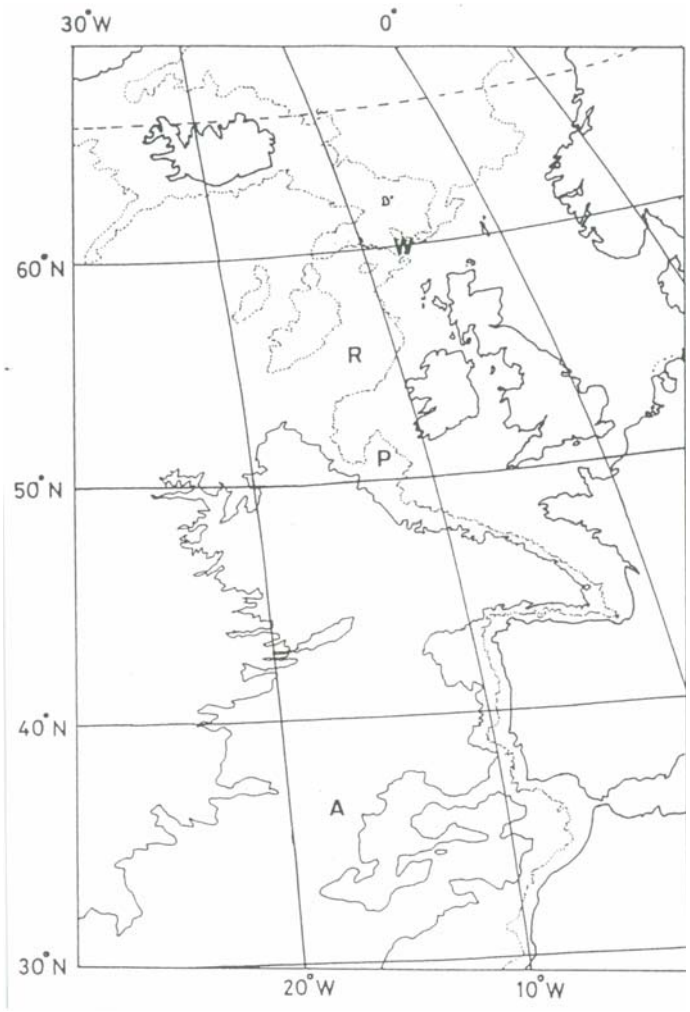
PORCUPINE MARINE NATURAL HISTORY SOCIETY

NEWSLETTER

December 2002 Number 11



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Porcupine Marine Natural History Society

Newsletter

No. 11 December 2002

Hon. Treasurer
Jon Moore
Ti Cara
Point Lane
Cosheston
Pembroke Dock
Pembrokeshire
SA72 4UN
01646 687946
jon@ticara.co.uk

Hon. Editor
Frances Dipper
7 Rutland Green
Hilton
Huntingdon
Cambs
PE28 9NT
01480 830507
fdipper@dial.pipex.com

MEMBERSHIP

Chairman
Julia Nunn
Cherry Cottage
11 Ballyhaft Rd
Newtonards
Co. Down BT 22 2AW
porcupine@strangfjord.freeserve.co.uk

Porcupine MNHS welcomes new members- scientists, students, divers, naturalists and lay people. We are an informal society interested in marine natural history and recording particularly in the North Atlantic and 'Porcupine Bight'. Members receive 3 newsletters a year which include proceedings from scientific meetings.

Individual £10 Student £5

CONTENTS

EDITORIAL

Your Council would like to apologise for the fact that there was no July/August issue of the Newsletter this year. This was because insufficient copy was received and so there was nothing to publish. The general way in which things work is that papers from the Annual Meeting in March are published in the two following newsletters (i.e April and July/August issues). The November/December issue sweeps up anything left over from previous meetings. Contributions received from members, write-ups of field trips etc., are published in whichever issue follows their receipt. Following the annual meeting in March this year (2002) it has proved extremely difficult to persuade those that presented their papers, to actually write them up. I had lots of promises and I'm sure everyone had good intentions but, in spite of numerous appeals, very little happened. In future we will be asking all speakers at the annual meeting to provide their written papers at the time of the conference (assuming they want their papers published).

Meanwhile, I would also like to encourage more members to contribute to the newsletter. **LETTERS to the Editor, short ARTICLES, requests for INFORMATION, book REVIEWS, scandalous STORIES about other Porcupines, PHOTOGRAPHS – all are acceptable!!**
So please get writing. As you have all been so busy you must have something to write about!

Web site.
Please note the new web site address below. Please VISIT the site and send your comments to Ann Bunker. Please also send in any photos you would like to see on the site plus interesting articles. An article on the web site is a valid publication.

E-mail addresses
Thank you to all of you that have sent their e-mail addresses to me over the past few months. We are still trying to combine the various lists we have so if you have sent your address and we are still not using it, please bear with us. Anyone who has NOT told us their e-mail address and would like to receive information such as reminders of meeting, in this way, please send to me or to Julia Nunn.

Obituary
It is with the deepest sadness that I have to tell you that Annette Little died in July, after losing her long battle with cancer. Annette was a much valued member of Council and friend and will be sorely missed. She supported Porcupine to the end, attending both the Annual Meeting in Edinburgh in March and the field trip to Dunbar immediately following. She died peacefully with her family around her.

COPY DEADLINES
March 1st for April issue
June 1st for July issue

NEW WEB ADDRESS

Note new web address: www.pmnhs.co.uk

Summary of Minutes of the Council Meeting held on November 16th 2002 at the Natural History Museum, London.

Present:
Roger Bamber
Peter Barfield
Anne Bunker
Frank Evans
Judy Foster-Smith
Jon Moore
Julia Nunn
Peter Tinsley

Apologies:
Mike Bailey
Paul Brazier
Sue Chambers
Frances Dipper
Ian Killeen
Ivor Rees
Shelagh Smith

The turn over of council members was discussed. Three council members (Ian Killeen, Mike Bailey and Ivor Rees) have resigned. With the sad death of Annette Little earlier this year there are now 12 council members. There is now space for people to join the Porcupine Council and current council members were asked to consider whether they knew anyone suitable to recommend. Thanks for their previous time and commitment were expressed to those who have now resigned.

Finances. The Hon. Treasurer Jon Moore gave a report.

Membership. The Membership Secretary Jon Moore gave a report.

Poster. This has now been produced. Thanks to Joshua for designing the poster.

Web. The address has now been changed to www.pmnhs.co.uk due to problems that could not be resolved with the previous one. The site is now back on line and can be managed without going through a third person. The new server can host forms.

JM had been approached by Steve Trewhela (non member) asking if we would like to use some of his photographs on our site. Council thought it would be useful to have a bank of photos for use on the web site and that these would be a starting point.

AB suggested that the next feature should be on *Sargassum muticum* and has approached Dr Steve Morrel from Dale Fort Field Centre who did his PhD on *S.muticum* to write an article. It was suggested that previous features are archived on the site.

JN has been the only person to suggest any links to other suitable sites. Several other sites were suggested at the meeting. AB will check the suggestions out and add to site if appropriate.

Later in the meeting a History page was suggested.

Newsletter. FD had sent report that it was becoming increasingly difficult to obtain copy and that the next newsletter could be delayed slightly due to her work commitments. Peter Tinsley offered to assist FD with production of the Newsletter.

Membership drive. In order to maintain/increase membership, Council decided the following: An A4 poster to go out with the newsletter. A membership leaflet to be sent out with the big newsletter after the conference. Send posters out to suitable organisations. JN will produce a distribution list. Ask for member's e-mail addresses.

Conference. Friday and Saturday 14th and 15th of March. National Museum of Wales, Cardiff. Andy Mackie. JM has a list of potential speakers.

It was decided to charge £25 *(may be £30 –ed.)* (£15 for students) conference fee and to ask for a £10 deposit for the conference dinner.

Field Trips. Ivor Rees had sent comments regarding future trips, which were read to the council members present. Paul Brazier had written a report of the recent field meeting to the Inland Sea, Anglesey, which will be published in the newsletter. JN will contact Jan Light regarding a possible future meeting to be held jointly with the Conchological Society.

Constitution. JN will make changes to the original constitution and send round to Council for comment and approval.

Data Custodians. JN raised the issue of producing guidelines and adhering to the law when reproducing and releasing data. JN will circulate a paragraph concerning this issue for comment. This paragraph should be placed in the newsletter at its first appearance and subsequently be kept on the web site.

History of Porcupine. This project is ongoing. JN will contact SS to suggest that FE would be willing to help. In the meantime it was suggested that a summary of Porcupine's history should go on the web site. FE will e-mail AB with short history and AB will publish it as a page on the web site.

Netty (Annette) Little. There was a discussion on the best way to remember Netty. JM suggested an education interpretation board or similar. JM will investigate. AB suggested making the next features page, since it was seaweed one, a tribute to Netty. This was agreed. JM suggested making a talk on seaweed a permanent feature of the conference. JM will approach suitable speakers for the next conference.

Council thanked RB for providing the excellent venue for this meeting.

RB treated council members who did not have to rush off to see the Harry Potter film, or catch a train, to a fascinating tour of the tank room.

FD plus white tip reef shark in Sipadan, Sabah. Photo by Liz Wood

This is what your editor was doing whilst the rest of Council were having their meeting in London!

MEETINGS, MEETINGS, MEETINGS, MEETINGS, MEETINGS

PORCUPINE MEETINGS

PORCUPINE ANNUAL CONFERENCE 2003

First announcement for the annual conference
14-15 March 2003 (Fri/Sat)
National Museums and Galleries of Wales, Cardiff

The provisional conference theme is: **Ecology, Taxonomy and Conservation**. The two days of talks will be held in the Museum's Reardon lecture theatre, with an adjacent area for posters to be viewed during refreshment breaks. A field meeting at a suitable site in the Cardiff area will hopefully be arranged for Sunday 16th (low tide at midday).

