Institute of
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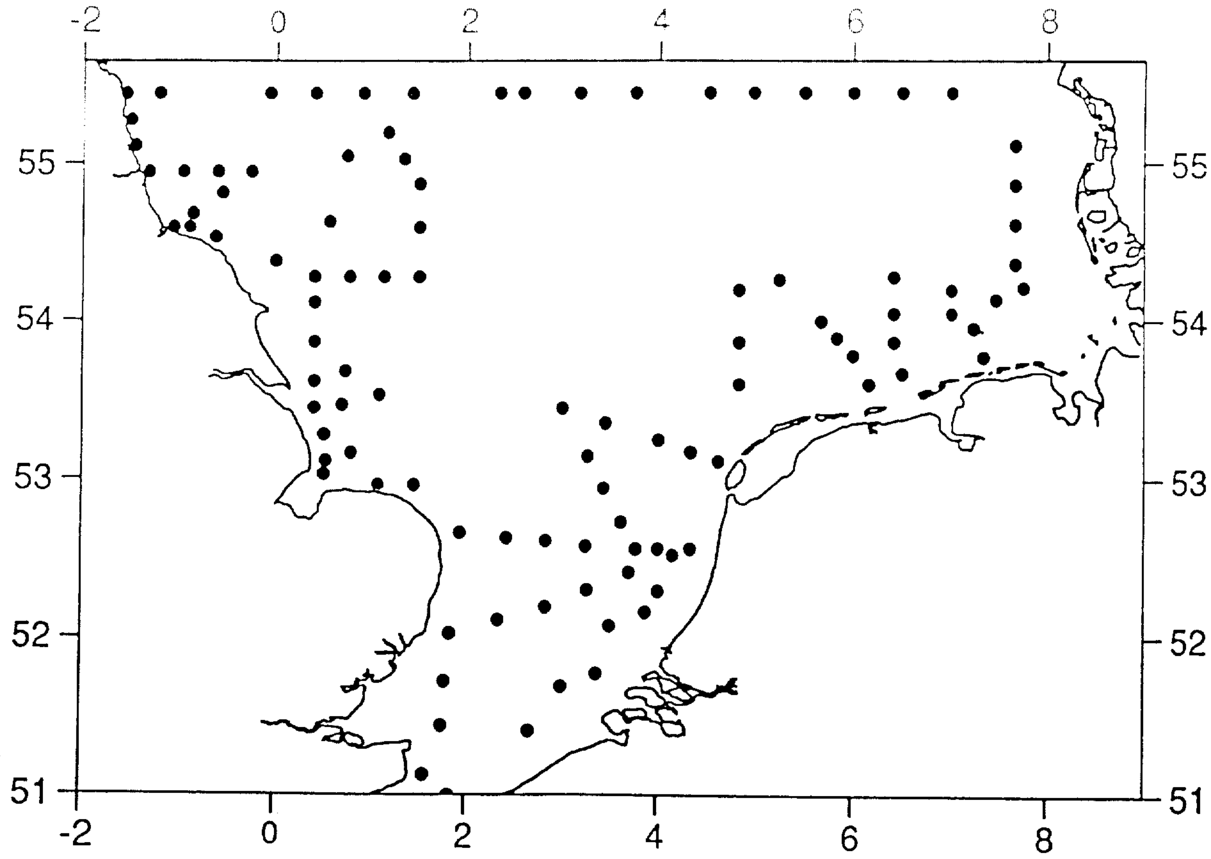
Deacon Laboratory

RRS Challenger Cruise 39

01 Nov - 13 Nov 1988

NERC North Sea Community Research Project
Survey Cruise No. 4

Cruise Report No 215 1990



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CRUISE REPORT NO. 215

RRS CHALLENGER CRUISE 39
01 NOV-13 NOV 1988

NERC North Sea Community Research Project
Survey Cruise No. 4

Principal Scientist
D J Hydes

1990

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AUTHOR

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ABSTRACT

Challenger Cruise 39 was the fourth monthly survey of the southern North Sea between the Dover Straits and 55°30'N performed as part of the NERC North Sea Community Research Programme. The weather was moderate and 115 out of the planned 120 survey stations were sampled. Measurements were made of physical, chemical and biological parameters on station and continuously between stations. Parameters sampled include temperature, salinity, dissolved oxygen, nutrients, zooplankton and suspended sediments in the water. Dissolved and particulate atmospheric samples were collected. On this survey, ornithological and cetacean observations were also made.

KEYWORDS

ATMOSPHERIC CHEMISTRY
ATMOSPHERIC PARTICLES
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CURRENT METER DATA
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OXYGEN
PRIMARY PRODUCTION
SURVEY
SUSPENDED PARTICULATE MATTER
ZOOPLANKTON

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Depart:	Great Yarmouth	31 October 1988
Arrive:	Great Yarmouth	13 November 1988

OBJECTIVES

Challenger Cruise 39 was a component cruise in the fifteen monthly cruises planned as part of the NERC North Sea Community Programme. This was the fourth cruise in the programme. For these cruises a set cruise track covering the different water masses and inputs to the southern North Sea, south of 55`30'N has been designed. The aim was to make measurements at the 127 stations on the track. The measurements are: salinity, temperature, transmission, fluorescence, irradience, nutrients, phytoplankton, dissolved oxygen, suspended solids and trace metals using a CTD rosette water bottle system, and net trawls for zooplankton. Underway measurements are made of irradience, and Acoustic Doppler Current Profilers (ADCP) and temperature, salinity, fluorescence, transmission and oxygen on instruments fed from a "non-toxic" seawater supply. Current meter and current profiler moorings were to be serviced at six sites.

NARRATIVE

RRS *Challenger* came alongside in Great Yarmouth at the end of Cruise 38 at 1400Z on Monday 31 October 1988. The scientific party for Cruise 39 started going aboard at 1500Z. Setting up of gear then started. All the scientific party were on board by 1900Z. About that time, Derek Lewis arrived from Barry with a replacement unit for the ship's main scientific computer. Repairs to the computer were completed the next morning. During the afternoon it was reported that MAFF had found a free-floating spar buoy from one of the North Sea Programme (NSP) moorings. At that stage, the message was that the buoy was probably from mooring "F".

