Porcupine Newsletter

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CONTENTS

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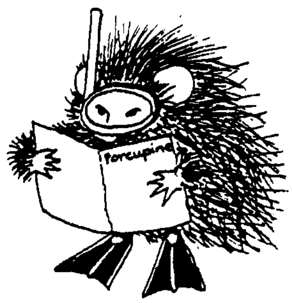

PORCUPINE

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EDITORIAL

ROGER BAMBER has retired after 7 years as Hon. Editor of PORCUPINE NEWSLETTER. We are all extremely grateful to him. His enthusiasm, wit and organisation have ensured that the already popular PN has become - in all the "best" circles, a must.

This is a hard act to follow. I hope readers will forgive my eccentric typing. For this issue at least I have taken the easy way out and some articles have been copied directly from the nice laser typescript provided.

The general style, nature of articles, etc, remains the same. But, as Roger has so often stressed, PN depends on you the contributors to provide copy, short or long, relevant to a meeting or not. Notes for the exchange of information, interesting observations, controversial points, questions on this and that, leaven the longer more formal articles. Notices of other meetings are welcome, so long as well in advance.

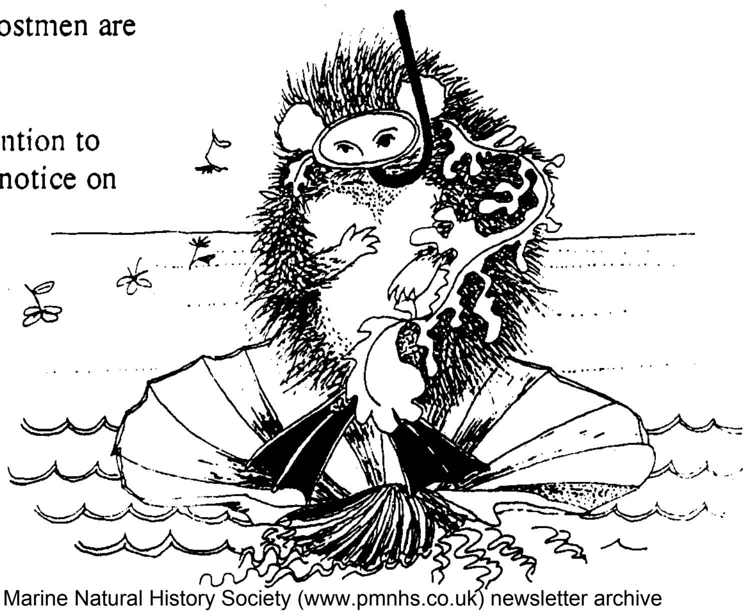
While I am pleased to accept articles offered in any typed form, it would be very nice if in addition to paper copy, a 3½" disk, preferably as a plain ASCII text file would be handy. If in any other form please state. Diagrams should not be inserted but should be on separate files, but I would like camera ready copy as well in case of hiccups. We can now accept photographs - prints in black and white or colour to be reproduced in black and white.

I am very pleased that Sue Arnott (née Evans) is willing to draw more Porcupines - see the new ones in this issue. If anybody has a bright idea or would like one to illustrate their article, please let me know.

You will notice that I am somewhat out in the sticks - sans Institution, Modem, Fax or, at the moment, Answering Machine, but my telephone does work even though it has a hard time competing with bird song, low-flying military aircraft and other country noises (give me time to rush from the far end of the garden!) and the local postmen are wonderful.

I would particularly like to draw your attention to the new PRIZE COMPETITION, see the notice on the following page.

Finally, the usual plea from Jon Moore, Hon. Treasurer. Please, some subscriptions are still outstanding - £8 for full members, £5 for students. We would like your money so that we can continue to send your PORCUPINE NEWSLETTER.



AGM REPORTS

MINUTES OF THE SEVENTEENTH ANNUAL GENERAL MEETING OF PORCUPINE, held at The Royal Museum of Scotland on 6th March 1994 at 10.07 am.

Dave Connor was in the chair; nineteen members were present. Apologies for absence were received from Fred Woodward, Ian Killeen, Jan Light and Robin Harvey. The Minutes of the Sixteenth Annual General Meeting (Published in PORCUPINE NEWSLETTER, Vol.5 No.7) were approved.

The Hon. Secretary's Report was presented by Roger Bamber (in the absence of the Hon. Sec.) and approved.

The Hon. Treasurer's Report was presented by Jon Moore and approved. There was discussion over whether we were achieving optimal interest rates on our bank accounts.

The Hon. Editor's Report was presented by Roger Bamber and approved.

The following Office Bearers were elected:

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

Roger Bamber was thanked by the meeting for his nine-years service as Hon. Editor.

Roger Bamber (on stepping down from Office-bearing) and Susan Chambers were nominated for election to Council. The following Council Members were elected:

Roger Bamber	Bill Farnham	Jan Light
Susan Chambers	Willie Fowler	Ivor Rees
Dave Connor	Robin Harvey	Ralph Robson
Mark Davis	Christine Howson	Dennis Seaward
Iain Dixon	Antony Jensen	Martin Sheader
Frank Evans		Fred Woodward

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

Future meetings were announced for the Autumn of 1994 at Guernsey, C.I. in September; the Spring 1995 and next Annual General Meeting is proposed for MAFF Burnham or Lowestoft, and the Autumn 1995 Meeting for the Isle-of-Wight. The last two have yet to be confirmed.

Frank Evans informed the Meeting of the proposal for a Porcupine annual essay prize (of £100) for submissions by bona fide students. Noting the healthy balance of funds, the Council expressed its interest in serious ideas for additional uses of funds.

The Meeting closed at 10.28 with the chair proposing thanks to those involved in the organization of the Edinburgh Meeting, particularly Susan Chambers.

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PORCUPINE
RECEIPTS AND PAYMENTS ACCOUNT
for the year ended 31 December 1993

Year to 31.12.92 £	£			Year to 31.12.93 £	£
		RECEIPTS			
111		Subscriptions-	1991	3	
1113			1992	45	
16			1993	1154	
-			1994	8	
	1240				1210
	43	Sale of P.N. back numbers			2
	115	Bank Interest (net of tax)			58
	110	Sale of T Shirts			22
	-	Donations			50
	1508	Total Receipts			1342
		PAYMENTS			
277		Newsletter-	Printing	422	
128			Postage	120	
44			Envelopes	23	
449		Total Newsletter Costs		565	
99		T Shirt Costs		-	
26		Phone & Postage		-	
	574				565
	934	**SURPLUS BEFORE MEETINGS**			777
		MEETINGS			
52		Oban		-	
73		Cornwall		-	
	125				-
	809	**SURPLUS FOR THE YEAR**			777
	1584	**BALANCE BROUGHT FORWARD**			**2393**
		BALANCE CARRIED FORWARD			
977			Current Account	1723	
1416			Deposit Account	1447	
	2393				**3170**

Jon Moore
....
Hon Treasurer

Nick Light
....
Hon Auditor

17 February 1994

HON. SECRETARY'S REPORT FOR 1993

Two PORCUPINE meetings were held in 1993:

Peterborough was the venue for the Annual General Meeting on 13 and 14 March and was host to one of the highest ever attendances at a PORCUPINE meeting. The title of ***Coastal & Inshore Marine Communities - Conservation & Coastal Management*** attracted about 120 members and friends. The meeting was jointly hosted by English Nature and the Marine Conservation branch of JNCC. We are very grateful to these organisations for their support and in particular to David Connor, Keith Hiscock, the MNCR team and Dan Lafoley for organising such a successful event.

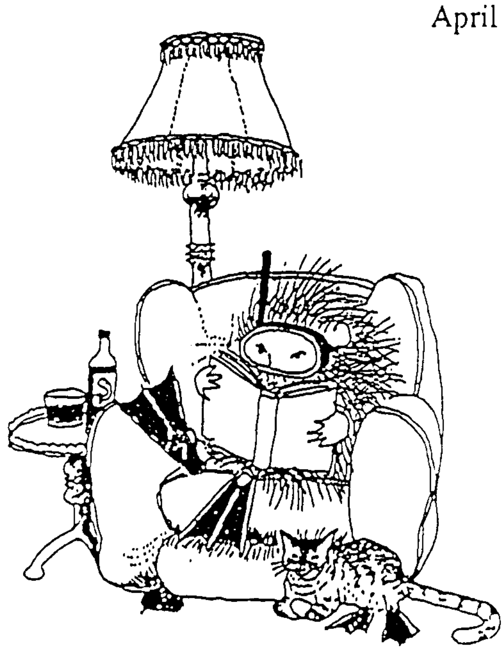
The Autumn meeting was held at the Port Erin Marine Station on the Isle of Man between 8 and 10 October. In spite of the distance and expense of visiting the island, 13 PORCUPINES made the journey to join the group of Port Erin staff and students. Papers on the theme of ***Experimental Marine Ecology*** were presented. On Friday 8 October the Marine Station's research vessel "*Roagan*" was made available for use. Five PORCUPINES took the opportunity to dredge off the south of the island. Lists and reports of the dredging will appear soon. We thank Professor Trevor Norton and his staff for hosting the meeting and for making all of the Marine Station's facilities available to us. Special thanks are due to Beverley Wilson for her excellent organisation.

As a result of the publicity and interest generated at the Peterborough meeting there has been a significant increase in membership. This currently stands at 204 comprising the following categories: 186 full members, 8 student members, 2 honorary life members, and also 8 libraries/ institutions entitled to free issues of the PORCUPINE NEWSLETTER.

As in previous years, could I stress the importance that individual PORCUPINES actively promote the interests of the SOCIETY. As all of you know there is much to be gained from membership so please do all you can to ensure the continuing health and success of PORCUPINE.

Ian Killeen, Hon. Sec.

April 1994



PRIZE ESSAY

An essay on any aspect of

THE BIOGEOGRAPHY OF THE NORTH EAST ATLANTIC

or a region thereof

first prize £100

is offered by PORCUPINE

Open to registered students, undergraduate or post-graduate, including Open University

Rules

1. Competitors must be registered students, either full time or part time, undergraduate or post-graduate. They must not at the same time be staff members of research establishments or institutions of higher education.

