I.O.S.

R R S CHALLENGER CRUISE 14/81

14 SEPTEMBER 1981 – 1 OCTOBER 1981

BENTHIC BIOLOGY AND PHYSIOLOGY IN THE PORCUPINE SEA-BIGHT

CRUISE REPORT NO 135
1982

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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(I.O.S. Cruise 512)

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ITINERARY

Depart Barry 0800 GMT 14 September 1981
Arrive Milford Haven 1000 GMT 23 September 1981
Depart Milford Haven 0945 GMT 24 September 1981
Arrive Barry 2200 GMT 1 October 1981

OBJECTIVES

1 To lay two pairs of sea-bed transponders, at about 1200 m and 4000 m respectively, to facilitate close-spaced sampling with the epibenthic sledge to examine small-scale variations in the epibenthic mega-fauna.

2 To obtain five epibenthic sledge samples at each transponder site.

3 To obtain some of these hauls in conjunction with a forward-facing Benthos 374 camera, taking photographs at 3-second intervals to check the performance of the odometer wheel.

4 To make three Bathysnap deployments and recoveries, one to last approximately seven days over the period of the planned port-call at Milford Haven.

5 To obtain epibenthic sledge hauls at 3000-4000 m in search of the holothurian Kolga hyalina.

6 To obtain otter-trawl samples as and when possible, but particularly in depths greater than 2000 m.

7 To obtain S.M.B.A. multicore samples at approximately 500 m intervals from 5000 m to 4000 m for a study of the meiofauna.

8 To obtain fish samples for physiological determinations (see Physiology section).

NARRATIVE

Challenger sailed from Barry at 0800/14 into fresh W to SW winds which lengthened the passage to the Sea-Bight. The PDR fish was deployed at 1600/15, but echo-sounding was not commenced until 0700/16.

The first station, at 51°N:13°W in about 2000 m, was reached at 0930/16 by which time the wind speed had fallen to 10-15 knots. An otter trawl (51201) to provide material for the physiologists was completed by 1440/16 and a wire test of the Bathysnap release to 1600 m was completed by 1600/16. A successful multicorer cast (51202) was made in 1940 m and Challenger then made for an earlier Bathysnap position at 51°02N:12°59W.

After some delay in assembling the new version of Bathysnap, with the addition of a current meter, the gear was deployed at 2095/16 (51203) and reached the bottom at 2218. Some difficulty was experienced in obtaining an adequate fix on Bathysnap because of a dearth of satellite fixes and the rejection of those that did arrive, but a satisfactory position was obtained after a forced update at 2116 and Challenger then made for the main intended shallow-water work area at about 51°30N:13°00W.

An echo-sounding survey was carried out in the desired region from 0400/17 to 1000/17, confirming that the whole region is free from any topographical irregularities which would interfere with epibenthic sledging activities. The first transponder was launched at 1115/17, but because of the absence of suitable fixes the deployment of the second transponder was delayed until after a multicorer sample (51204) and a trawl haul (51205) had been obtained. These were completed by 1925/17 and the problem of the transponder deployment was returned to. Good satellite fixes were again very infrequent and the second transponder was finally launched at 0300/18, but not accurately fixed.

With the two transponders now deployed, the ship steamed around in the vicinity to establish their distance apart and to gain experience in positioning the vessel relative to them with a view to fishing the epibenthic sledge. However, with the wind increasing to 25-35 knots the sledge could not be launched, and an otter trawl was therefore made (51206), the gear being shot and landed head to wind, but hauled downwind.

By the time the trawl was landed (1500/18), a very heavy swell was running and the ship was therefore hove to awaiting an improvement. By 1700/19 the seas had

moderated slightly, though the wind speed was still around 23-30 knots and an increase to force 9 was forecast for the area. Challenger therefore made for the 500 m station in the hope of using bad weather time for steaming. By the time the shallow station was reached (1030/19) the wind and seas had completely died down and a successful multicore sample was obtained (51207).

Challenger now returned to the transponder position, initially in light airs which increased to 10-20 knots by the time the transponders were reached at 1530/29.

