 120,80,50,30,20 & 6 M.	3553
9798 # 2	12/ 5	44 0.0N 44 0.4N	17 0.0W 16 50.5W	RMT 1 RMT 8	10-1005	0204-0441 NIGHT	OBLIQUE FLOW DIST. 9.03 KM.	
9799 # 1	12/ 5	43 0.0N 43 0.2N	16 59.6W 17 0.4W	CTD MS	6-2000	1156-1322	WB @ 2000 & 6 M.	4359
9799 # 2	12/ 5	43 0.2N 43 0.2N	16 59.8W 16 53.7W	RMT 1 RMT 8 LLP	10-1000	1335-1520 DAY	OBLIQUE FLOW DIST. 6.10 KM.	
9800 # 1	12/ 5	42 44.7N 42 43.0N	16 54.1W 16 50 0W	RMT 1 RMT 8	360- 625	1821-1937 DAY	ANGLE TEST FOR NEW CROSS FLOW DIST. 4.11 KM.	
9801 # 1	13/ 5	41 59.4N 41 56.9N	16 58.7W 16 51.3W	RMT 1 RMT 8	10-1005	0046-0248 NIGHT	OBLIQUE FLOW DIST. 7.77 KM.	
9801 # 2	13/ 5	41 56.2N 41 56.2N	16 48.8W 16 48.9W	CTD MS	3-2000	0339-0501	WB @ 2000,150,120,80,50,30,20 & 6 M.	4679
9801 # 3	13/ 5	41 55.1N 41 53.2N	16 44.0W 16 41.6W	RMT1M RMT8M	530- 700	0754-0856 DAY	NET 1 FLOW DIST. 3.50 KM.	
9801 # 4	13/ 5	41 53.3N 41 51.5N	16 41.7W 16 39.4W	RMT1M RMT8M	695- 805	0856-0956 DAY	NET 2 FLOW DIST. 3.75 KM.	
9801 # 5	13/ 5	41 51.5N 41 49.7N	16 39 5W 16 37 2W	RMT1M RMT8M	800- 900	0956-1056 DAY	NET 3 FLOW DIST. 3.84 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS		MEAN SOUND M.
9801	13/ 5	41 49.3N	16 34.0W	RMT1M	300- 400	1244-1345	NET 1		
# 6		41 51.6N	16 33.7W	RMT8M		DAY	FLOW DIST.	3.89 KM.	
				LLP					
9801	13/ 5	41 51.6N	16 33.7W	RMT1M	400- 510	1345-1445	NET 2		
# 7		41 53.7N	16 33.8W	RMT8M		DAY	FLOW DIST.	3.89 KM.	
				LLP					
9801	13/ 5	41 53.7N	16 33.8W	RMT1M	500- 600	1445-1546	NET 3		
# 8		41 55.9N	16 33.7W	RMT8M		DAY	FLOW DIST.	3.86 KM.	
				LLP					
9801	13/ 5	41 57.4N	16 33.4W	RMT1M	10- 95	1630-1720	NET 1		
# 9		41 59.2N	16 33.5W	RMT8M		DAY	FLOW DIST.	3.09 KM.	
				LLP					
9801	13/ 5	41 59.1N	16 33.5W	RMT1M	95- 200	1720-1820	NET 2		
# 10		42 1.3N	16 33.6W	RMT8M		DAY	FLOW DIST.	3.71 KM.	
				LLP					
9801	13/ 5	42 1.2N	16 33.6W	RMT1M	200- 300	1820-1920	NET 3		
# 11		42 3.5N	16 33.9W	RMT8M		DAY	FLOW DIST.	3.66 KM.	
				LLP					
9801	13/ 5	41 48.4N	16 35.3W	RMT1M	300- 400	2159-2259	NET 1		
# 12		41 49.5N	16 37.9W	RMT8M		NIGHT	FLOW DIST.	3.30 KM.	
9801	13/ 5	41 49.5N	16 37.9W	RMT1M	395- 500	2259-2359	NET 2		
# 13		41 50.7N	16 40.2W	RMT8M		NIGHT	FLOW DIST.	3.53 KM.	
9801	13/ 5	41 50.7N	16 40.2W	RMT1M	500- 600	2359-0059	NET 3		
# 14	14/ 5	41 51.5N	16 42.4W	RMT8M		NIGHT	FLOW DIST.	3.57 KM.	
9801	14/ 5	41 52.1N	16 44.3W	RMT1M	10- 100	0157-0247	NET 1		
# 15		41 52.6N	16 46.5W	RMT8M		NIGHT	FLOW DIST.	3.06 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS		MEAN SOUND M.