2. The Essay must be original work, typewritten or word-processed, and not exceeding 3,000 words. It may treat any part of the N E Atlantic, any group or groups of animals or plants, and any zone or zones from the shore to the deep ocean but must centre on biogeography. It may be illustrated with drawings, diagrams or graphs in black and white but not photographs.

3. Prizes are: for the winner: £100 plus two years' free membership of PORCUPINE. For each of two runners-up: two years' free membership of PORCUPINE.

4. The decision of the judges is final. The judges may refuse to declare winners and refuse to award prizes at their discretion.

5. Contributions must not have been published or submitted for publication elsewhere.

6. The winning contribution and those of the runners-up will be submitted to the Hon. Editor of PORCUPINE NEWSLETTER, the scientific journal of the Society, for possible publication. Publication will be at the Hon. Editor's discretion.

7. Contributions must be submitted to the Hon. Secretary of PORCUPINE at the address below to arrive not later than 30 November 1994. Winners will be notified before 31 January 1995.

Ian Killeen, Hon. Secretary PORCUPINE, 163 High Road West, Felixstowe, IP11 9BD.

THE ECOLOGICAL STEERING GROUP ON THE OIL SPILL IN SHETLAND

AN INTERIM REPORT ON SURVEY AND MONITORING MAY 1993*

By William Ritchie
AURIS Business Centre, 23 St Machar Drive, Old Aberdeen AB2 1RY

This report is presented three months after the oil spill. That space of time is enough to enable us to assess the work and to sketch our own future directions, but it is not sufficient to arrive at broader or deeper conclusions. For that the reader will have to avait our substantive report in 1994, and, for some species and habitats, even one year of monitoring might be too soon for authorative impact assessment.

The grounding of the "*Braer*" on 5 January 1993 precipitated an oil spill unlike any other. Although 85,000 tonnes of crude oil were released into the sea, there was at no time a conventional slick. As a result of the light character of the oil, the high wind and wave energy conditions that prevailed for the first ten days, the oil was dissipated into the sea. In addition, oil was cast on or over the land in a form of a spray or aerosol in a manner hitherto unknown. The precise pattern and movement of the oil, once dispersed into the water, was not predicted and depended on the dynamics of local currents. The form of the coastline was also important in governing the nature of the event. It has become clear from events in Shetland that our current models for the fate of oil in water for a spill such as this are inadequate and need to be developed further, if responses are to be able to deal satisfactorily with future events of this kind.

The distinctive nature and location of the "*Braer*" oil spill have determined the survey and monitoring programme of the ESGOSS. the coastal effects have been given relatively less prominence than would be normal for a coastal oil spill of this magnitude. In contrast, greater effort is required in assessing the effects on marine ecosystems both near and at a distance from the incident, and especially on the seabed, where a substantial part of the dispersed oil is known to have lodged. Monitoring of standard targets such as intertidal species, coastal soils and vegetation, and indicator species, notably the internationally important population of cliff-nesting sea birds, is under way and we have given special attention to an extension of a pre-esisting sandeel research project. But all of these have had to be set in the context of the unique nature of this oil spill, which included:

1. Severe storm, wind and wave conditions, giving rise to long periods of very turbulent water movements.
2. A reflective, exposed coastline with an absence of fragile sheltered coastal environments.
3. The release of a very light crude oil over a period of several days.
4. Winter conditions, including long periods of rainfall and sleet.
5. A relatively high significance of spray and aerosol effects on adjacent land areas.

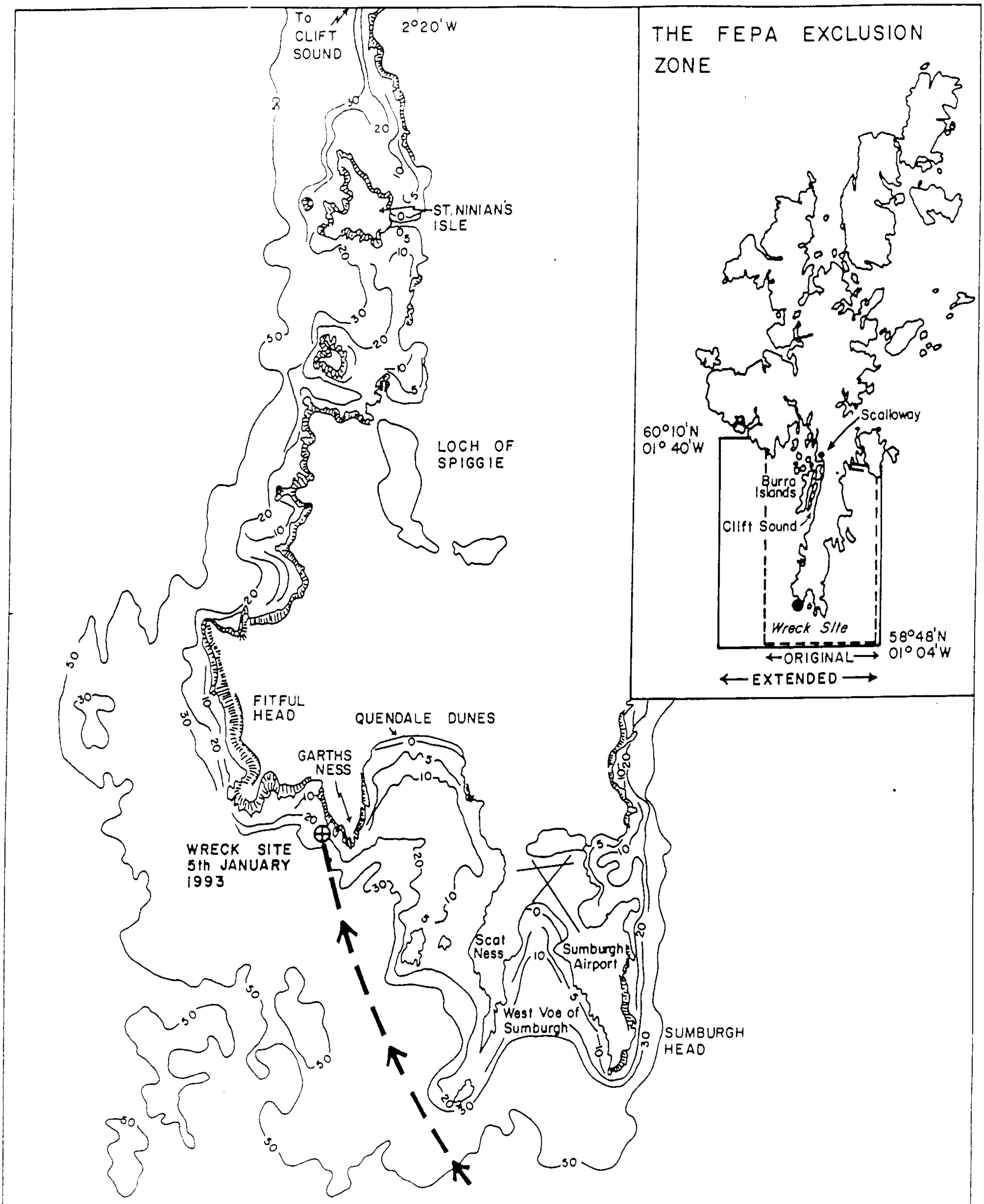


Figure 1 Generalised bathymetry (depths in metres) & location of wreck & track of 'Braer'.

6. The absence of a "conventional" oil slick, and minimal oil stranding on any type of coastline.
7. The dispersal of a large fraction of oil into the water and its subsequent transport by the strong winter sub-surface currents to basins of fine sedimentation at considerable distances from the point of release.

Monitoring work on oil in water concentrations began on the first day of the grounding of the "*Braer*" and initially showed values as high as 20,000 times backgound concentrations in the vicinity of the wreck. However, the area to the east of Shetland was at no time significantly affected, and concentrations even near the site of the grounding fell rapidly. Oil appears to have become bound to the sediments, and a significant volume has been deposited in two basins of fine sedimentation, one (around 10,000 tonnes) to the west of Shetland and another (around 12,000 tonnes) relatively distant, to the south east of Fair Isle.

Fishing is the main industry in Shetland, and the effect of the oil spill on sea fishing and fish farming has deserved special attention. A fisheries exclusion zone was declared by the Scottish Office Agriculture and Fisheries Department on 8 January and detailed monitoring instituted both within and outwith the zone. It proved possible to relax the ban on fishing for white fish within the zone on 23 April, although monitoring continues, centred on flatfish. All stocks of the 1991 cohort of farmed salmon in the affected area were irretrievably contaminated. Monitoring continued on the 1992 cohort to establish whether they would clear as hydrocarbon concentrations were declining. Although levels of contamination were high in wild shellfish, they also were declining. The effect of the spill on sea mammals does not appear to have been marked. Substantial studies are under way, however, to investigate the impact of the oil spill on other marine communities, both at sea and along different types of shorelines: initial results showed substantial casualties in the neighbourhood of the wreck. Sea bottom and shore-based communities are inevitably affected by storms such as those experienced in the winter of 1993 in Shetland, and not all casualties would have been due to the oil. Substantial programmes have been launched to study the effects on sea birds and their main prey species including the very important sandeel populations.