An attempt to shoot the first epibenthic sledge of the cruise on the transponder area was delayed by a series of problems, including faults in the Benthos camera power pack, the camera itself, and in the weak link which parted during an attempted launch. The sledge was finally shot (51208#1) without the camera at 1912/19 and landed at 2139 with a distressingly large catch of sponges which had clearly blocked the net and prevented it from fishing quantitatively. During this haul and the previous two the dynamometer on the main warp was not working. The fault was traced to one of the boards which was replaced by a board from one of the auxilliary winches. The dynamometer worked satisfactorily for the remainder of the cruise. As a result of the large catch in haul 51208#1 one of the weak links on the lower bar of the net mouth had broken. The two weak links on this bar were replaced by small shackles and a second haul was made some 2 nm away from the first haul position and in slightly deeper water in an attempt to avoid the sponges. This second haul (51208#2) was also delayed by a continuing fault on the Benthos camera and an IOS camera was therefore fitted in its stead. The sledge was finally shot at 0129/20 and was inboard by 0333, this time with the total catch having been lost through a long split in the net; to judge from the photographs obtained during this haul, we had clearly failed to avoid the sponges!

A third sledge haul in this area (51208#3) was shot at 0540, this time with the Benthos camera operating correctly and directed forwards to take photographs at three-second intervals. To avoid an excessively large catch, the distance fished was reduced to 349 m and the net was landed successfully at 0723/20.

Challenger now made for the 2000 m station to retrieve Bathysnap and to trawl for physiological material, arriving on station at 1400/20. Because of the inconvenience to the physiologists on board of material arriving on deck during the night, a trawl (51209#1) was shot immediately and landed at 1803/20. By this time, however, it was too late to release Bathysnap, which could not be retrieved

during the night on this cruise because of a fault in the flashing beacon. Consequently, the vessel was hove to on the position some 15 nm upwind (west) of the Bathysnap position with the intention of making a trawl haul in the early hours of the 21st so as to return to the Bathysnap position for a retrieval at first light. The trawl was accordingly shot at 0214/21, but with about 3000 m wire out the haul (51209#2) was aborted because the ship was over a canyon area and the net was brought inboard by 0422. Bathysnap was released at 0543 and was successfully taken inboard at 0722/21. During this recovery, however, the starboard auxilliary winch overheated badly.

With very little time remaining before the deadline for the return to Milford Haven, Challenger made a southerly course towards the mouth of the Sea-Bight to get into as great a water depth as possible for a Bathysnap cast, although it was already clear that the hoped for deployment in 4000 m would not now be achievable. In fact, Bathysnap was deployed in 2665 m (51211), close to an earlier Bathysnap position (51107#1), and a multicore cast (51210) was made during the descent, the corer reaching the sea floor before Bathysnap. During this cast, made with a heavy swell, a severe kink appeared in the main warp some 40 m from the end and a new termination therefore had to be made.

After obtaining an adequate, but not very good, fix on the Bathysnap position the vessel proceeded towards Milford Haven and two attempts to obtain multicore samples were made in 200 m at the outer edge of the shelf. The first of these (51212#1) obtained three short cores in a fairly coarse-grained substrate, while the second (51212#2) failed to obtain a single core.

Challenger now sailed directly to Milford Haven, docking at Pembroke Dock at 1000/23. Having taken on fuel and water the ship was expected to depart at 1700/23, but because of 35-40 knot southwesterly winds the departure was delayed until 0945/24.

During the passage back to the Sea-Bight the wind moderated a little and a proposed trawling station in 2000 m (51213) was completed by 0342/26 and Challenger proceeded to the Bathysnap position which was reached by 1200. Some difficulty was experienced in locating Bathysnap because of the relatively poor fix obtained. However, by 1300 the gear was located and released after searching at the correct sounding. It reached the surface only a few hundreds of metres away from the ship and was landed successfully by 1415/26, despite a heavy swell in 25-30 knot southwesterly winds.

Challenger now proceeded southwesterly to a proposed station at about 3800 m for a fine-meshed benthic sledge haul in search of the small holothurian Kolga hyalina. Unfortunately, by 1900/26 when we reached the proposed station position the wind and sea conditions were unsuitable for the sledge and an echo-sounding run upwind (335°) was therefore undertaken in order to shoot the otter trawl on a downwind course. After some difficulty with twisted sweeps, the trawl (51214) was finally shot at 2056 and brought inboard at 0501/27.