9801	14/ 5	41 52.6N	16 46.5W	RMT1M	100- 200	0247-0347	NET 2		
# 16		41 53 2N	16 49.1W	RMT8M		NIGHT	FLOW DIST.	3.82 KM	
9801	14/ 5	41 53 2N	16 49.1W	RMT1M	200- 300	0347-0447	NET 3		
# 17		41 54.1N	16 51.5W	RMT8M		NIGHT	FLOW DIST.	3.37 KM.	
9801	14/ 5	41 55.5N	16 55.2W	RMT1M	890-1110	0623-0823	NET 1		
# 18		41 57.8N	17 0.0W	RMT8M		DAY	FLOW DIST.	6.34 KM.	
9801	14/ 5	41 57.8N	17 0.0W	RMT1M	1100-1280	0823-1023	NET 2		
# 19		42 0.2N	17 4.5W	RMT8M		DAY	FLOW DIST.	6.16 KM.	
9801	14/ 5	42 0.2N	17 4.5W	RMT1M	1280-1500	1023-1223	NET 3		
# 20		42 2.5N	17 9.1W	RMT8M		DAY	FLOW DIST.	6.79 KM.	
9801	14/ 5	42 2.6N	17 10.7W	RMT1M	300- 400	1359-1459	NET 1		
# 21		42 0.8N	17 8.4W	RMT8M		DAY	FLOW DIST.	3.46 KM.	
9801	14/ 5	42 0.8N	17 8.4W	RMT1M	400- 515	1459-1559	NET 2		
# 22		41 59.0N	17 6.5W	RMT8M		DAY	FLOW DIST.	3.48 KM.	
9801	14/ 5	41 59.0N	17 6.5W	RMT1M	515- 600	1559-1659	NET 3		
# 23		41 57.2N	17 4.4W	RMT8M		DAY	FLOW DIST.	3.09 KM.	
9801	14/ 5	41 58.1N	17 1.5W	RMT1M	975-1010	1819-1919	NET 1		
# 24		41 59.3N	16 59.3W	RMT8M		DAY	FLOW DIST.	2.99 KM.	
9801	14/ 5	41 59.3N	16 59.3W	RMT1M	990-1015	1919-2019	NET 2		
# 25		42 0.3N	16 56.9W	RMT8M		DUSK	FLOW DIST.	3.51 KM.	
9801	14/ 5	42 0.3N	16 56.9W	RMT1M	990-1010	2019-2119	NET 3		
# 26		42 1.4N	16 54.4W	RMT8M		DUSK	FLOW DIST.	3.91 KM.	
9801	14/ 5	42 2.9N	16 50.5W	RMT1M	600- 700	2254-2354	NET 1		
# 27		42 3.7N	16 47.9W	RMT8M		NIGHT	FLOW DIST.	3.37 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801 # 28	14/ 5 15/ 5	42 3.7N 42 4.4N	16 48.0W 16 45.0W	RMT1M RMT8M	700- 800	2354-0054 NIGHT	NET 2 FLOW DIST. 3.73 KM.	
9801 # 29	15/ 5	42 4.4N 42 5.1N	16 45.1W 16 42.4W	RMT1M RMT8M	800- 900	0054-0154 NIGHT	NET 3 FLOW DIST. 3.46 KM.	
9801 # 30	15/ 5	42 2.1N 42 4.5N	16 53.3W 16 51.5W	RMT1M RMT8M LLP	25- 300	0459-0614 DAWN	NET 1 FLOW DIST. 4.43 KM.	
9801 # 31	15/ 5	42 4.4N 42 6.0N	16 51.6W 16 50.2W	RMT1M, RMT8M LLP	295- 375	0614-0714 DAWN	NET 2 FLOW DIST. 3.96 KM.	
9801 # 32	15/ 5	42 6.0N 42 7.7N	16 50.2W 16 48.6W	RMT1M RMT8M LLP	335- 415	0714-0814 DAY	NET 3 FLOW DIST. 4.37 KM.	
9801 # 33	15/ 5	42 7.5N 42 5.9N	16 48.6W 16 50.5W	RMT1M RMT8M LLP	350- 420	0908-1008 DAY	NET 1 FLOW DIST. 3.28 KM.	
9801 # 34	15/ 5	42 6.0N 42 4.1N	16 50.5W 16 52.4W	RMT1M RMT8M LLP	310- 390	1008-1111 DAY	NET 2 FLOW DIST. 3.73 KM.	
9801 # 35	15/ 5	42 4.1N 42 2.2N	16 52.4W 16 54.0W	RMT1M RMT8M LLP	390- 445	1111-1211 DAY	NET 3 FLOW DIST. 3.55 KM.	
9801 # 36	15/ 5	42 0.5N 41 58.9N	16 55.7W 16 57.3W	RMT1M RMT8M LLP	360- 425	1306-1405 DAY	NET 1 FLOW DIST. 3.09 KM.	