Setting up and stowing of gear was generally completed by sailing time which was 1400Z on Tuesday 1 November. All the equipment for the cruise was operational except for the RVS deck-mounted transmissometer. The ship sailed at 1414Z. The pilot was dropped at 1455 after leaving the estuary. Course was set for N. Scoby buoy which was reached at 1600Z. The Simrad pole was attached to the side of the ship and monitoring of surface waters through the ship's non-toxic supply was started. The first station AA was reached at 1649Z. CTD and plankton net casts were started at this station. The position of mooring E near CTD station AB was reached at 1920Z. As the weather was calm it was decided to try to recover this mooring in the dark. The spar buoy beacon could not be seen. Without it, night-time recovery would be difficult. A short acoustic survey of the area to locate the acoustic beacon on the mooring was conducted for one hour but failed to verify that the rest of the mooring was still present. Later reference to the mooring log showed that the spar buoy found by MAFF was in fact the one from site E rather than site F, as had been originally suggested to us.

The first transect AA-AG, seven stations from Norfolk to the Dutch coast, was completed 0725 on Wednesday 2 November. During the night at Station AE the spar buoy at mooring F was spotted at its correct position. Station AM was worked before returning to mooring site F in daylight. Mooring F was reached at 1032Z. The mooring was successfully recovered intact with wires and shackles in good condition. The mooring was redeployed by 1232Z. Course was set for Station AI on the run down to Orford Ness. Station AM of Orford Ness was reached at 2335Z.

November 3 started as a bright calm day. The Dover Straits second station AG in French waters was reached at 0820Z. Good progress was made between sampling sites *en route* towards the stations off the Rhine estuary. The perished rubber springs on two Goflo bottles were replaced. A cold wind from the SE penetrated into the ship through all the open cable ports. These should be blocked before winter or work in the lab. spaces may not be a pleasant experience in January and February.

Friday 4 November was another bright, chilly day. About 0800Z something probably fouled round the EM log head. The hull seating was damaged, as a result, in raising and lowering it while trying to get it to work. It blew several fuses before it was finally fixed. Mooring site D (BB) was reached at 1100Z, well ahead of the previous day's estimate. A pop-up ADCP was present at mooring site D. An acoustic search for the mooring was conducted from 1130 to 1500Z. This search was unsuccessful. A second ADCP was deployed at 1531Z. Towards the end of the acoustic search, the input stage on the PES recorder broke down under the high output loading; this was quickly repaired. The ADCP moorings, at present in use at North Sea Programme sites, do not carry lights to make them visible at night. Due to the limited daylight hours available in winter, the lack of lights on the ADCPs places an unfortunate constraint on the CTD station programme as that has to be planned around reaching the ADCP sites in daylight to make recovery possible. For this reason, it was decided to cut stations BJ, BT and CF and CG *en route* to mooring site B.

Saturday 5 November was a day of steady progress on the zigzag course off the Dutch coast towards the German Bight. One Goflo bottle started to give problems - the ball valve sticking between stations BE and BG. During the night, between 2000Z and 0700Z, the level B on the computer system repeatedly crashed - possibly due to corrupted memory coming across from the battery back-up.

Sunday 6 November. Good progress was made. Station BZ in the German Bight was reached at 1342Z. Conditions were consistently better than the shipping forecast for the area which was force 5 to 6.

Mooring site B was reached at 1000Z on 7 November. Conditions were good for mooring work and became even calmer during the course of work. As we approached the station, the spar buoy marking the current-meter rig, which was mounted below a sub-surface float, and the toroid buoy of the thermistor chain were clearly visible. The RVS current-meter rig was taken in first, turned round and then redeployed as a "U"-shaped mooring. The thermistor chain and buoy were then recovered. A CTD dip was then made to check if temperature structure was still present at this site, in which case the thermistor chain would be redeployed. The CTD rosette pylon had to be serviced at this station before it could be used. Water was penetrating the pylon through a faulty "O" ring on the perished pressure-balancing bellows. This was manifesting itself as an erratic return signal after firing of the bottles. Changing the silicone oil in the pylon cured this problem. The CTD dip showed no stratification at site B and the thermistor chain was not redeployed. Work at site B finished at 1523Z. We then proceeded to mooring site A along the 55`30'N transect.

On the morning of 8 November, winds were up to forecast at 25 knots, gusting to 35. As these were from the SW they did not impede progress and we were still able to maintain about 9 knots between stations. At Station CR, the hand plankton net was carried under and aft of the ship and fouled in the region of the screw and rudder tube. The assistance of the mate and engineers was required to extricate us from this problem. Turning the screw by hand did not free the net. It was eventually decided to cut the rope. The ship then tested its control. This produced a knocking for a while which was presumably the net weight moving in the slipstream before it broke away. Mooring site A was eventually reached at 1223Z. The toroid buoy of the thermistor chain was sited. The ADCP was located, acoustically released and brought on board by 1252Z. The toraid buoy and thermistor chain were all on board by 1334Z. Both operations progressed smoothly in spite of the inclement sea state. The CTD dip revealed that the seasonal thermocline, which had been mixed down from about 30 to 50 m depth between September and October, was still detectable below 50 m. As a result, the thermistor chain and toraid buoy were redeployed. We were underway to complete the 55`30'N transect at 1540Z. Weather conditions deteriorated during the evening. Station CU was successfully accomplished in force 8, gusting 9, but Station CV was abandoned as it was steady 9 with waves occasionally coming along the gunwale.

The weather forecast was for improving conditions so it was decided to steam to the next priority one station and heave to there until conditions improved. Station CX was reached at 0150Z on Wednesday 9 November and was worked successfully at 0330Z. By 0900Z the wind had moved round to the south and had fallen to less than 10 knots. The swell fell away during the day. The next target was the mooring at site C (DM) which was an ADCP mooring. These have to be retrieved in daylight, so the full set of stations along the north east coast could be worked before arriving at DM at 0515Z on Thursday 10 November.