In a heavy swell from the northwest, the vessel now made for a proposed Bathysnap position in 4000 m and the gear was deployed by 1355 (51215).

Challenger now moved to the main proposed deep water station centred at about 49°50N:14°10W and an echo-sounding survey was conducted until 1500/27. Although rough ground was encountered both to the northwest and southeast a sufficiently extensive area of suitable sea-bed was found and the two transponders were deployed on a southwesterly course through the centre with an intended separation of about 8 km.

The first benthic sledge haul in this area (51216#1) was completed by 0016/28, but during hauling about 50 cm of unlaid wire was removed at the long splice between the 13 mm and 16 mm sections of the main warp with about 7200 m.w.o. During the next sledge haul (51216#2) a much longer strand was found to be unlaid at the same point and it was deemed prudent not to pay this section outboard. At this point the sledge was still 900 m above the bottom and an attempt was made to fish it by controlling the ship's speed. In order to get the gear to sink, almost all way had to be taken off the ship and during this manoeuvre the sledge turned over; this was not realised at the time, since the "upside down" trace appeared in an unexpected position on the Mufax record. Consequently, although the sledge spent some 45 minutes on the bottom, no sensible traces were obtained and when it was brought inboard at 0840/28 the suprabenthic net contained about 150 litres of mud, while the benthic net was empty!

While Challenger now proceeded downwind the main warp was streamed and the faulty splice was replaced by a cut splice which gave no further trouble.

A third epibenthic sledge haul at the 4000 m station (51216#3) was successfully completed by 1925/28 and this was followed by an otter-trawl which was shot at 2130/28. During the pay-out period the ship passed directly over one of the transponders and paying out was delayed in order to avoid fouling it. Consequently, the trawl did not reach the bottom until 0150/29 and was not recovered until 0620/29.

Challenger now returned to the Bathysnap position and the gear was successfully recovered at 0952/29.

With the available station time rapidly running out it was clear that we would not achieve the intended five sledge hauls at the 4000 m station. However, it appeared that there would be time for one further haul at the deep station and a second haul, with the fine-meshed net fitted, at about 3000 m in search of Kolga hyalina. Accordingly, the epibenthic sledge was shot at 1124/29 and retrieved at 1620/29 (51216#5). During the haul, however, the south to southwest wind increased to 30-35 knots and the resulting swell caused some concern since the main warp frequently became completely slack as the vessel pitched, particularly during shooting.

The weather deteriorated further during the passage to the proposed 3000 m station and by the time this position was reached it was clear that the epibenthic sledge could not be shot safely. The vessel therefore made a course towards Barry with the intention of using the remaining station time for a sledge haul and a trawl on the continental shelf. The weather improved significantly overnight and these hauls (51217#1 and 2) were successfully completed by 1633/30. Challenger now made direct for Barry, docking at 2200/1.

It is a pleasure to record our thanks to the Master, officers and crew for their assistance and co-operation throughout this cruise.

BENTHIC INVERTEBRATES

Epibenthic sledge and trawl catches were obtained from five faunistically distinct depths; 150 m, 1180-1204 m, 1380 m, 1950-2015 m and 3810-4070 m.

The shallowest station (51217) provided a surprisingly small benthic catch, though the fine central net collected almost 40,000 Sagitta decipiens. Of particular interest, however, was a very large zooplankton catch in the suprabenthic net dominated by an estimated 12 million copepods, mainly Metridia lucens.

The catches between 1180 and 1205 m (51206 and 51208#1 and 3) were dominated by large numbers of the sponge Pheronema which formed up to 80% of the catches by volume. This presented a serious handling problem which was particularly unfortunate since this area had been selected for the examination of catch replication using the transponders. A number of species appeared to be commensal with the sponges, small ophuiroids, pectinids, scaphopods, worms and the spider crab, Dorynchus thomsoni, being particularly abundant. Apart from the sponges and their commensals the invertebrates in these catches were similar to those found at other stations at the same depth which lack the sponges. The most abundant forms were the holothurians Ypsilothuria talismani, Laetmogone violacea and Benthogone rosea, the echinoids Phormosoma placenta and Echinus affinis, and the asteroids Brisingia sp. and Plutonaster bifrons. The crustaceans were dominated by amphipods, natant decapods, the galatheid Munida rugosa and the crab Geryon tridens.

