Porcupine Newsletter

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PORCUPINE

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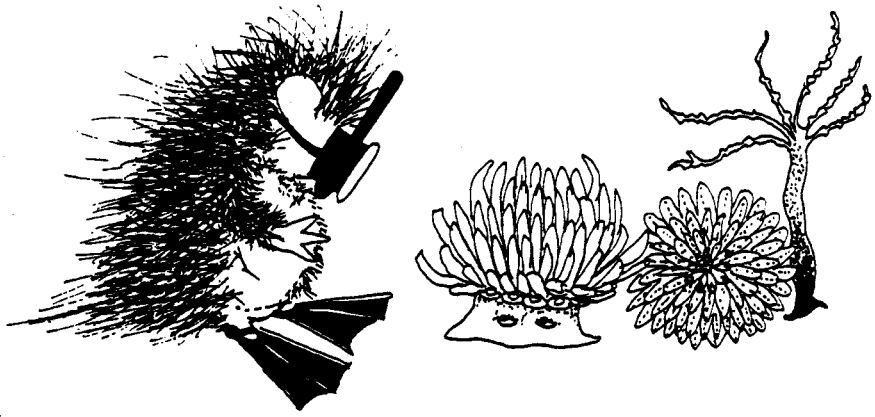
EDITORIAL

Much of what was reported at the AGM as Hon. Editor's Report for 1995 is equally appropriate to this Editorial, thus to save repetition it is included here.

1995-1996 has been a good year for PORCUPINE NEWSLETTER. Parts 1-3 of Volume 6 were published in May, August and December 1995. Most articles were generated by meetings but others were also submitted. Copy, at the time of the AGM, was in good supply, but the Scarborough meeting has not generated the usual length of papers and again the cry is for more contributions, especially important as there will not be a meeting prior to the time another Newsletter should be published (early August). I have asked also for short notes and comments, perhaps on previous articles. I am happy to publish requests for information, even Letters to the Editor!

Attention is drawn to the RESOLUTION passed at the AGM concerning funding of the "*Marine Fauna of the Cullercoats District*". This updated version will make a considerable contribution to the wider knowledge of the fauna and flora of the coasts and seas of Northeast England and should be whole-heartedly supported.

Most back numbers of PORCUPINE NEWSLETTER are still available and as they are taking up valuable space at various locations we would be delighted to sell them at £1 per copy including postage & packing. Discounts for larger orders negotiable. Please contact me.



MINUTES OF THE NINETEENTH ANNUAL GENERAL MEETING OF PORCUPINE

held at Scarborough on 17th March 1996

Susan Chambers was in the chair. after several apologies for absence the Minutes of the eighteenth Annual General Meeting were accepted as a true record. there were no Matters Arising.

The Hon. Secretary's Report was presented by Ian Killeen and approved.

The Hon. Treasurer's Report was presented in brief by Jon Moore (full details delayed because of the oil spill off Milford Haven) and approved.

The Hon. Editor's Report was presented by Shelagh Smith and approved.

The following Office Bearers were re-elected:

Hon. Secretary	Ian Killeen
Hon. Treasurer	Jon Moore
Hon. Editor	Shelagh Smith

Robin Harvey and Dennis Seaward retired from Council. The following Council Members were elected/re-elected:

Mike Bailey	Frank Evans	Jan Light
Roger Bamber	Willie Fowler	Ivor Rees
Susan Chambers	Helgi Gudmundsson	Ralph Robson
Dave Connor	Christine Howson	Martin Sheader
Mark Davis	Antony Jensen	Jeff Tang
Francis Dipper		

The Hon. Auditor Nick Light was thanked for his work last year, and was re-elected for the coming year.

Future Meetings were announced and discussed by the Hon. Secretary (see back page of this Issue).

RESOLUTION:

Following the talk given by Judy-Foster-Smith (see p. 98), there was discussion on the proposal to donate funds for updating of the "*Cullercoats Marine Fauna*". It was agreed that PORCUPINE should donate £2,500 subject to the additional money required being obtained from the other sources which have been/are to be approached.

Any other business:

The Essay competition has died due to lack of interest. only one essay was received and this was not up to standard.

Publicity for Meetings:

A target list of Institutions should be made to which posters should be directed.

Hon. Secretary to insert notices on a regular basis in ECSA Bulletin and MBA Newsletter.

Mike Bailey to put the data on the WEB.

HON. SECRETARY'S REPORT FOR 1995

Following my normal practice, I shall say something about the two meetings held during 1995 and then make a few comments about the status of membership.

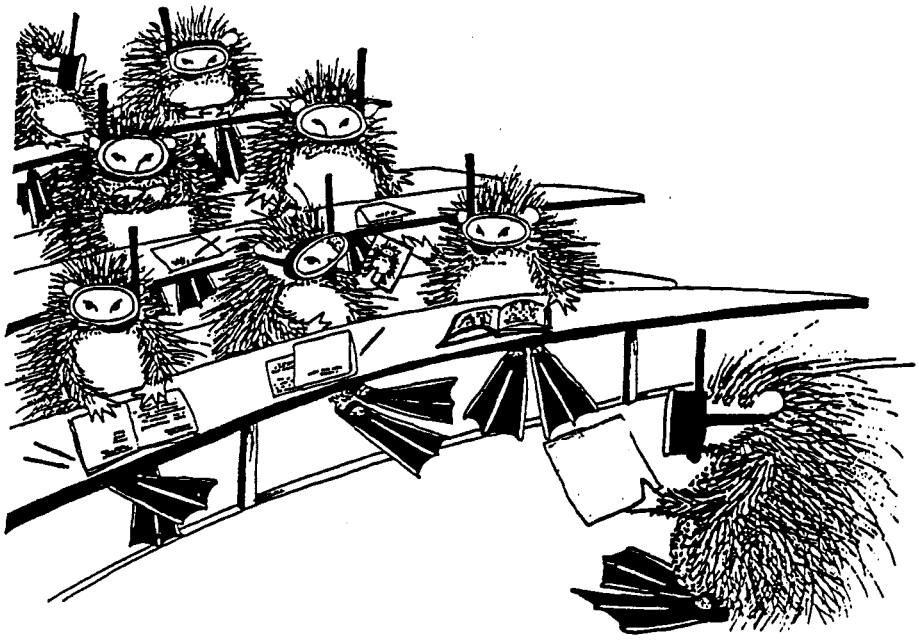
The Spring Meeting was held st the University Marine biological Station at Millport on the Isle of Cumbrae. The title of the meeting was **Marine Biotopes (Communities in their environment)**. There was a goo attendance for this meeting with some excellent contributions to the theme of the meeting. Spanning five days (2-6 March) this meeting allowed opportunity for some field work on the island. On Monday the Stations research vessel "*Aora*" was made available to PORCUPINES and sampling was carried out off the south end of the island producing useful data (notably molluscan!). PORCUPINE is grateful to Willie Fowler for organising this meeting and to the Director and staff of UMBS for hosting the meeting.

The Autumn meeting took place at the National Museum of Wales in Cardiff on 7th and 8th October. Forty people attending this excellent meeting, the broad theme of which was **Sampling**. Papers ranged from topics such as methodologies and techniques for gathering data; the subsequent analysis of results using statistical techniques; video technology. We are grateful to Alison Trew for showing PORCUPINES around the Melvill-Tomlin Room and the Library on Sunday. Our thanks are also due to Andy Mackie for organising this meeting and to the Director of NMW and Graham Oliver and the staff.

There were no entries for the Essay Writing Competition during 1995 and as response to this initiative has been poor its continuation is being reviewed.

Membership currently stands at 181 which included Institutions. This is the same as last year although 19 new members have joined PORCUPINE, replacing those lost during the year. As the level of membership remains static can I ask members to encourage recruitment by actively promoting PORCUPINE.

Ian Killeen - Hon. Secretary



PORCUPINE
RECEIPTS AND PAYMENTS ACCOUNT
for the year ended 31 December 1995

Year to 31.12.94 £	£			Year to 31.12.95 £	£
		RECEIPTS			
1336		Subscriptions-	1994 & Prior	40	
34			1995	1295	
16			1996	24	
-			1997	8	
	1386				1367
	43	Bank Interest (net of tax)			152
	22	Sale of T Shirts			-
	150	Donations			-
	-	Advert in Pocupine News			15
	1601	Total Receipts			1536
		PAYMENTS			
348		Newsletter-	Printing	641	
178			Postage & Envelopes	197	
526		Total Newsletter Costs		838	
74		Hon Sec Expenses		54	
	600				892
	1001	**SURPLUS BEFORE MEETINGS**			**644**
	(18)	**MEETINGS - Costs (Credit)**			**38**
	1019	**SURPLUS FOR THE YEAR**			**606**
	3170	**BALANCE BROUGHT FORWARD**			**4189**
		BALANCE CARRIED FORWARD			
2731			Current Account	715	
1458			Deposit Account	4078	
	4189				**4793**

Jon Moore
.....
Hon Treasurer

N. de Light
.....
Hon Auditor

7 May, 1996

THE MARINE FAUNA OF THE CULLERCOATS DISTRICT: PAST, PRESENT AND FUTURE

By JUDY FOSTER-SMITH
Dove Marine Laboratory, Cullercoats, North shields, Tyne & Wear NE30 4PZ

What is the '*Marine Fauna of the Cullercoats District*'?

The Marine Fauna of the Cullercoats District is a series of publications produced as 'Reports of the Dove Marine Laboratory' which consist of species records for the Cullercoats District dating from as early as the 1920s and compiled over the last 30 years or so by marine biologists based at the Lab. It can be regarded as one of the most important collections of marine species records for the British Isles. Details of species abundance, dates observed, and sites are given, and, in many cases, status and observations on life histories and ecology are included.