The CTD and plankton net casts were made before heaving to, to wait for dawn, to start recovery of the ADCP mooring. The ADCP was sighted at the surface at 0726Z. It was on board at 0737Z. The refurbished ADCP recoverd at Site A was redeployed at 0755Z. We then set course for mooring Site A to redeploy the ADCP recovered at C after it had been refurbished. *En route* at Station EF, it was discovered that the level B computer system was not logging the CTD data. This was traced to a faulty IO board on the level B which was replaced. The ADCP was successfully redeployed at site A at 1758Z. We then turned into the wind for the first time on this cruise. About 2200Z the wind was gusting to 30 knots and we were running into heavy swell; this reduced our speed to about 5 knots. The wind started to decrease about midnight.

By 0800Z on Friday 11 November, conditions had ameliorated and the day was bright and calm with the wind from the west at less than 10 knots. From Station EG, we sailed directly to Scarborough where the second engineer left the ship on compassionate grounds. While *en route* to and from Scarborough, the rosette pylon was again bled to reduce pressure in the bellows. There was gas on top of the oil. This may have been produced by corrosion. The rosette should be cleaned and serviced after each survey cruise as it is in such constant use during the survey cruises. The cruise track was regained at Station DM at 1840Z.

Station DQ off the Humber estuary was reached at 0147Z on Saturday 12 November. From this point we turned east and worked three stations, DR, DS, and EK which repeated the track of cruise 33. The day was calm and clear and good progress continued to be made. Station EN, the closest approach to the Great Ouse in the Wash, was reached at 1249Z. The waters at this and adjacent stations were extremely turbid and sedimentation occurred in the deck transmissometer tank. The final CTD Station AA was completed at 2114Z. The time between Stations DQ and AA was some $1\frac{1}{2}$ hours faster than cruise 33 due to favourable winds and tide. The evening was memorable also for a spectacular sunset. After completing CTD work, we went to mooring site E.

An unsuccessful acoustic survey to locate the mooring beacon was conducted until 0100Z on Sunday 13 November. Atmospheric sampling was carried out with the *Challenger* hove to on the mooring site until 0600Z. The intention had been to start to drag for the mooring. At this time, however, the wind had risen to force 7 and the sea was rising. The search for the mooring was abandoned and course was set for Yarmouth. Logging surface parameters ceased to 0800. A successful survey cruise ended at 1250Z with RRS *Challenger* alongside and secure in Great Yarmouth.

PROJECT AND EQUIPMENT REPORTS

ATMOSPHERIC SAMPLING

Objectives

1. To collect high volume filter samples of atmospheric particulates for inorganic and organic analysis.

2. To collect cascade impactor samples for inorganic analysis using a new, Liverpool University, cascade impactor housed in an RVS-constructed housing.

3. To collect cascade impactor/wind tunnel samples of large atmospheric particles.

4. To collect rainwater samples for major ion and trace metal analysis.

5. To deploy a new type of passive NO_x adsorption tube for evaluation.

Results

1. General

Although weather conditions were reasonably moderate for the time of year, sample collection was considerably restricted by both a large number of days with strong winds from astern and, also, the presence of spray at deck level preventing the use of the low level samplers.

The equipment generally worked well with the provisos outlined in (2) and (3) below.

Serious concern about the working conditions in the main laboratory arose in two respects. First, the preparation of battery parks in the area, requiring the prolonged use of soldering materials, raises serious doubts about trace metal contamination of retrieved atmospheric samples, even when they are being handled in the laminar flow cupboard. Second, the continued habit of smoking within the laboratory (a no smoking area) by certain personnel also raises the question of contamination. Smoke can be smelled within the laminar flow cupboard even when smokers are in the outer wet laboratory. As some of the atmospheric samples are being analysed for combustion products, this practice must be seen as unsatisfactory (see recommendations).

2. Specific

(i) The high volume samplers behaved well with a total of nine batches being collected.

(ii) The new cascade impactor could not be made to operate to its full potential because of adverse weather conditions and some access problems associated with the outer housing design. There was also a lack of knowledge of full operating protocols. This was caused by the unforeseen and unfortunate absence of a key member of the Liverpool group who was obliged to attend a funeral rather than participate in the installation prior to leaving Great Yarmouth.

This package will be returned to Liverpool for modifications prior to the next survey cruise.

(iii) Adverse weather conditions also limited the amount of use of the Essex cascade impactor system. In addition, problems with the unfavourable wind direction cut-out microswitch (which kept sticking) further cut down sampling time.

(iv) There was no significant rainfall during the cruise and only one partial sample was collected.

(v) The NO_x samplers were deployed without difficulty and a total of 55 samples of three different exposure periods were collected.

Conclusions and Recommendations

A moderately successful cruise where the principal limiting factor was adverse weather conditions. However, we recommend that:

1. The laminar flow cupboard be moved to the dark room and sited in the position at present occupied by the salinometer. This can be moved round the corner on the same bench.

2. Some consideration be given to normal safety practices concerning the practice of smoking in laboratory areas. We **recommend** that the no smoking signs in the chemical, main and wet/fish laboratories be enforced in accordance with good laboratory practice **recognising** that this is likely to be very unpopular with the ship's engineers and others who use the wet laboratory as a place for tea and coffee breaks.

3. Although the new steps up to the deckhouse top are a great improvement over the previous ladders, we recommend the re-installation of safety chains at the top as this would add to safety, particularly at night.

4. Consideration will be given to changing the sampler design to compensate for rain events that will inevitably be associated with moderate-to-strong wind conditions during winter months, with the rain generally being nearly horizontal.

5. A new platform should be constructed for the top of the monkey island access ladders for safer working.

6. A semi-enclosed perspex box should be constructed to afford extra protection to the NO_x samplers.

7. We request two berths on all survey legs. There are now six atmospheric sampling systems in operation on *Challenger*, each with its own operating protocol. It is difficult, even for two people who know what they are doing, to keep these systems running on a 24-hours basis given the complexity of the cruise track and the associated changes in relative wind direction and speed. If we are restricted to a single person, as anticipated in some future cruises, then it seems likely that we will not be able to run the atmospheric sampling programme at all efficiently.

MRP, AR

SUMMARY OF MOORING OPERATIONS

Site A Two visits

8 November 1988: thermistor chain recovered; ADCP recovered; thermistor chain redeployed - structure present below 50 m.

10 November 1988: ADCP deployed.

Site B One visit

7 November 1988: current meter rig recovered; current meter redeployed; thermistor rig recovered, not redeployed.

Site C One visit

10 November 1988: ADCP recovered; ADCP deployed.

Site D One visit

4 November 1988; ADCP not recovered; ADCP deployed.

Site E Two visits

Mooring not located.