The conference dinner will be held at a nearby restaurant on the evening of Friday 14th

The conference will be organised jointly by Jon Moore (see contact details below) and Andy Mackie (National Museum of Wales.

Please register your interest in:

Attending the conference
Presenting a talk/paper/video
Presenting a poster

Please include your full name and postal address if you would like to receive the 2nd announcement and booking form by post. A list of hotels/B&Bs will be provided with the 2nd announcement.

Porcupine Marine Natural History Society
Tí Cara, Point Lane,
Cosheston, Pembroke Dock,
Pembrokeshire, SA72 4UN,
Wales, UK.

Tel: (+44) 01646 687946
Email: jon@ticara.co.uk

OTHER MEETINGS

Coastal Futures 2003 Review and Future Trends January 22-23rd, SOAS, London - Keynote speakers: Elliot Morley, Minister for Fisheries, Water and Nature Protection and David Erwin, CEO Ulster Wildlife Trust. Contact: Bob Earll, CMS, Candle Cottage, Kempley GL8 2BU, 01531 890415;
bob.earll@coastms.co.uk
www.coastms.co.uk

ECSA 36 -2003, Environmental Management, United Kingdom. Contact ECSA Conference Coordinator: V.N. de Jonge, Dept. Marine Biology, University of Groningen, PO Box 14, The Netherlands. E-mail: v.n.de.jonge@biol.rug.nl

British Coelenterate Society, Saturday 8th March 2003

Professor J.S.Ryland (j.s.ryland@swansea.ac.uk) has invited the British Coelenterate Society to hold its next meeting at the School of Biological Sciences, University of Wales Swansea. Please make a note of the date: further information available from: Leonie Salmon, Tropical Marine Ecology Group, School of Ocean Sciences, University of Wales, Bangor, Menai Bridge, Anglesey, LL59 5AB E-mail: ospa14@bangor.ac.uk

February 4th World Wetlands Day London Wetland Centre

The aim of this conference is to bring together all the key organisations in the UK involved in wetlands issues to share knowledge, discuss innovative techniques, network, consider good practice case studies and promote business and wetland biodiversity.
The programme can be found on the coastms website: www.coastms.co.uk

FREE TO GOOD HOME

Laser granulometer for particle size analysis.
Malvern 3601 built about 1989.
Previously owned by SEPA East Region.
I have not used this instrument so cannot guarantee its condition.
Ready for collection from Inverness.
Phone Julian Hunter 01463 731367 or e-mail: hunter.biological@btinternet.com

NEWS, NEWS, NEWS

The 2002 PDV epidemic

The following information has been compiled from the WWW and information sent in by Roger Bamber.

Most of you will be aware that this summer a new epidemic of phocine distemper reached the North Sea. On 13th August it was confirmed that 5 common seals from the population in the Wash in southeast England had died of PDV. The response to the outbreak in the UK is being coordinated by the Institute of Zoology in London. Collaborating organizations are the Scottish Agricultural College (SAC), Inverness, Marine Environmental Monitoring (Wales), the Sea Mammal Research Unit (SMRU) and The Natural History Museum, London. The telephone number to call if you find a dead or live sick seal anywhere in the UK is 0871 244 7999. The helpline will tell you what to do, depending on where you are, and will redirect the information you supply to the relevant organisation.

Weekly Status Reports are available on the Sea Mammal Research Unit website (http://smub.st-and.ac.uk) providing up-to-date information on the PDV epidemic in UK seals. (*Note from Ed: once in the site, click on Quicklinks and choose PDV*.)The Sea Mammal Research Unit (SMRU) has been sending out regular status reports, the latest of which is as follows (*as at time of going to press – ed*.):

Report No. 16 November 27th 2002.

Between 20 November and 26 November there have been 77 dead seals reported around the UK bringing the total to **3387** since the beginning of the outbreak. In the last week there have been 12 dead seals reported from the English coast bringing the total to 2686. This represents a gradual decline in weekly dead seal reports within England since a peak of 431 in the week 11-17 September . 39 cases have been confirmed as positive for PDV (38 common and 1 grey) and 10 cases have been confirmed as negative for PDV.

PORCUPINE PROBLEMS
Information requests

Ballan wrasse breeding

The following information was sent to me (Frances Dipper) in response to a request in the new edition of my book 'British Sea Fishes' for any interesting 'fishy' observations. It is reproduced here with kind permission from **John Kirby, Aramis Sub Aqua Club,** BSAC Branch No. 2006.

Location: Pinnacles, Farne Islands. Date: 25/7/99. Depth 12 m. Water temperature: 13º C. Slight tide running.

On the above date we observed three ballan wrasse around a flat topped rock with a 'Z'-shaped crack running across it's top surface. One of the wrasse repeatedly swam in a wriggling action backwards and forwards along the crack which we took to be an egg laying action. The other two wrasse held station approximately a metre away observing this action which we assumed was to allow one of them to fertilise the eggs. Unfortunately we had to finish the dive before we saw this occur. Also watching the action were two or three silver fish about 8 inches long hanging vertically mouth down. We thought they might be small pollock but not sure. Presumably these were waiting to feed off any eggs going free. If they were successful in laying any eggs they certainly would not have any protection from cover as the rock was completely bare of vegetation. Until reading your book we did not realise what a rare event we were witnessing or we would have made better notes. Hope this is of some use to you.

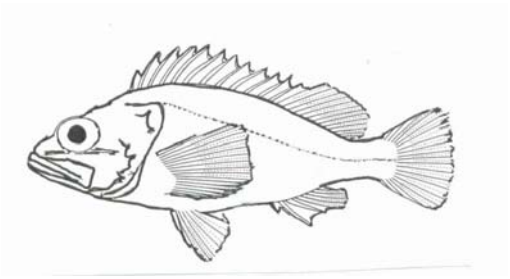
John Kirby

Bluemouth record
Douglas Herdson

I have received a report and photo of a Bluemouth, *Helicolenus dactyloptera* caught by an angler from the shore at Berrow Beach, near Weston-Super-Mare, Somerset (Bristol channel). I am familiar with this fish from occasional landings in Plymouth by boats fishing at around 300 metres in the Bay of Biscay, but this is the first case I have heard of one in shallow water. Has anyone else come across this species inshore?

Douglas Herdson, Information Officer, National Marine Aquarium, Rope Walk, Coxside, Plymouth PL4 0LF
Telephone 01752 275216/01752 600301, Fax: 01752 275217
Email: Douglas.Herdson@national-aquarium.co.uk

Bluemouth



PORCUPINE PIECES

Function and phylogeny of falcigers and spinigers

By Peter Gibson
ICAPB, University of Edinburgh, West Mains Road, Edinburgh EH9 3JT, UK

One probable reason for the success of polychaetes is their wide variety of chaetal types giving a range of function. Chaetae are light in weight, strong and metabolically inexpensive. The compound chaeta of errants is the falciger (Fig. 1a) and is found in nereids as well as other families. Aspects of its function are puzzling. In preserved polychaetes the falciger is normally seen, as in identification keys, with the distal blade or apex aligned with the basal shaft. The falciger is, however, jointed between the shaft, projecting from the parapodium, and the blade. In preserved specimens the blade, at times, is found at an angle to the shaft or is missing all together. There appears to be an elastic ligament in the joint, which allows the blade to bend at an angle to the shaft. When pressed against the substratum, bending would give the chaeta increased traction during locomotion (Fig. 1b). The blade normally has filaments or teeth on one side, which could further increase traction. The ligament at the base of the blade in a faliger of a glycerid is well illustrated by Hartmann-Shröeder (Fig. 110b, *Polychaeta*, Die Tierwelt Deutschlands 58, 1996). Glycerids are largely surface dwellers although they can both burrow and swim.

Falcate polychaetes frequently live for part of the time within galleries in mud and sand. One might therefore expect burrowing species, such as many nereids, to have chaetae adapted for this purpose. However, their chaetae differ from the crotchets found in sedentary (tube living) species. Errant species do not dig in the sense that they excavate material which is removed from the burrow, but force their way into mud or sand, which is, presumably, then compacted into the sides of the burrow.

Polychaetes living in galleries move by use of their parapodia and chaetae. A parapodium is a complex structure and has an intricate set of muscles within the body that move both it and the chaetae it bears. In *Nereis* the bundles of chaetae can be seen to move the worm forwards when walking on the surface of the sea bed (Grey, *Journal of experimental biology* 16, 9-17, 1939). This type of movement would appear not to occur in sedentary polychaetes; they have relatively small simple parapodia and chaetae which do not normally project far from the body. The functional difference between errant and sedentary polychaetes can be accounted for by the need for errants to leave their burrows on occasions to feed on the sea bed (Fauchald & Jumars, *Oceanography & Marine Biology Annual Review* 17, 193-284). Sedentary species feed whilst in their burrows. Many of the errant species also swim by using their parapodia whereas sedentary species normally only leave their borrows to spawn having first metamorphosed into epitokes. The chaetae of this reproductive stage are long and simple, and swimming is produced by forward moving waves of the body

forcing the chaetae backwards against the water.

When moving along galleries in mud or sand the chaetae of errants need purchase. The falciger, by bending at the joint would allow the distal blade to press against the wall of the burrow to provide grip (Fig. 1c). Asicular chaetae and crotchets are unlikely to be as satisfactory for this since they would simply sink into the wall. Rather, these types of chaetae have evolved to grip the harder walls of the burrows of sedentary species. In the errants, the tube must also constrict movement and therefore the falciger, which is long, needs to bend.