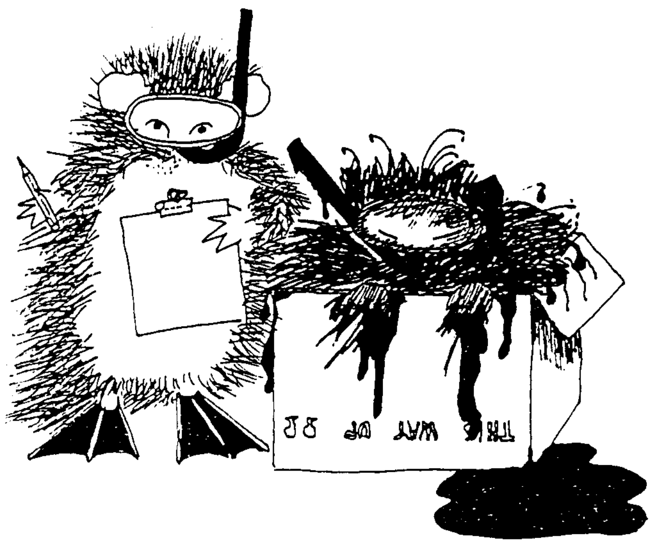
The effects of the oil contamination on vegetation, soils and land fauna have so far proved to have been slight, and bear out past experience. The only major unknown has been the rates of accumulation of polynuclear aromatic hydrocarbons by grazing sheep and the effects on those animals, but accumulation rates proved reassuringly low, Among the sea birds, only shag and black guilllemot numbers appear to have significantly fallen locally. The spill occurred in winter when most of Shetland's sea birds had moved away. But studies of possible sublethal effects on sea birds are under way, concentrating on their main food, sandeeels. Studies are planned to look for any effect on otter numbers and cub production in 1993: in addition, post mortems on otters for hydrocarbon contamination will proceed.

Other issues and wider applications are also discussed, including wildlife rescue, cultural heritage and the effects on human population.

There is general agreement that knowledge gained from the "*Braer*" can be used to improve oil spill tracking models. The most important requirements we have identified so far are:

1. To develop methods for integrating high resolution coastal models with low resolution shelf-wide models. These models should be held and regularly maintained by an appropriate agency for rapid response in the event of spills.
2. To consider the range of data with which to refine models that should be collected shortly after an incident (e.g. through satellite tracked buoys, fluorimeter surveys); how these data are disseminated to the various groups involved; and how they are used for the preparation of response plans.
3. To improve understanding of processes affecting the behaviour of oil at shoreline exposed to severe weather conditions.
4. To research the effects of wind and waves on vertical mixing and on oil droplet size under extreme environmental conditions. The use of more models should be investigated.
5. To develop a model of the transport of oil in the atmosphere and integrate it with a hydrodynamic model. This may require some research into atmospheric transport mechanisms and deposition mechanisms. Such a model would also be of use when considering the impact of oil spills on lee shores and coastal land areas.
6. To research the uptake of oil by suspended sediments and the mechanisms involved in the transport and deposition of oil associated with suspended particles. A better understanding of such processes should lead to their eventual inclusion in numerical models.

*William Ritchie has invited me to make this summary from the report titled above - Hon. Editor.



THE IMPACT OF THE *BRAER* OIL SPILL ON SHETLAND'S BREEDING SEABIRDS

By MARTIN HEUBECK

AURIS/SOTEAG Ltd, Broonies Taing, Sandwick, Shetland, ZE2 9HH

The initial results of Tystie [Black Guillemot] pre-breeding surveys that were attempting to quantify the effect of January 1993's "*Braer*" oil spill on breeding numbers in Shetland are as follows: Four species comprised 82% of the oiled birds found; Shag (975), Eider (122), Kittiwake (136) and Tystie (219). There was no way of knowing how many victims were never found. Other questions to be answered included whether the losses would be spread widely among the breeding populations (in which case they may not be detectable) or be more localised, and in the case of Kittiwake, whether the birds found were actually from the Shetland population. (The only ringed Kittiwake found had been ringed as a chick on the Farne Islands in 1964 - the oldest Kittiwake recorded in SOTEAG's long-running monitoring programme). This programme was expanded in 1993 to assess the impact of January's oil spill, with financial and logistic support from the Ecological Steering Group on the Shetland Oil Spill. Sullom Voe Association, JNCC, SNH and RSPB.

Since the early 1980's, breeding numbers of Tystie had increased at monitored sites in some areas of Shetland (especially on the west coast) or else had remained rather stable. Where localised reductions had occurred after inshore oil pollution incidents (Yell Sound in 1979, Mousa in 1985 and southeast Mainland in 1991), the numbers had increased again relatively quickly. The outcome of the 1993 surveys remains much as originally reported. Reduced numbers were found in Fair Isle (-25% since 1989) and on West Burra (-35% since 1992), but not at other monitored sites elsewhere in Shetland. Results of a survey of the entire coast of the south Mainland proved difficult to interpret for some areas, especially for most of the oil-affected coast between Sumburgh Head and the Scalloway Islands where the only counts available for comparison dated from 1982/83. However, the conclusion reached was that the "*Braer*" had had little or no impact on breeding numbers along the southeast Mainland coast. Along the coast of southwest Shetland, and allowing for probable changes between 1982/83 and 1992, 1992-93 decreases in some areas (e.g. the Scalloway Islands) had probably been greater than the 35% observed at the Burra monitoring sites, but probably less elsewhere (e.g. counts of 77 at St Ninian's Isle in 1983, and 75, 72 and 86 in 1993.

The greatest fears back in January were for the Shag population, in view of the numbers found oiled and the overall decrease in recent years. After the experiences gained during fieldwork for the Seabird Colony Register (SDCR) our monitoring strategy for Shag has been to count and map nests and adults along entire stretches of coast from a Zodiac inflatable. Land counts were only made at colonies where a high proportion of nests can be seen from the cliff top. In June 1993 we repeated these counts for as much coastline as possible for which post-SCR counts existed. The most obvious impact of the oil spill was on breeding numbers at Sumburgh Head (the origin of 15 of the 34 ringed birds found), where a count from the land of 151 nests compared with 304 in 1992 and 508 as recently as 1988. No 1992 counts were available for the coast of southwest Mainland (where smaller numbers breed) and so while 1993 counts indicated considerable reductions (e.g. 9 nests at St Ninian's Isle compared with 38 in 1989), it was not clear when the decreases had occurred. Further north along the west coast of Shetland and along most of the east coast, the 1993 counts indicated relatively small decreases in breeding numbers which broadly corresponded with recent trends. Eleven recoveries were of birds ringed at Fair Isle and six from Foula; a survey of Fair Isle found 946 nests, only 9% less than the 1,043 recorded in 1990.

The Shetland Kittiwake population has declined markedly in recent years, but at greatly varying rates at different colonies or regions. In 1993, counts of nests and adults were made at all colonies except those on Foula, Noss, northwest Mainland and Unst. Apart from increases at some of the small colonies on Fetlar, Yell and Out Skerries, the recent decreases had continued, in some areas at rates greater than recorded recently but at lesser rates at others. At colonies in the southern half of Shetland, from Watsness in the west to Mousa in the east, totals of 3,693 nests were recorded in 1993, 4,917 in 1991 and 8,905 in 1981. Because of the considerable recent changes at colonies it is difficult to know how much the reductions in breeding numbers in 1993 were attributable to the "*Braer*" or simply reflected a continued downward trend, but the latter is probably the case.

Surveys of flocks of moulting Eider suggested that after a considerable decline from an estimated 16,500+ birds in 1977, the Shetland popluation (assumed to be largely resident) had stabilised by 1991-92 at c. 7,200. The 1993 population estimate was 7,00 birds, again based on surveys of moult flocks which located 6,544 birds. In January 1993 most of the oiled Eider were found in the Sumburgh area, where moulting numbers were c. 450 lower than in 1992. The proportion of the total population moulting in each area varies from year to year but it is interesting to note that further north along the oil-affected coast of southwest Mainland (where few oiled Eider were found), moulting numbers were actually higher in 1993 (636) than in 1992 (529). In conclusion, it is likely that the impact of the "*Braer*" on Shetland's Eider population was relatively small and that had the oil spill not occurred, numbers may have increased slightly between 1992 and 1993.

MARINE MONITORING IN NORWAY - THE NORWEGIAN COASTAL WATER MONITORING PROGRAMME

MATS WALDAY
Norwegian Institute for Water Research, Oslo, Norway

Introduction

There are several marine monitoring programmes in Norway, both national and international.The Norwegian Coastal Water Monitoring Programme is a part of the Norwegian Monitoring Programme, which also includes fresh-water and terrestrial monitoring.

Discharges of nutrients to estuaries, fjords and coastal waters, can disturb the ecological balance in the ecosystem and have serious implications for the natural plant and animal communities. The objective of the Norwegian Coastal Water Monitoring Programme is *to obtain an overview of the trophic status, and to obtain long term data series so that any changes or long term trends can be identified at an early stage.*

The programme is covering three different fields:
- Hydrography
- Soft-bottom communities
- Hard-bottom communities

Area

The investigated area stretches from the Swedish border up to the Sognefjord north of Bergen (figure 1). This stretch of coastline is defined as one of the most vulnerable marine areas in Norway, because of the population density and influence from long-distance pollution.

The archipelago and the fjords dominate the area and the substrate is typified by rocky shores, and a few sandy beaches. Tidal amplitude is small. The predominant water-current is westerly (Norwegian coastal current) but may be locally influenced by tides, winds and freshwater outflows. The water masses that influence the stations may be divided into three categories:

1. Skagerrak-coastalwater (25-32 S‰)
2. Upper Skagerrak-water (32-34.5 S‰) and lower Skagerrak-water (34.5-35 S‰,)
3. Atlantic water (>35 S‰).

Hydrography

The hydrographic part of the programme includes hydrochemistry and observations of phytoplankton. Four locations are investigated about every fortnight.The programme measures the following parameters:
Temperature, salinity, oxygen, tot-P, PO_4 -P, particulate -P, tot-N, NO_3-N + NO_2-N, NH_4-N, particulate -N, Si_2O_3-Si, particulate -C, TSM, chl.-a, secci-depth and phytoplankton.

Soft-bottom communities

Twenty locations (50 - 460 m depth) are investigated in May-June every year, with respect to:

Community composition (4 parallels with a 0.1 m^2 Day- or vanVeen-grab)
< 63 mm sedimentfraction
TOC
Tot-N

Hard-bottom communities

The hard-bottom communities are examined at 20 locations from 0 to 30 m depth in May-June every year. The stations are situated on the exposed or semi-exposed outer areas of the coastline This part of the programme includes:

- Vertical transect registrations by a biologist who records, semi-quantitative and qualitative, all benthic algae and sessile or slow moving macroscopic animals.
- Stereophotography on fixed locations on vertical walls (5-14 m depth).
- Sub-littoral quadrate registrations (3 x 0.25 m^2).
- Kelp forest registrations (no. of plants, size, fouling etc.).
- Video recordings (documents the vertical transect).