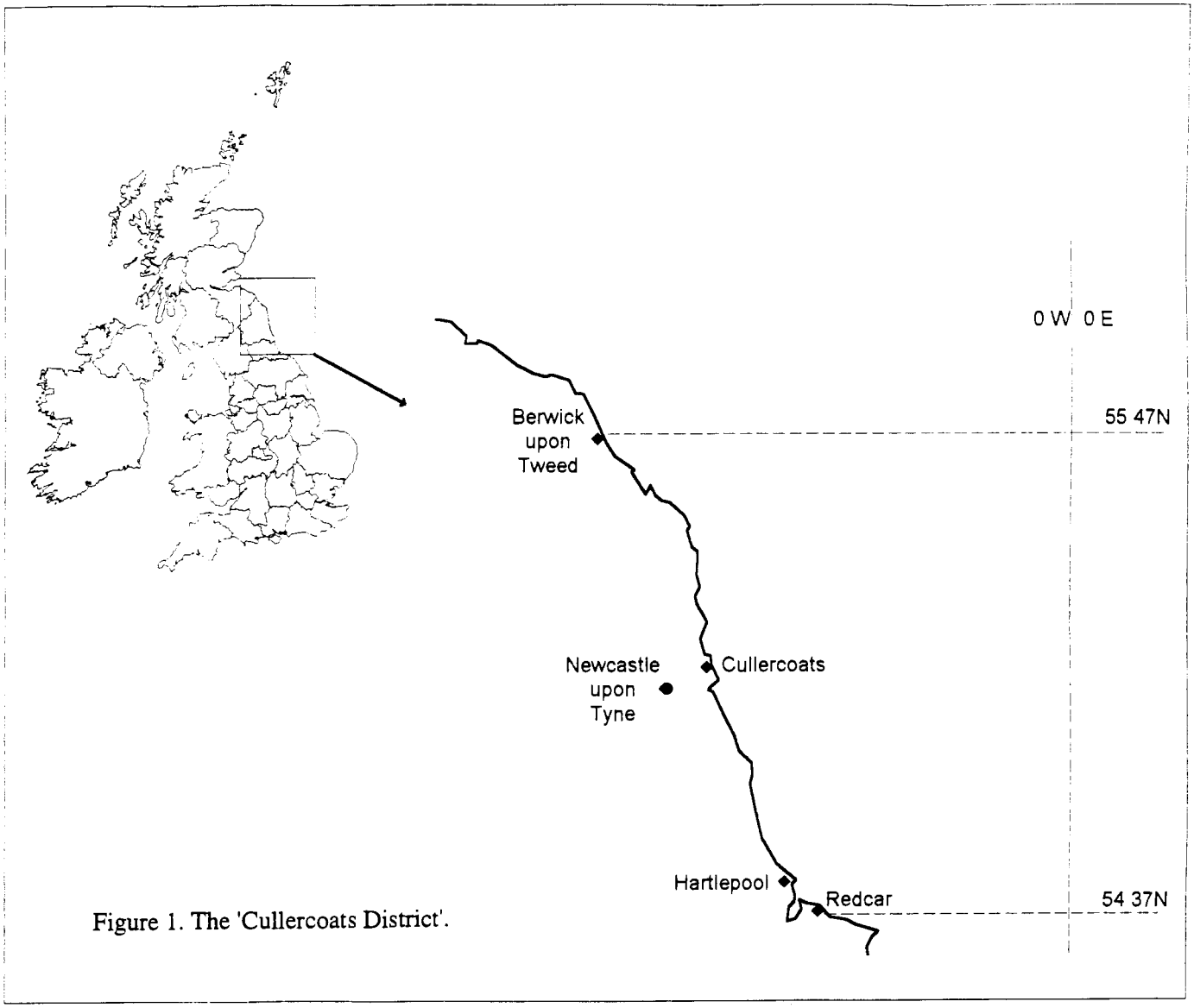


Figure 1. The 'Cullercoats District'.

Where is the '*Cullercoats District*'?

The term Cullercoats District was originally intended to be used in the same broad sense as 'Plymouth' and 'Liverpool' were referred to for fauna lists produced by the Plymouth and Liverpool marine stations. (*i.e.* not just Cullercoats beach!). The District was defined by H.O. Bull in 1933 as 'roughly from Berwick upon Tweed (Lat. 55° 47'N) south to Redcar (Lat. 54° 37' N) and extending seawards to Longitude 00° 00' (Figure 1). In other words, it stretches along approximately 150 km of coastline, encompassing the coasts of Northumberland, Tyne & Wear, Durham and Cleveland and extends about 100 km offshore. So the area is very much part of the North Sea !

THE PAST

When did it all begin?

The idea of the Fauna lists clearly came from Dr. H.O. Bull who worked at the Dove Marine Laboratory from the 1930s until he retired in 1968, apart from the war years. In 1933 he published a '*Classified Index to the Literature of the Cullercoats Marine Fauna and Flora 1832-1932*'. This provided an extremely valuable summary of early marine biological work carried out on the north east coast (or, in the context of this meeting, the western North Sea), and it highlights the contributions to our knowledge of marine species made by workers like Alder, Brady, Hancock, Hodge, Howse, Johnston, Meek, Norman and Storrow, to name but a few. The Index includes a cross-reference of the literature to taxonomic group, and this appears to have formed the basis of the species records information for the different volumes produced for the Marine Fauna series.

As well as the Index, Dr Bull also produced a document entitled '*The Anthozoa of the Cullercoats District*' in 1939, presumably before the idea of the series was conceived. It was, however, effectively a prototype for the Marine Fauna series. But it was not until 1963 that the first volume of the series, '*Porifera*', appeared.

Production of the volumes

After the '*Porifera*' the volumes were somewhat haphazardly produced. The taxonomic sequence used was certainly not predictable. Volume 2, for instance, includes the strange combinations of Chilopoda, Apterygota, Euphausidacea, and Cetacea. Presumably the groups chosen reflected the particular interests of the authors at the time.

The rates of publication were also irregular (Figure 2). Again, this clearly reflects the availability of the people willing and able to do the work. The two periods of greatest productivity coincided with the endeavours of Herbert Bull (1960s) and Frank Evans and Roger Bamber (1980s) in particular. (Note that no new volumes have appeared since 1989).

Who were the people involved?

Fifteen people in all have contributed to volumes of the Marine Fauna. All have had association with the Dove Marine Laboratory to a greater or lesser extent. H.O. Bull, who has already been mentioned, for instance, was Deputy Director of the Laboratory.
Most of the others have been research students and/or staff at the Dove for varying lengths of time.

Whatever their connection with the Dove it is clear that these people, through their own particular interests or obsessions, have helped to provide an extremely valuable resource of marine species information for the North Sea.

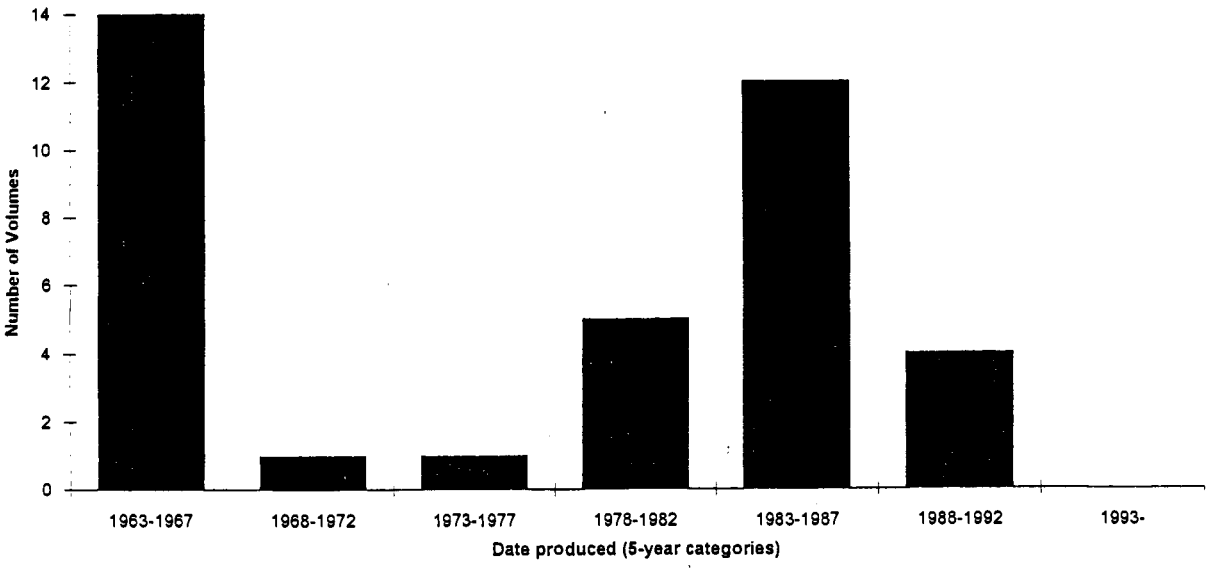


Figure 2. The dates of production of volumes

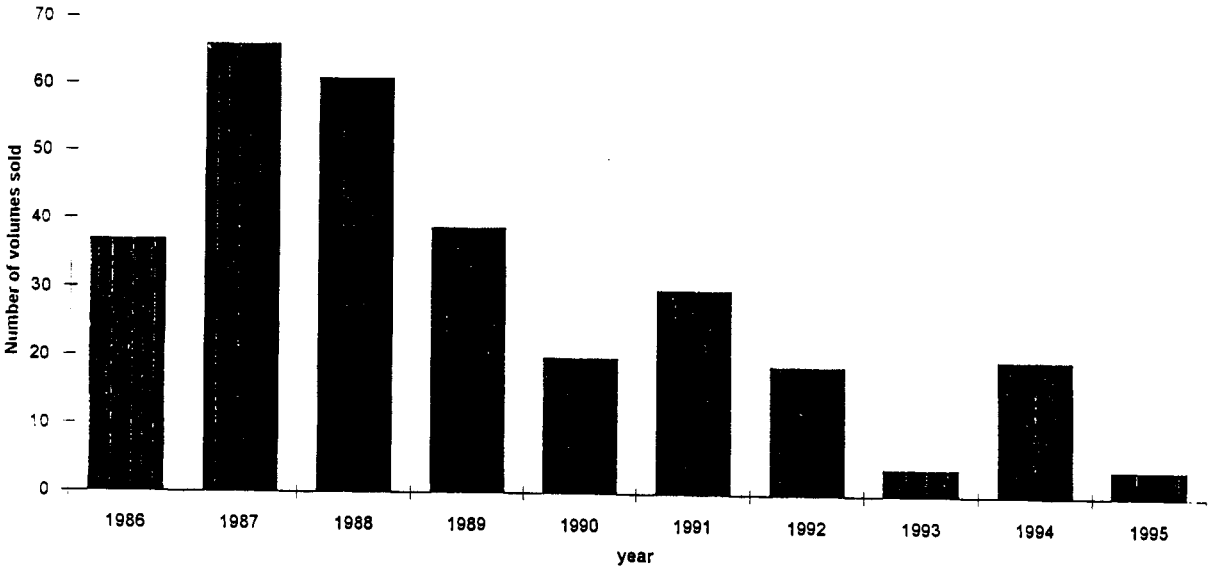


Figure 3. Annual sales of volumes

We have, for instance, early records for species which are now regarded as rare and endangered. The Allis Shad *Alosa alosa* is one such example: this species is recorded as being 'frequently taken' in the mid 19th century and early 20th century; now it is a protected species under Schedules 5 and 8 of the Countryside and Wildlife Act, 1981.