Many errant polychaetes, such as syllids, live entirely on the surface of the sea bed in areas with protective sheltering, yet they bear falcigers. The probable reason for the falcigers is that crevices and other such structure are similar to tubes and syllids have evolved from falciger-bearing ancestors. Another surface living family, the phyllodocids, have chaetae of the falciger type - the spiniger. These chaetae are more robust than falcigers but the distal blade must also be capable of movement. The distal end of the shaft is generally swollen and toothed as though it has evolved for gripping. Pleijel shows nice scanning electron micrographs of spinigers in his book on the Phyllodocidae (*Marine Invertebrates of Scandinavia*, 8, 1993). The distal segment, as with the falcigers, has filaments suitable for gripping soft surfaces.

The nephtyids are largely surface dwellers and have neither falcigers or spinigers but burrow in muddy ooze or sand. Their chaetae are geniculate and bear distal filaments. These chaetae are probably used in a similar way to falcigers and appear to be a compromise. The permanent bend may be associated with burrowing in soft muds, but at the same time is strong (non-jointed) and flexible enough for crawling on the surface of the sea bed.

It is not difficult to see how spinigers might be modified to produce falcigers. Dales (*Annelids,* Hutchinson, 1967) postulated that the phylogeny of errant polychaetes can best explained by reference to the types of nephridia found in families (Fig. 9, p. 75). His three types of nephridia are (in the present study) associated with either falcigers or spinigers (Table). From Dales one can conclude that since protonephridia are primitive they must have given rise to the other two types of nephridia, and falcigers therefore have been derived from spinigers.

There are other evolutionary ramifications of the spiniger and falciger. The shafts of the two types of chaeta are forked or cupped at their ends to bear the distal blades. Were a forked shaft to lose its distal blade it could be readily modified into a pectinate or lyrate chaeta. The shafts of the spinigers of onuphids and glycerids bear distal rounded processes at the edge of the distal depression, from these it is a simple step to derive the pectinate chaetae of eunicids or the lyrate chaetae of aricids. Onuphids and the eunicids, with their ventral proboscis, are clearly closely related. The typical crotchet of sedentary species with its hooked end can be easily derived from the terminal blade of the falciger through loss of the proximal shaft. This, of course, suggests that some sedentary species have evolved from errant species.

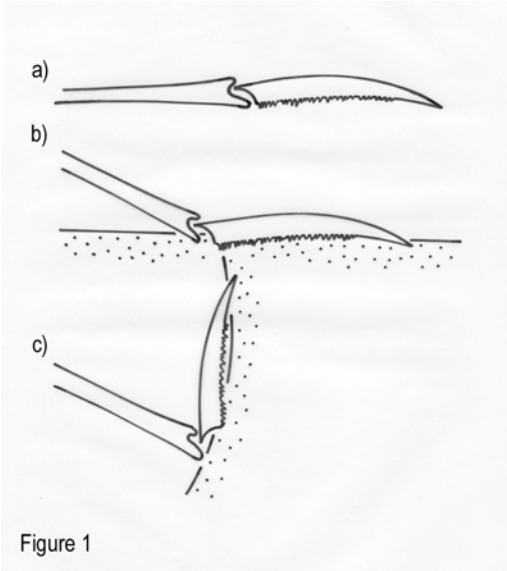
If the falciger is derived from the spiniger then divergent evolution has occurred and if this is not the case then their evolution is convergent. Both processes pose a problem when speculating on phylogeny based on similarities of specific structures or whole organisms living in similar habitats. Confidence in the degree of relatedness depends upon comparing many similar structures within the species and not just on two types of

chaeta. Quantitative comparisons of a variety of different types of chaetae in different families are needed but these will, presumably, always be problematic

Table. Spinigers and falcigers compared with families grouped according to their nephridia (Dales, *Annelids,* 1967).

Chaetae	Families	Habitats	Nephridia
spiniger	glycerids & phyllodocids	soft sea bed	protonephridia
falciger	nereids & syllids	mud galleries, sea bed, crevices	metanephridia & metanephromixa

Figure 1. Position of a typical falciger in the parapodium of a) a preserved specimen; and the probable position of a falciger in a live specimen when walking b) on a soft substratum, and c) within a burrow.



I am grateful to Dr Derek Cosens for reading through this piece and making corrections to my English

A Giant Squid Captured to the west of Scotland in 2002

Douglas Herdson
National Marine Aquarium, Plymouth

At 02:00 hours on the morning of 3rd January 2002, Skipper George Jacks and his five man crew on the F. V. Marina Polaris (a three year old, 28 metre stern trawler, FR153 from Fraserburgh) hauled up their net at the end of a five and a half hour tow. It was dark and the conditions rough. They were fishing at 57° 49′N 9° 42′W, at the edge of the continental shelf due west of St. Kilda, about 100 miles off the Hebrides. The depth here is 420 fathoms (770 metres) and they were using a twin-rigged demersal trawl. This means they would have had between 1000 to 1260 fathoms of warp out (1800 to 2300 metres or between one and one and a half miles). Their catch was around three and a half tonnes of demersal (bottom) white fish. This was mainly Blue Ling, Angler (Monkfish), Black Scabbard, Ling and Hake, less commercially important species included Bluemouth and ratfish.

As the net was dragged up the stern ramp a large white object, looking like a dead dolphin, was seen in the cod end. When the net was opened it was obvious that it was a large squid and so it was dragged across the deck and stored below in flaked ice.

It is unusual for giant squid to be caught in demersal hauls as they are thought to hang above the bottom in a sloping head down posture with their very long tentacles hanging down ready to catch fish or smaller squid. It is possible that the squid was caught in the net whilst it was being shot or hauled. Working at these depths the trawl would have taken around 10 minutes to reach the bottom and 15 to 20 minutes to haul up, however that is a rather short period, less than half an hour, in open water compared to five hours on the bottom.

It was landed at Scrabster in the north of Scotland on January 8th. It was taken out of the original ice, which had frozen and re-iced for landing. It is possible that some damaged to the specimen including the loss of its tentacles occurred at this stage. When a purchaser was not found locally it was shipped to J. Charles (Fish Merchants) in Aberdeen. A visiting buyer from Interfish in Plymouth was at J. Charles when the squid arrived and realised that the National Marine Aquarium in Plymouth might be interested. When the NMA heard of this they were very keen to obtain this specimen, as they had recently bought a forty foot animatronic giant squid to go into their 'Twilight Zone' exhibit, which was to open in May 2002. Mr Andrew Charles of J. Charles very kindly agreed that the aquarium could have the squid and shipped it down to Interfish in Plymouth. On arrival in Plymouth it was transferred to the National Marine Aquarium, where it was examined by aquarium staff with Dr Malcolm Clarke, formerly of the Marine Biological Association and an expert on these squid, and Dr Phil Pascoe of Plymouth Marine Laboratory. It was also made available to the media, before it was deep frozen for further samples to be taken at a later date and for it to be preserved permanently.

It was a female *Architeuthis dux*, and, with a mantle length of 127 cm, this specimen was medium sized. At this stage it was found that most of the two tentacles had been lost and the ends of most of the eight arms had been abraded, the eyes had collapsed, and the head and arms had become detached from the main body (the mantle). However this kind of damage is to be expected and generally the specimen was in good condition. Much of the skin had been lost and the general colour was that of the white

muscle tissue; the remaining skin showed the pattern of chromatophores (colour cells) which gave it a speckled dark red pattern. The presence of the nidamental glands identified it as a female but it was not in breeding condition. (Its size also made it unlikely that it would be mature, as it is thought that *Architeuthis*, like other cephalopods, probably breeds once and then dies.) The detailed measurements of the squid are given below.

When the specimen was defrosted the statoliths were extracted to determine the age of the animal. These are tiny "bones" about 2 mm long in the head, which serve as balance organs. They may show marks, which are probably day rings, when ground and examined under a microscope; in much the same way as most trees have annual growth rings across their trunks. At present it is not known how long *Architeuthis* can live, but it is thought to be two to four years. If correct this would make them one of the fastest growing animals in the world. Three mature males caught in Ireland were about half the size of this specimen and studies of their statoliths suggested ages of 294 to 422 days (10 to 14 months). It may be that males mature smaller and younger than females.

Tissue samples were taken for DNA analysis. There have been nineteen species of *Architeuthis* described but it is unlikely that there are more than seven, and most recent work suggests that there are three species – *Architeuthis dux* in the north Atlantic, *Architeuthis martensi* or *japonica* in the northern Pacific and *Architeuthis sanctipauli* in the Southern Ocean. However DNA studies have so far been carried out on only two specimens, one from New Zealand and one from Newfoundland (Atlantic coast of Canada), and the results so far published show no significant differences between them. If DNA from this Scottish specimen is similar, it will support the theory that there is only one species of giant squid with a cosmopolitan distribution in the middle depths (500 to 1500 metres) of the oceans.

It had been intended to examine the gut contents but the gut was damaged. However gut analyses on squid are notoriously difficult, since, because the narrow oesophagus passes through the middle of the brain, the prey is torn into small pieces by the beak before it is ingested. Other studies have shown that *Architeuthis* feed on fish, squid and benthic organisms, including horse mussels and ascidians.

The squid was carefully arranged and then preserved in buffered saline formalin. When preservation was complete it was installed in a transparent tank. It has been on show since May in the 'Twilight Zone' exhibit at the National Marine Aquarium along with a display of squid beaks. It is the only *Architeuthis* on public exhibition in Britain.

This is believed to be the 25th *Architeuthis* recorded in British waters since 1673. Fifteen have been stranded on the shores of the British Isles, nine caught in fishing gear and one found in the stomach of a sperm whale. Of these eight were on the Irish coast, sixteen off Scotland and one stranded in England. Fuller details can be found on Dr Martin Collins's University of Aberdeen website http://www.oceanlab.abdn.ac.uk/archi/archbrit.htm. There is a report of a giant squid being caught by fishermen from Aberdeen in 1971, but nothing more is known about this.