The program is funded by the State Pollution Control Authorities (SFT) and it has been running since 1990.

Results are presented yearly in the form of a data report and every 5th year as a more comprehensive report comparing the results for the last 5 years . There will also be produced a report in a more popular form at this time.

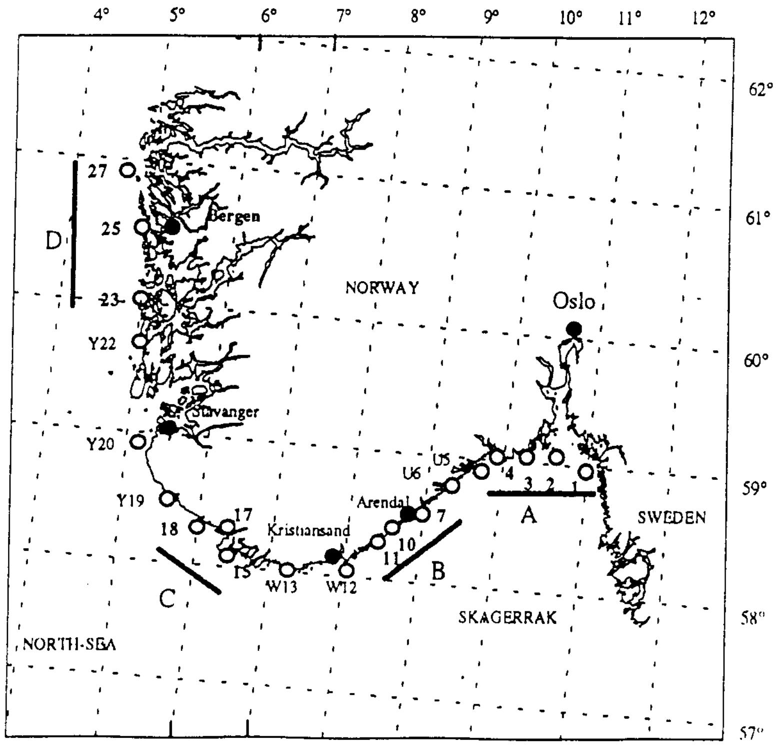


Figure 1. *Area investigated under the Norwegian Coastal Water Monitoring Programme. The map shows the hard-bottom stations with the four main areas (A-D).*

MARINE ENVIRONMENTAL MONITORING: APPLICATION OF TECHNOLOGY

Jeff K.S. Tang
School of Ocean Sciences
University of Wales, Bangor
Menai Bridge LL59 5EY

Introduction

Monitoring is integral to the proper management of human impacts on the marine environment and the health of the biotopes provides the ultimate guide to environmental status. However, while the chemists have been able to automate the detection of many contaminants, the classical naturalists would be quite at home with many of the techniques still used in marine biological studies. Ecological monitoring can play a fuller role in marine management but the advantage needs to be taken of developing technologies to improve:-

a. the validity of interpolations between spot samples;

b. the rapidity with which results are produced, especially if assessing quality standards;

c. the handling of increasing amounts of data in diverse formats;

d. the interpretation of results to lay decision makers and the concerned public.

The areas of developing technology that have the greatest potential for enhancing ecological monitoring are remote visual and acoustic imaging, with the employment of multimedia database systems to aid interpretation.

Visual & Acoustic Imaging Equipment

Various types of remote sensing are increasingly being employed as adjuncts to benthic surveys, for putting the small physical samples that can be obtained with dredges, grabs or corers into a broader context. The development and use of still and video cameras for marine research was reviewed by Holme (1984), while Burns (1991) describes some additional types now available. Operated remotely, still cameras give higher resolution than video cameras, and when operated by scuba divers can produce good close-up details. Video cameras however have the advantage of producing continuous real-time data. *In situ* sediment profile imaging is a particularly good example of a technology that has advanced understanding of the sediment-water interface as well as having promise as a monitoring tool.

While conventional echo-sounding has been used to obtain basic depth information for over 50 years and side-scan sonar has been used to map bedforms for many years, computer processing of sonar signals for assisting descriptions of bottom types is more recent. The processing of sonar signals for assisting descriptions of bottom types is more recent. The ROXANN system, which uses echo-integration techniques on the multiple as well as the first echo return to give clues to the bottom type, is increasingly being used to assist in ecological studies, though it was originally developed as an aid to fishermen. Scanning sonars are now regularly used by the offshore oil industry for the guidance of inspection vehicles and this technology also shows great promise for ecological monitoring. It was used to great effect by Hartley & Watson (1993) for plotting the spread of drill cuttings piles underneath platforms. Hardin *et. al.* (1992) and Thekkethala & Spruance (1992) reviewed the use of sonar survey equipment.

The use of lasers in the marine environment has been described by Tusting & Davis (1992). To date they have been little used for ecological work but they have promise for measuring the sizes of organisms.

Table 1 compares the effectiveness of sampling with imaging gear and two types of conventional sampling gear. The exacting nature of observation underwater, the need for simultaneous recording of different attributes of the site (bottom type, occurrence of different species, estimates of density), the desirability for a ready and permanent record describing and demonstrating phenomena which cannot easily be portrayed in any other way, as well as minimising disturbances to the study site are the reasons for the use of imaging gear (Tang, 1993). Table 2 summarises the types of sampling or recording that can be done when imaging gear is employed.

There are inherent limitations associated with the various types of imaging gear and must be taken into consideration when deciding on the type of imaging gear to be used in marine surveys. Both underwater video and still cameras require a light source for illumination during recording, and the power for the lights come form either battery packs or a surface umbilical connection. The battery packs add bulk and weight to the equipment set-up and can only provide limited power, while umbilical connections greatly restrict manoeuvrability. An additional problem associated with the use of lights is the degradation of the light beam due to backscatter (caused by particles in the water column) and adsorption by sea-water. Sonar is limited by its poor resolution of marine organisms (that is it can only pick up those species that have some body structures able to reflect the sonar beam), but has the advantage of imaging at scales not possible with light. Lasers do not suffer from the degradation that affects normal light but laser imaging gear is expensive to purchase and maintain.

TABLE 1: COMPARISON OF DIFFERENT SAMPLING GEAR TYPES

Gear ability to sample different habitats or different organisms indicated by good or poor (G & P respectively). Processing time for collected data is indicated by high (H) or low (L).

	*Imaging Gear	Grabs	Trawls
Habitat Types			
Soft Sediments	G	G	G
Rugged/Rocky	G	P	P
Species Types			
Sedentary Megafauna	G	P	G
Mobile Megafauna	G,P	P	G
Infauna/Meiofauna	P	G	P
Small-Scale Spatial Distribution of Species	G	G	P
Processing Time			
Shipboard Sorting	L	H	L-H
Laboratory Sorting	H	H	L-H

*Includes still and video cameras, sonars and lasers

TABLE 2: MARINE OBSERVATIONS MADE POSSIBLE BY VISUAL IMAGING

TYPE OF OBSERVATION	COMMENT	ANCILLARY INFORMATION
Identification of marine objects	Cover species, populations, communities, organism parts, geologic features, sedimentary features. Video sequence for behaviour and to enhance identification. Shows habitat characteristics and associations.	lat., long., time, depth, etc. collect for lab work
Spatial/temporal mapping	Spatial patterns from quadrat and transect analyses. Temporal changes of spatial patterns from measurements on relevant time scales.	lat., long., time, depth, etc.
Measurement of marine properties	Structured light illuminate particles in known volume to measure size frequency distribution. Dye dispersion studies to describe fine scale currents and mixing. Flux studies by measurements of particle velocity and current (can indicate migration movements of organisms).	lat., long., time, depth, etc.
Description of marine objects	(Quantitative measurements must be done for statistical significance)	
static	Quadrat analysis. Species - analysed by number, % cover, presence-absence, size-frequency, associations and habitat type.	lat., long., time, depth, etc.
dynamic, short time scale	Transect analysis, enumerate species, etc. Moving image for recognition and i.d. behaviour, sediment dispersion, geologic analysis.	lat., long., time, depth, etc.
dynamic, long time scale	Movement of species, recruitment, pop. change, growth, substrate change. Time lapse image or video can record long time scale events.	lat., long., time, depth, etc.

Multimedia Databases

Scientific requirements for information derived from images, the need to integrate these interpretations with data collected by conventional sampling gear and the desire to share the data in an interdisciplinary environment demands novel approaches in the use of computer hardware and software technology (Crain, 1992; Diaz, 1993).

These come in the form of multimedia computer database systems which provide the means of integrating data from multiple sources into a stable coherent set-up with multiple levels of interpretation, manipulation and access (Gritton & Baxter, 1992). Such systems will enable the mapping of species, documentation of population dynamics and species interaction, study of community structure, and correlation of all these with physio-chemical factors. They can also provide the archives for time series to examine long-term natural process and impacts of Man's activities.

Putting together a multimedia database is more complex than a standard database, since it must deliver images of high and documentable quality. A team of people is required to edit and integrate the large volumes of different data types together while ensuring integrity in the data structure and setting up appropriate links between the different data types. There is also a need for "experts" to set up an interface layer that allows for consistent and reliable identification of species or groups from the stored images and interpretation of the data. Furthermore the system should be set up to focus on managing information extracted from the data rather than the physical aspects of the data, since the data medium may change in future.