THE PRESENT

What is the present situation?

In all there are 27 volumes of the Marine Fauna series covering 43 taxonomic groups. They contain a huge amount of information and they record some extremely interesting observations. Much of the information is anecdotal and makes rather unique and enjoyable reading. For instance, there are notes on unusual habitats, such as the nasal cavities of the Grey Seal which are home to the mite *Halarachne halichoeri*; on migratory behaviour of, for example, the mysid *Neomysis integer* which moves up river in summer and down to the sea in winter; on specimens housed in Museums, such as the Decapod *Palaemon serratus* in the British Museum (Natural History); and on breeding in aquarium conditions, such as in the leech *Pontobdella muricata*.

However, insofar as the volumes being useful for the efficient retrieval of 'scientific' information, this is another story :-

(a) The format of the volumes is inconsistent, ranging from small, printed perfect-bound booklets to spiral bound photocopied typescript.

(b) The series is not complete. The volumes include almost all of the major phyla and the majority of the lesser phyla, but there are some obvious gaps. For instance, the phyla Nematoda, Nemertea and Hemichordata have not been included, not to mention the Protozoa, Platyhelmintha and Tardigrada!

(c) The title of the series is not appropriate. In spite of the title *'The Marine Fauna of the Cullercoats District'*, two of the volumes are devoted to the seaweeds!

(d) The information is becoming increasingly dated. As taxonomy changes and as more recent information is becoming available, so the Marine Fauna series is becoming more out of date. Only one of the volumes, on seaweeds, has been updated (in the form of a supplement) since its original publication.

Perhaps as a consequence of all of these factors, the demand for the volumes over the last 10 years, as indicated by the annual sales in the order book at the Dove, has waned considerably (Figure 3). So, in spite of the very important regional species information contained in the volumes of the *'Marine Fauna'*, the series has effectively stagnated and is in danger of becoming almost totally neglected.

THE BIT BETWEEN THE PRESENT AND THE FUTURE

However, all is not lost - because one of those important Cullercoats species has effectively 'saved the day'.

Because of the extremely efficient management of the Porcupine Society and its funds (flattery can get you somewhere!) the Society was in the unusual situation of looking around for someone to be generous to. And Frank had a brainwave. He was aware of the sorry state of the Marine Fauna series and he proposed that some of the funds could be used to upgrade the information onto a word processing package and installed onto the Internet.

THE FUTURE

I think I can safely say that there is a future for the '*Marine Fauna of the Cullercoats District*'. The idea of recreating the series has been lurking around the Dove for some time, but Frank has provided stimulus to make it happen.

The proposal for the immediate future, then, is that the whole series of 27 volumes will be revamped and produced in a much more consistent way than it is at present. It is intended that the information will be published as 2 hard-backed volumes, and also installed on the Internet and made available on disc/CD. By doing this the information can be made available to a whole range of users. Porcupine members have generously agreed to provide substantial funds for the project.

The plan is that the existing volumes will be either scanned or re-typed and imported onto Word 6. Information will be formatted in such a way that it will still be readable as text in the hard copy volumes, but also so that it can be sorted and cross-referenced using the Internet and disc/CD copies.

Species records will be updated to take into account the more recent observations and also the many taxonomic changes. In addition, some of the gaps in the coverage of taxonomic groups can be filled. Dr Peter Garwood, for instance, already has a draft volume on Nemertea which will be included. The arrangement of the information will be in an accepted systematic sequence (*e.g.* as in Hayward and Rylands (1990) '*Marine Fauna of the British Isles and north-west Europe*').

In addition, the title of the series will be changed to include the seaweeds. It has also been pointed out that the inclusion of 'Cullercoats District' in the title implies a very parochial geographical area and, while I would not want to see the phrase dropped, it may be appropriate to indicate the true geographical extent of the records. Thus the new title of the series would be something like: '*The Marine Fauna and Flora of the Cullercoats District: Marine Species Records for the North East Coast of England*'.

Clearly this is going to involve a huge amount of work - far more than was originally envisaged. However, many of the original authors have agreed to revise their own volumes, and additional funding to employ someone to do the scanning, typing and basic editing is being sought.

The whole project is rather timely in view of:-

(a) The renewed interest in species records in relation to the UK Biodiversity Action Plan and the need to catalogue our marine biological resources.

(b) The Centenary of the site of the Dove Marine Laboratory as a research station in 1997. It is intended that the new volumes will be published as the first volumes of the '*Dove Marine Laboratory Centenary Series*'.

In summary then, the Marine Fauna of the Cullercoats District is about to come to life again in a different and much more useful guise. It will be a lot of hard work by all those involved, but I have no doubt that it will be worthwhile.

DATA PROCESSING & ANALYSIS - THEIR ROLE IN BENTHIC STUDIES

By JEFF K.S. TANG
School of Ocean Sciences, University of Wales, Menai Bridge, Gwynedd, LL59 5EY, U.K.

INTRODUCTION

The use of image sampling equipment alongside conventional sampling gear in marine biological surveys have become increasingly common. Image sampling equipment can be divided into two types, spectral sampling gear (e.g. underwater video), and acoustic sampling gear (e.g. RoxAnn). This group of sampling instruments offer several unique advantages over conventional sampling gear. Data is collected in real time (with the exception of still photography, which requires processing), which means that the data can be reviewed almost instantaneously. The sampling carried out in a 'non-destructive' manner, thus enabling the same site to be studied repeatedly over time to provide a clear overall view of the spatial and temporal changes to the marine organisms and the substrata in the sublittoral marine environment. Image sampling gear also enable continuous recording unlike the conventional sampling gear, therefore greatly increasing the area that can be surveyed in a given time period.

The deployment of image sampling gear does create problems. One problem is the large volume of data produced, and the second problem is from the variety of media and formats used to record the data. The solution to managing and analysing the large volume data contained on different media requires the use of powerful computers with multimedia capabilities.

Extracting meaningful information from the raw data collected by image sampling gear involves a two step process. The first step can be described as "data processing" and the second step as "data analysis". The function of the data processing is to prepare the raw data for analysis, and the role of data analysis is to interpret and extract relevant, meaningful information from the data.

This paper briefly describes the working of this two-step process using the raw data collected in a marine survey employing an acoustic (RoxAnn) and a spectral (underwater camera) imaging gear. RoxAnn (Marine Microsystems Ltd., Aberdeen) is an acoustic bottom classification system using the return echoes from the transmitted pulse provided by a conventional echo-sounder to determine the roughness and hardness of the seabed. The underwater still camera system was mounted on a photosledge and consisted of a Photosea 1000 underwater camera fitted with a Nikor 28mm lens.

DATA PROCESSING

Data processing have the role of managing the raw data produced by image sampling gear, and that involves reducing the data volume, converting the raw data into formats that a computer system can recognise and utilise, and providing quality control for the raw data being placed into the computer. The large volume of raw data generated by image sampling gear can overwhelm the storage capacity and processing capabilities of the any computer system. In order to stop this from happening, the volume of data must be reduced down to a manageable size. Data reduction normally involves the removal of redundant or repetitive data from the raw data. These are data which provide no new or relevant information and can therefore be removed.

Reduction of the RoxAnn data-set involved exporting the data from Microplot into a spreadsheet programme, such as Novell's QuattroPro for Windows. The data were then viewed in the spreadsheet to locate duplicate and redundant data values and then remove them. The result was a data file that was much smaller in size compared to the file produced by Microplot for exporting into the

spreadsheet. Table 1 shows a sample of the RoxAnn data in a spreadsheet before and after data reduction was carried out. The data reduction process of the photographic images involved the viewing and discarding blurred or distorted images.

The still images recorded by the underwater camera onto film must be digitised, that is converted to a digital format which can be recognised and understood by a computer system. This involves the copying the images on the slides onto a PhotoCD, a commercial process carried out by Kodak. Since the data collected by RoxAnn was logged directly into a computer by the Microplot survey software (Sea Information Systems, Aberdeen), no conversion was required.

Quality control is necessary to ensure that the raw data being placed in the computer for analysis is consistent and accurate, because any errors in the raw data can lead to incorrect interpretations when the data is analysed. For the RoxAnn data, the quality control measures include "noise" removal and application of correction factors. On the photographic images, this involves image enhancement.

The RoxAnn system can pick up systematic and apparently random disturbances or "noise" which can degrade the quality of the raw data collected. The disturbance may originate naturally (e.g. fish schools interfering with the acoustic signals) or internally from the electronic components contained in RoxAnn (e.g. electrical spikes caused by power fluctuations). "Noise" removal requires a working combination of the human operator and computer. Using a spreadsheet software, the operator reviews the RoxAnn data and pick up values which differ significantly from the preceeding and following data values. The human operator will need to have considerable experience with the conditions and environment present in the study area (so as to assess what is accurate and representative data and what is not), in order to check the values and make the necessary decision for excluding the spurious data from analysis. The human experience becomes most important where the spurious data values come close to the actual correct data values.