Until 2001 *Architeuthis* had not been seen alive by scientists, then fourteen young giant squid were captured in a fine net at a depth of 6 metres off New Zealand. They were about ten millimetres long and all died within a few days. While *Architeuthis* are rarely seen by man this does not necessarily mean that they are rare.

Few people have visited, studied, or fished in what is believed to be their normal habitat of the mesopelagic zone of the open ocean.

Characteristics of this squid

- Total length (Tip of fin to ends of arms, tentacles missing): 315cm (but the ends of the arms were abraded so the intact length would have been about 330 cm)
- Mantle length: 127 cm
- Tentacle length: Absent (would expect these to be about 400cm)
- Arm length: 167 cm
- Arm circumference (at base): 20 cm; 21 cm; 20 cm.
- Sucker cup diameter (max.): 13 mm; 15 mm; 15 mm
- Sucker cup diameter (min.) 10 mm; 9 mm; 8 mm.
- Head length: c. 60 cm
- Buccal mass diameter: 11 – 12 cm
- Lower beak length: 4 cm
- Upper beak length: 4.5 cm
- Left eye diameter: 80mm
- Left pupil diameter: 40mm
- Right eye diameter: 95 mm
- Right pupil diameter: 60 mm
- Girth: about 120 cm
- Weight (without tentacles): 53.2 kg
- Sex: female

From the above data it is estimated that the total length including the tentacles would have been over 5.5 metres and the total weight would have been around 60 kg.

The giant squid is the largest animal without a backbone known. They can grow to sixteen metres long and estimates of maximum weight vary between 300 and 1800 kilograms. Usually they are only three metres in the body with tentacles up to seven metres in length, but they do have the largest eye in the world, which can be 20 centimetres in diameter.

They feed on fish and smaller squid. They are preyed upon by sperm whales; many *Architeuthis* and other squid beaks have been recovered from whale stomachs, and the whale's skin may show scars from the toothed suckers of the squid. Malcolm Clarke estimated in 1977 that the then world population of sperm whales could be consuming 100 million tonnes of squid each year.

It is claimed that one day in October 1873 twelve year old Tom Piccot went out fishing with his father and another man in Conception Bay on the coast of Newfoundland, Canada. In the choppy waters they sighted what looked like a sail floating on the water. They went over and when they stuck a hook into it, it raised its head showing a large beak-like mouth and its massive tentacles. It wrapped its arms around their boat and started to drag it below the waves. They were sure that they were about to die. Young Tom seized a tomahawk in the boat and chopped off two of the tentacles. The squid let out an almighty squirt of ink and slipped away into the depths.
One of the tentacles cut off was nineteen feet long and it was sent to Dr Verrill at Harvard. This was the first specimen of *Architeuthis*, the giant squid, to be examined in a laboratory and the basis for the first description of *Architeuthis dux.*

Contrary to what most people think, specimens of *Architeuthis* are most likely to be found in cooler waters. More giant squid have been found washed up in Newfoundland than anywhere else in the world, with several in the 1870's, and again in the 1960's. They are also caught by the deep-water fisheries off New Zealand. Most giant squid in Europe have been found washed up on the coasts of Norway or Scotland. So little is known of their way of life that almost everything is disputed. Clarke (1966) suggested that they live in warm water and can be paralysed by cold water, while Brix (1983) thought that their respiratory pigment, haemocyanin, would be inefficient in warm water.

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The Porcupine Recording Scheme

Jon Moore
Ti Cara, Cosheston, Pembrokeshire, SA72 4UN (jon@ticara.co.uk)

The annual influx of 'by-the-wind-sailors' (*Velella velella*) was particularly spectacular this year, and made the local TV news in some areas. Between the end of May and the beginning of June there were records of millions of stranded *Vellela* from Bognor in Sussex to Cork in Ireland, including many parts of the Irish Sea, and a few reaching as far as the Isle of Cumbrae. The records are too numerous to describe in detail, but records from many sites on the south coast of England, the north coast of Cornwall, the south coast of Wales and the south coast of Anglesey

describe thick stinking strandlines of the blue coloured discs. Rafts of them have also been reported from offshore by canoeists and the research vessel Prince Madog. I have also received a report of spectacular strandings of *Velella* around Majorca and Menorca in the Mediterranean in May, and a search of the web found records of unusually large strandings of them in California this year; so it was not only a UK phenomenon. [Note: More UK records are also listed on the website of the British Marine Life Study Society.]

Of additional interest to the above, is the relatively few records of the violet snail *Janthina janthina*, which feeds on *Velella* and is often recorded from *Velella* strandings. On this occasion the only records I have seen come from Lin Baldock, who reports a specimen found by her sister Anne Baldock at Widemouth Sand in N. Cornwall at the end of June, and from Roger Herbert, who received two specimens a week earlier from sites on the south and north of the Isle of Wight. Apparently this doubles the total number of *Janthina* ever recorded from the Isle of Wight.

A further influx of hundreds of *Velella* at Studland in mid November was reported by Steve Trewhella.

A record of the colourful jewel anemone (*Corynactis viridis*) has been sent to me by Tom Mercer who is studying drop-down video from the Farne Islands, taken by SNH staff (Ben James and Graham Saunders). Although a long way outside the previously recorded range for the species and only recorded on video (including a 'few blurred close-ups'), the 'extensive sheets' of these distinctive anemones (22m, just beyond Longstone) could not really be anything else. Known primarily from exposed south and west coasts, the only other North Sea records are from Shetland – unless someone out there has any more (?).

Interesting records of anemones seem to be this year's thing. Anne Bunker found a cluster of 20 *Anthopleura thallia* at Broadhaven in Pembrokeshire in April, while Roger Herbert reports that a single specimen of the other *Anthopleura, A. ballii*, was found at Bembridge on the Isle of Wight in June. Last, but not least, Bernard Picton recorded a number of specimens of the rare burrowing anemone *Edwardsia timida*, in muddy shell gravel at 12m, during a survey of the Menai Strait in August. Interestingly, the species was recorded from Church Island in the 1930s, just 3km further up the Strait, but the only UK records from recent years have been from a few sites on the west coast of Scotland and in Strangford Lough.

Now for a few brief records of unusual fish. Sunfish were recorded in the Firth of Clyde and the Firth of Forth (near the Isle of May) this summer. Also from the Firth of Clyde, a record of Albacore (*Thunnus alalunga*). A boar fish (*Capros aper*) was found stranded at St Catherines Point on the Isle of Wight in June. A meagre (*Argyrosomus regius*) was caught in an otter trawl in the Solent in April. Finally, a specimen of a Flying Gurnard (*Dactylopterus volitans*) was caught in a scallop dredge at 70m off Newlyn, Cornwall, in September. The specimen is now at the National Marine Aquarium.

A 2m long specimen of the non-native Northwest Pacific kelp *Undaria pinnatifida* was recorded by Jenny Mallinson from the pontoon at the Southampton Oceanography Centre (SOC) in February. She harvested it to feed to Ormers in the SOC aquarium!

Thanks to: Lin Baldock, Roger Bamber, Anne Bunker, John Cross, Graham Etheridge, Frank Evans, Jason Hall-Spencer, Roger Herbert, Doug Herdson, Christine Howson, Jenny Mallinson, Tom Mercer, Bernard Picton, Ivor Rees, Denis Skilicorn, Keith Talbot, Steve Trewhella, Nick Weeks.

Porcupine Marine Natural History Society autumn field trip, Rhoscolyn, Anglesey, Wales. 21-22 Sept 2002

by Paul Brazier

Participants

Paul Brazier, Ivor Rees, Betty Green, Shelagh Smith, David Hurd, Natasha Lough, Ali Brunstrom, John Bratton, Hannah Brazier, Kathryn Baukham, Richard Birch

Introduction

Details of sites visited are given in Table 1 below. The Inland Sea, an enclosed sea with a tidal range restricted by culverts at the north and south ends, provided the group the opportunity to visit a second site, whilst the open coast was still at high water. Unfortunately, when the open coast is experiencing spring tides, the Inland Sea is experiencing perpetually high tides, with only a 1m tidal drop from the spring high tide mark. Both days proved bright and clear, with the saltmarsh and grasses steaming in the morning sun.

Table 1. Sites visited

Location name	OS grid Ref	Date and time	Low water
Inland Sea	SH 268 798	21.09.02 08:30 hrs	09:15
Aberffraw upper estuary	SH 356 690	21.09.02 14:30 hrs	17:00
Porth Cwyfan	SH 339 682	21.09.02 15:30 hrs	17:00
Inland Sea	SH 271 799	22.09.02 10:00 hrs	09:45
Trearddur Bay	SH 253 790	22.09.02 16:00 hrs	17:30

Inland Sea

The route to the shore of the Inland Sea led us past numerous lagoons of varying degrees of salinity, providing the opportunity to see different communities in each.The surrounding marsh, as part of a private nature reserve is ungrazed so there was no poaching, rapid drainage or disturbance. In the top of the saltmarsh, what could only best be described as smelling, muddy puddles, were home to dense swarms and shoals of flies and their respective larvae.Below this, you could see the marine influence by the way the Porcupine members huddled round to reach the water without daring to test the mud depth. Here were dense growths of green and blue green algae, the seagrass *Ruppia maritima* and very dense, though small lugworm *Arenicola marina* casts. The distraction of a more diverse pool quickly dragged the Porcupiners onwards to yet another muddy lagoon with a margin of *Spartina* sp. and *Zostera noltii* dominating the bottom of the lagoon. There were signs of molluscan life, with hydrobiids and empty *Mya arenaria* and *Abra tenuis* shells.