9801 # 37	15/ 5	41 58.9N 41 56.9N	16 57.3W 16 59.1W	RMT1M RMT8M LLP	315- 380	1405-1506 DAY	NET 2 FLOW DIST. 3.77 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	15/ 5	41 57.8N	16 59.0W	RMT1M	220- 340	1506-1605	NET 3	
# 38		41 55.2N	17 1.0W	RMT8M		DAY	FLOW DIST. 3.82 KM.	
				LLP				
9801	15/ 5	41 54.1N	17 1.2W	RMT1M	280- 345	1734-1834	NET 1	
# 39		41 54.1N	16 58.4W	RMT8M		DAY	FLOW DIST. 3.33 KM.	
				LLP				
9801	15/ 5	41 54.1N	16 58.5W	RMT1M	285- 370	1834-2003	NET 2	
# 40		41 54.0N	16 54.3W	RMT8M		DAY	FLOW DIST. 5.17 KM.	
				LLP				
9801	15/ 5	41 54.0N	16 54.3W	RMT1M	25- 275	2003-2058	NET 3	
# 41		41 53.9N	16 51.8W	RMT8M		DUSK	FLOW DIST. 3.40 KM.	
				LLP				
9801	15/ 5	41 53.9N	16 51.2W	CTD	3- 110	2145-2257		5517
# 42		41 54.0N	16 51.1W	UFL		NIGHT		
				FL				
				PUMP				
9801	15/ 5	41 54.0N	16 51.1W	CTD	6- 110	2308-0040		5517
# 43	16/ 5	41 54.5N	16 51.4W	UFL		NIGHT		
				FL				
				PUMP				
9801	16/ 5	41 54.5N	16 51.4W	CTD	10- 80	0044-0405	186 MINS @ 40 M.	
# 44		41 55.1N	16 53.4W	UFL		NIGHT		
				FL				
				PUMP				
9801	16/ 5	41 56.1N	16 54.2W	RMT1M	15- 200	0455-0610	NET 1	
# 45		41 58.4N	16 55.3W	RMT8M		DAWN	FLOW DIST. 4.14 KM.	
				LLP				
9801	16/ 5	41 58.3N	16 55.3W	RMT1M	195- 295	0610-0710	NET 2	
# 46		42 0.2N	16 56.2W	RMT8M		DAWN	FLOW DIST. 3.55 KM.	
				LLP				

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	16/ 5	42 0.1N	16 56.1W	RMT1M	295- 380	0710-0810	NET 3	
# 47		42 2.0N	16 57.0W	RMT8M		DAY	FLOW DIST. 3.01 KM.	
				LLP				
9801	16/ 5	42 3.8N	16 57.5W	RMT1M	380- 440	0904-1002	NET 1	
# 48		42 5.5N	16 58.1W	RMT8M		DAY	FLOW DIST. 2.88 KM.	
				LLP				
9801	16/ 5	42 5.5N	16 58.1W	RMT1M	340- 425	1002-1104	NET 2	
# 49		42 7.5N	16 58.7W	RMT8M		DAY	FLOW DIST. 3.55 KM.	
				LLP				
9801	16/ 5	42 7.4N	16 58.7W	RMT1M	290- 370	1104-1204	NET 3	
# 50		42 9.5N	16 59.2W	RMT8M		DAY	FLOW DIST. 3.96 KM.	
				LLP				
9801	16/ 5	42 9.7N	16 57.6W	RMT1M	385- 425	1254-1355	NET 1	
# 51		42 9.1N	16 54.4W	RMT8M		DAY	FLOW DIST. 3.48 KM.	
				LLP				
9801	16/ 5	42 9.1N	16 54.4W	RMT1M	370- 450	1355-1455	NET 2	
# 52		42 8.5N	16 51.5W	RMT8M		DAY	FLOW DIST. 3.82 KM.	
				LLP				
9801	16/ 5	42 8.5N	16 51.5W	RMT1M	335- 395	1455-1554	NET 3	
# 53		42 8.0N	16 48.7W	RMT8M		DAY	FLOW DIST. 3.30 KM.	
				LLP				
9801	16/ 5	42 8.0N	16 44.5W	RMT1M	175- 200	1910-1940	NET 1 - LLP NOT FUNCTIONAL	
# 54		42 8.6N	16 43.3W	RMT8M		DUSK	FLOW DIST. 2.04 KM.	
				LLP				
9801	16/ 5	42 8.6N	16 43.3W	RMT1M	185- 220	1940-2020	NET 2 - LLP NOT FUNCTIONAL	
# 55		42 9.5N	16 41.6W	RMT8M		DUSK	FLOW DIST. 2.43 KM.	
				LLP				

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	16/ 5	42 9.4N	16 41.7W	RMT1M	190- 210	2020-2100	NET 3 - LLP NOT FUNCTIONAL	