Site F One visit

2 November 1988: current meters recovered; converted U-shape mooring and redeployed.

ADCP AND THERMISTOR MOORINGS

The two thermistor moorings at Stations A and B were successfully recovered. Both were in good condition, there was no visible damage. A thermistor mooring was redeployed at A. At Station B the sea was well mixed, so the mooring here was not redeployed.

The ADCP at Station A was successfully recovered and redeployed at Station C. Similarly, the ADCP at Station C was recovered and redeployed at Station A. The ADCP at Station D was not recovered. A three-hour acoustic search was made without any contact. At the end of the search, another ADCP was deployed at D.

GB, AB, DF

CTD/ROSETTE SYSTEM

The CTD system worked well over the 115 casts. Temperature and salinity checks were done at each station and produced consistent results. Temperature returned by the CTD was between + 0.003°C and - 0.003°C of the reversing thermometer readings, while the salinity read about 0.01 below the bottle samples analysed on the Autosal. The pressure sensor had an offset of 2.9 m.

The transmissometer and light meters worked well but the fluorimeter gave a problem. During the cruise, the reference voltage drifted causing the instrument to clamp its output to - 0.36 volts. Therefore, this unit was changed for the PML fluorimeter and that worked well till the end of the cruise.

The rosette system worked well at first, then it started not giving confirmation pulses. It was then noticed that the diaphragm was internally pressurised. The rosette was stripped down to release the pressure and the oil was replaced. The likely reason for this is that the diaphragm is leaking under pressure and is acting as a one-way valve. The IOL Goflo bottles produced a few little problems with not closing properly. These were either replaced or serviced, as required.

AJ, DP

DECK INSTRUMENTS AND ADCP

The fluorimeter worked well throughout the cruise and so did the light meters and solarimeter. The RVS transmissometer was found to be faulty before sailing and therefore was not used throughout the cruise. After eight days, the Plymouth transmissometer started giving erratic readings and continued to do so for two days.

The ADCP gave no problems, other than when going into deep water it lost bottom tracking and therefore the number of bins had to be increased.

AJ, DP

CURRENT METER MOORINGS

Mooring F was recovered and all mooring wires, etc. were in good order. The flasher unit in spar was faulty and therefore changed. The rig was relaid with new meters and meter wires. A S4 current meter (17) was set up with the wrong header, *i.e.* NSCH39ET instead of NSCH39FT; this will have to be corrected on recovery.

Mooring B was successfully recovered after two months and this rig was relaid as a U-shape mooring. The acoustic release was left in the meter line so that it can be used as a beacon.

The spar buoy on mooring E was missing so an acoustic search was made in the area but the mooring was not located. Bad weather also prevented the attempt to drag for the mooring.

Data was retrieved and subsequently transferred to floppy discs from all the recovered meters. No instrument faults were apparent.

AJ, DAP

SUSPENDED SEDIMENTS

Objectives

1. To obtain horizontal and vertical profiles of beam transmittance using three transmissometers, two deck-based transmissometers for the horizontal profiles and a transmissometer mounted on the CTD rosette for the vertical profiles.

2. To calibrate this transmittance data by filtering appropriate water samples for suspended solids.

Data Collection

1. Beam Transmittance

A continuous surface profile of beam transmittance along the whole survey track was not obtained during this cruise as serious problems were experienced with both deck-based transmissometers. Electronic failure of the RVS transmissometer, apparent after installation, meant that no data were obtained from this unit at any time during the cruise. Unfortunately, the same problem appeared to develop with the PPIMS transmissometer on day 7 which meant that no surface profile data were obtained for days 8 to 10.

For days on which transmittance data were obtained, a non-toxic supply rate of approximately 20 litres/minute was maintained. Over the first two days there were a couple of occasions when the water entering the PPIMS transmissometer jacket was highly aerated; this was due to air in the header tank. Apparently, it is RVS practice to leave the control valves at the base of the header tanks fully open and alter the flow rate using the flow meters only. However, as happened here, this would cause problems when water enters the header tank at a lower rate than that leaving it; thus, the control valves on the header tank must be altered every time the flow rate at the flow meters is changed significantly.

Vertical beam transmittance profiles were obtained at every CTD station using a transmissometer mounted horizontally on the CTD rosette. These profiles extended from the water surface to within 1-5 metres of the bottom.

2. Calibration data

All calibration samples were filtered through pre-weighed 0.45 micron membrane filters using the PPIMS filtration system. The filters were flushed with distilled water and dried in individual petri dishes in a laminar flow air cupboard. When fully dry they were stored in the fridge.

To calibrate beam transmittance for the horizontal profile, samples were obtained four times a day from the outlet to the PPIMS deck-based transmissometer.

To calibrate beam transmittance data for the vertical profiles, samples were obtained from the Goflo bottles mounted on the CTD rosette which were triggered at the surface, mid-depth and bottom of each profile.

Samples were obtained from the following CTD stations: 815-846, 848-849, 851-857, 859-875, 877, 879, 881, 883, 886, 888-893, 895-903, 905-909, 911-928.

Problems

1. The original arrangement was for the filtration to be done using the IMER "Chicken feeder" system. This, however, appeared to be totally inadequate for filtering suspended solids as all the metal work on the system (mostly directly above the filter stacks which, by design, have no lids) was very corroded and flaked when touched. Any samples filtered using the system as it stood were liable to be highly contaminated. In case the PPIMS system could not be fixed, all exposed surfaces of the IMER system were coated in masking tape.

   Although there were a few problems with the PPIMS system, these were temporarily solved and this was the system used. The major problem appeared to be that the outflow from the drainage reservoir was not airtight and tended to suck out back up even though the tap was fully off. Either a new tap is required or an airtight cap is needed to put over the end of the outflow pipe. Another problem was that the filtration tap on the left of the system (as you look at it), even though vertical, occasionally did not allow water to drain out of the stack and several samples had to be abandoned.