To reach the Inland Sea required crossing a bracken-swathed hillock before dropping back down to an eelgrass-laden beach. It was a surprise to find that the sea was still only in the *Fucus spiralis* zone, but maybe it would drop? Considerable amounts of narrow-leaved eelgrass *Zostera angustifolia* was washed up on the leeward side of the Sea, but much was still attached in the shallows (still at the mid shore level!). Here and in the lower saltmarsh pools, much netting, scooping, rummaging was achieved in order to find and collect specimens. This resulted in taking away clumps of washed up *Zostera* sp., *Codium* sp., and scoops of mud and shells for later observation.

On day 2, three people snorkeled from the same point, beyond Ynys Berlan to

a small rock that lies at the extreme low water mark (approximately 1m deep at the time). The sublittoral fringe was very interesting, with dense large *Codium fragile* plants, dense red algae and sparse broad fronded *Laminaria digitata*.

Aberffraw upper estuary
A small search was made around the cobbles, gravel and muddy gravel of the upper estuary (immediately below the road bridge). The surroundings consisted of mud stained, baked sea aster dominated saltmarsh with small creeks. Cobbles were covered with *Fucus ceranoides* and green algae, whilst specimens of gammarids and other crustacea were collected by Ivor from under and between cobbles. Stickleback, mud shrimp and juvenile flounder were spotted.

Table 2. Additional site visits by Shelagh Smith and David Hurd

Location name	Lat and Long	Date
Trearddur Bay	53°16.7'N 04°36.9'W	20 September 2002
Rhoscolyn	53°14.7'N 94°35.4'W	20 September 2002
Inland Sea	53°16.9'N 04°35.8'W (approx.)	21 September 2002
Aberffraw	53°11.1'N 04°30.0'W	21 September 2002
Red Wharf Bay	53°18.3'N 04°08.8'W	22 September 2002

Porth Cwyfan
The outstanding coastal walk from Aberffraw to Porth Cwyfan (Kevin's port!) took in beautiful views across to Snowdonia and a range of rocky and sandy habitats backed by patches of shingle vegetation or ungrazed scrub.

Porth Cwyfan is a very exciting shore to survey due to the combination of exposed and sheltered shores with areas of sand scour, deep ridges and extensive rockpools. The location of Cwyfan chapel on a rock in the middle of the bay enhances the beauty of the bay.

Shelagh was seen striding to the corners of the shore, gathering intently from an assortment of habitats, before eagerly returning to the upper shore, looking as though she had swum for some of the samples, "I fell in!" was the response to questions! A thorough, though not complete species list was collected for Porth Cwyfan, with a much more detailed list of mollusc species provided by Shelagh. Ivor pointed out a lush growth of *Cystoseira tamariscifolia*, considered the most northerly record in Britain to date. General species recording was completed in the *Fucus vesiculosus* and *Fucus serratus* zones.

Trearddur Bay
A ramble just west of the lifeboat station proved interesting, amongst boulders and cobbles. A comprehensive species list was not prepared, but a couple of notable species are:

- Presence of *Osilinus* (=*Monodonta*) *lineata* on the upper shore, marking a known northern limit in Wales for this species, which has recovered from the species retreat southwards after the cold winter of 1963.
- Strand weed of *Asparagopsis armata*, a very distinct pink-coloured red alga with barbed hooks. This is a non-native species only sparsely recorded in north Wales.

Table 3. Inland Sea species records

Habitat	MCS Code (old)	Species name	Abundance	Comment / common name
Sm pools	P15760	*Arenicola marina*	A	Lugworm
	S10270	*Corophium volutator*	-	Mud shrimp
	S22150	*Palaemonetes varians*	-	
	S01270	*Neomysis integer*	-	Mysid
	?	*Sphaeroma rugicauda*	-	Isopod
	S07710	*Gammarus duebeni*	-	
	S07690	*Gammarus chevreuxi*	-	
	-	*Cymbiodyta marginella*	-	Water beetle
	-	*Ceryon sternalis*	-	Water beetle
	-	*Stenus cicindeloides*	-	Rove beetle
	-	*Chartoscirta cincta*	-	Bug
	W02740	*Hydrobia ulvae*	C?	Mud snail
	ZX00040	*Zostera noltei*	C	Dwarf eelgrass
	ZS02110	*Enteromorpha* spp.		Gut weed
***Zostera* bed**	D11580	*Anemonia viridis*	A	Snakelocks anemone on *Zostera angustifolia*
	D05850	*Kirchenpaueria pinnata*	R	On old *Zostera angustifolia* and *Chorda filum*
	P15760	*Arenicola marina*	F	Lugworm
	W02310	*Tricolia pullus*	R	Pheasant Shell
	W02500	*Littorina littorea*	R	Edible winkle
	W12720	*Doto* sp.	R	Single specimen on *Zostera* leaf
	W20670	*Macoma balthica*	O?	Baltic tellin
	W21060	*Abra tenuis*	F?	??
	ZG03430	*Gasterosteus aculeatus*	O	Three-spined stickleback, individuals and a small shoal
	ZX00030	*Zostera angustifolia*	A	Narrow leaved eelgrass
	ZM08070	*Ceramium* sp.	O	Red filamentous alga
	ZS03330	*Chaetomorpha melagonium*	O	
	ZS03300	*Chaetomorpha ??*	C	
	ZS02110	*Enteromorpha* spp.	C	Gut weed
Sublittoral fringe	D11580	*Anemonia viridis*	C	Snakelocks anemone
	D12370	*Cereus pedunculatus*	O	Daisy anemone
	P15760	*Arenicola marina*	O	Lugworm
	ZD01410	*Ascidiella aspersa*	F	Sea squirt
	ZG07400	*Pomatoschistus* sp.	O	Probably painted goby, but unconfirmed
	ZM08070	*Ceramium* sp.	F	Red filamentous alga
	ZM11010	*Polysiphonia* sp.	F	Red filamentous alga
	ZM03840	*Corallinaceae* spp.	C	Pink encrusting algae
	ZM06050	*Mastocarpus stellatus*	C	Carrageen
	ZM06110	*Chondrus crispus*	A	Carrageen
	ZR06740	*Fucus serratus*	F	Serrated wrack
	ZR06320	*Laminaria digitata*	F	Kelp
	ZR06250	*Chorda filum*	F	Bootlace weed
	ZS04200	*Codium fragile subsp. atlanticum*	C	
	ZS03330	*Chaetomorpha melagonium*	F	

Table 3. Inland Sea species records (contd)

Upper shore	W02640	*Littorina obtusata/mariae*	O	Flat winkle
	W02600	*Littorina saxatilis*	F	Rough winkle
	W02520	*Melarhaphe neritiodes*	O	Smooth winkle
	W02740	*Hydrobia ulvae*	-	Mud snail
	R01200	*Elminius modestus*	O	Australian barnacle
	R01080	*Semibalanus balanoides*	O	Acorn barnacle
	ZR06750	*Fucus spiralis*	F	Spiral wrack
	ZR06810	*Pelvetia canaliculata*	O	Channel wrack
	ZY00360	*Verrucaria maura*		Black tar lichen

Table 4. Aberffraw species records

Habitat	**MCS Code (old)**	**Species name**	**Abundance**	**Comment / common name**
Estuarine creek	S14480	*Sphaeroma* sp.	-	-
	S23310	*Crangon crangon*	-	Mud shrimp
	ZG07400	*Pomatoschistus* sp.	-	Goby
	S07590	Gammarids		Gammarid shrimps
	ZG00120	*Anguilla anguilla*		Common eel
	ZG03430	*Gasterosteus aculeatus*	R	Three-spined stickleback
	ZG08990	*Platichthys flesus*	R	Juvenile flounder
	ZR06690	*Fucus ceranoides*	O	Horn wrack
	ZS02110	*Enteromorpha* spp.	F	Gut weed

Table 5. Porth Cwyfan species records

Habitat	**MCS Code (old)**	**Species name**	**Comment / common name**
General species list	ZR06750	*Fucus spiralis*	Spiral wrack
	ZR06690	*Fucus ceranoides*	Horn wrack
	ZR06640	*Ascophyllum nodosum*	Knotted wrack
	ZR06810	*Pelvetia canaliculata*	Channel wrack
	ZS02110	*Enteromorpha* sp.	Gut weed
	ZM11150	*Polysiphonia lanosa*	Red filamentous alga
	ZM11050	*Polysiphonia elongata*	Red filamentous alga
	ZS03560	*Cladophora rupestris*	Green alga
	ZS02400	*Ulva* sp.	Sea lettuce
	ZM06310	*Plocamium cartilagineum*	Comb alga
	ZM02560	*Dilsea carnosa*	

***Fucus vesiculosus* zone**	C05230	*Hymeniacidon perleve*	
	C08650	*Haliclona viscosa*	
	D11580	*Anemonia viridis*	Snakelocks anemone
	D11690	*Urticina eques*	Dahlia anemone
	P00970	*Harmothoe* sp.	Scaleworm
	P15760	*Arenicola marina*	Lugworm
	P23550	*Spirorbidae* indet	Spiral keel worm
	S07590	*Gammaridae* indet.	Gammarid shrimp
	S21690	CARIDEA	Prawn/Shrimp
	S24650	*Pagurus bernhardus*	hermit crab
	W00740	*Lepidochitona cinerea*	Chiton
	W01340	*Patella vulgata*	Common limpet
	W01930	*Gibbula cineraria*	Grey topshell
	W01950	*Gibbula umbilicalis*	Purple topshell
	W02500	*Littorina littorea*	Edible winkle
	W02640	*Littorina obtusata/mariae*	Flat winkle
	W02770	*Rissoidae* indet	Rissoid snail
	W08170	*Nucella lapillus*	Dogwhelk
	W08440	*Buccinum undatum*	Common whelk
	W09530	OPISTHOBRANCHIA	Sea slug
	Y08880	*Bryozoa* indet crusts	Encrusting bryozoans
	ZB02780	*Ophiopholis aculeata*	Brittlestar
	ZD00010	ASCIDIACEA	Seasquirt
	ZD02090	*Botryllus schlosseri*	Star ascidian
	ZM00010	***RHODOPHYCOTA***	Red algae
	ZM03790	*Hildenbrandia rubra*	Red encrusting alga
	ZM03840	*Corallinaceae* indet	Pink encrusting algae
	ZM04040	*Corallina officinalis*	Coral weed
	ZM06110	**Chondrus crispus**	Carrageen
	ZM11150	*Polysiphonia lanosa*	
	ZR02810	*Leathesia difformis*	
	ZR04570	*Dictyota dichotoma*	
	ZR07160	*Halidrys siliquosa*	Sea oak
	ZS03560	*Cladophora rupestris*	
	ZY00350	*Verrucaria* sp.	Black tar lichen