# 56		42 10.2N	16 40.0W	RMT8M		DUSK	FLOW DIST. 2.27 KM.	
				LLP				
9801	16/ 5	42 7.7N	16 41.0W	RMT1M	980-1010	2303-0003	NET 1 - 1000 M. # 1	
# 57	17/ 5	42 5.7N	16 42.5W	RMT8M		NIGHT	FLOW DIST. 3.12 KM.	
9801	17/ 5	42 5.7N	16 42.5W	RMT1M	990-1010	0003-0103	NET 2 - 1000 M. # 2	
# 58		42 3.6N	16 43.6W	RMT8M		NIGHT	FLOW DIST. 4.04 KM.	
9801	17/ 5	42 3.6N	16 43.6W	RMT1M	990-1010	0103-0203	NET 3 - 1000 M. # 3	
# 59		42 1.5N	16 44.7W	RMT8M		NIGHT	FLOW DIST. 3.91 KM.	
9801	17/ 5	41 57.1N	16 49.1W	RMT1M	985-1010	0424-0524	NET 1 - 1000 M. # 4	
# 60		41 55.2N	16 51.2W	RMT8M		DAWN	FLOW DIST. 3.55 KM.	
9801	17/ 5	41 55.3N	16 51.1W	RMT1M	995-1010	0524-0624	NET 2 - 1000 M. # 5	
# 61		41 53.6N	16 53.3W	RMT8M		DAWN	FLOW DIST. 3.71 KM.	
9801	17/ 5	41 53.6N	16 53.2W	RMT1M	1000-1010	0624-0724	NET 3 - 1000 M. # 6	
# 62		41 52.0N	16 55.4W	RMT8M		DAWN	FLOW DIST. 3.87 KM.	
9801	17/ 5	41 51.9N	16 54.4W	RMT1M	990-1010	0921-1021	NET 1 - 1000 M. # 7	
# 63		41 52.8N	16 52.0W	RMT8M		DAY	FLOW DIST. 2.84 KM.	
9801	17/ 5	41 52.8N	16 52.0W	RMT1M	990-1010	1021-1121	NET 2 - 1000 M. # 8	
# 64		41 53.7N	16 49.5W	RMT8M		DAY	FLOW DIST. 3.57 KM.	
9801	17/ 5	41 53.7N	16 49.5W	RMT1M	990-1010	1121-1221	NET 3 - 1000 M. # 9	
# 65		41 54.7N	16 46.7W	RMT8M		DAY	FLOW DIST. 3.84 KM.	
9801	17/ 5	41 56.8N	16 40.6W	RMT1M	990-1010	1432-1532	NET 1 - 1000 M. #10	
# 66		41 57.6N	16 37.6W	RMT8M		DAY	FLOW DIST. 3.60 KM.	
9801	17/ 5	41 57.5N	16 37.7W	RMT1M	980-1010	1532-1632	NET 2 - 1000 M. #11	
# 67		41 58.3N	16 34.8W	RMT8M		DAY	FLOW DIST. 3.80 KM.	

STN.	DATE 1978	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	17/ 5	41 58.3N	16 34.9W	RMT1M	995-1010	1632-1732	NET 3 - 1000 M. #12	
# 68		41 58.9N	16 32.1W	RMT8M		DAY	FLOW DIST. 4.04 KM.	
9801	17/ 5	41 57.6N	16 34.6W	RMT1M	990-1010	1948-2048	NET 1 - 1000 M. #13	
# 69		41 56.2N	16 37.0W	RMT8M		DUSK	FLOW DIST. 3.71 KM.	
9801	17/ 5	41 56.3N	16 37.0W	RMT1M	990-1010	2048-2148	NET 2 - 1000 M. #14	
# 70		41 54.9N	16 39.3W	RMT8M		DUSK	FLOW DIST. 3.66 KM.	
9801	17/ 5	41 55.0N	16 39.2W	RMT1M	995-1010	2148-2248	NET 3 - 1000 M. #15	
# 71		41 53.7N	16 41.6W	RMT8M		NIGHT	FLOW DIST. 3.73 KM.	
9801	18/ 5	41 51.5N	16 45.9W	RMT1M	990-1010	0046-0146	NET 1 - 1000 M. #16	
# 72		41 50.1N	16 48.2W	RMT8M		NIGHT	FLOW DIST. 3.19 KM.	
9801	18/ 5	41 50.1N	16 48.1W	RMT1M	990-1010	0146-0246	NET 2 - 1000 M. #17	
# 73		41 48.8N	16 50.9W	RMT8M		NIGHT	FLOW DIST. 3.73 KM.	
9801	18/ 5	41 48.8N	16 50.8W	RMT1M	990-1010	0246-0346	NET 3 - 1000 M. #18	
# 74		41 47.8N	16 53.5W	RMT8M		NIGHT	FLOW DIST. 3.91 KM.	
9801	18/ 5	41 46.8N	16 56.0W	CTD	3-2000	0450-0613	WB @ 2000, 1500, 1000 & 6 M.	