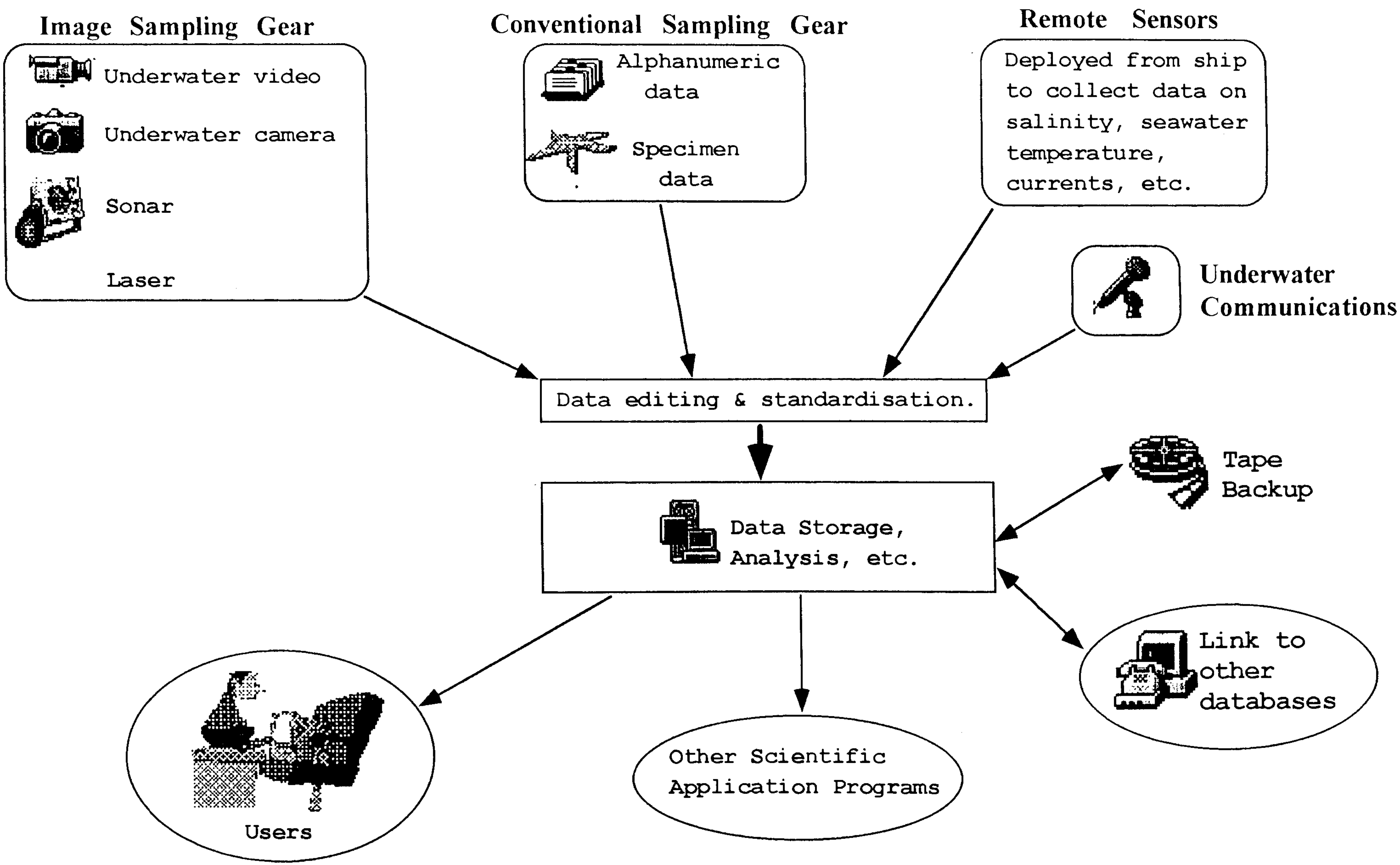
Figure 1 is a schematic showing the operating environment of a multimedia database designed for marine studies and monitoring.

Other Issues

Data tends to be spread across many different databases and varies in complexity, detail and quality, having been compiled for different reasons and managed by different organisations with different attitudes to making information available (Diaz, 1993). Therefore trying to develop a "fully integrated" database to be used by researchers and policy makers is quite difficult. Fortunately this is not a major problem as linkage to other databases while desirable, is not essential.

The demands and expectations from imaging gear and multimedia computer systems often means acquiring new "state-of-the-art" technology. However, the new technology is very costly, and even the established and mature technology used in such equipment is not cheap to

FIG. 1: OPERATING ENVIRONMENT OF A MULTIMEDIA DATABASE FOR MARINE STUDIES AND MONITORING



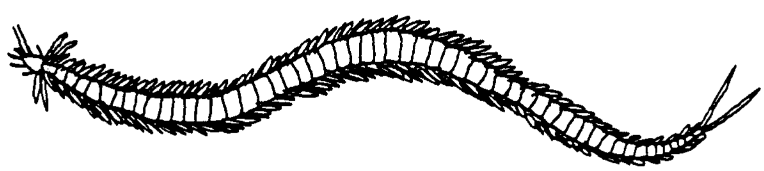
Porcupine Newsletter, 5 (9), 1994

purchase and maintain. Hopefully as imaging gear and multimedia computer systems become more widely used and accepted, the prices should come down to a reasonable level.

Finally there is the problem concerning data security, data copyright and data misuse. Increasing numbers of organisations are linking up their computer systems into networks (such as JANET, INTERNET) to provide more storage capacity and to enable better information interchange. However such networks also increase the vulnerability of the data stored on the various computer servers, and since there are no fool-proof computer security systems, there is a possibility that unauthorised people ("hacker") can get access to the data (especially sensitive data). Modern computer software makes "cut and paste" activities very fast and easy, which means that chunks of data (whether it be text , images, etc.) can be copied from any application (database, wordprocessor, etc.) available on the network and pasted to a document. At the moment, no clear guidelines exist to determine how much data can be copied, before it constitutes a violation of copyright. Many networks are designed to facilitate public access, and no control can be exercised over users on use of the data. The information gathered from the data can be misrepresented, or in cases of incomplete data sets, a totally wrong conclusion can be drawn. Solutions to this particular problem is still being researched and discussed, but the best and only answer for the moment is to rely on the personal integrity of the user.

Conclusion

Imaging survey equipment is not meant to replace existing conventional sampling gear but to serve as a valuable adjunct to conventional sampling. Because of the greater expense and complexity of imaging gear, combined with the requirement for greater care in operation and maintenance, the deployment of such equipment for a particular survey requires careful consideration and planning. Multimedia database systems function as a valuable repository for information but require commitment from institutional management in the form of continued investment to develop and maintain such systems, and the co-operation between scientists and engineers to develop and implement a coherent usable system. The combination of imaging gear with analytical computer database systems, and added to the interpretative power of human experts, provides a very powerful and effective environmental monitoring set-up.



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REPRESENTATIVE REPLICATION FOR SEDIMENT BENTHOS MONITORING: APPLICATION OF VARIED STRATEGIES IN THE IRISH SEA

by E.I.S.Rees, P.L.Allen and J.Coppock

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INTRODUCTION

Offshore sediment biotopes vary patchily on spatial scales from centimetres to kilometres and on a wide range of time scales. Small to intermediate scale patchiness often hinders sample replication and creates uncertainties in how representative samples from single positions may be, with attempts to keep statistical confidence limits narrow conflicting with needs to obtain broadly representative coverage. Such ephemeral patchiness has long been recognised as a feature of the benthos in parts of Liverpool Bay (Eagle, 1975), but variability at these small scales has hitherto been perceived as intractable when grabs are lowered blind from the surface. Now, with the ready availability of GPS electronic navigation systems, the time is ripe for a re-consideration of how best to spread or concentrate the placing replicate grab samples. In this paper some comparisons are made between results from replicates taken at single nominal positions and in sets of quasi-replicate samples from spread out positions. The use of a regular hexagon, as a plan for spreading the loci at which quasi-replicates are taken, was particularly explored.

To harmonise the monitoring of sludge disposal grounds round Britain, the Benthos Task Team of the inter-departmental Marine Pollution Monitoring Management Group has recommended the adoption of Treatment v Reference protocols (Rees et al 1990: MAFF, 1993). To judge whether ecological quality standards are met also requires measures of confidence intervals and hence replication. However there is an unresolved debate about when to take the replicate samples from as small a spatial spread as practicable and when to deliberately impose a measure of spread on the placing of quasi-replicates in the treatment and reference localities.

PAST PRACTICE AND EVIDENCE FOR LOCAL VARIATION

While position fixing for offshore grab sampling was usually by main chain Decca, the sets of samples, which were treated as if they were randomly taken replicates from the same place, will have often fallen far short of these criteria. Tide and wind drift while the samples were actually being taken would have compounded poor navigational repeatability. In practice therefore, the replicates would often have been taken sequentially along the lines of drift. It would not be unusual if the position where the last sample had been taken on one visit to a station was over a kilometre from the position where the last sample was taken on a subsequent visit. Such a spatial scale well exceeds the mosaic of the seabed types that are sometimes detectable using side-scan sonar or Roxann.

Some of the same nominal reference station positions in the Morecambe Gas Field were visited twice only two days apart during a single cruise in 1990. Examination of the data showed that although the same broad biotope type, dominated by *Amphiura filiformis* was encountered each time, the individual samples clustered more closely with the ones that had been taken on the same visits to the particular station. Since the time separation was so short, it was concluded that the differences were due to quite small differences in the positions actually sampled.

During October 1993 two sets of 9 grab samples were taken in Red Wharf Bay, off NE Anglesey. They were taken on separate trips 2 days apart, with the ship being anchored at approximately the same location and were subsequently worked up by the same group of MSc students. The samples of muddy sand held large numbers of small bivalves such as *Spisula subtruncata* and *Nucula nitidosa* but were dominated by small *Lagis koreni.* After editing to eliminate doubtful identifications and species standardisation, a principle components analysis of the two sets of data showed separate clustering of the samples taken on the two days (Fig 1). The difference was again ascribed to local patchiness at a scale of no more than 250 metres.

TRIALS OF QUASI-REPLICATION ON HEXAGONAL MINI-GRIDS

Hexagonal mini-grids, using GPS navigation and with 500 metre spacing between sampling loci were worked during 1992 and 1993 on inshore areas in Liverpool Bay and Conwy Bay. The habitats were muddy sands, falling into the *Abra* community category with masses of *Lagis koreni.* Similar mini-grids were sampled further out in Liverpool Bay on the offshore gravely sands with more diverse faunas.