***Fucus serratus* zone**	C04840	*Halichondria panicea*	Bread crumb sponge
	C05230	*Hymeniacidon perleve*	
	D00160	*Haliclystus* sp.	Stalked jellyfish
	D11580	*Anemonia viridis*	snakelocks anemone
	P15760	*Arenicola marina*	Lugworm
	P23040	*Pomatoceros triqueter*	Keel worm
	R00640	*Verruca stroemia*	Barnacle
	S25020	*Pisidia longicornis*	Long clawed porcelain crab
	S25070	*Porcellana platycheles*	Flat clawed porcelain crab
	S25850	*Macropodia rostrata*	long-legged spider crab
	S26900	*Carcinus maenas*	Shore crab
	W01340	*Patella vulgata*	Common limpet
	W08170	*Nucella lapillus*	Dogwhelk
	W08890	*Hinia reticulata*	Netted whelk
	Y08880	*Bryozoa* indet crusts	Encrusting bryozoans
	ZB02350	*Ophiothrix fragilis*	Brittlestar
	ZD00060	*Clavelina lepadiformis*	Light bulb seasquirt
	ZD02140	*Botrylloides leachi*	Colonial ascidian
	ZM02660	*Dumontia contorta*	
	ZM06050	*Mastocarpus stellatus*	Carrageen
	ZM06110	*Chondrus crispus*	Carrageen
	ZM06160	*Chondracanthus acicularis*	
	ZM06250	*Polyides rotundus*	
	ZM07650	*Antithamnion* sp.	
	ZM08070	*Ceramium* spp.	
	ZM10795	*Osmundea osmunda*	Pepper dulse
	ZM10800	*Osmundea pinnatifida*	Pepper dulse
	ZM11010	*Polysiphonia* spp.	
	ZR00290	*Ectocarpus* sp.	
	ZR02810	*Leathesia difformis*	
	ZR03900	*Aglaozonia*	(Asexual Cutleria)
	ZR04570	*Dictyota dichotoma*	
	ZR06180	*Scytosiphon lomentaria*	
	ZR06250	*Chorda filum*	Bootlace weed
	ZR06740	*Fucus serratus*	Serrated wrack
	ZR07110	*Cystoseira tamariscifolia*	
	ZS02400	*Ulva* sp.	Sea lettuce
	ZS03380	*Cladophora* sp.	
	ZS03560	*Cladophora rupestris*	
	ZY00380	*Verrucaria mucosa*	Black tar lichen

Table 6. Species lists from Shelagh Smith and David Hurd
Anglesey: Trearddur Bay, 53°16.7'N 04°36.9'W, 20 September 2002
Shell sand only (dead shells) collected on poor tide. Sandy bay with rocks at the side and middle. Calm sunny weather.

Gibbula cineraria (L., 1758)
Gibbula umbilicalis (da Costa, 1778)
Dikoleps pusilla (Jeffreys, 1847)
Tricolia pullus (L., 1758)
Patella pellucida (L., 1758)
Patella vulgata L., 1758
Littorina littorea (L., 1758)
Littorina compressa Jeffreys, 1865
Littorina fabalis Turton, 1825
Littorina obtusata (L., 1758)
Littorina saxatilis (Olivi, 1792)
Littorina saxatilis var. *neglecta* Bean in Thorpe, 1844
Melarhaphe neritoides (L., 1758)
Skeneopsis planorbis (O Fabricius, 1780)
Eatonina fulgida (J Adams, 1797)
Rissoa interrupta (J Adams, 1800)
Rissoa parva (da Costa, 1778)
Cingula cingillus ((Montagu, 1803)
Manzonia crassa (Kanmacher in G Adams, 1798)
Onoba aculeus (Gould, 1841)
Onoba semicostata (Montagu, 1803)
Pusillina inconspicua (Alder, 1844)
Hydrobia ulvae (Pennant, 1777)
Trivia arctica (Pulteney, 1799)
Trivia monacha (da Costa, 1778)
Ocenebra erinacea (L., 1758)
Nucella lapillus (L., 1758)
Odostomia plicata (Montagu, 1803)
Odostomia turrita (Hanley, 1844
Odostomia unidentata (Montagu, 1803)
Brachystomia carrozzai (Aartsen, 1987)
Brachystomia eulimoides (Hanley, 1844)
Chrysallida indistincta (Montagu, 1808)
Ondina divisa (J Adams, 1797)
Partulida pellucida (Dillwyn, 1817)
Turbonilla acuta (Donovan, 1804)
Mytilus edulis L., 1758
Musculus costulatus (Risso, 1826)
Musculus discors (L., 1767)
Aequipecten opercularis (L., 1758)
Chlamys distorta (da Costa, 1778)
Lucinoma borealis (L., 1758)
Lasaea adansoni (Gmelin, 1791)
Mysella bidentata (Montagu, 1803)
Goodallia triangularis (Montagu, 1803)
Gari fervensis (Gmelin, 1791)
Arctica islandica (L., 1767)
Gouldia minima (Montagu, 1803)
Venerupis senegalensis (Gmelin, 1791)
Turtonia minuta (O Fabricius, 1780)
Mya truncata L., 1758
Hiatella arctica (L., 1758)

Table 7. Species lists from Shelagh M Smith and David Hurd
Anglesey: Rhoscolyn, 53°14.7'N 94°35.4'W, 20 September 2002,
Sandy bay facing south, partly sheltered. Cliffs on the east side and lower rocks on the west side, with boulders and weed cover. Short investigation, many species from weed washings. Calm sunny weather.

Live
Gibbula cineraria (L., 1758)
Gibbula umbilicalis (da Costa, 1778)
Patella pellucida (L., 1758)
Patella ulyssyponensis Gmelin, 1791
Patella vulgata L., 1758
Lacuna pallidula (da Costa, 1778)
Lacuna vincta (Montagu, 1803)
Littorina littorea (L., 1758)
Littorina fabalis Turton, 1825
Littorina obtusata (L., 1758)
Littorina saxatilis (Olivi, 1792)
Melarhaphe neritoides (L., 1758)
Rissoa interrupta (J Adams. 1800)
Rissoa parva (da Costa, 1778)
Onoba aculeus (Gould, 1841)
Onoba semicostata (Montagu, 1803)
Pusillina inconspicua (Alder, 1844)
Hydrobia ulvae (Pennant, 1777)
Nucella lapillus (L., 1758)
Buccinum undatum L., 1758
Runcina coronata (Quadrefages, 1844)
Mytilus edulis L., 1758
Modiolarca tumida (Hanley, 1843)
Lasaea adansoni (Gmelin, 1791)
Mysella bidentata (Montagu, 1803)
Cerastoderma edule (L., 1758)
Macoma balthica (L., 1758)

Dead shells

Lacuna parva (da Costa, 1778)
Littorina saxatilis var. *neglecta* Bean in Thorpe, 1844
Ocenebra erinacea (L., 1758)
Hinia reticulata (L., 1758)
Heteranomia squamula (L., 1758)
Chlamys distorta (da Costa, 1778)
Lucinoma borealis (L., 1758)
Donax vittatus (da Costa, 1778)
Chamelea gallina (L., 1758)
Venerupis senegalensis (Gmelin, 1791)
Turtonia minuta (O Fabricius, 1780)
Hiatella arctica (L., 1758)

Table 8. Species lists from Shelagh M Smith and David Hurd
Anglesey: Inland Sea, 53°16.9'N 04°35.8'W (approx.), 21 September 2002

Enclosed shallow water, brackish in part, poor tide. Muddy sand with *Zostera*, a few boulders. Calm sunny weather. Note that *Hydrobia ulvae* uncommon, only four found, while *Ventrosia ventros*a (30) and *Potamopyrgus antipodarum* (41) both common, indicating low salinity. Identification from live specimens.

Gibbula cineraria (L., 1758) (dead)
Littorina littorea (L., 1758)
Littorina saxatilis (Olivi, 1792)
Littorina saxatilis var. *tenebrosa* (Montagu, 1803)
Hydrobia ulvae (Pennant, 1777)
Ventrosia ventrosa (Montagu, 1803)
Potamopyrgus antipodarum (J E Gray, 1843)
Ovatella myosotis (Draparnaud, 1801)
Mytilus edulis L., 1758) (dead)
Cerastoderma edule (L., 1758) (dead)
Abra tenuis (Montagu, 1803)
Mya arenaria L., 1758 (dead)

Table 9. Species lists from Shelagh Smith and David Hurd
Anglesey: Aberffraw, 53°11.1'N 04°30.0'W, 21 September 2002
Open shore with irregular rocks provides some shelter. Pools. Much weed cover. Calm sunny weather. All **live** species.