Depth values logged by the RoxAnn survey system are not adjusted for tidal variation and therefore in order to relate the recorded depth data to chart datum, a correction must be applied. First the tidal cycles for the day when the surveys were carried out were calculated and the necessary depth adjustments applied to the depth data in a spreadsheet programme. An example of this correction can be seen applied to the depth values in Table 1.

With the digitised photographic images, the brightness and contrast levels may be too low, so that the human eyes cannot pick up much details which can help in the identification of species, or for image analysis to determine the percentage cover of particular organisms or substrata types. The enhancement is carried out using image processing computer software such as Corel PhotoPaint with the necessary inputs from a human operator to decide on the degree of brightness and contrast required.

DATA ANALYSIS

Once the raw data had been prepared by the processing stage, it is ready for analysis. The role of data analysis is to examine and interpret the acoustic (RoxAnn) and spectral (underwater photographs) signatures of the collected raw data and extract relevant information. The level of analysis can range from simple to very complex ones, depending on the questions that have to be answered in the study. The answers required from the data will determine the kind of analytical software packages to be used.

Programmes like DGM3 (L.M. Technical Services) were used to produce three-dimensional maps of the survey area from the RoxAnn data. The maps show the spatial distribution of the different seabed and community types (with their characteristic roughness and hardness index) overlain on the depth profile of the survey area. Fig. 1 is an example on one such three-dimensional map.

The photographic images were used to provide qualitative information such as the type of epibenthic organisms present, their orientation and distribution on the sea bottom, and their interactions with each other and with the substrata. Quantitative information were obtained by using an image processing software like Jandel's SigmaScan, which can determine the percentage cover of different benthic

species (knowing the standard area covered by the image) or densities of various epibenthic species present.

CONCLUSIONS

The combination of data processing with data analysis enables the maximum amount of high quality information to be extracted from the data collected by image sampling gear. However, there are drawbacks. While the data analysis step can be more or less be automated, the data processing step still requires a high degree of human intervention. A considerable amount of time must be spent in the laboratory by an experienced operator and the operator must be paid, which all adds to the cost of carrying out marine surveys. Furthermore capital investment is required to acquire the necessary computer hardware and software, and should be accompanied by the dedication and motivation to continually upgrade both the software and hardware.

With the increasing usage of image sampling gear in marine surveys, the important role of computerised data management and analysis cannot be overlooked. The financial cost will be high, but the benefits gained must surely outweigh the monetary cost.

PORCUPINE UNDERGROUND

OR

THE HAMLET OF PORCUPINE AND FOWEY CONSOLS MINE

By J B LEWIS
5 Clemens Close, Newquay, Cornwall TR7 2SG

Fowey consols was one of the biggest Cornish copper mines. It operated in the period 1813 - 1867 and produced 383,000 tons of ore which sold for £2.2M approximately. The mining sett covered 1500 acres with 7 miles of shafts and 150 miles of levels underground, with a maximum depth from the surface of 2,000 feet in the richer eastern part. All this was done without the use of mechanical rock drills. At its peak in the 1830's and early 1940's the mine employed about 900 men underground and a similar number of mainly women and children at the surface to process the copper ore prior to sale. Some of the processing took place very near Porcupine using Cornish stamps to crush the rock.

Porcupine was (and is) a hamlet, about 1 mile north of Tywardreath, which in mining days clustered around the Inn (PORCUPINE INN), brewhouse and stables. The Inn also contained the Magistrates' Rooms where Tywardreath Division Petty Sessions were held.

[The presence of this Porcupine in Cornwall was originally drawn to my attention by Stella Turk - Hon. Ed.]

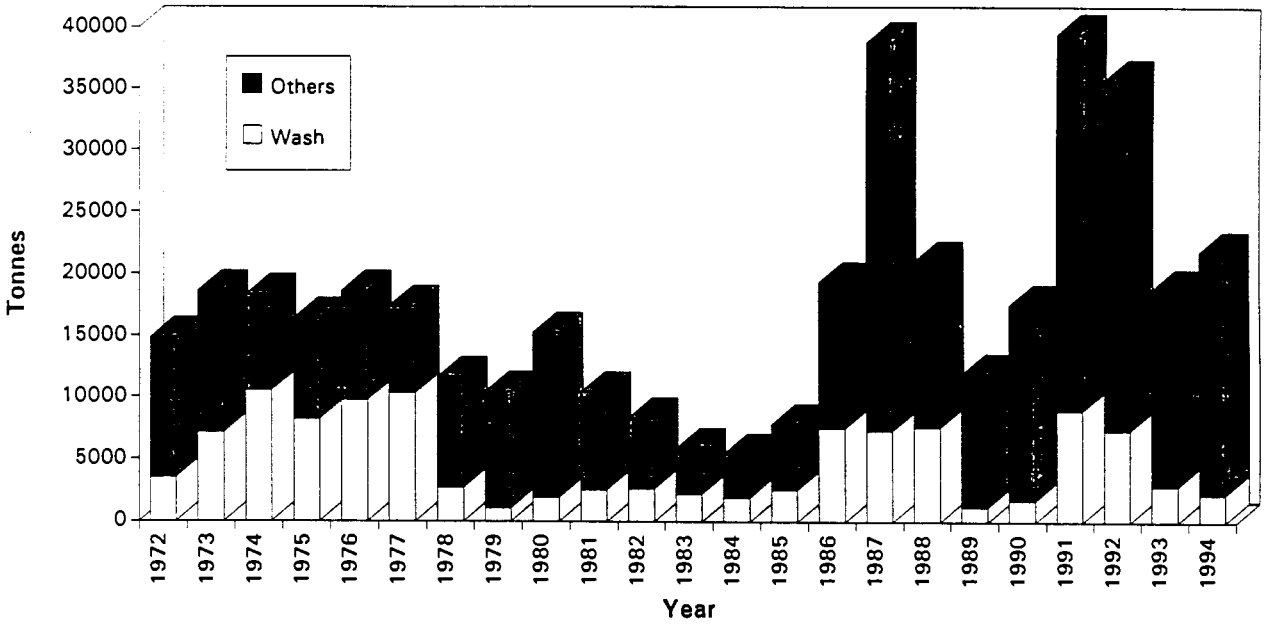
HOW REGULAR IS COCKLE SETTLEMENT IN THE WASH?

By PETER WALKER
Ministry of Agriculture, Fisheries & Food, Fisheries Laboratory, Lowestoft, Suffolk, NR33 0HT, U.K.

INTRODUCTION

The Wash is one of the principal cockle producing areas of England and Wales. Figure 1 shows that since 1972 the Wash landings have ranged from 9% (1990) to 59% (1977) of the total England & Wales landings. The Ministry of Agriculture, Fisheries and Food (MAFF) is responsible for the overall management of shellfish stocks in England & Wales, but the local management of the Wash cockle fishery is the responsibility of the Eastern Sea Fisheries Joint Committee (ESFJC).

Figure 1. Cockle landings England & Wales 1972-1994 (Tonnes wet weight)



In the mid 1980s an industry-management liaison group, the Wash Development Group, sought to increase shellfish production from the Wash. ESFJC decided that more effective management of molluscan stocks would be achieved if a single Wash Regulating Order could be obtained to replace the four existing orders which were approaching their renewal dates. (A Regulating Order enables an authority to set regulations within a fishery and issue licences to those exploiting the fishery). Local fishery interests did not oppose the introduction of the new order, on the understanding that all future management decisions would be made on the basis of scientific advice. As ESFJC had no scientifically qualified field staff, it was agreed that support and staff training be provided by the Shellfish Resource Group (SRG) of the MAFF Fisheries Laboratory until trained staff were available.

At this time SRG was investigating the biological mechanisms controlling the dynamics of a number of commercial mollusc populations, including the cockles of the Burry Inlet, South Wales. The only previous work by SRG on cockles in the Wash had been an estimate of standing stock biomass in 1967-8. Surveying the 270 sq km of intertidal flats in the Wash had taken a two man team, with support boat and crew over 40 days to complete. Restrictions on the manpower available in the mid 1980s required new studies to be organised into shorter, more concise units. A programme of work was agreed which between 1986 and 1991 included the following topics:-

1. Estimation of the total exploitable cockle biomass using suction dredgers (1986).

2. Estimation of the "reserve" spawning cockle biomass in the high intertidal (more than 4 m above chart datum), beyond the reach of commercial exploitation (1989).

3. Assessments of the probable sampling effort required to obtain a reliable estimate of the total cockle biomass of the Wash (1990-91).

Within two years of the start of the SRG Wash cockle programme, a widespread failure of spatfall in both cockle and mussel populations occurred throughout northern Europe. MAFF and ESFJC agreed to undertake a five year study of the variations in cockle settlement on a number of cockle beds, in an attempt to understand the causes of this spatfall failure.

This paper considers some of the factors which had to be taken into account in setting up such a survey programme for a commercially exploited mollusc species.

THE SURVEY

Selection of study sites was based on summaries of existing data sets. ESFJC's Annual Reports from 1968 contained qualitative data for areas of cockle spat settlement and of commercially exploited beds. Survey reports produced by MAFF and the Institute of Terrestrial Ecology contained more quantitative data. Based on the combined information from these sources, eight sites (Figure 2) were selected for sampling during 1991, the first year of the study. Three sites had direct access from the shore, five required the use of a survey vessel for access. The site on Thief Sand was dropped after 1991 to simplify the survey vessel's work schedule.