The catch at 1380 m (51205) differed from those at 1180-1205 m only in lacking the sponge and sponge commensals.

In the range 1950-2015 m (51201, 51213, 51209) the catches were as expected, being dominated by the holothurians Paelopatides gigantea, Benthogone rosea, the ophiuroid Ophiomusium lymani, the echinoid Phormosoma placenta and the asteroids Plutonaster bifrons, Bathybiaster vexillifer and Benthopecten simplex.

The five catches from the deepest zone (3810-4070 m, stns 51214 and 51216) differed considerably one from another although they were all from within an area of 100 square miles. The samples from 51216 were intended for the study of replicability using a pair of transponders and the variation amongst them was indeed disturbing. The most surprising observation was the total absence of holothurians at 51216#3 whilst,only about half a mile away at 51216#4 the catch

was dominated by Psychropotes longicauda, Benthodytes sp., Benthothuria sp. and Oneirophanta mutabilis. There were also large variations in numbers of the ophiuroid Ophiocten hastatum which was numerically dominant at some stations. Pagurids were abundant at one station with Munidopsis antonii (51214) but both were virtually absent at other stations.

R Lampitt

PHOTOGRAPHY

IOS CAMERAS

A new electronic control circuit board has been incorporated into the IOS Cameras since the previous cruise. The new board has a new set of timer settings with a maximum normal time interval between exposures of 32 minutes and the possibility of increasing this to 64 or 128 minutes, with a link change on the control circuit card. The card also includes a switch to select the LED exposure to suit either a medium speed monochrome film or 200 ASA colour film.

IOS shutterless cameras were used successfully on 5 epibenthic sledge hauls and the shuttered version was used on one haul (51217#1).

The shutterless camera was used three times on Bathysnap. On the first occasion, using standard black and white film, one control circuit board failed after 40 exposures and no more pictures were taken. On the second deployment, using thin-based film (Ilford HP5, 400 ASA), photographs were taken successfully at 16-minute intervals for 5 days. Finally, colour film was used successfully on the short, third Bathysnap deployment.

Some problems were encountered in using the "Benthos 374" camera. On its first attempted deployment (51208#1) a fuse blew and two transistors overheated and blew up. After replacing the transistors and the resistor with more powerful ones, and also replacing the fuse, the camera worked adequately. The Benthos camera apparently failed because operation at the fast rate created extra load due to stopping and starting at short intervals and resulted in greater stress on components. The failure should not recur, since the replacement components are intended for higher power heavier duty use.

P I Wallin

ORNITHOLOGY

On average, seven standard 10-minute observations were made each day. As far as possible these observations were spread evenly throughout the daylight hours. No species was consistently present. Gannets (Sula bassana) were recorded at more observations than any other species, and were particularly abundant over the continental shelf. Most individuals were either adult, or birds of the year. Fulmars (Fulmarus glacialis) and greater shearwaters (Puffinus gravis) were also frequently seen. Greater shearwaters were sometimes abundant, concentrations of 100 or more birds being seen over, and at the edge of, the continental shelf. Fulmars, although seen frequently, were never present in large numbers. Usually only one or two were seen at a time, and counts of ten or more were rare. Distributional overlap between Wilson's storm petrel (Oceanites oceanicus) and the British storm petrel (Hydrobates pelagicus) was minimal, the former occurring over deep water, and the latter mainly over the continental shelf. Two Cory's shearwaters were seen on 16 September. Very few migrant land birds were seen even when on passage South of Ireland.

M H Thurston

MULTIPLE CORER

The SMBA multiple corer was used successfully on 10 occasions, at depths ranging from 510 to 4167 m. Only one abortive haul was made and excellent cores ranging from 15 to 40 cm long were obtained at each of the stations sampled. These cores provided abundant material for meiofaunal and chloroplastic pigment studies.

I am most grateful to Dr Peter Barnett of the SMBA laboratory at Oban for allowing us to use his gear and for providing the expert services of Jim Watson.

A L Rice

MEIOFAUNA, CHLOROPLASTIC PIGMENTS AND BENTHIC RESPIRATION

Meiofauna and chloroplastic pigment samples from a series of SMBA multiple corer drops from Challenger cruise 8/81 had already been examined. To obtain further data on the distribution of meiofauna and chloroplastic pigments with

depth, a further depth transect was sampled, concentrating on the transponder sites and including a shelf, a slope and a rise station.