Lepidochitona cinerea (L., 1767)
Acanthochitona crinita (Pennant, 1777)
Gibbula cineraria (L., 1758)
Gibbula umbilicalis (da Costa, 1778)
Osilinus lineatus (da Costa, 1778)
Tricolia pullus (L., 1758)
Patella pellucida (L., 1758)
Patella ulyssyponensis Gmelin, 1791
Patella vulgata L., 1758
Lacuna pallidula (da Costa, 1778)
Lacuna vincta (Montagu, 1803)
Littorina littorea (L., 1758)
Littorina compressa Jeffreys, 1865
Littorina fabalis Turton, 1825
Littorina obtusata (L., 1758)
Littorina saxatilis (Olivi, 1792)
Rissoa interrupta (J Adams, 1800)
Rissoa parva (da Costa, 1778)
Onoba aculeus (Gould, 1841)
Onoba semicostata (Montagu, 1803)
Pusillina inconspicua (Alder, 1844)
Hydrobia ulvae (Pennant, 1777)
Nucella lapillus (L., 1758)
Buccinum undatum L., 1758
Hinia reticulata (L., 1758)
Berthella plumula (Montagu, 1803)
Mytilus edulis L., 1758
Heteranomia squamula (L., 1758)
Lasaea adansoni (Gmelin, 1791)
Mysella bidentata (Montagu, 1803)
Cerastoderma edule (L., 1758)
Venerupis senegalensis (Gmelin, 1791)

Table 10. Species lists from Shelagh Smith and David Hurd
Anglesey: Red Wharf Bay, 53°18.3'N 04°08.8'W, 22 September 2002,
Large sandy bay with boulder beach at top. Shell sand and large dead shells only collected. Sand fairly worn with not as many species cast up live as expected. Valves of species such as *Fabulina fabula* and *Donax vittatus* sorted with preference for one valve (not counted) indicating hydrodynamic drift. *Ervilia castanea* not on my list for the area. This is a southern species.

Leptochiton asellus (Gmelin, 1791)
Calliostoma zizyphinum (L., 1758)

Tricolia pullus (L., 1758)
Patella vulgata L., 1758
Retusa truncatula (Bruguière, 1792)
Nucula nitidosa Winckworth, 1930 juveniles (live cast-up)
Nucula sulcata Bronn, 1831
Mytilus edulis L., 1758 juveniles (live, cast-up)

Turritella communis Risso, 1826

Lacuna pallidula (da Costa, 1778)
Lacuna vincta (Montagu, 1803)
Littorina littorea (L., 1758)
Littorina fabula Turton, 1825
Littorina obtusata (L., 1758)
Littorina saxatilis (Olivi, 1792)
Littorina saxatilis var. *neglecta* Bean in Thorpe, 1844
Skeneopsis planorbis (O Fabricius, 1780)
Rissoa interrupta (J Adams, 1809)
Rissoa parva (da Costa, 1778)
Onoba aculeus (Gould, 1841)
Onoba semicostata (Montagu, 1803)
Pusillina inconspicua (Alder, 1844)
Hydrobia ulvae (Pennant, 1777) (live, cast-up)
Potamopyrgus antipodarum (J E Gray, 1843) (live, cast-up)
Hyala vitrea (Montagu, 1803)
Tornus subcarinatus (Montagu, 1803)
Polinices montagui (Forbes, 1838)
Euspira catena (da Costa, 1778)
Ocenebra erinacea (L., 1758)
Nucella lapillus (L., 1758)
Buccinum undatum L., 1758
Colus jeffreysianus (P Fischer, 1868)
Neptunea antiqua (L., 1758)
Hinia reticulata (L., 1758)
Mangelia nebula (Montagu, 1803)

Oenopota rufa (Montagu, 1803)
Oenopota turricula (Montagu, 1803)
Odostomia plicata (Montagu, 1803)
Odostomia turrita Hanley, 1844
Odostomia unidentata (Montagu, 1803)
Brachystomia eulimoides (Hanley, 1844)
Brachystomia scalaris (Macgillvray, 1843)
Chrysallida indistincta (Montagu, 1808)
Chrysallida interstincta (J Adams, 1797)
Partulida pellucida (Dillwyn, 1817)

Turbonilla lactea (L., 1758)
Turbonilla acuta (Donovan, 1804)
Eulimella laevis (Brown, 1827)
Acteon tornatilis (L., 1758)
Philine aperta (L., 1767)
Diaphana minuta Brown, 1827
Retusa obtusa (Montagu, 1803)

Modiolus modiolus (L., 1758) juveniles (live, cast-up)
Ostrea edulis L., 1758
Crassostrea gigas (Thunberg, 1793)
Aequipecten opercularis (L., 1758)
Chlamys distorta (da Costa, 1778)
Heteranomia squamula (L., 1758)
Thyasira flexuosa (Montagu, 1803)
Lasaea adansoni (Gmelin, 1791) (live, cast-up)
Tellimya ferruginosa (Montagu, 1803)
Mysella bidentata (Montagu, 1803) (live, cast-up)
Acanthocardia echinata (L., 1758)
Cerastoderma edule (L., 1758)
Mactra stultorum (L., 1758)
Spisula elliptica (Brown, 1827)
Spisula solida (L., 1758) juveniles (live, cast-up)
Spisula subtruncata (da Costa, 1778) (large dead shells & juveniles live, cast-up)
Lutraria lutraria (L., 1758)
Ensis arcuatus (Jeffreys, 1865)
Ensis ensis (L., 1758)
Ensis siliqua (L., 1758)
Pharus legumen (L., 1758)
Phaxas pellucidus (Pennant, 1777)
Angulus tenuis (da Costa, 1778) (live, cast-up)
Fabulina fabula (Gmelin, 1791) (live, cast-up)
Moerella pygmaea (Lovén, 1846)
Macoma balthica (L., 1758)
Donax vittatus (da Costa, 1778) juveniles (live cast-up)
Gari fervensis (Gmelin, 1791)
Abra alba (W Wood, 1802)
Abra nitida (Müller, 1776)
Abra prismatica (Montagu, 1808)
Ervilia castanea (Montagu, 1803)
Arctica islandica (L., 1767)
Chamelea gallina (L., 1758)
Timoclea ovata (Pennant, 1777)
Tapes rhomboides (Pennant, 1777)
Venerupis senegalensis (Gmelin, 1791) juveniles (live, cast-up)
Dosinia lupinus (L., 1758)
Mya truncata L., 1758
Corbula gibba (Olivi, 1792)
Hiatella arctica (L., 1758)
Thracia convexa (W Wood, 1815) fragments
Thracia phaseolina (Lamarck, 1818)
Thracia villosiuscula (Macgillvray, 1827)

' PORCUPINE 2002. CHANGES IN MARINE BIOLOGY OVER THE LAST 25 YEARS

Papers from the PMNHS meeting held at the National Museums of Scotland, Edinburgh from 14th – 16th March 2002

Broad scale mapping in the Forth: The Firth of Forth Spatial Project

Dr Richard Park
Senior Marine Biologist, SEPA, Clearwater House, Heriot Watt Research Park, Avenue North, Riccarton, Edinburgh EH14 4AP. Richard.Park@SEPA.org.uk

Abstract only
The Firth of Forth Spatial Study (FFSS) aims to review the current status of soft sediment benthos in the Forth. This short presentation will describe the collaborative interest and roles of National Museums of Scotland, Heriot-Watt University, Scottish Natural Heritage and Scottish Environment Protection Agency in the FFSS and briefly discuss the relevance of this review to the Urban WWTD and Water Framework Directive. The presentation will include examples of broad scale mapping of sediment type and benthic habitats within the inner firth.

Monitoring the Sublittoral at the Sullom Voe Oil Terminal: Data from the 1990's.

Trevor Baker
BMT Cordah Ltd, Doherty Building, Pentlands Science Park, Penicuik, nr Edinburgh, EH45 9LD.
T.baker@cordah.co.uk

Introduction
The construction of the oil terminal at Sullom Voe, Shetland Islands (Figure 1) was initiated in 1976, the same year that environmental monitoring commenced. Throughout the operational life of the terminal an integrated monitoring programme has been underway, including assessments of the saltmarsh areas (SOTEAG pers. comm.), the rocky shores most recently reported in 2001 (Fortune and Moore 2001), the dog whelk populations since the impact of imposex was detected (Fortune et al 2001), the terminal outfall surveys (I.Dixon pers comm.) and the subject of this brief report, the chemical and macrobenthic monitoring progamme.
The data from the early part of the monitoring programme were reported by May and Pearson (1994). While this paper, looks not to repeat this work but rather merely bring to the attention of interested parties some of the data from the previous decade and 2000. This paper does not aspire to provide an in depth analysis but will hopefully increase general appreciation of the Sullom Voe sublittoral environment and its fauna.

Outline methodology

Over the lifetime of the survey, the methodology has been varied on a number occasions. Not least with respect to the number of sample stations, the number of replicate samples from each station for both macrofaunal and hydrocarbons, the parameters measured and the analytical methods used. Because of these changes, the reasons for which are outwith the scope of this paper, I have focussed on the data from the last 10 years which represent six of the eighteen surveys carried out to date.

In essence the chemical and macrobenthic monitoring programme consists of a biennial survey of 25 subtidal stations (21 only reported here, Figure 2) from which three replicate 0.1m^2 macrobenthic samples, sieved over a 1.0mm mesh, are collected in conjunction with additional samples for sediment particle characterisation and hydrocarbon analysis (three replicates combined). Alternate surveys include samples for major and trace element analysis. The surveys are carried out between late June and early July.

Sedimentary environment

The stations are located at a depth of less than 30m and sediments range from fine mud to coarse sands. Typically they are poorly sorted sediments, particularly in the main body of study area (station 5 – 11, 17-34). Table 1 gives these parameters from the 2000 survey (Barfield, Baker and Jackson, 2000). The mud content at selected stations (Figure 3) is indicative of both the spatial and the temporal variation in sediment character that has been recorded since 1990. Evidently, the outer Voe and Yell sound stations support a sandier substrate than more sheltered locations within the voe proper, and especially at its head at Station 1 (Figure 3). No consistent pattern in temporal variation is immediately apparent.