# 75		41 46.3N	16 55.8W	MS				
9801	18/ 5	41 44.5N	16 59.6W	RMT1M	990-1010	0820-0920	NET 1 - 1000 M. #19	
# 76		41 43.6N	17 2.2W	RMT8M		DAY	FLOW DIST. 3.06 KM.	
9801	18/ 5	41 43.7N	17 2.1W	RMT1M	990-1020	0920-1022	NET 2 - 1000 M. #20	
# 77		41 42.8N	17 4.8W	RMT8M		DAY	FLOW DIST. 3.80 KM.	
9801	18/ 5	41 42.8N	17 4.7W	RMT1M	990-1010	1022-1122	NET 3 - 1000 M. #21	
# 78		41 41.7N	17 7.5W	RMT8M		DAY	FLOW DIST. 3.88 KM.	
9801	18/ 5	41 51.2N	17 8.0W	RMT1M	1500-1710	2207-0008	NET 1	
# 79	19/ 5	41 55.5N	17 6.3W	RMT8M		NIGHT	FLOW DIST. 6.69 KM.	

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STN.	DATE 1978	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	19/ 5	41 55.5N	17 6.3W	RMT1M	1690-1900	0008-0208	NET 2	
# 80		41 58.0N	17 0.8W	RMT8M		NIGHT	FLOW DIST. 7.64 KM.	
9801	19/ 5	41 58.0N	17 0.9W	RMT1M	1900-2100	0208-0408	NET 3	
# 81		42 0.0N	16 55.7W	RMT8M		NIGHT	FLOW DIST. 7.55 KM.	
9801	19/ 5	41 51.8N	17 0.1W	RMT1M	2100-2300	1334-1536	NET 1	
# 82		41 49.0N	17 5.1W	RMT8M		DAY	FLOW DIST. 6.83 KM.	
9801	19/ 5	41 49.0N	17 5.0W	RMT1M	2300-2500	1536-1736	NET 2	
# 83		41 46.1N	17 10.2W	RMT8M		DAY	FLOW DIST. 7.48 KM.	
9801	19/ 5	41 46.3N	17 10.0W	RMT1M	2500-2700	1736-1936	NET 3	
# 84		41 43.9N	17 14.8W	RMT8M		DAY	FLOW DIST. 7.82 KM.	
9801	20/ 5	41 44.6N	17 10.2W	RMT1M	2700-2900	0033-0233	NET 1 - FLOW POSSIBLY INACCURATE	
# 85		41 45.1N	17 4 4W	RMT8M		NIGHT	FLOW DIST. 6.40 KM.	
9801	20/ 5	41 45.1N	17 4.4W	RMT1M	2900-3100	0233-0434	NET 2 - NO FLOW	
# 86		41 45.8N	16 58.4W	RMT8M		NIGHT		
9801	20/ 5	41 45.8N	16 58.5W	RMT1M	3100-3300	0434-0634	NET 3 - FLOW POSSIBLY INACCURATE	
# 87		41 46.1N	16 52.7W	RMT8M		DAWN	FLOW DIST. 7.24 KM.	
9801	20/ 5	41 50.3N	16 58.3W	RMT1M	3700-3900	1308-1512	NET 1	
# 88		41 52.6N	17 3.7W	RMT8M		DAY	FLOW DIST. 6.58 KM.	
9801	20/ 5	41 52.5N	17 3.6W	RMT1M	3500-3710	1512-1712	NET 2	
# 89		41 54 4N	17 8 6W	RMT8M		DAY	FLOW DIST. 7.80 KM.	
9801	20/ 5	41 54.4N	17 8.5W	RMT1M	3300-3500	1712-1912	NET 3	
# 90		41 56.8N	17 12.6W	RMT8M		DAY	FLOW DIST. 7.03 KM.	
9801	21/ 5	42 1.5N	17 8.7W	RMT1M	4300-4520	0033-0303	NET 1 - NO FLOW	
# 91		42 4 2N	17 2.4W	RMT8M		NIGHT		

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STN	DATE 1978	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9801	21/ 5	42 4.2N	17 2.4W	RMT1M	1610-4300	0303-0847	NET 2 - FAILED TO CLOSE 'TIL 1610 M.	
# 92		42 9.6N	16 48.6W	RMT8M		DAWN		
9801	21/ 5	42 9.6N	16 48.6W	RMT1M	1610-1610	0847-0848	NET 3 - LEAKAGE TEST	
# 93		42 9.6N	16 48.5W	RMT8M		DAY		
9801	21/ 5	42 10.3N	16 46.5W	CTD	6-4000	1017-1312	WB @ 4000,50,20 & 6 M.	