For meiofaunal analysis a maximum of 6 corer tubes from each station were sub-sampled with small piston corers (modified medical syringes), coring 3.46 cm^2 surface area to a depth of 5 cm. These samples were split into 1 cm layers and were preserved separately in 4% buffered formalin.

Further samples of the upper 5 cm of the sediment were taken for chloroplastic pigment determinations as an indication of the sedimentation of primary organic matter. These sub-samples were taken with small syringes covering 1.13 cm^2 surface area and were again split into 1 cm layers. These samples were deep frozen.

Benthic respiration of the sediment was measured on board ship. Immediately after recovery 4 multiple corer tubes were immersed in a water bath at their in situ temperature. Each tube was sealed at the bottom with a rubber stopper and at the top with a plexiglass plate incorporating a Clark-type oxygen electrode and a stirrer bar to prevent oxygen stratification within the enclosed water. The oxygen decrease in the water overlying the sediment was recorded continuously during an incubation period of 12 hours.

O Pfannkuche

BATHYSNAP MK III

The Bathysnap successfully used on cruise 8/81 was modified to take an Aanderaa current meter which had itself been modified to accommodate a small direction vane. This necessitated an increase in buoyancy and a slight increase in height, but the gear was still not difficult to handle on deck. Three deployments were made at depths of 2025, 2665 and 3995 m, the deepest of which was baited (?Bathysnack). Apart from a partial camera failure at the shallowest station (see photography report) there were no problems and the previous deployment and recovery difficulties seemed to have been overcome.

R S Lampitt

PHYSIOLOGY

OBJECTIVES

i To measure Na^+ fluxes in deep sea fish erythrocytes as a function of pressure and other related properties. An examination of their pressure tolerance.

ii To measure the fluidity of the bilayer component of deep sea fish membranes as a function of pressure and temperature in order to test the prediction that adaptation to high pressure and low temperature requires a very fluid membrane.

Neither measurement has been carried out at sea before. In view of the limited time and space available, the experiments were planned as preliminary attempts only.

RESULTS

FISH ERYTHROCYTE EXPERIMENTS

From depths of 1200 to 2000 m about 40 fish were sampled for blood; many were found lacking in sufficient blood for experimental purposes, but many plasma osmolarity determinations were made. $^{22}Na^+$ efflux and ^{23}Na steady state level experiments were carried out ashore. From 4000 m depth some 30 individuals were analysed and similarly experimented on.

MEMBRANE FLUIDITY EXPERIMENTS

Lack of blood cells forced us to use more heterogeneous preparations, namely fractions rich in mitochondria (fish liver), synaptosomes (brain) and myelin (brain). Fluidity determinations were carried out on samples from some 50 fish from 2000 to 4000 m depths. The fluorescence photometer was in use for more than 170 hours. Interpretation of the data must await the completion of control experiments on shallow water fish.

A G MacDonald, C Shelton, A Cossins and A Pegueux

INSTRUMENTATION

BENTHIC SLEDGE MONITORING SYSTEM

Performed well, apart from erratic transmissions from monitor J 19 during one haul (broken solder joint) and the failure of some rechargeable cells in one power pack (detected and cured in laboratory).

OTTER TRAWL MONITORING SYSTEM

The mecury tilt switches provided clear indication of bottoming and towing attitude: during one haul, the floating input of an unused indicator pulse facility caused an extra pulse to appear (cured by tying the input to ground). A new type of battery pack was tried during the later hauls which results in maximum transmission power being available throughout the battery life (the previous version dropped to half power by the end of life); this battery pack provided clear signals throughout the longest haul (4000 m depth, 12000 m range) so a larger capacity version will now be adopted as the standard power pack for these monitors: the right-angle tube adaptor shook loose during the recovery of one haul; this did not allow water into the tube and was cured by the use of yards of PVC tape. A more positive clamping system needs to be designed.