Figure 2 shows a principle components plot from a 500 metre spaced mini-grid in the inshore Burbo area, between the Dee and Mersey estuaries. The samples were taken in late winter, at a time when the populations of even the dominants were low and no prior transformation was applied to the data. This diagram shows that the 5 true replicates taken at the central locus of the hexagon gave a spread in ecological hyperspace that was almost as wide as that from the 6 samples taken around the periphery of the heexagon. In this case it can be concluded that there was little additional loss of coherence to the data by spreading the quasi-replicates on this scale. Results from winter sampled hexagons on the gravely sands further offshore also showed little difference between the clustering of the true replicates and the spread quasi-replicates.

The Burbo hexagon was worked again in September 1993, at a time when there was a super-abundance of small *Lagis koreni.* On this occasion, only single samples were taken at each locus on the mini-grid. To allow for the high numbers of the dominant, square-root transformations were applied and then a similarity matrix was calculated, using the Czekanowski coefficient to compare all possible pairs of loci. With such a mini-grid it was possible to compare the average similarities between nearest neighbour loci 500 metres apart and pairs separated right across the hexagon or across the chords. In the September 1993 Burbo example the average similarity between nearest neighbour pairs of loci was 68.41 (n=12, SE 2.10), while for those further apart the average similarity was 60.67 (n=9, SE 2.36).

By contrast with the above examples, a hexagonal mini-grid that was worked in Conwy Bay in October 1992 with 5 true replicates being taken at the centre, did show an obvious difference in the coherence of the data. On a principle components plot (Fig. 3) the 5 central locus replicates clustered in the middle, while the peripheral loci occupied positions round this central cluster. The placing of the peripheral loci on this diagram even fitted their geographical relationships. In this case it is apparent that the 500m spacing of the sampling loci was too great for the scale of the ecological trends in Conwy Bay.

Figure 4 compares the principle components clustering of square-root transformed data from two 500 m interval scale hexagons from Liverpool Bay sampled in September 1993. One of the hexagonal mini-grids was located near that part of the licensed sludge disposal ground which is most often used by the disposal vessel. The other was chosen as a reference super-station and was located well seaward of the outer fringe of the disposal area, though on similar sediment. The diagram shows that the clustering of the samples from the treatment and reference hexagons did not overlap. This happened even though many of the higher rank species were the same. The differences in the closeness of the clustering also shows that variability within the treatment hexagon was much greater than in the reference one. This is in keeping with the contention by Warwick and Clark (1993) that increased variability is one of the consequences of stress on marine communities. Differences seen in the K-dominance plots from some of the loci on the sludge treatment hexagon are also in keeping with this greater patchy variation (Fig. 5).

DATA POOLING FROM WIDER AREAS FOR DETECTING TEMPORAL CHANGE

Offshore disposal of sewage sludge from the Manchester and Liverpool conurbations, macrofauanal sampling has caused monitoring to be carried out on a wide grid of stations in Liverpool Bay on an almost annual basis since 1970. The licensed disposal ground covers about 75 km^2 and since tidal currents cause dispersal, the sampling has had to be widespread, As a consequence rather few replicates have usually been taken at any one station. Nevertheless, roughly the same proportions of sampling effort went into different types of ground each year so by pooling data from entire surveys it has been possible to follow the fluctuations of quite sparsely occurring species as well as the common dominants. Examples of the long-term fluctuations of four species, none of which were dominants, are shown in figure 6. Rees and Walker (1991) have shown that data of this multi-station derived sort can be pooled and analysed for temporal trends using multivariate methods. They showed that in Liverpool Bay, clearer long-term signals of change were obtained by taking the data for a sparse category of species separately from the common dominants. Only by pooling stations could enough records be obtained of the sparse species. The study also showed that the benthos from a wide grid in Liverpool Bay changed at much the same time and in the same way as was observed at single stations in the North Sea by Buchanan and Moore (1986).

CONCLUSIONS

In recent years much effort has gone into the choice of sampling hardware for macrofaunal monitoring, as well as the protocols for sorting, counting, identification and data processing (Rees et al, 1990; Rees et al, 1991). The same aspects have been given most attention in preparing quality control procedures for BS5750. However, it is contended here that weakness more often lies in planning the sampling than in the subsequent mechanics of processing the samples. In a major review of before and after sampling procedures, Underwood (1993) concluded by saying that "increased rigour in the design of sampling programmes to detect environmental impacts is long overdue".

Where small - medium scale patchiness is expected, deliberately organised spreading of quasi-replicate sample positions may assist temporal repeatability and representativeness at the expense of minor reductions in the coherence of the single data sets. Deliberate spreading using GPS position fixing should limit distortion from variable amounts of sampling vessel drift. This approach also provides a greater chance that the samples will be representative of slightly wider areas than the tidally aligned strips along which replicates have previously been taken. Clearly such spreading of sampling loci cannot be adopted where there may be biotope boundaries or where impact gradients are steep, as round outfall pipes and offshore platforms. With care in the choice of spread scale and perhaps the use of sonar to check for gradients, both the National Marine Monitoring Plan of a 3 x 3 pattern, chosen for chemical monitoring of sediments and the hexagon pattern discussed here have merits. Both should increase repeatability in benthic monitoring programmes, whether for studies of dispersed impacts or for long-term change studies. That pooling of data from an entire bay detected long-term changes paralleling those seen elsewhere in NW European shelf seas during the 1970s and 1980s reinforces an intuitive view that the quest for narrow confidence limits in single data sets should not be dominant to the quest for representative temporal repeatability.

ACKNOWLEDGEMENTS

The main data used in analyses for this paper came from monitoring surveys carried out for North West Water Ltd. We are also grateful to the Masters and crews of RV Prince Madog for much assistance over the 24 years that the Liverpool Bay benthos has been monitored.

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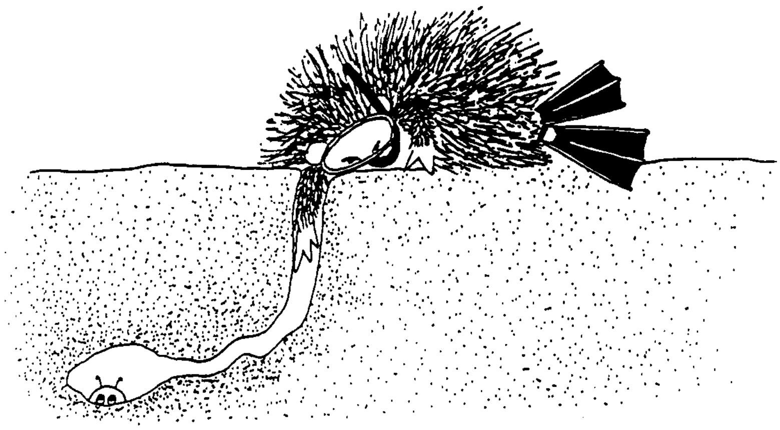


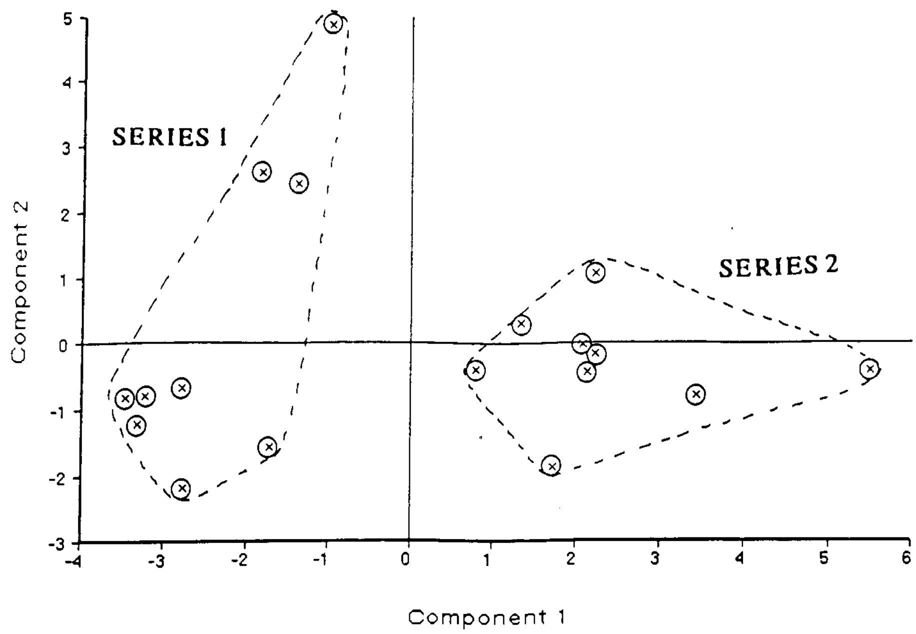


FIGURE 1

Principle components analysis of replicate grab samples taken when the vessel was anchored near to the same position in Red Wharf Bay on trips 2 daya apart in October 1993.

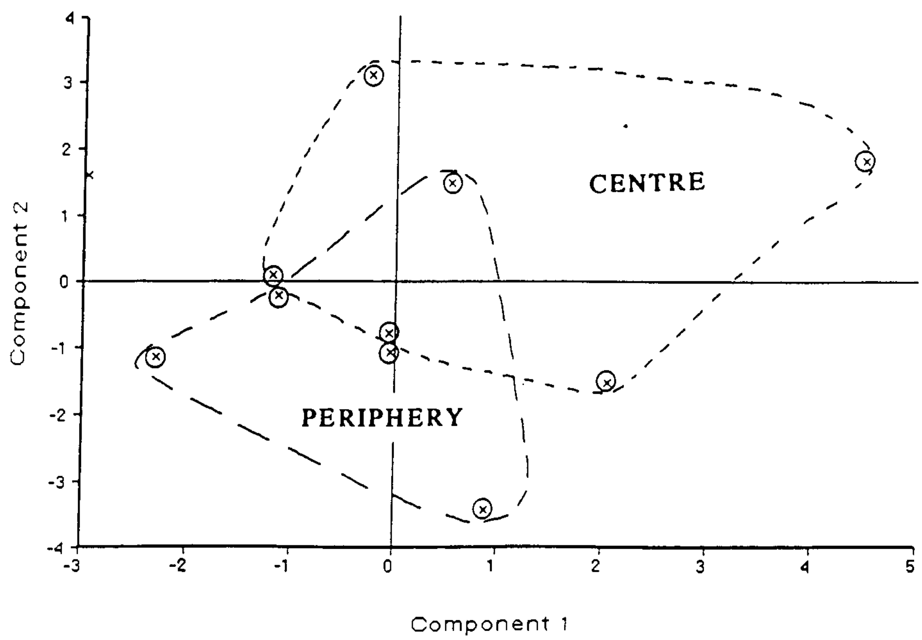


FIGURE 2

Pinciple components analysis of grab samples taken on a hexagonal mini-grid in the Burbo area of Liverpool Bay, February 1993. The grid had 500m spacing between loci, with 5 replicates being taken at the central locus and single samples at the peripheral loci.