# 94		42 9.3N	16 45.7W	MS				

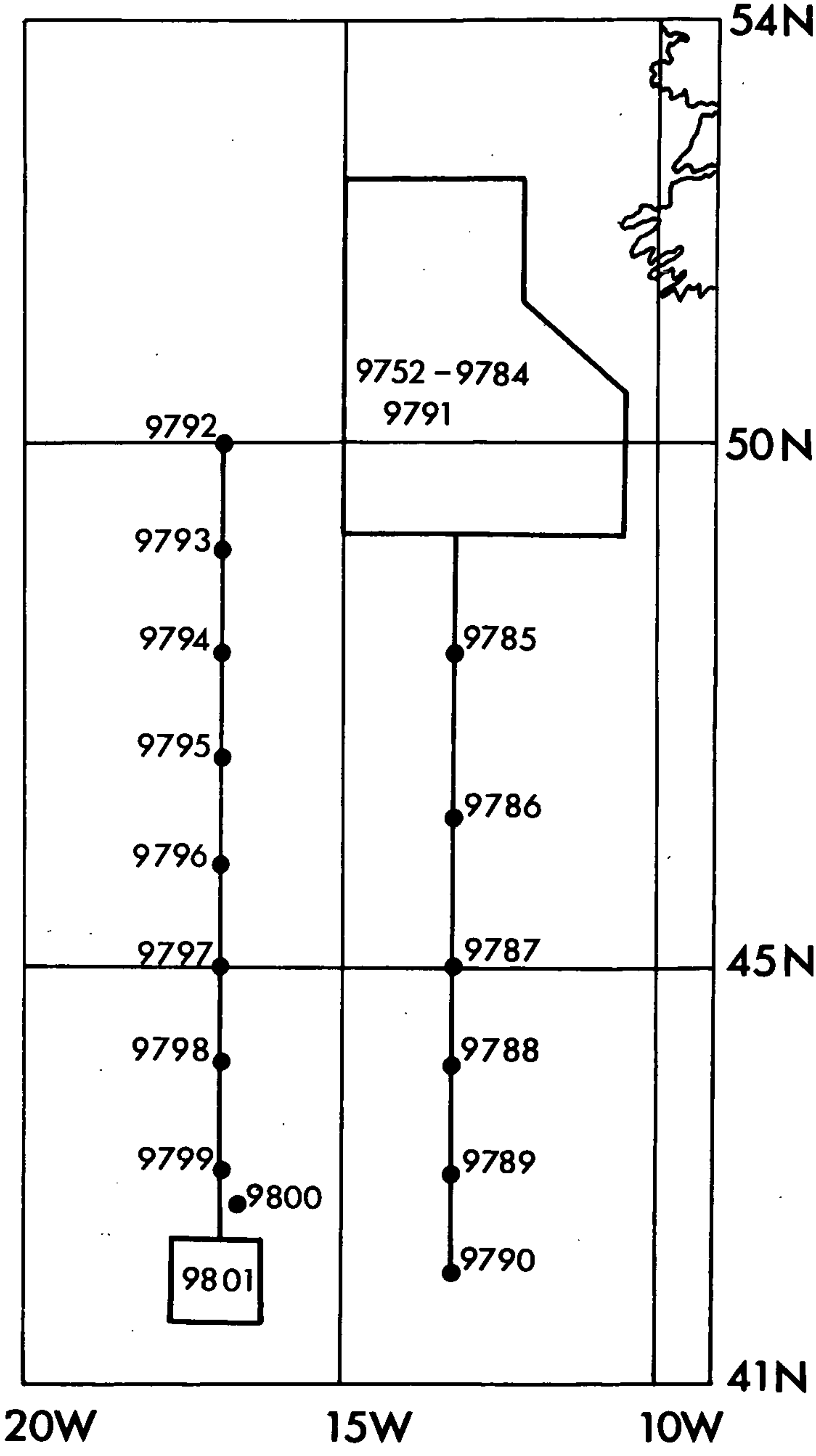
FIGURE CAPTIONS

Fig. 1. Track chart for the whole cruise.

Fig. 2. Detailed start positions for midwater net tows conducted in the Porcupine Sea Bight area.

Fig. 3. Detailed start positions for benthic sampling conducted in the Porcupine Sea Bight area.