MONITOR CALIBRATIONS

Both the monitor systems appeared to be in disagreement with the PES system over fishing depths; subsequent to this cruise it has been found that some Mufax recorders sweep non-linearly across the paper; the effect is that the depth scale spacing which is linear with time can be different on the two sides of the recorder. The effect on recorders so far measured can be more than 2% with the result that calibration sticks based on the Applied Physics Group recorder, which is linear to better than 0.5%, appear out by as much as 30 m at the right hand side of the recorder. The only solution at present is to draw individual sticks to suit each recorder.

BATHYSNAP

The current meter 15-minute sampling was found to be varying; the 5 and 10

minute alternatives were checked and found to be stable so the current meter was used with 10-minute sampling. The flashing light beacon failed due to an internal fault (inaccessible, so irreparable). The main release was achieved using one retractor and one pyro-release, and compass clamping used a further retractor. During the 3 recoveries, one main retractor failed due to a faulty wiring harness (repaired) and the retractor pistons appear to be picking up scratches during operation (being investigated by the Ocean Engineering Group). During the recovery attempt following the mid- cruise break, the satellite navigation (which was not regular) positioned the ship in the wrong depth of water; the correct depth was located by a short sounding survey, whereupon the acoustic beacon in Bathysnap was switched on and recovery completed in the normal manner.

MULTIPLE CORER

This was guided onto the sea bed using a standard Acoustic beacon type which performed as required.

DECK MONITORING EQUIPMENT

Minor faults on both Mk IV deck units were soon repaired or by-passed. Basic faults in the three brand new dolphin towing cables prevented the use of the backward-looking PES transducer element and minidirectional ceramic ring transducer until late in the cruise; this did not affect the majority of the work, but did enforce a slight redesign of the two transponder arrays to allow operation within the limits of the standard PES system.

G R J Phillips

POSITIONS OF TOWED GEARS ON THE BOTTOM

The benthic programme at IOS has centred on the Porcupine Sea Bight since 1976. Within the Bight, soundings range from 200 to 4200 m. Through most of this depth range suitable bottoms for fishing the epibenthic sledge (BN1.5) and otter trawl (OTSB 14) were readily available. This is not true, however, in the constriction between the Goban Spur and the tail of the Porcupine Bank, at depths in the range of 2700 to 3400 m. Here the bottom is relatively steep shelving, and is much dissected by the canyon system of the Bight. There are very few flat areas present and patches large enough to fish the OTSB 14 at 3 knots for an hour are very much at a premium. Transponders can be utilised to mark such sites, but these instruments are expensive and their use can be justified only in special circumstances.

Towing benthic biological samplers in slope and rise environments involves the use of long towing warps. Fishing the BN1.5 and OTSB 14 in depths greater than 4000 m necessitates paying out about 8500 m and 13000 m of wire respectively. As a consequence, the gear will be some considerable distance horizontally from the ship and may be in totally different soundings and bottom topography.

If transpoders are not available, a best estimate of the geographical position of the gear can be obtained by calculation. The Magnavox satellite navigation system is basic in concept, and provides only satellite fixes and intervening DR positions. There is no facility for updating the DR reckoning nor is a shipborne computer available. The Magnavox data are therefore submitted to computer analysis after the cruise is completed, and track charts are produced. The position of the ship at the times of first and last bottom contact by the gear can thus be established. Dynamic considerations suggest that during a tow the main warp is to all intents and purposes straight. The drag of the gear will cause at most minor deviations affecting only the outboard few hundred metres. The depth of the net is continuously monitored, as is the length of wire out. The resultant triangle can be solved to give the horizontal distance of the net behind the ship. A constant heading is maintained throughout a haul from deployment to recovery of the net. Changes of speed will have little effect on leeway, and hence course made good over the ground, as BN1.5 hauls are made head to wind and OTSB 14 hauls stern to wind. Track charts indicate that courses made good during hauls are virtually constant. It can thus be assumed that the track of the gear on the bottom follows that of the ship over

the ground. The calculated distance astern of the net in conjunction with the track chart enables positions of first and last bottom contact of the gear to be read off.