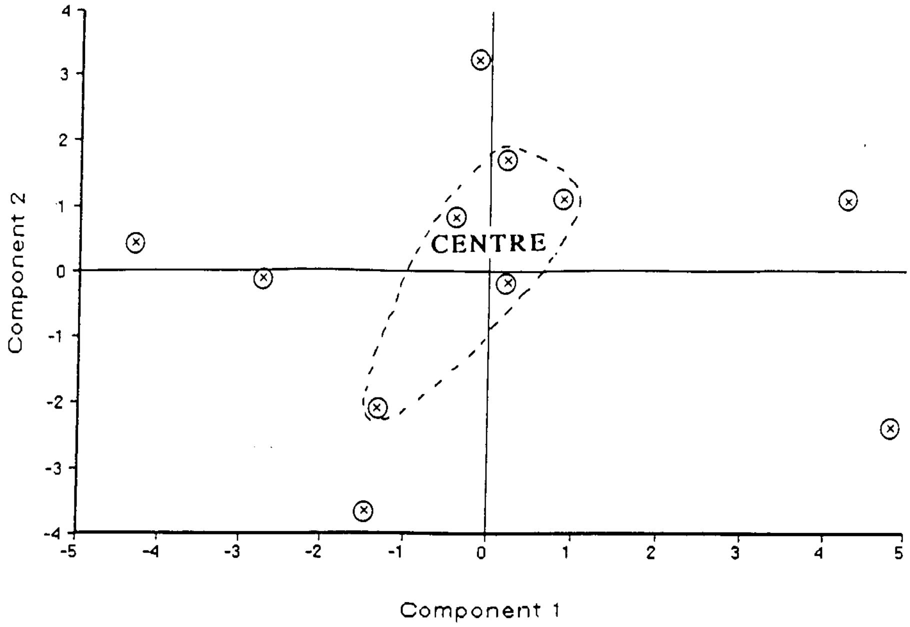


FIGURE 3

Principle components analysis of grab samples taken on a hexagonal mini-grid in Conwy Bay, October 1992. The grid had 500m spacing between loci, with 5 replicates being taken at the central locus and single samples at the peripheral loci.

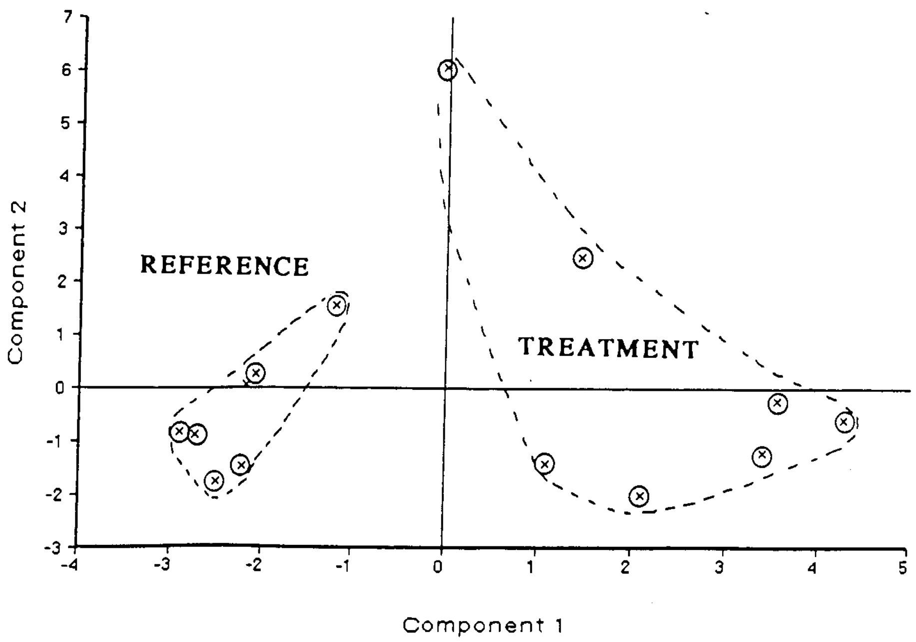


FIGURE 4

Principle components analysis of grab samples taken on two hexagonal mini-grids in Liverpool Bay, September 1993. The cluster marked Treatment was from the sludge disposal area and the cluster marked Reference was from similar sediment at a distance.

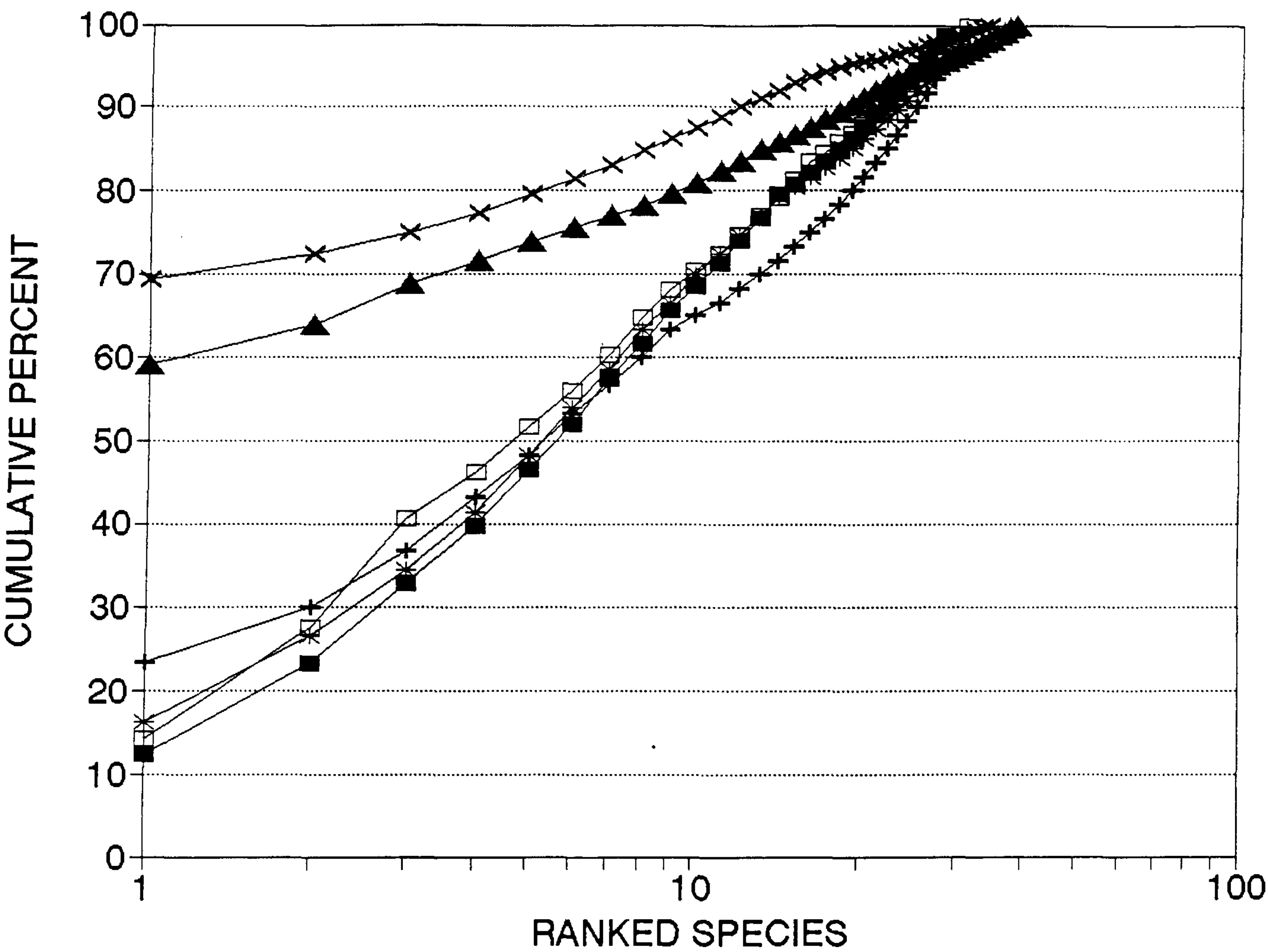


FIGURE 5

Variablity in K-dominance plots (Rank against Cumulative Abundance) for grab samples taken at separate loci on a hexagonal mini-grid in the sludge disposal area of Liverpool Bay, September 1993.