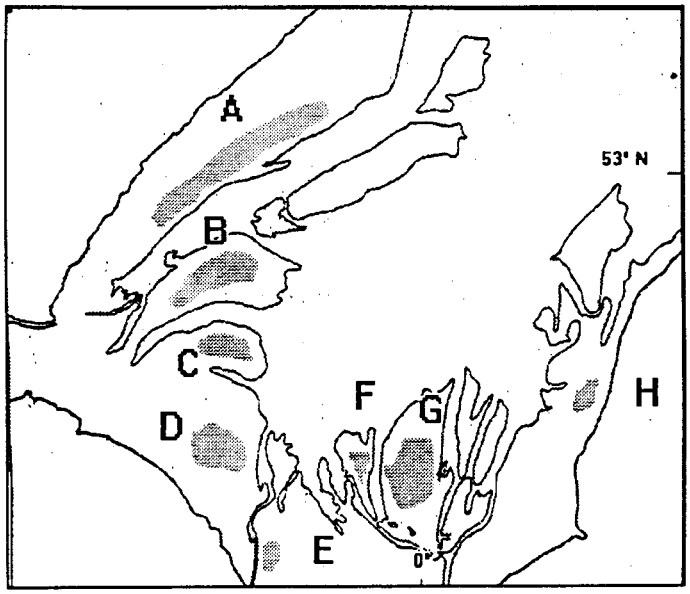


Figure 2. Sites selected for survey, September 1991.
A - Wainfleet & Wrangle, B - Roger, C - Gat, D - Holbeach,
E - Inner Westmark Knock, F - Thief, G - Daseley's, H - Stubborn

The peak period of cockle spatfall occurs in June/July. However, existing summertime fieldwork commitments, for both SRG and ESFJC, meant that the earliest time slot available for survey fieldwork in the Wash was during September's spring tides. The manpower allocation for each survey was 8 days for the two man SRG team and 4 days for ESFJC survey vessel and its 3 man crew.

SAMPLING METHODS

The areas to be sampled at the sites selected for study ranged from 2 km^2 on Inner Westmark Knock to 20 km^2 on Wainfleet & Wrangle Sands. To survey areas of this size in one or two days would required some form of transportation for the survey team. Four wheel drive, 300 cc Honda All Terrain Vehicles (ATVs), which had been used with great success in the Wash surveys of 1989-9, were also used for this study.

Safety of the ATV operators was an essential part of the survey design. All ATV operators were required to complete a recognised user training course and the machines themselves carried a wide range of safety equipment. For position finding each machine was fitted with Global Positioning System (GPS) electronic navigator equipment. For the mutual safety of their drivers the ATVs were always used in pairs. When operating on offshore banks, the ATVs were craned off and onto the beached survey vessel using a hydraulic sea crane.

Previous work on cockle distributions by the SRG in the Wash and Burry Inlet had shown the importance of achieving maximum spatial cover over the survey area. Using two ATVs, experience had shown that about 35 samples per day was a realistic target, when sampling in the period two hours before to two hours after the time of low water.

For each site a regular grid of approximately 35 sampling stations was prepared (Figure 3). The spatial separation of the stations varied between the sites, being dependant upon the area of the site being sampled, with a higher density on small areas.

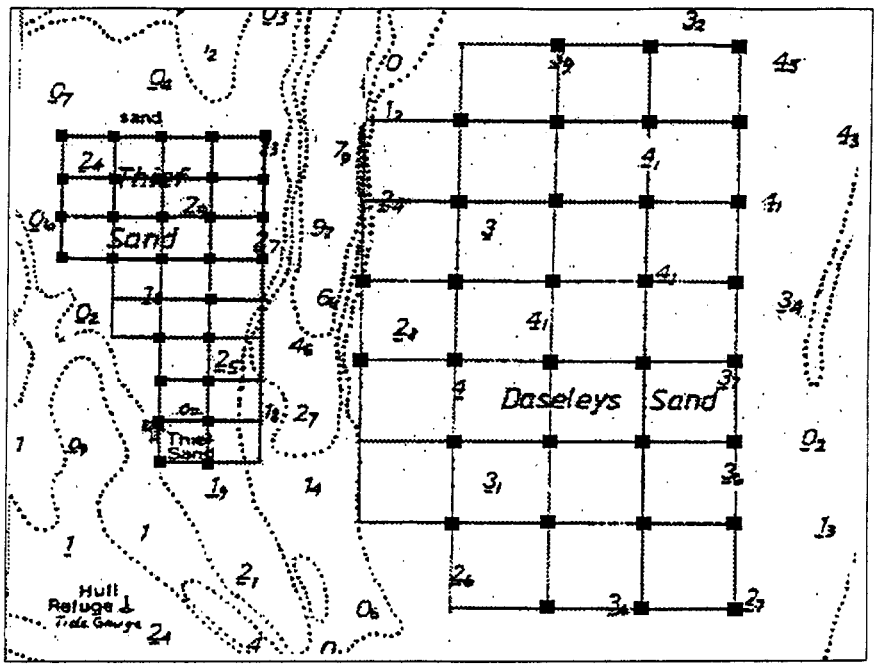
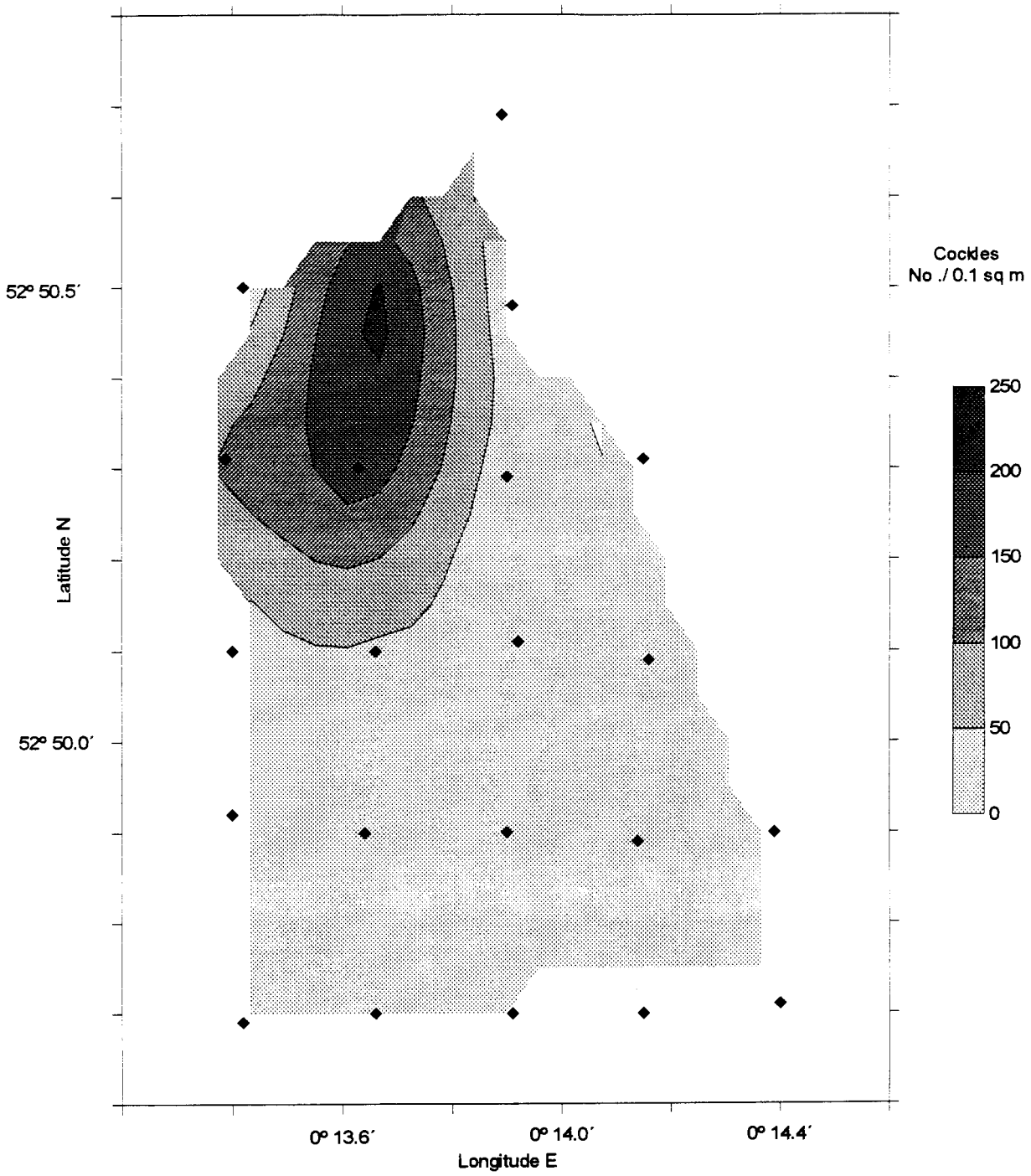


Figure 3. Two typical sampling grids as employed on the September 1991 survey. Station positions are shown as filled squares.
Separation of the stations on Thief sand was 0.1 minute of latitude by 0.25 minutes of longitude. That on Daseley's sand was 0.2 minutes of latitude by 0.5 minutes of longitude.

At each station a single sample was collected using a 1/10 m^2 quadrat driven 5 cm into the substrate. The substrate sample was removed using fingers and a rake and washed through a 4 mm mesh sieve. All cockles in the sample were retained in labelled bags, for subsequent measuring, ageing and weighing ashore. The precise co-ordinates of the sampling site, as fixed by the GPS navigator, were noted in a waterproof field notebook.

Figure 4. Contour map showing the distibution of cockle spat on Inner Westmark Knock, September 1991. Sampling stations shown as diamonds



DATA RECORDING AND STORAGE

Database files were set up in Microsoft's Excel computer software, recording position and catch by age data for each station, transcribed from field notebooks. Laboratory determinations of age, length and weight data were noted first on paper recording sheets and then transferred onto computer file. Excel has proved adequate for handling the quantity of data generated in the study.

RESULTS

Data processing is still being undertaken at present as the last survey of the five-year study has only recently been completed (October 1995).

Distribution maps of each age group by bank and year are produced using the Surfer contouring and surface mapping software package. Maps of this type (Figure 4) enable a visual assessment to be made of variations in spat distribution across the sampling grid, and also allows comparisons between years.

To summarise the data from the seven areas sampled over the last five years, the mean densities of cockle spat are presented in Figure 5. It is possible to identify a number of major features in this figure.