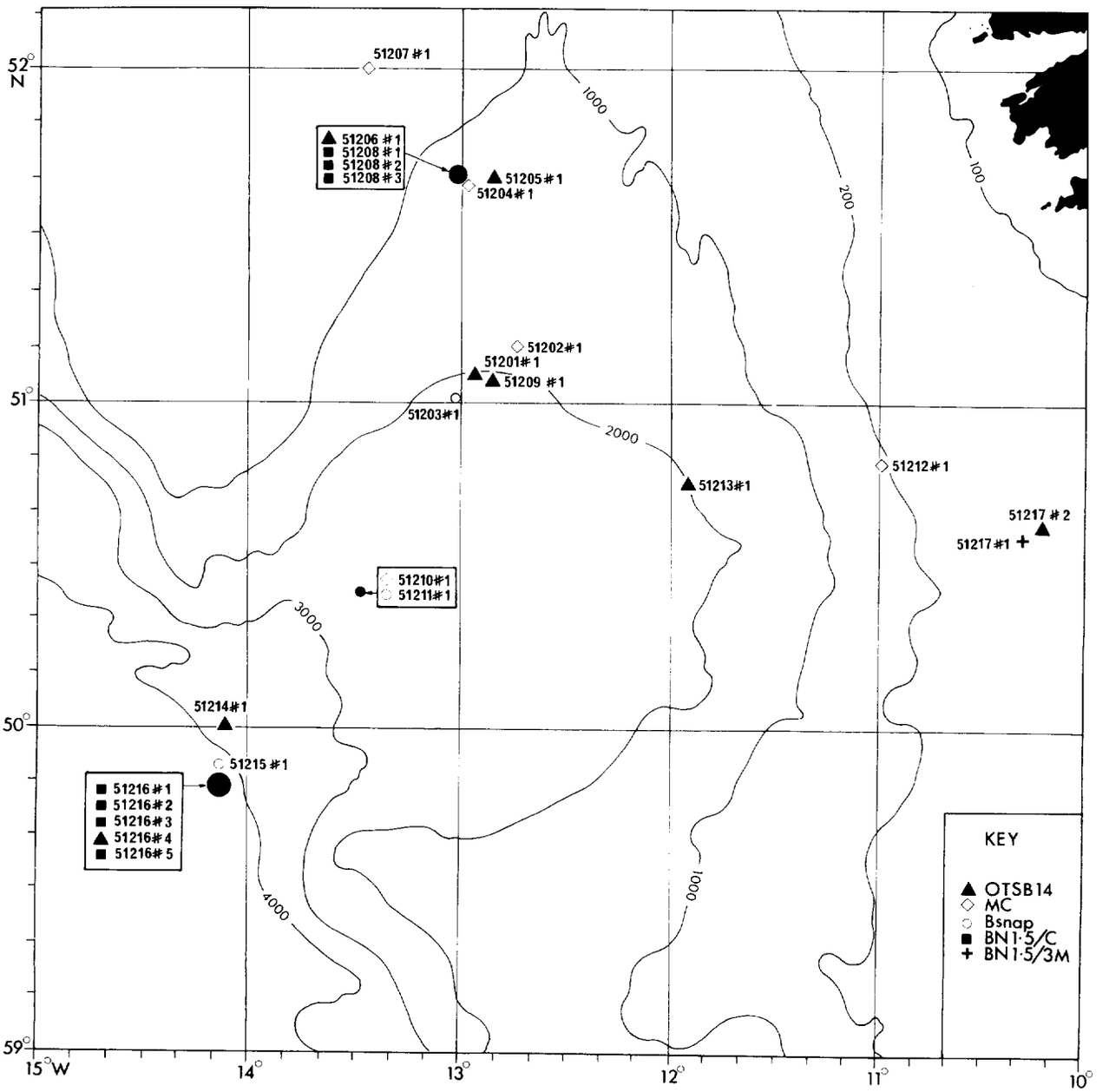
Beginning with this cruise, positions given in the station list are positions of gear on the bottom rathern than ships' positions which have been used heretofore.