2. At some of the deep water/offshore stations, six litres of water were being filtered through each filter paper. Having only a small number of two-litre containers proved a problem, especially in rough weather, when the ship had to stay on station until all the water needed was extracted from the Goflo bottles. It would be useful to have at least four five-litre containers and some tubing that could be attached to the Goflo outlet pipe to allow the water to drain into the containers.

3. A list of stations sampled for sediments on all previous survey cruises would have been useful, as would additional consumables such as a scalpel, rubber bands (approximately 150) and some masking tape, and a distilled water bottle with a fine nozzle.

RJ, DP, CS

PRIMARY PRODUCTION

Objectives

1. At every station - filtered water samples from the surface, mid-depth and bottom CTD bottles for chlorophyll analysis.

2. At alternate stations - replicate 50 ml water samples from the surface CTD bottle to be preserved for phytoplankton analysis.

3. At dawn daily - 24-hour ^{14}C primary production incubation at six simulated depths.

4. To measure dissolved oxygen in surface water semi-continuously using the Endeco D.O. system coupled to the pumped water supply.

5. To determine dissolved oxygen by Winkler titration from a limited number of bottle casts and at intervals from the pumped water supply.

Rationale

1. The samples will be analysed and chlorophyll *a* concentration determined. These will be used to derive an algorithm to convert fluorescence into chlorophyll a concentration for both the surface continuous trace and the depth profiles from the CTD casts.

2. Phytoplankton species composition will be determined. A large number of samples is to be collected but only the most relevant analysed.

3. Primary production is to be estimated for each CTD profile using an algorithm relating depth-integrated primary production to irradiance and chlorophyll a concentration. The ^{14}C incubations are to be used to calibrate the algorithm.

4. Seasonal and spatial distribution in dissolved oxygen concentration and percentage saturation are to be determined. These will then be related to features such as primary production and phytoplankton blooms.

5. The concentration of dissolved oxygen measured by Winkler titration from the bottle casts will be used retrospectively to provide a calibration, or offset, for the CTD oxygen probe data. Measurements on samples from the pumped water supply are compared with results from the Endeco D.O. system to ensure that the electrodes have not drifted from the pre-set calibrations. In the case of electrode drift, the data will be used to construct a calibration curve to correct probe data.

Summary of Results

1. Two-litre samples for chlorophyll determinations were filtered at all 110 stations. Generally, three samples, one from the surface, mid-depth and bottom CTD bottles, were collected. However, samples from six depths were collected from the cast used to set up the ^{14}C incubations.

2. Two 50 ml samples, one preserved with Lugol's iodine and the second with formalin, were collected at 54 stations.

3. Ten twenty-four hour ^{14}C primary production incubations were performed. One incubation initiated pre-dawn daily from the 2 to 11 November. The stations sampled were 820, 830, 839, 848, 863, 874, 882, 888, 902 and 911 respectively.

4. The Endeco D.O. system sampled at 15-minute intervals throughout the duration of the cruise. For the first seven days it kept to its pre-set calibration and was hence reading the actual oxygen concentration (confirmed by Winkler titration, section 5 below). The electrode membranes had to be replaced on day seven and subsequently did not revert to their original calibration.

5. Winkler titrations were used to determine oxygen concentrations from the CTD samples at 21 stations including all ten of the six-bottle pre-dawn casts. Measurements were made 74 times on samples taken from the pumped water supply. All depth profiling stations were included in the 43 samples taken at the site of CTD casts. This data will be used to calibrate retrospectively the electrode response (section 4 above) since day seven, back in Southampton.

Comments and Observations

On the whole, a satisfactory survey cruise for the Biology Group. It would be better, however, to judge the cruise after analysis of the collected samples. On board, four out of the five objectives (chlorophyll a, phytoplankton, primary production and Winkler titrations) were fully met. Oxygen data from the second half of the cruise, Endeco D.O. system, awaits post-cruise calibration and may result in all five objectives being met.

During the cruise, suggestions for alterations to experimental methods and problems with apparatus were noted in the appropriate log books. These will thus be brought to the attention of the relevant scientist immediately after the cruise. This is thought to be the most efficient procedure and hence they are not mentioned here.

Samples were chosen for dissolved oxygen determinations by Winkler titrations to maximise the usefulness of the information gained. Hence samples were collected mainly at CTD stations; pumped water supply and surface CTD bottle samples collected at same site; inclusion of samples to be used for primary production measurements; collected at the same time that the Endeco D.O. system was making a measurement.

Ten, not eleven, primary production incubation experiments were performed as one vial of 14C was spilt. The spillage was contained in the white plastic tray positioned in the fume cupboard and absorbed into the paper towel used as a lining. All ^{14}C apparatus was soaked in

Decon and rinsed with tapwater. After the last incubation experiment the laboratory was cleaned and found to be free from contamination.

RJ, DHP, CS

ORNITHOLOGICAL OBSERVATIONS

Objectives

To help in the Nature Conservancy Council/Seabird Group assessment of the distribution of seabirds in the Southern North Sea. The data accumulated will help to provide an index of species abundances in different areas throughout the year. This will help us to understand local and long haul migrations and will enable patterns to be predicted which will allow positive conservation action to be taken in the event of pollution incidents at sea.

Methods

(a) Observation

Observations of all birds were done in a systematic manner using a 180° viewing arc from above the bridge. Each watch consisted of a number of ten-minute scans and counts which were done consecutively for periods of 100 minutes. Binoculars were only used to check species identification. A set procedure was followed enabling all data to be compared.

(b) Recording

Records were made on NCC standard sheets - one providing information on environmental parameters, *e.g.* location, ship's course, wind strength and direction, swell magnitude, temperature, pressure, and one for logging all sightings.

Results

The weather was good throughout, thus work was only limited by my other allocated duties. A total of 2700 minutes (45 hours) of observation was carried out.