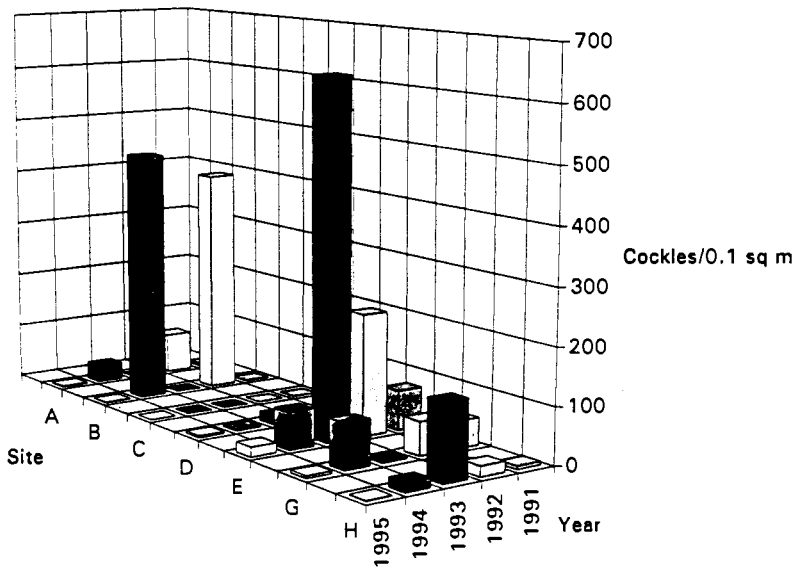
1. There is substantial variation in the mean density of spat between the beds in any one year.

2. The best sites for cockle spatfall were on the Inner Westmark Knock and Roger Sand. Spat densities on these sites were considerably higher than elsewhere.

3. The Inner Westmark Knock had spat settlement every year, but none was found on the Gat Sand.

4. Spatfalls, even at the two best sites, varied considerably from year to year, and not necessarily in the same way. For example, the highest spatfall on Inner Westmark Knock was in 1993, when there was no settlement on the Roger Sand.

Figure 5. Mean density of cockle spat at 7 sites in the Wash, 1991-95, all positive stations. A Wainfleet Wrangle, B Roger, C Gat, D Holbeach, E Inner Westmark Knock, G Daseley's, H Stubborn.



ESFJC SURVEYS

The distributional data from this recruitment survey are used by ESFJC as the basis of their more detailed surveys of the distribution of fishable stocks on these and other beds in the Wash. Intensive sampling is undertaken in any area known to contain cockles at commercially harvestable densities. The stock biomass estimates produced from this intensive sampling form the basic information upon which ESFJC base their management decisions.

THE IMPACT AND MANAGEMENT OF VISITOR PRESSURE ON ROCKY SHORES IN NORTH-EAST ENGLAND

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The ever-increasing demand for public outdoor recreation means that trampling damage is becoming more widespread on British rocky shores. This increasing level of human activity has been proposed as the cause of changes in the composition of some intertidal communities in other temperate regions (for example on the west coast of the USA; Brosnan & Crumrine, 1994).

Trampling may result in a reduction in the abundance of foliose algal species such as fucoids (e.g. Ghazanshahi *et al.*, 1983) and, subsequently, may affect understorey algae which are normally afforded protection by this canopy. Community-level effects, such as changes in composition to a community dominated by species of algae with turf-like growth forms have also been observed (e.g. Thom & Widdowson, 1978; Brosnan & Crumrine, 1994). Perhaps most significantly of all, trampling can result in localised increases in the amount of open space, the major limiting resource for sessile organisms in rocky intertidal communities (Dayton, 1971; Paine, 1984).

To preserve biodiversity and aesthetic appeal of heavily-visited shores, management of visitor pressure could be necessary. In intertidal areas of north east England, field experiments were initiated to evaluate two of the options available to managers of temperate shores.

I. Rocky shores are only able to sustain a certain amount of visitor pressure before changes in the natural community result. This value is termed the "recreational carrying capacity" and can, in theory, be used by managers to set levels of public access. Intertidal plots were subjected to different intensities of sustained trampling pressure comparable to those observed during visitor surveys at the study sites. The abundance of algae and bare space was monitored regularly for two years.

As few as five people, walking on the same area of shore each spring tide period, were found to alter the species composition of the algal community. Trampling removed the fucoid canopy, thus exposing understorey species (e.g. *Mastocarpus stellatus* Stackh. and *Chondrus crispus* Stackh.). These species were then subject either to dessication or to direct trampling pressure. As a result of algal mortality, large amounts of open space were cleared in the canopy which provided a mechanism for the attachment of different species. Opportunistic species, particularly the green alga *Enteromorpha* spp., were prevalent, as were species with turf-like growth forms (for example, the sand-binding species *Audouinella* spp.). The diffuse holdfasts of such species are thought to make them less susceptible to trampling damage (Brosnan & Crumrine, 1992).

II. The ability of trampled intertidal communities to recover to pre-impacted condition was assessed by monitioring abundances of algae and bare space in previously trampled plots. The effectiveness of a "closed season" management strategy - whereby areas of shore are made inaccessible to the public for certain periods of the year to allow community recovery - is dependent both on the ability of this recovery to occur and on the duration of the process.

When visitor pressure was restricted to very small areas of shore ($0.25m^2$ plots) for 12 months, a subsequent 9 month untrampled phase was insufficient to allow recovery of the community to its pre-trampled state. Open space created by the trampling disturbance had been recolonised by opportunistic algae and turf species were again prevalent. These results raise the problem that, after a period of sustained pressure on these shores, effective closed seasons would need to be lengthy in duration to allow community recovery to occur.

REFERENCES

Brosnan, D.M. & Crumrine, L.L. 1992. *Human impact and a management strategy for Yaquina Head Outstanding Natural Area.* A report to the Bureau of Land Management, Department of the Interior, Salem, Oregon, 105pp

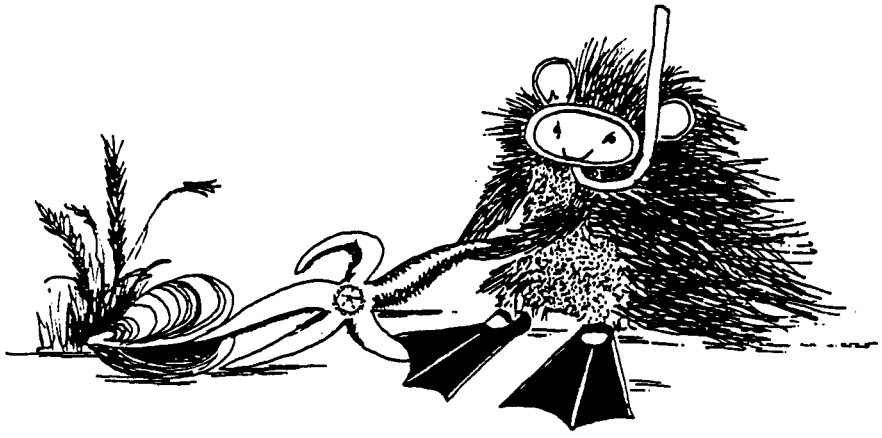
Brosnan, D.M. & Crumrine, L.L. 1994. Effects of human trampling on marine rocky shore communities. *J. exp. mar. Biol. Ecol.* **177**: 79-97

Dayton, P.K. 1971. Competition, disturbance and community organisation: the provision and subsequent utilisation of space in a rocky intertidal community. *Ecol. Monogr.* **41**: 351-389

Ghazanshahi, J., Huchel, T.D. & Devinny, J.S. 1983. Alteration of southern Californian rocky shore ecosystems by public recreational use. *J. environ. Management* **16**: 379-394

Paine, R.T. 1984. Ecological determinism in the competition for space. *Ecology* **65**: 1339-1348

Thom, R.M. & Widdowson, T.B. 1978. A resurvey of E. Yale Dawson's 42 intertidal algal transects on the Southern Californi mainland after 15 years. *Bulletin of the Southern California Academy of Sciences* **77**: 1-13



MUCUS FROM MARINE GASTROPODS AS AN AID TO NUTRITION

By MARK DAVIES
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Mucus is a highly functional and complex product. In invertebrates the functional component (10 % by weight) is typically a macromolecule of glycosaminoglycan - covalently-linked polysaccharide and protein units. The remainder of the mucus is water (90 %) and inorganic ions. For marine molluscs mucus is often thought of as a friction-reducer in locomotion, but its functions far outstretch this. Mucus has been shown to aid in feeding, egg protection, adhesion, buoyancy, dispersion, desiccation and heat tolerance, construction of burrows and tubes, and to protect molluscs from predators. In locomotion, mucus has been shown to represent a large drain on assimilated energy in intertidal molluscs (Davies et al., 1990), by being the most costly component of locomotion (Davies et al., 1992). Given this, it might be expected that mucus laid down on a substratum during locomotion has post-deposition functions of use to its producer who might then recoup some of the energetic cost of the production of the mucus.

This was investigated in the European species *Patella vulgata* L.(limpet) and *Littorina littorea* (L.) (periwinke) with a view to discovering whether deposited mucus could act as a provendering agent. Pedal mucus from these two species deposited onto Perspex was fixed in the intertidal and the decay of mucus monitored. Pedal mucus from *L. littorea* had a half-life of 10 days and that of *P. vulgata* a half-life of 40 days. These periods are probably long enough to allow for mucus re-ingestion on shore. Given the density and movement patterns of European gastropods it is likely that much of the rocky shore, for much of the time is covered with a layer of mucus. Thus for those molluscs which browse the substratum, feeding on mucus is probably unavoidable.

Pedal mucus from these species was again placed in the intertidal, this time on cellulose nitrate filter discs. The discs were harvested after 1 and 7 days. SEM examination revealed significantly more diatoms and a greater species richness of diatoms on the discs coated with *P. vulgata* mucus in comparison with control discs and discs coated with *L. littorea* mucus. Chlorophyll A analysis revealed significantly more chlorophyll A on discs coated with *P. vulgata* mucus than on control discs and discs coated with *L. littorea* mucus, although this effect was confined to the most exposed of three shores tested. More chlorophyll A was recorded after 1 than after 7 days.

As a comparison similar studies were made on the south-east Asian limpet *Cellana grata* (Gould). The mucus of this species had a half-life of only 2 days, although the shore it was tested on was considerably more exposed than those used in Europe. Mucus again had a significant effect on the weight of chlorophyll A present on filter discs, although chlorophyll a values were generally four orders of magnitude lower than in Europe. Chlorophyll A values peaked at about 4 days after mucus was introduced into the intertidal.