Fig. 4. Detailed positions of CTD stations conducted in the Porcupine Sea Bight area.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20W
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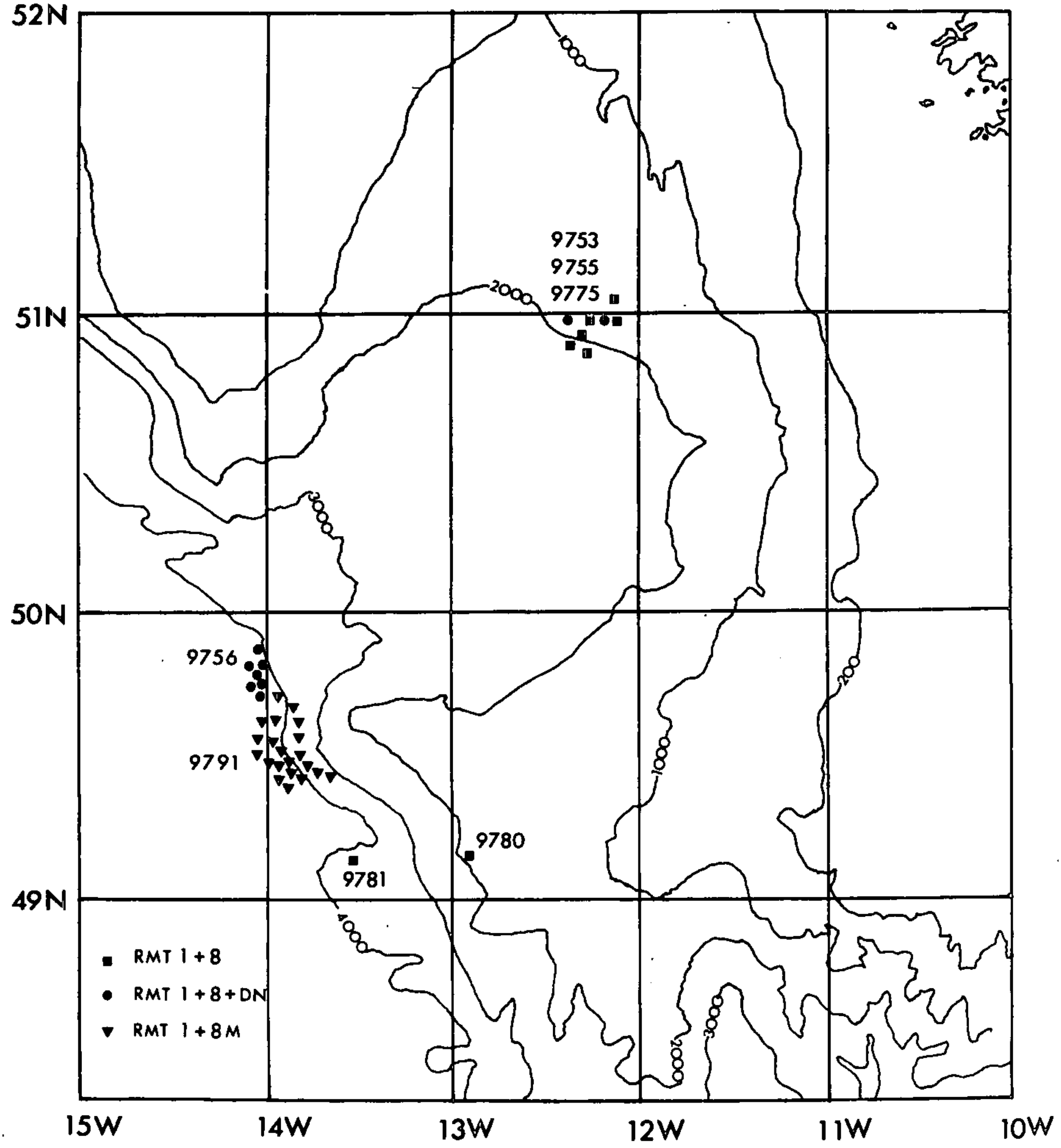
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50N
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15W
14W
13W
12W
11W
10W
9753
9755
9775
9756