Species List (alphabetical)

Seabirds

Black-headed gull	***Larus ridibundus***
Common gull	***Melanitta nigra***
Common scoter	***Larus canus***
Fulmars	***Fulmarus glacialis***
Gannets	***Sula bassana***
Greater black-back gull	***Larus marinus***
Guillemots	***Uria aalge***
Herring gull	***Larus argentatus***
Kittiwake (black-legged)	***Larus bridactyla***
Lesser black-back gull	***Larus fuscus***
Little auk	***Alle alle***
Puffin	***Fratercula arctica***
Razor bill	***Alca torda***
Storm petrel	***Hydrobates pelagicus***

Landbirds

Blackbird	***Turdus merula***
Chaffinch	***Fringilla coelebs***
Greenfinch	***Carduelis chloris***
Purple sandpiper	***Calidris maritima***
Sparrow (house)	***Passer domesticus***
Starlings	***Sturnus vulgaris***

Whilst it is unwise to comment too deeply on the data amassed without first consulting similar observations, certain points may be made. As expected, the vessel-following gulls were most common, especially the smaller kittiwakes which were almost permanent visitors. Of the larger gulls, the herring gull was the most numerous, though the pink-legged great black backs (both in summer and winter plumage) were also well represented. Of the auks, the guillemot (or common murre) was the most commonly observed, increasing in numbers with increasing latitude. There were fewer razorbills than expected but similarly higher numbers of little auks - the three specimens seen were at the southern periphery of their range.

Whilst no unusual sightings were observed, it was surprising to note the absence of certain species, namely, terns, shearwaters, many petrels and seaducks. Also, whilst many light fulmars were seen, their dark and double-dark morphs were distinctly lacking. The one petrel recorded was that of an exhausted storm petrel which found refuge on the ship's deck - but soon perished.

Due to other work, dawn observations were limited to casual sightings. However, these revealed many landbirds, often using the ship as a resting point, especially starlings, which on one occasion had about seventy individuals on the ship's upper deck. Again, there were no surprise visitors. A single purple sandpiper provided the cruise's only wader.

Overall, it should be noted that the range of seabird species was fairly narrow. The gulls were always greater in number than the auks, which were dominated by the guillemot species.

RJ

MARINE MAMMAL OBSERVATIONS

Objectives

The Cetacean Group was established to obtain new information on the status, distribution and aspects of the biology and ecology of porpoises, whales and dolphins in British waters. This cruise was used to continue to improve upon the sighting network, so adding to the data essential for establishing temporal and spacial population changes. Due to the present plight of the North Sea's seal colonies, it was intended also to record their sightings (dead or alive).

Method

Observations were carried out simultaneously with the seabird watch. Once more, standard recording forms were used to log all sightings and to record environmental factors.

Results

Only one casual observation of a cetacean was made throughout the twelve-day trip. Fleeting observations from a number of people identified it as one of two species, the white-beaked dolphin or the Atlantic white-sided dolphin. The specimen was about nine-feet long with a back-curved dorsal fin midway along its length. Its nose was beaked, not blunt like that of a porpoise, nor elongated to a bottlenose. It also had a white belly with white flank patches. However, one observer saw the dolphin to also have a white saddle, i.e. a patch, dorsal and posterior to the fin, extending to the fluke. Hence the specimen appears to be a white-beaked dolphin (*Lagenorhynchus albirostris*). This is supported by its breaching behaviour, which is seldom shown by the white-sided species.

Overall, the number of cetacean sightings was disappointing, though not surprising. The negative results are probably a reflection of the dolphins' decline in the North Sea. No seals were observed on the trip.

RJ

NUTRIENTS

The nutrients measured on this cruise were ammonia, nitrate, nitrite, phosphate and silicate. This was the first survey cruise on which ammonia was measured routinely. The method is still not properly reliable and the ammonia system had to be flushed out with dilute sulphuric acid before each run to achieve acceptable peak shapes. Good peak shapes were achieved on all the other channels. Occasional spiking occurred on the nitrite channel due to small bubbles passing through the cell. We were unable to trace the source of these bubbles.

Samples were measured from each of the CTD stations. These were a surface, mid-depth and bottom sample on each cast, except the pre-dawn cast when six samples were collected.

Data from the analyser was successfully transferred to the "run" system on Challenger; this enabled contour plots of the data to be produced before the end of the cruise.

HE, DH, AR

ZOOPLANKTON SAMPLING

At 62 stations, a vertical haul with a 300 μm net was made, just after or before the CTD-cast. Stations were chosen from all parts of the survey track, taking care that each province or water type in the southern North Sea was sampled several times. Hauls were done from 2-5 metres above the bottom (depending on wire angle and sea state) to the surface, with volumes of water filtered ranging generally from 10 to 30 m^3, corresponding to lengths of wire released from 25 to 75 m, respectively. The most shallow stations sampled were DQ and EM (15 m), the deepest DE (93 m). All catches were preserved in 4% formaldehyde, but with prior measurement of displacement volume to obtain a first impression of the level and distribution of zooplankton biomass during the cruise. To that end, the catch, after removal of larger organisms such as ctenophores, hydromedusae, shrimps and fish larvae, was concentrated and sucked dry on a 47 mm gauze filter and transferred into a partly-filled measuring cylinder. In this way, the volume observed represented mainly mesozooplankton (copepods, etc.) but sometimes considerable amounts of larger species of phytoplankton were present as well.

The general pattern of displacement volume in November 1988 resembled to a great extent those observed in the August and September surveys, with higher levels of plankton biomass along the Dutch coast, in the German Bight, and at Dogger Bank. Compared with the survey in October (when wind conditions prevented sampling in the German Bight), displacement volume was about the same at, and east of, Dogger Bank but had increased by about one magnitude at the British side of the Southern Bight and by more than one magnitude along the Dutch side, especially at the stations influenced by the Rhine (AV, AG and BF). Here, a conspicuous "blooming" of the chlorophyll *b*-containing species *Halosphaera* was largely responsible for the high displacements observed (> 1 ml per m^3). The distribution of this sphere-shaped phytoplankton species extended all along the Friesian Islands up to the stations near Denmark (with a displacement larger than 1 ml per m^3 at Station CH again), except for the inner parts of the German Bight. The mass occurrence of *Halosphaera* will hardly be detectable in the chlorophyll and Lugol samples as densities were probably too low in the rosette samples, compared with the amounts of water scanned by the 300 mm net. Whether autumn blooming, such as described above, occurred as well in zooplankton has to await proper analysis and comparison between surveys.