It would appear that mucus may well be used as a provendering agent by intertidal molluscs as it can persist for long enough to be ingested and has the ability to collect microalgae, probably by virtue of its sticky properties. Non-homing species are unlikely to use mucus in a deliberate manner to enhance nutrition as those that did would be selected out, given evolutionary stable strategy considerations. It is more likely that mucus is used serendipitously in this way as a 'bonus' to nutrition. Thus, far from being wasted, the energy in mucus may be recycled contributing to conservation of energy within rocky shore ecosystems.

REFERENCES

Davies, M.S., Hawkins, S.J., Jones, H.D. (1990). Mucus production and physiological energetics in *Patella vulgata* L. *J. moll. Stud.* **56**: 499-503

Davies, M.S., Jones, H.D., Hawkins, S.J. (in J. Grahame *et al.*, eds.) (1992). Pedal mucus production in *Littorina littorea* (L.). *Proc. Third Int. Symp. Littorinid Biology*. 227-233

PALAEOENVIRONMENTAL CHANGES IN THE NORTHERN NORTH SEA, 18,000 BP TO PRESENT

By J DOUGLAS PEACOCK
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In spite of much work in the last two decades, it is still uncertain whether ice from Scandinavia and Britain occupied the North Sea basin during the last glaciation, which culminated some 26,000 to 18,000 years ago. However, there is evidence that there were considerable areas of dry land in the central and southern North Sea shortly after the beginning of deglaciation. In the northern North Sea, in the area immediately north of the Viking Bank (60°40'N, 2°00'E), lithological and faunal analysis of sediments collected in vibrocores enables the muds and sands underlying the sea floor at 140 m below sea-level to be divided into eight informal units, three of which occur widely.

Immediately below the surface there is a well-sorted sand (Unit 1), usually under a metre thick, which contains partly decayed shell fragments and scattered intact burrowing bivalves. It is interpreted as the local representative of the sediment that forms active and inactive sand waves in the northern North Sea, and is of Holocene age (0 to 10,000 radiocarbon years ago (BP)). This immediately overlies a bioturbated fine-grained sand and silt (Unit 2) which contains a species-poor boreo-arctic fauna near the top, passing downwards into a high-arctic fauna with the bivalve *Portlandia arctica* (Gray, 1824). The earlier part of this unit was certainly deposited during the last period (the so-called Loch Lomond Stadial, 10,000 to 11,000 BP) when there were glaciers in the mountains of Scotland, the Lake District and North Wales.

In many places the Unit 2 sediments were either not deposited or have been removed by erosion, and the Holocene sands (1) rest directly on a shell hash, sand and gravel layer (Unit 3) which is widespread throughout the northern North Sea and can be traced southwards to near the coast of Aberdeenshire. The hash, which is usually well under a metre thick, contains a boreo-arctic fauna with numerous barnacle plates (*Balanus balanus* (L., 1767) and *B. crenatus* Bruguière, 1789) and eighteen species of mollusc, including *Chlamys islandica* (Gmelin, 1791) and *Modiolus modiolus* (L., 1758). The nearest analogue to the sediment and fauna in Unit 3 is the *Chlamys/Modiolus* biocoenosis found today associated with tidal streams in the western Barents Sea. The water depth at the time seems to have been between 30 to 40 m and 70 m, that is roughly 70 to 100 m below present, and the water temperatures similar to those at the North Cape of Norway today. Unit 3 was certainly deposited during the cool interstadial that is known to have predated the Loch Lomond Stadial and has been dated to about 11,000 to 13,000 BP.

In two of the vibrocores, Unit 3 is underlain by silty clay up to a few metres thick with stones that were probably dropped from melting sea ice or icebergs. The molluscan fauna is of shallow water, high-arctic type, and includes species such as *Delectopecten greenlandicus* (Sowerby, 1842), *Portlandia arctica* and *Macoma loveni* Jensen, 1905 which are found in East Greenland fjords today. These are accompanied, particularly towards the sandy bottom of the unit, by *Musculus discors* (L., 1767) (the arctic forms *laevigatus* (Gray, 1824) and *substriatus* (Gray, 1824)), a species associated with seaweed in shallow water and a maximum depth of about 40 m (much less in turbid waters). The sandy base lies on well-sorted sandy gravel with many rolled shell fragments which is interpreted as having been laid down within wave-base. Sea-level at this time would have been almost 140 m below present. Radiocarbon dates of about 15,500 BP from the top of the gravel and 13,500 from the silt higher up confirm that the deposits were formed during the very cold marine climate towards the end of the last glaciation.

TOWARDS AN IMPROVED UNDERWATER FLASH

By GIL GREEN
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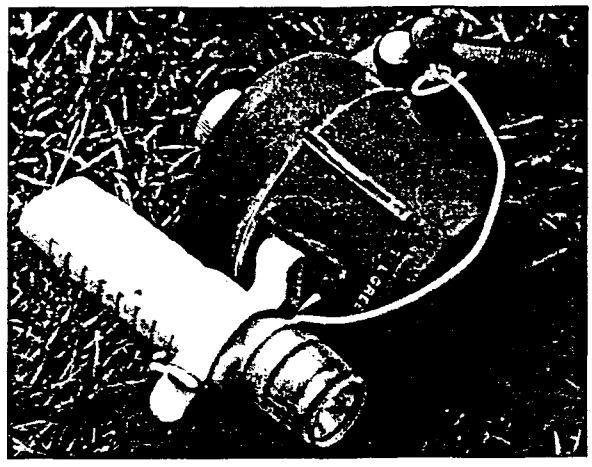
The worst thing that can happen to an underwater flash unit, apart from gross mechanical damage, is an inleakage of water. If the inleakage is of fresh water there is some hope of recovery after careful drying. If salt water is involved the problem is much more serious. Salt water is an electrolyte, i e it can conduct electricity by virtue of chlorine (-) and sodium (+) ions and when dissimilar metals are present an electric current will flow resulting in an electroplating process which will wreck a printed circuit board and any components that are not watertight. The presence of batteries in the circuit will greatly accelerate the process of destruction. Above all electronic flash units must not leak.

Where and how do leaks occur? Almost invariably at demountable joints and rotating shaft seals, both of which rely upon 'O' - rings to exclude water. Demountable joints are regularly broken and re-made to allow batteries to be changed or removed for charging and it is after this operation, not always carried out under ideal conditions, that leaks are most likely to occur. Rotary shaft seals allow internal switches (ON/OFF). TTL, etc.) to be operated often under water and there is always the possibility of failure due to deterioration of 'O' - rings or the lubricant necessary for smooth rotation.

The writer has modified an Oceanic 2000 flash unit (rebuilt after flooding but now using a Cobra CX120 flash circuit) in an attempt to eliminate these causes of inleakage. This has been done by sealing Ni/Cd rechargeable batteries permanently unto the unit. Charging the batteries is accomplished by connecting an external charger to two 1.5mm diameter stainless steel electrodes sealed through the body of the unit and connected to the batteries via a diode which allows charging current to flow but prevents discharge through the water when submerged. In order to permit external monitoring of the batteries the diode can be bypassed by an internally mounted reed switch actuated by a small hand-held magnet†. ON/OFF switching is accomplished by a second internally mounted reed switch actuated by a sliding bar magnet mounted on the outer casing (Photograph 1).



Housing for the external switch magnet

† During discharge the on-load voltage of a fully charged Ni/Cd cell falls approximately linearly from 1.25 to 1.20v (discharge at the standard one hour rate) before decreasing rapidly. For a battery of four cells this represents a drop of 0.2v in 5v. It is easy to measure this fall accurately, with a sensitive voltmeter by "backing off" most of the voltage with a stable supply, say, from am alkaline battery source stabilised by a zener diode. A better alternative is to incorporate a multiple LED display into the flash housing which would indicate the state of charge continuously when the unit is switched on. This would eliminate the need for the reed switch across the charging diode. Lack of space precluded this being done with the Oceanic.

It is important to know something about reed switches. In spite of their proven reliability when operated within the manufacturer's specification they do not have a very good reputation in underwater equipment and the write believes this may be due to lack of understanding by designers as to what takes place during the first few milliseconds following switching on flash units (inductive loads) or even torches (resistive loads‡).

A reed switch consists of two metal "reeds" of rhodium-plated ferromagnetic material mounted in a cylindrical glass envelope containing a inert gas (argon) or a reducing gas (hydrogen) or a mixture of the two. In the presence of a magnetic field from, say, a small bar magnet, the reeds are mutually attracted thus closing the switch. Compared to mechanical switches of comparable size, reed switches ar poor performers when it comes to switching large currents. The initial surge on an electronic flash is quite likely to exceed five amps, it needs an oscilloscope to observe it! Because the load is inductive, breaking the circuit can give rise to a similar problem.

In the case of the Oceanic the problem was overcome using the circuit illustrated (Figure 1). The two NPN transistors constitute a "Darlington pair" and are available on a single chip (price about 80p). The emitter current of the first transistor is the base current of the second transistor, if the current gain of each transistor is, say, 100, then the current gain of the pair will be 100 x100 = 10,000. The current through the reed switch is limited by the 2.2k resistor.