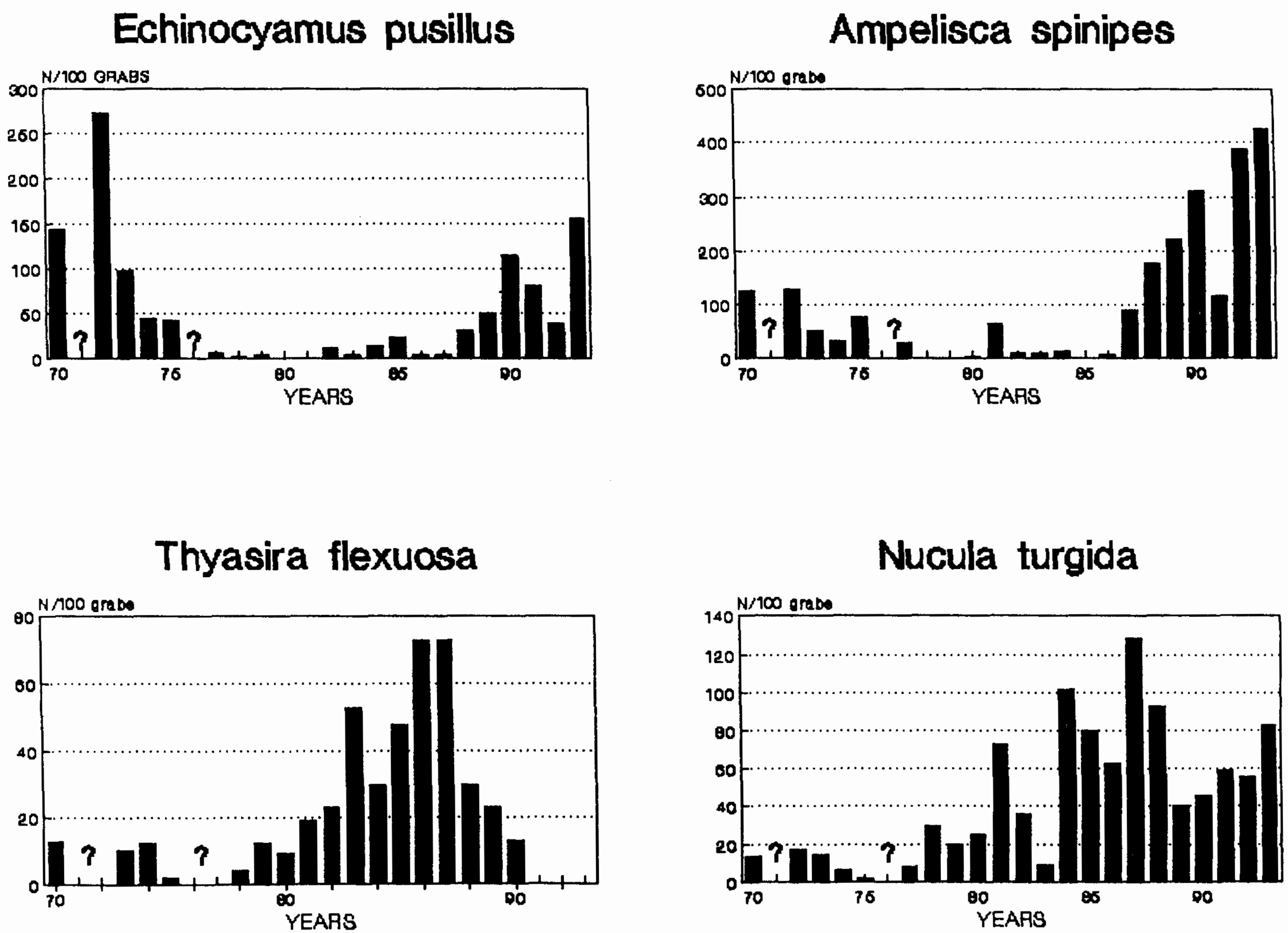


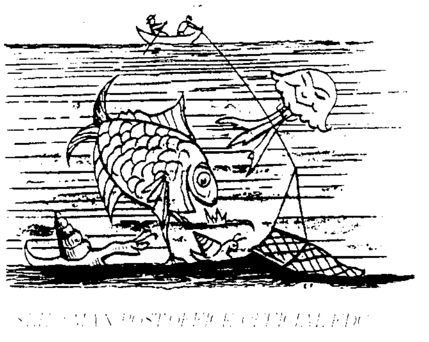
FIGURE 6
Examples of changes in the abundance of some macrofaunal species over the 1970 - 1993 in Liverpool Bay, derived by pooling data from widely spread stations.

Porcupine Newsletter, 5 (9), 1994

ISLE OF MAN POST OFFICE HONOURS EDWARD FORBES

DAVID HEPPELL
National Museums of Scotland, Edinburgh

On 5 May 1994, the marine biologist Edward Forbes was honoured by the issue of a set of six stamps by the Isle of Man Post Office, as part of the *Europa 1994 - Discoveries* series. Some of us had a preview of these at the October PORCUPINE meeting in Port Erin as I was able to display a preview of the stamps and the artwork for them thanks to Sally Cambelton of the Isle of Man Philatelic Bureau, Douglas. The choice of designs for the stamps was evolved by Trevor Norton and myself with Sally's collaboration, and involved finding a selection of marine invertebrates associated with Forbes. After several months of deliberation and a search for suitable illustrations the following subjects were chosen. The nudibranch *Eubranchus tricolor*, one of the first species named by Forbes in his book on the Mollusca of the Isle of Man, *Malacologia Monensis* is featured on one of the 20p stamps, from a slide by Gordon MacSkimming. Another 20p stamp depicts two *Loligo forbesii* swimming, while the third bears a portrait of Forbes himself who, born in Douglas in 1815, was probably the Isle of Man's most famed scientist. As well as being a marine biologist and a founder of the science of oceanography, he was a notable botanist and geologist, and his early death in 1854, less than a year after he had been appointed Regius Professor of Natural History at the University of Edinburgh, was mourned as a national loss. His geological interest is commemorated by the first of the three 30p stamps, which illustrates, from the type specimen now in the Natural History Museum, London, the fossil starfish *Solaster* [now *Brachisolaster*] *moretonis*. This species from Gloucestershire, one of the last species described by Forbes and unique for long after its discovery, was not published until after his death. The remaining two 30p stamps depict the cloak anemone *Adamsia carcinopados* (perhaps still better known as *Adamsia palliata*) on a hermit crab and the sunstar *Solaster endeca*. Forbes was the author of these two generic names. On the first day cover there is another portrait of Forbes, together with one of his noted humorous cartoons of the naturalists' dredge. The artwork for these stamps is by Jennifer Toombs. They were issued as two sheetlets of 15 (5 x 3) with a compound perforation 15.75/2cm vertically x 13.25/2 cm horizontally, printed by offset lithography on unwatermarked paper with bluish PVA gum, each stamp measuring 28 x 42.45mm.



[This reproduction of the First Day Cover is 90% actual size]

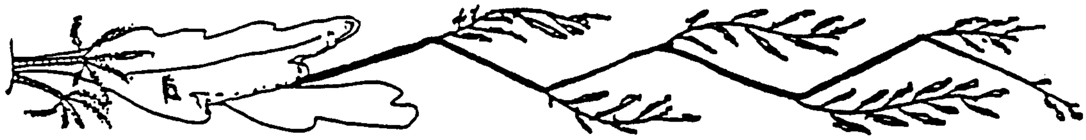
AULACOMYA ATER (MOLINA, 1782) [Mollusca: Pelecypoda] COLLECTED FROM THE MORAY FIRTH

By DAVID W McKAY
SOAFD Marine Laboratory, Victoria Road, Aberdeen

On 4 March 1994 a clump of 23 live mussels were trawled up in the Moray Firth from a depth of 90m. The mussels ranged in length from 50mm to 90mm and appeared to be from four to eight years old. The shells are similar in outline to the common mussel (*Mytilus edulis* L., 1758) but have a dark brown periostracum over a white or bluish-purple shell with pronounced radial ribs and thus have been identified as *Aulacomya ater* (Molina, 1782).This is a largely Magellanic species found in Peru, Chile, Southern Argentina and the Falkland Islands. It occurs there on the shore, particularly in situations more exposed than those occupied by the local *Mytilus edulis chilensis* Gay in Hupé, 1854. It is also found offshore to at least 100m in beds and forming anchorage for kelp holdfasts, similar to the N E Atlantic *Modiolus modiolus* (L., 1758).

The origin of the present clump of *Aulacomya ater* is not known, but the considerable range of both age and size in this small clump suggests that it most likely has fallen from a barge, or possibly a ship or oil platform, which had become fouled while in the S Atlantic.

Specimens have been lodged in the National Museums of Scotland, register number NMSZ 1994047.1



EFFECTS OF MARINE MICROFOULING ON THE ESTABLISHMENT OF SUBTIDAL HARD SUBSTRATUM COMMUNITIES (Abstract)

By SABINE K WIECZOREK and CHRIS D TODD
Gatty Marine Laboratory, University of St Andrews, St Andrews, Fife
KY16 8LB

Sessile marine invertebrate larvae can recognise suitable settlement substrata from various environmental cues, including epilithic organic/microbial "films".

We have undertaken a series of monthly manipulative panel studies in a tidal rapid (Clachan Sound) on the west coast of Scotland to assess the effects of "filming", and the presence of previously settled incumbents, on subsequent larval settlement. Filming of substrata, whilst excluding larval settlement, was achieved by the enclosure of settlement panels within tight-fitting, but removable, mesh screens. Inhibitory and facilitatory responses to filming and/or incumbents were noted and varied markedly between species, with season and between two local habitats of contrasting flow regimes.

PORCUPINE SUMMER MEETING

CHANNEL ISLANDS

Monday 5 September - Sunday 11 September

Leader: Roger Brehaut.
For information please contact Ian Killeen.

This joint meeting with the Conchological Society is going ahead although precise details are still to be finalised. It is hoped to visit a variety of marine habitats including the submarine caves on Sark and also to make a trip to Herm. It may be possible to arrange a dredging trip.

It will be up to individual PORCUPINES to make their own accommodation arrangements, but unless you are taking a vehicle staying in St Peter Port is advised. Details of accommodation can be obtained from:

States of Guernsey Dept of Tourism: PO Box 23, St Peter Port, Guernsey GY1 3AN.

Travel costs vary considerably according to the mode of transport, but a rough guide indicates flight from London: PEX saver £74: Skylink Plus £136. Car from Weymouth £240-£340, passengers £50-£80, return.

As yet no arrangements have been made regarding an indoor meeting at the weekend. Until PORCUPINES give a firm expression of interest in such, the meeting will be focussed on fieldwork.

It is essential that all PORCUPINES and friends wishing to attend all or part of this meeting should contact Ian Killeen as soon as possible [phone 0394 274618].