On two occasions the line to the nets fouled on the side of the ship during recovery. At station B1 (5 November), the wire angle suddenly increased and the line caught on the SIMRAD transducer pole. This took fifteen minutes to free. At station CR (8 November), the hand net was taken under the hull by the ship's drift and it caught near the propeller and rudder. One-and-a-half hours were lost in trying to free the line. From station BM onwards a 5 kg weight was being used on the hand net instead of the original 11 kg weight. In the light of this accident it is recommended that an 11 kg weight should be used in future and that the hand net should be hauled in immediately there is any sign of its drifting under the ship.

MAB

ACKNOWLEDGEMENTS

The willing help, co-operation and advice of the Master, Officers and Crew of RRS *Challenger* are gratefully acknowledged. Everyone on board played their part to make *Challenger* 39 a successful cruise.

TABLE 1 - Challenger 39 - Station List

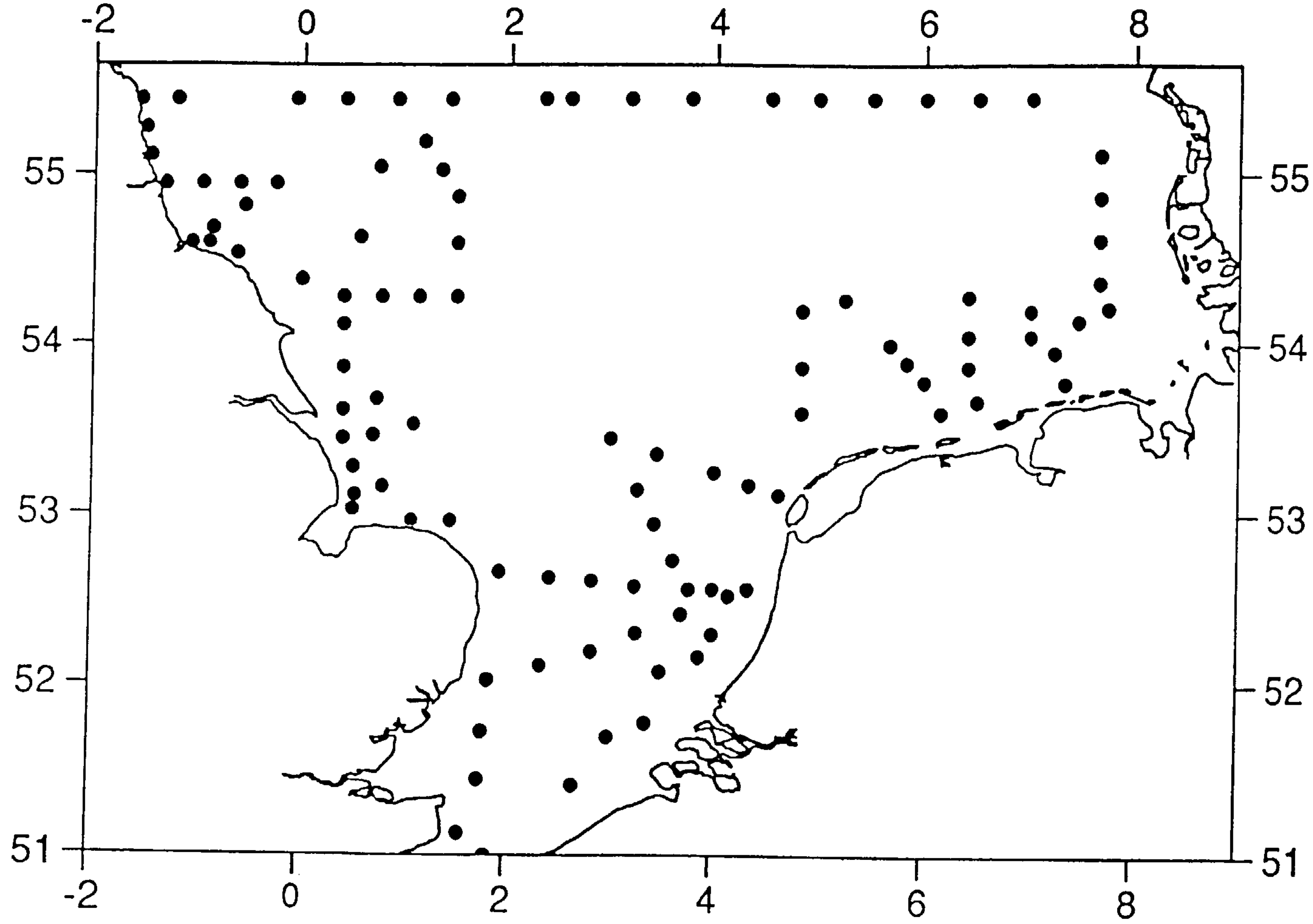
STATION	DAY	TIME	START POSITION LATITUDE	LONGITUDE	DEPTH (m)
815	306	17.03	52°43.0'N	1°55.9'E	28
816	306	20.22	52°41.4'N	2°24.8'E	48
817	306	22.50	52°40.0'N	2°50.0'E	44
818	307	00.52	52°37.9'N	3°14.8'E	39
819	307	03.34	52°36.9'N	3°45.6'E	27
820	307	05.27	52°36.9'N	3°59.8'E	25
821	307	07.09	52°37.0'N	4°20.0'E	20
822	307	08.41	52°34.6'N	4°08.6'E	24
823	307	13.48	52°27.5'N	3°41.7'E	31
824	307	15.57	52°21.4'N	3°15.6'E	34
825	307	18.15	52°15.1'N	2°50.2'E	41
826	307	20.43	52°10.1'N	2°20.1'E	57
827	307	23.38	52°05.9'N	1°49.9'E	27
828	308	02.00	51°46.9'N	1°47.1'E	27
829	308	04.03	51°11.0'N	1°33.9'E	37
830	308	06.39	51°11.0'N	1°34.0'E	52
831	308	08.24	51°02.9'N	1°50.7'E	31
832	308	13.40	51°28.1'N	2°40.1'E	30
833	308	16.40	51°44.7'N	2°59.7'E	31
834	308	18.38	51°49.8'N	3°21.9'E	27
835	308	21.26	52°08.4'N	3°30.2'E	34
836	308	23.11	52°13.1'N	3°52.1'E	26
837	309	00.39	52°25.2'N	3°58.2'E	25
838	309	02.57	52°36.5'N	3°45.6'E	28
839	309	04.38	52°46.8'N	3°37.0'E	30
840	309	06.44	53°00.0'N	3°25.9'E	28
841	309	08.45	53°12.3'N	3°15.8'E	27
842	309	11.09	53°30.0'N	3°00.0'E	37
843	309	17.49	53°24.2'N	3°27.1'E	30
844	309	20.47	53°18.0'N	4°00.0'E	27
845	309	23.10	53°13.4'N	4°19.9'E	30
846	310	01.11	53°39.2'N	4°49.9'E	25
847	310	04.28	53°39.1'N	4°50.0'E	32
848	310	04.55	53°39.2'N	4°50.2'E	31
849	310	06.50	53°55.1'N	4°49.7'E	41
850	310	09.47	54°15.0'N	4°49.7'E	47
851	310	09.56	54°15.0'N	4°49.7'E	47
852	310	11.54	54°19.0'N	5°14.9'E	43
853	310	14.35	54°02.9'N	5°40.0'E	38
854	310	15.44	53°56.4'N	5°50.0'E	34
855	310	17.09	53°50.1'N	6°00.3'E	30
856	310	18.53	53°39.0'N	6°10.2'E	27
857	310	20.30	53°43.1'N	6°30.0'E	23
858	310	22.13	53°55.1'N	6°24.9'E	27
859	310	22.36	53°55.1'N	6°24.9'E	27
860	311	00.06	54°06.0'N	6°24.9'E	34
861	311	01.50	54°20.0'N	6°24.8'E	38
862	311	03.19	54°25.='N	6°42.4'E	37
863	311	05.15	54°14.9'N	7°00.2'E	37