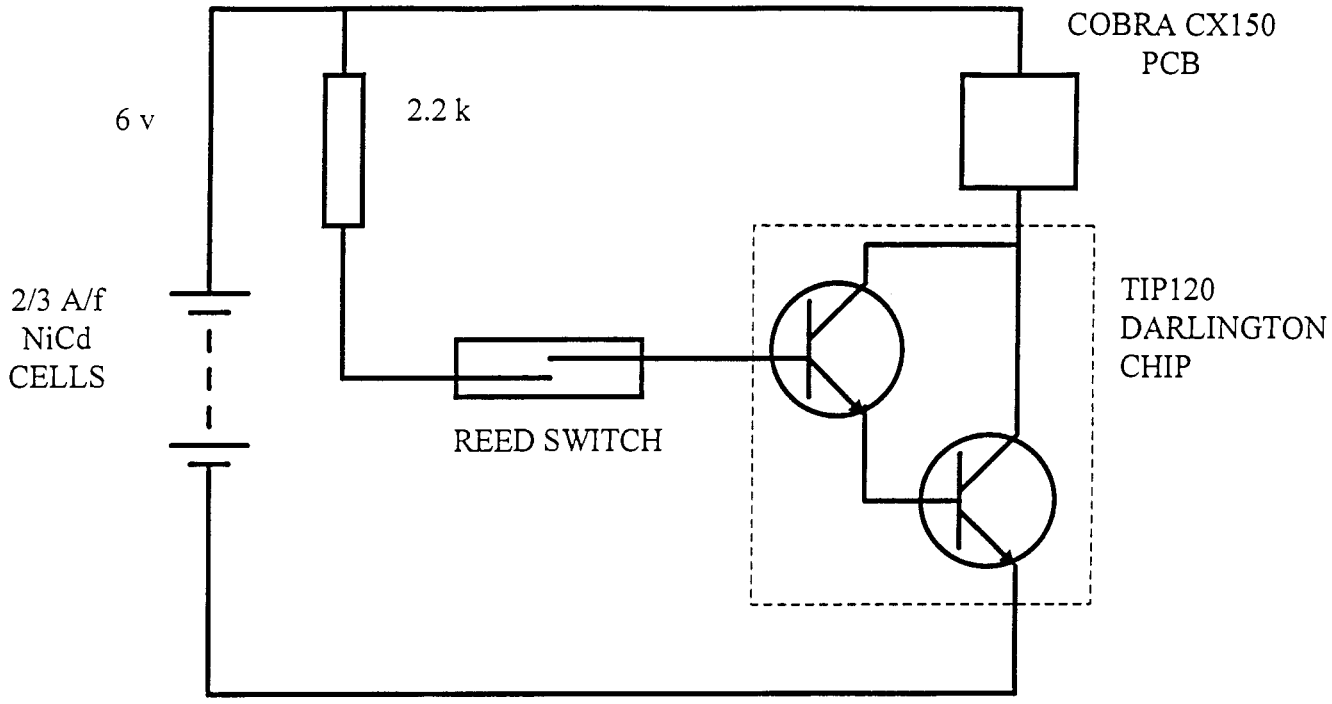
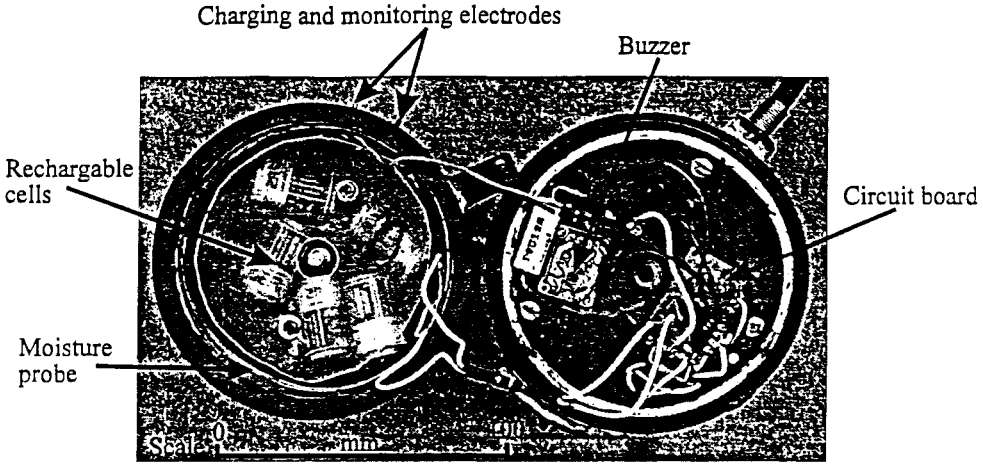


FIGURE 1 SWITCHING CIRCUIT OF THE FLASH UNIT

‡ The current taken by a torch bulb is dependent on the resistance of the filament. At the moment of switching on the resistance is low and the current higher than it is a few hundred milliseconds later when the torch is at its brightest. Measurements on a MINI Q40 diving torch showed that the "switch" on current is three times that of the running current.

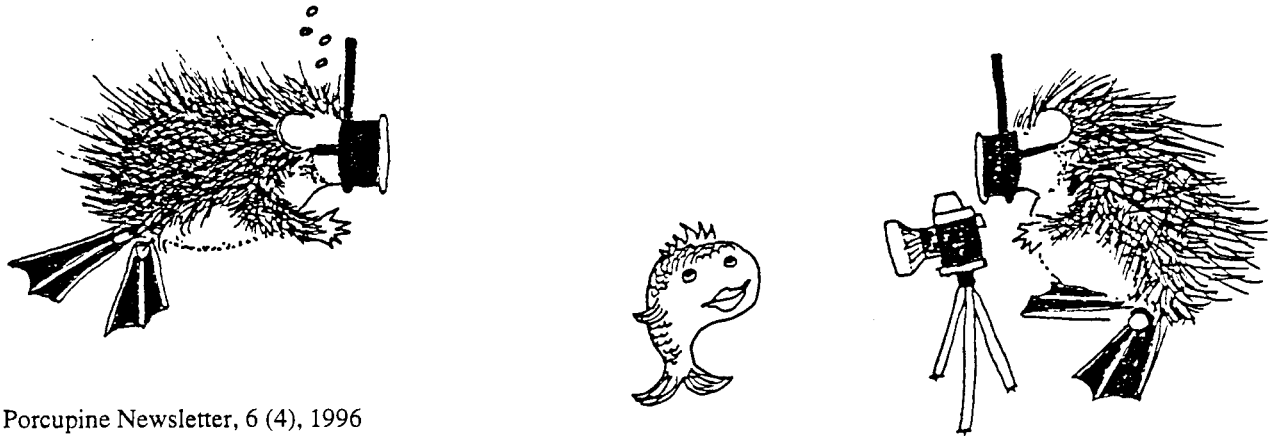
Though the intention is to produce a non-leaking flash it seemed desirable to fit a sensitive leak detector capable of detecting traces of water too small to immediately affect operation of the circuit. Concentric rings of bare wire, mutually insulated and closely spaced were attached to the inner circumference of the housing. Initially a sensitive current was arranged to switch an ultra-bright LED and a piezo sounder if a conductor path was established between the rings. tests revealed the difficulty of establishing satisfactory acoustic coupling between the sounder and the body of the unit and the sounder was replaced with a small electromechanical buzzer. The buzzer had a much higher current demand which required a further transistor being added to the sensing circuit (Photograph 2).



Modified Oceanic 2000

There is no reason why most flash units should not be modified to allow external charging without altering the other switching arrangements. The work took about half an hour in the case of a MORRIS AQUA FIII. Substitution of Ni/Cd cells for alkaline does, however, reduce the number of flashes from 130 to 40 (manufacturer's data). In the case of a simple non-TTL circuit the substitution would reduce the energy of the flash to about 60% of the original (less than one stop). In the case of the low power Oceanic this seemed too great a sacrifice but by using five smaller (2/3 Af size) Ni/Cd's in place of four alkaline cells the full power was retained.

Quite apart from the greater reliability of the permanently sealed unit, the writer would like to claim another advantage - that it is a time-saver. Anyone who has taken part in survey expeditions knows the pressure on individual members, writing up results, filling cylinders, cooking, processing films, maintaining equipment, especially photographic equipment, where an error can be costly. A flash unit requiring no mechanical maintenance must surely be an advantage.



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P. F. S. Cornelius. Hydroids and Medusae of the Family Campanulariidae Recorded from the Eastern North Atlantic, with a World Synopsis of the Genera. Bulletin of the British Museum (Natural History), Zoology, Vol. 42 No. 2, 1982. £1.

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List of Serials with Title Abbreviations Pertaining to 1970 Literature. Zoological Record Supplement. The Zoological Society of London, 1971. £1.

Report and Transactions 1975, Volume XIX, Part V. La Societe Guernesiaise, 1976. (Includes "The Mollusca of Guernsey" by Roger Brehaut). £1.

Various Eds. Progress in Underwater Science, Vols 1, and 4 to 16 (the last). Reports of the Underwater Association for the years 1975, and 1978 to 1990. £10.

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FUTURE PORCUPINE MEETINGS

The next PORCUPINE MEETING ***Animal/Sediment Interactions in the Marine Environment*** will be held on 14 & 15 September 1996 at the Royal Holloway University of London, Egham. This is a joint meeting with the Marine Studies Group.

Arrangements for the meeting are progressing well and a First Circular accompanies this issue of PORCUPINE NEWSLETTER. An early reply would be helpful to the convenors.

Topics and speakers who have been booked include:-

Ted Rose	Sediments and echinoid evolution
John Wilson, Andre Freiwald	
Mats Willumson	Deep water coarl reefs west of Norway
Shelagh Smith	Sediments and fauna of the Porcupine Bank
Ian Killeen	*Sabellaria* colonies and associated nalacofauna
Roland Goldring	Burrows in the fossil record
Jan Light, John Wilson	Biogenic carbonates and associated macrofauna on the north Scottish continental shelf

Ohter speakers include Peter Allison, Mark Cullen, Pete Garwood, Soren Jensen, Henrietta Lidiard & Simon Chenry and Azra & Peter Meadows.

The Spring meeting ***Marine Protected Areas*** *is* 22 & 23 March 1997 provisionally at Portaferry, Co Down, N Ireland.

Organiser: Julia Nunn, Cherry Cottage, 11 Ballyhaft Road, Newtownards, BT22 2AW, N. Ireland. Tel: 01247 817710

REPORT ON THE SCOTTISH MARINE GROUP SPRING MEETING

This meeting on THE INTERTIDAL ZONE took place at Heriot Watt University on 10 April 1996. The aim of the meeting was to provide a platform for students to give dissertations on their research. They were judged on the quality of this research and the manner of its presentation, both in content and as a lecture with a winner being announced. The standard was very high and the talks a pleasure to attend. Eight students contributed and we have permission from SAMS to approach them with a view to publication of abstracts or longer in PORCUPINE NEWSLETTER.

PORCUPINE should encourage students. This kind of venture is an ideal platform for them.