M H Thurston

STATION LIST

STATION	DATE 1981	POSITION (START)+ N	W	POSITION (END)+ N	W	GEAR	SAMPLER DEPTH (M)	DURATION	DISTANCE RUN (M) ODOMETER OR SHIPS LOG	CALCULATED	REMARKS
51201#1	16:9	51°05.4'	12°55.8'	51°06.8'	12°52.9'	OTSB 14	1970-1980	1210-1300	3710	4230	Ship position: satellite fix 1222 51°07.53'N 12°51.22'W
51202#1	16:9	51°10.7'	12°44.6'			MC	1940	1638			10 cores
51203#1	16:9	51°01.1'	13°01.7'			BSNAP	2023	2218/16-0543/21			
51204#1	17:9	51°38.7'	12°57.5'			MC	1306	1504			10 cores
51205#1	17:9	51°39.7'	12°50.9'	51°40.3'	12°47.5'	OTSB 14	1373-1394	1721-1808	4630	4120	Ship position: satellite fix 1606 51°38.91'N 12°55.72'W
51206#1	18:9	51°40.3'	13°00.8'	51°40.3'	12°59.9'	OTSB 14	1200-1210	1320-1333	-	1140	
51207#1	19:9	52°00.0'	13°26.0'			MC	588	1059			Good cores
51208#1	19:9	51°41.3'	12°59.7'	51°42.2'	13°01.1'	BN1.5/C	1200-1170	2000-2031	560	2283	Weak link on lower bar parted No camera.
51208#2	20:9	51°40.9'	12°58.9'	51°40.9'	13°01.2'	BN1.5/C	1220-1183	0213-0256	624	2688	Net torn, no catch.
51208#3	20:9	51°41.0'	13°01.1'	51°41.0'	13°02.0'	BN1.5/C	1185-1170	0647-0707	349	1054	Benthos camera forward-facing; 3 sec intervals.
51209#1	20:9	51°04.1'	12°51.6'	51°04.5'	12°49.2'	OTSB 14	2015-2000	1616-1653	-	2900	Ship position: satellite fix 1458 51°03.65'N 12°54.50'W
51209#2	21:9	-		-		OTSB 14	-	-	-	-	Haul aborted due to bottom topography
51210#1	21:9	50°24.5'	13°27.8'			MC	2664	1524			Good cores
51211#1	21:9	50°25.9'	13°27.9'			BSNAP	2664	1555/21-1301/26			
51212#1	22:9	50°48.6'	10°59.1'			MC	187	0416			3 short cores from hard sandy bottom
51212#2	22:9	50°48.7'	10°58.8'			MC	187	0431			Failed. No cores.
51213#1	26:9	50°45.2'	11°55.7'	50°43.8'	11°56.0'	OTSB 14	1980-1895*	0201-0234	2040	2700	Ship position: satellite fix 0027 50°43.72'N 11°56.00'W. *Depth inaccurate due to monitor fault. Probable depth, derived from PES 2026-2030m.
51214#1	27:9	50°00.9'	14°06.8'	49°58.0'	14°04.3'	OTSB 14	3820-3800	0139-0240	5930	6260	Ship position: satellite fix 0100 49°57.10'N 14°03.26'W
51215#1	27:9	49°52.7'	14°08.3'			BSNAP	4009	1623/27-0807/29			
51216#1	27:9	49°48.1'	14°10.3'	49°49.0'	14°11.2'	BN1.5/C	4070	2055-2137	1256	2041	
51216#2	28:9	49°49.0'	14°09.7'	49°50.6'	14°11.0'	BN1.5/C	4060	0541-0648	-	3362	Fished upside down. Supra-benthic net with c 150 litres of sediment.
51216#3	28:9	49°50.1'	14°07.1'	49°49.0'	14°07.2'	BN1.5/C	4050	1623-1702	1215	2011	
51216#4	29:9	49°49.4'	14°06.6'	49°54.3'	14°08.8'	OTSB 14	4000-3970	0150-0318	7230	9590	Ship position: satellite fix 0016 49°50.77'N 14°07.35'w
51216#5	29:9	49°48.7'	14°04.7'	49°47.3'	14°05.4'	BN1.5/C	4030-4040	1316-1404	1192	2711	Camera obscured latterly by supra-benthic net.
51217#1	30:9	50°36.1'	10°19.0'	50°36.3'	10°18.1'	BN1.5/3M	150	1317-1333	414	1265	Benthos camera backward facing; IOS shuttered camera forward facing
51217#2	30:9	50°37.7'	10°13.4'	50°39.3'	10°04.5'	OTSB 14	141-135	1441-1608	-	10830	Ship position: satellite fix 1447 50°37.91'N 10°12.53'W

+ For BN1.5 and OTSB 14, positions are for first and last bottom contact of gear, and not ship positions.



CHALLENGER CRUISE 14/81, (IOS CRUISE 512), STATION POSITIONS