TABLE 1 - Challenger 39 (continued 2)

STATION	DAY	TIME	START POSITION LATITUDE	START POSITION LONGITUDE	DEPTH
864	311	06.37	54°06.1'N	7°00.2'E	36
865	311	08.08	54°00.5'N	7°14.5'E	32
866	311	09.45	53°49.5'N	7°20.0'E	26
867	311	13.46	54°13.8'N	7°37.5'E	37
868	311	15.20	54°16.0'N	7°44.9'E	27
869	311	16.59	54°24.9'N	7°40.1'E	26
870	311	19.06	54°39.9'N	7°40.1'E	22
871	311	21.29	54°55.1'N	7°39.9'E	22
872	311	23.25	55°09.9'N	7°39.8'E	22
873	312	03.09	55°30.0'N	6°59.8'E	29
874	312	05.41	55°29.8'N	6°30.2'E	43
875	312	08.00	55°30.2'N	5°59.5'E	49
876	312	15.01	55°29.6'N	5°30.2'E	52
877	312	17.27	55°30.2'N	4°59.1'E	44
878	312	19.32	55°29.7'N	4°30.9'E	32
879	312	22.46	55°29.8'N	3°45.5'E	34
880	313	01.01	55°30.2'N	3°06.6'E	37
881	313	03.18	55°30.0'N	2°35.7'E	47
882	313	05.58	55°30.2'N	2°02.4'E	67
883	313	08.57	55°30.1'N	1°24.5'E	73
884	313	13.56	55°29.8'N	0°54.0'E	80
885	313	18.06	55°30.2'N	0°24.4'E	74
886	313	20.13	55°30.2'N	0°03.9'W	73
887	314	03.40	55°29.9'N	1°11.7'W	92
888	314	05.38	55°30.1'N	1°32.9'W	33
889	314	07.38	55°20.1'N	1°29.9'W	40
890	314	09.14	55°10.2'N	1°26.9'W	36
891	314	10.51	54°60.0'N	1°18.0'W	41
892	314	12.58	54°59.6'N	0°56.8'W	84
893	314	14.30	54°59.8'N	0°36.0'W	72
894	314	16.36	54°59.7'N	0°14.7'W	93
895	314	18.22	54°52.0'N	0°32.9'W	65
896	314	20.06	54°44.2'N	0°51.2'W	56
897	314	21.18	54°39.2'N	1°02.9'W	26
898	314	22.53	54°39.1'N	0°53.1'W	44
899	315	00.22	54°34.8'N	0°37.0'W	53
900	315	01.43	54°30.8'N	0°21.1'W	59
901	315	03.24	54°25.7'N	0°00.3'E	62
904	315	11.21	54°41.1'N	0°33.0'E	75
905	315	14.22	55°05.9'N	0°44.3'E	73
906	315	17.37	55°30.1'N	0°54.1'E	76
907	315	21.30	55°15.1'N	1°09.8'E	67
908	316	00.14	55°04.9'N	1°19.8'E	35
909	316	02.17	54°55.3'N	1°29.7'E	31
910	316	04.59	54°38.8'N	1°23.7'E	37
911	316	05.18	54°38.8'N	1°23.3'E	38
912	316	07.34	54°19.8'N	1°30.5'E	50
913	316	09.31	54°20.0'N	1°08.1'E	58
914	316	11.11	54°20.1'N	0°46.1'E	61

TABLE 1 - Challenger 39 (continued 3)

STATION	DAY	TIME	START POSITION LATITUDE	LONGITUDE	DEPTH
915	316	18.43	54°19.9'N	0°24.0'E	62
916	316	20.01	54°10.1'N	0°24.0'E	59
917	316	22.00	53°55.2'N	0°24.0'E	49
918	317	00.22	53°40.2'N	0°24.1'E	19
919	317	01.48	53°29.8'N	0°24.0'E	14
920	317	01.13	53°31.0'N	0°41.0'E	99
921	317	05.09	53°34.6'N	1°04.7'E	25
922	317	07.23	53°42.3'N	0°43.0'E	34
923	317	10.14	53°20.2'N	0°30.1'E	17
924	307	15.57	52°21.4'N	3°15.6'E	34
925	317	12.54	53°05.0'N	0°30.0'E	31
926	317	14.50	53°13.0'N	0°46.7'E	21
927	317	16.53	53°00.9'N	1°03.9'E	18
928	317	18.32	53°00.8'N	1°27.1'E	30
929	317	21.07	52°42.2'N	2°27.7'E	36



Station Positions: RRS *Challenger* Cruise 39 01-13 Nov 1988