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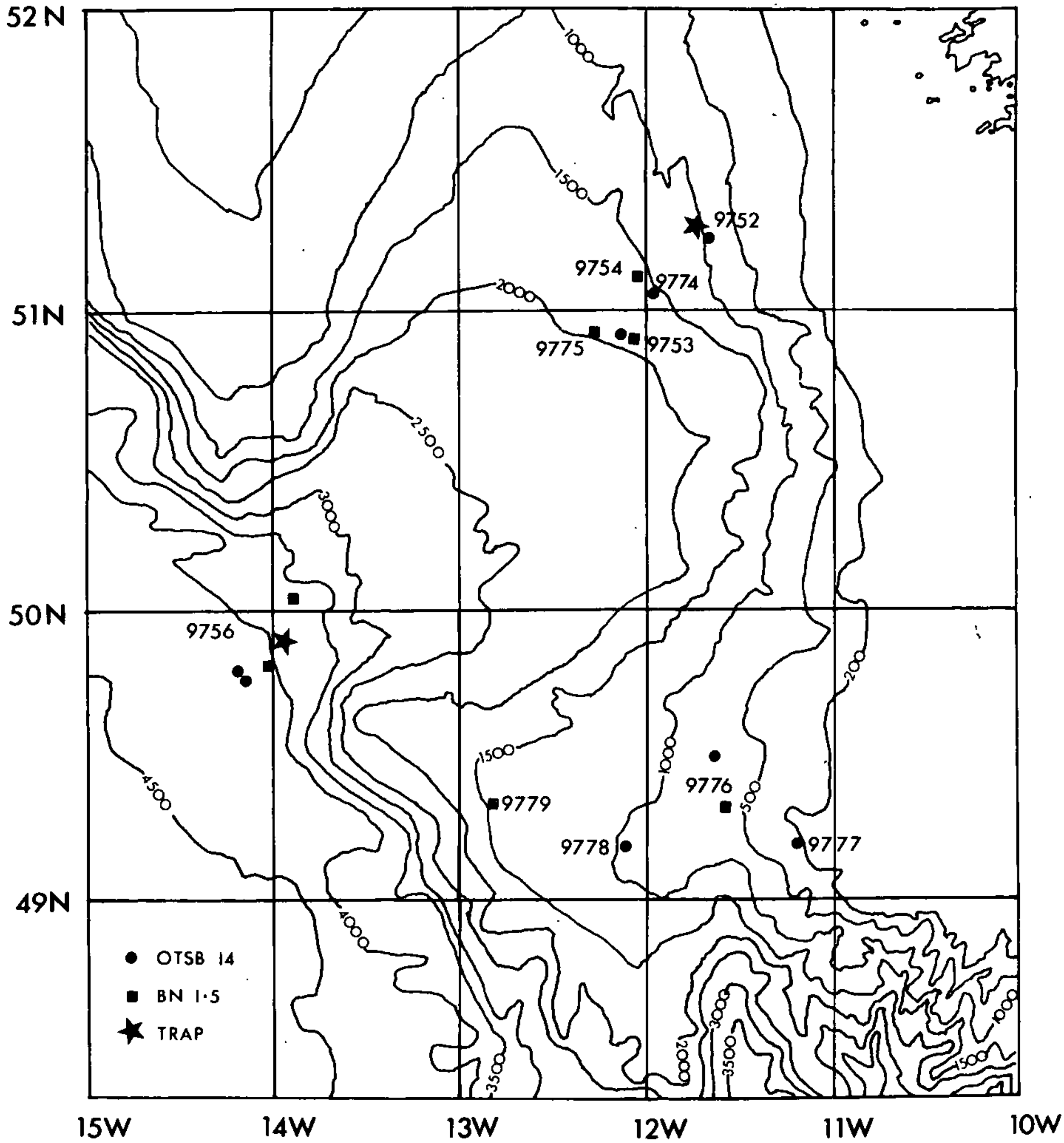
9780
9781
2000
3000
4000
1000
200
2000
3000
RMT 1 + 8
RMT 1 + 8 + DN
RMT 1 + 8 M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1500
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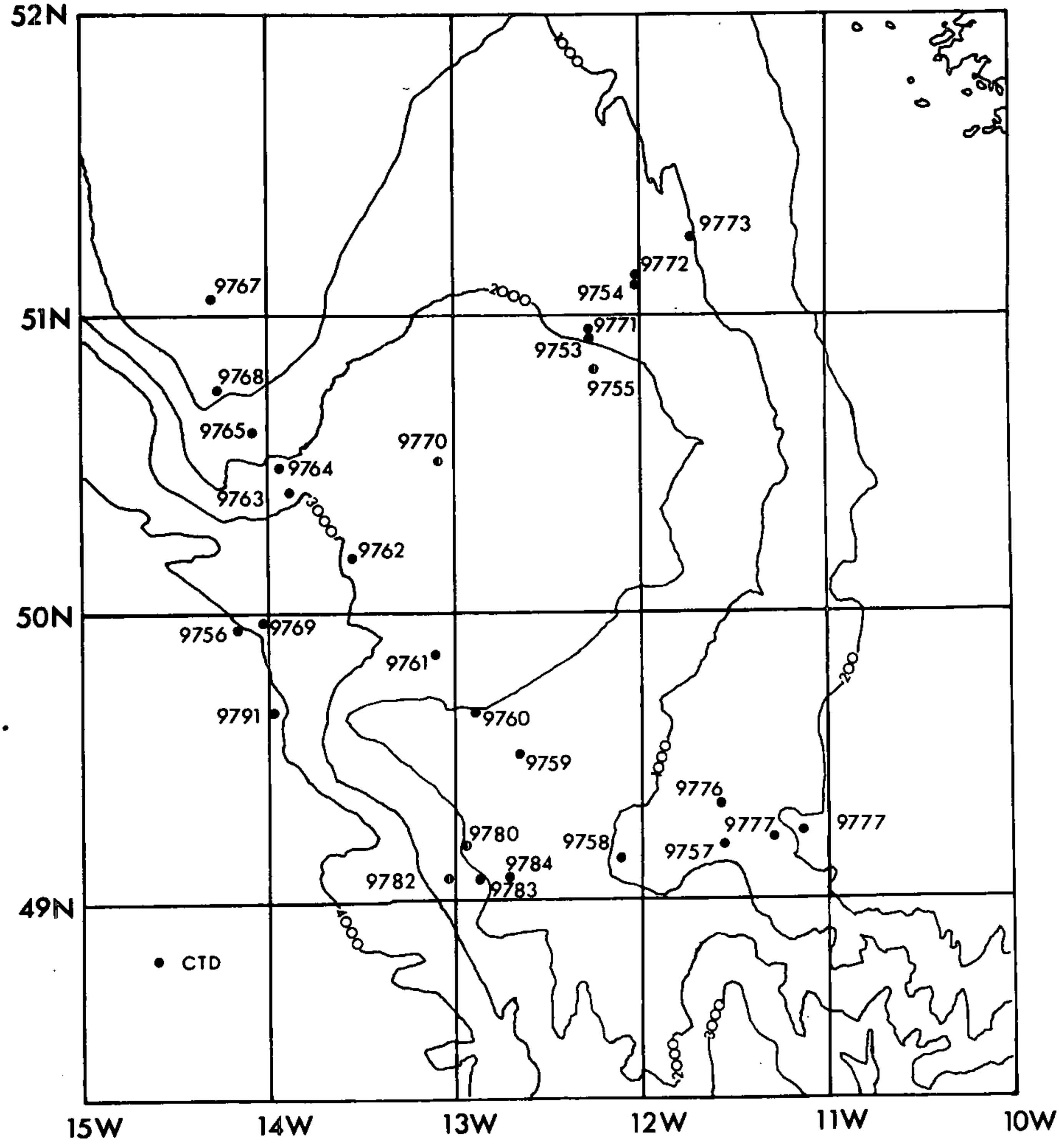
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