The hydrocarbon content of the sediments is widely variable with highest values occurring at Stations 1 and 6 and lowest in the coarsest sediments at stations 12 and 35 (Table 2, Figure 4). Temporal fluctuations during the 1990's indicate, across the whole survey area, a reduction in concentration from 1992 to 1996 and a near equal and opposite from then up to and including 2000. This trend does not shadow the recorded mud content of the sediment as it changes over the years (Figure 3). However, no comparison has yet been made between the clay component of the sediment and the hydrocarbon content. A correlation that may remain masked by proportional changes between slit and clay within the "mud" category (particle diameter less than 63µm).

The unresolved complex mixture, an approximate indicator of the petrogenic component, has typically remained as approximately 60 to 70% of the aliphatic concentration at most stations. At Station 1 the proportion is lower, 50 to 65%, as the terrigenous component of the sediment is far greater than elsewhere i.e. there is a lot of peat in the samples (Figure 5).

Macrofauna

Of the macrobenthic infauna, a list of those taxa represented by at least 10 individuals from the 2000 survey is given below (Table 3). Table 4 briefly summarises the number of taxa from each of the preceding five surveys and a total species count for the monitoring programme as a whole. This gives a clear indication of the species abundance in the survey area as a whole, particularly when considering the total species count for the life of the survey programme. Diversity, as addressed by the Shannon-Weiner diversity index (Figure 6), is with only one or two exceptions (Station 1 being

Table 1 Physical parameters of sediments. Sullom Voe Chemical and Macrobenthic Monitoring *Survey, June 2000.*

Station	Primary mode phi	Phi mean	Phi Skewness	Phi kurtosis	% mud	% gravel	% organic matter	*Folk classification*
Inner basin and southern Sullom Voe								
1	5.5	5.5	0.1	1.1	86.3	0.0	23.6	slightly sandy mud
3	4.0	3.7	-0.2	0.1	52.1	4.2	5.9	slightly gravelly sandy mud
4	-1.0	2.2	0.2	0.8	32.8	9.7	6.9	gravelly muddy sand
5	4.0	2.8	0.0	1.0	35.6	2.0	3.9	muddy sand
Main loading jetty area and west of Calback Ness								
7	4.0	4.7	0.8	1.6	64.8	4.1	8.8	slightly gravelly sandy mud
8	3.0	2.5	0.0	1.1	26.9	2.3	3.6	muddy sand
8A	4.0	3.7	-0.2	1.5	45.0	6.4	3.8	slightly gravelly muddy sand
9	4.0	3.3	0.0	1.0	47.3	2.2	2.5	muddy sand
10	4.0	4.2	0.2	1.3	56.8	2.3	2.7	sandy mud
11	4.0	4.2	0.1	1.9	58.8	2.1	3.5	sandy mud
17	3.5	3.5	0.2	1.3	41.4	0.6	2.6	muddy sand
Yell Sound and north of Calback Ness								
12	3.0	2.0	-0.4	0.9	10.0	0.7	0.4	slightly muddy sand
33	3.5	3.7	0.3	1.9	40.4	3.4	3.0	muddy sand
34	3.5	3.7	0.5	1.4	45.6	0.4	2.5	muddy sand
35	2.5	0.7	-0.1	0.8	4.6	7.1	1.1	sand
36	0.5	0.7	0.3	0.6	2.6	2.9	6.9	sand
37	-1.5	-4.5	0.2	0.8	0.2	25.7	3.6	gravelly sand
Garths Voe								
6	1.5	1.8	0.2	1.1	20.8	5.2	6.1	slightly gravelly muddy sand
6A	3.5	2.0	0.1	0.9	21.9	2.4	3.7	muddy sand
6F	4.0	4.5	0.0	1.1	66.8	0.3	14.4	sandy mud
32	3.5	4.3	0.4	1.1	64.2	1.4	9.6	sandy mud

the foremost exception) characteristically high. Typically values for the main body of Sullom Voe have ranged from 4.5 to 5.5, whilst the outer Voe and Yell Sound stations have rarely fallen below 5. The Garth's Voe stations and also, but to a lesser extent, Station 7 have been lower than the remainder. There are no self-apparent trends in diversity across the study area as a whole, with declines and rises occurring in different years at different stations. Whilst some, such as Station 12, show negligible variation throughout the ten years under observation.

Table 2 Hydrocarbon content data. Sullom Voe chemical and macrobenthic monitoring survey.

	GC aliphatics ug/g					UCM (ug/g)					
No.	1992	1994	1996	1998	2000	1990	1992	1994	1996	1998	2000
1	270	290	150	240	310	372	150	150	74	140	180
3	100	56	37	40	70	290	60	29	19	25	41
4	63	43	35	54	55	74	40	25	19	35	32
5	70	36	22	38	56	172	50	21	12	25	35
7	120	85	39	66	110	77	78	47	16	39	62
8	43	25	8.7	18	25	32	34	16	5.3	12	16
8a	44	20	9.7	20	23	87	36	11	6.4	14	15
9	62	26	11	27	27	46	49	16	7	18	17
10	45	34	11	25	41	120	35	21	4.8	15	26
11	42	22	7.9	16	35	53	34	16	6.6	10	24
17	30	19	30	18	37	53	23	12	18	11	25
12	8.9	4.9	4.4	2.7	10	73	6.6	3.6	3.1	2.1	8.6
33	12	11	11	7.8	10	76	8.5	7.2	6.4	5.1	6.2
34	13	12	12	6.8	7.3	46	9.8	8.1	5.6	4.8	4.8
35	2.8	2.5	2.2	1.1	1.4	7	2.4	1.7	1.5	0.83	0.99
36	4.1	3.5	3.1	2.6	3	5	3.6	2.4	2.4	2.2	2.3
37	4.2	3.1	1.8	3.7	2.6	8	3.5	2.5	1.4	3	1.9
6	110	8.1	7.5	230	40	25	52	4	3.2	68	16
6a	170	99	45	54	96	18	80	37	9.4	24	38
6f	190	170	86	160	170	173	120	120	29	67	73
32	260	140	140	95	180	243	160	58	38	41	83

Table 3 Macrobenthic species present in total abundances in excess of ten individuals. Sullom Voe Chemical and Macrobenthic Monitoring Survey, June 2000

Anthozoa			P	1264	Chone spp. indet.
D	583	Anthozoa indet.	P	1267	Chone duneri Malmgren, 1867
D	618	Virgularia mirabilis (O. F. Muller, 1776)	P	1269	Chone filicaudata Southern, 1914
D	766	Edwardsia sp. SV84.#14	P	1270	Chone infundibuliformis Kroyer, 1856
Platyhelminthes			P	1278	Euchone analis (Kroyer, 1856)
F	2	Turbellaria indet.	P	1289	Jasmineira caudata Langerhans, 1880
Nemertea			P	1334	Hydroides norvegica Gunnerus, 1768
G	0	Nemertea indet.	P	1341	Pomatoceros triqueter (L., 1758)
G	35	Tubulanus superbus (Kolliker, 1845)	P	1490	Tubificoides benedii (d'Udekem, 1855)
G	39	Cerebratulus spp. indet.	**Crustaceans**		
Priapulida			R	2426	Cylindroleberis mariae (Baird, 1850)
J	7	Priapulus caudatus Lamarck, 1816	S	140	Westwoodilla caecula (Bate, 1856)
Sipuncula			S	177	Leucothoe incisa Robertson, 1892
N	17	Golfingia vulgaris (de Blainville, 1827)	S	248	Urothoe elegans (Bate, 1856)
N	34	Phascolion strombus	S	249	Urothoe marina (Bate, 1857)

		(Montagu, 1804)			
N	47	Aspidosiphon muelleri Diesing, 1851	S	257	Harpinia pectinata G. O. Sars, 1891
Annelids			S	413	Atylus vedlomensis (Bate & Westwood, 1862)
P	15	Pisione remota (Southern, 1914)	S	429	Ampelisca diadema (A. Costa, 1853)
P	50	Harmothoe spp. indet.	S	440	Ampelisca tenuicornis Liljeborg, 1855
P	82	Lepidonotus squamatus (L., 1758)	S	588	Leptocheirus hirsutimanus (Bate, 1862)
P	92	Pholoe inornata Johnston, 1839	S	651	Pariambus typicus (Kroyer, 1845)
P	118	Eteone longa (Fabricius, 1780)	S	657	Phtisica marina Slabber, 1769
P	124	Hypereteone foliosa (Quatrefages, 1866)	S	1142	Tanaopsis graciloides (Liljeborg, 1864)
P	167	Eumida sanguinea (Oersted, 1843)	S	1201	Iphinoe serrata Norman, 1867
P	255	Glycera spp. indet. [juv.]	S	1472	Galathea intermedia Liljeborg, 1851
P	256	Glycera alba (O. F. Muller, 1776)	**Molluscs**		
P	260	Glycera lapidum Quatrefages, 1866	W	53	Leptochiton asellus (Gmelin, 1791)
P	268	Glycinde nordmanni (Malmgren, 1866)	W	224	Tectura virginea (O. F. Muller, 1776)
P	271	Goniada maculata Oersted, 1843	W	270	Turritella communis Risso,1826
P	305	Kefersteinia cirrata (Keferstein, 1862)	W	1028	Cylichna cylindracea (Pennant, 1777)
P	313	Ophiodromus flexuosus (Chiaje,1827)	W	1319	Onchidoridídae sp. SV92.#145
P	349	Ehlersia cornuta (Rathke, 1843)	W	1569	Nucula nitidosa Winckworth, 1930
P	365	Typosyllis armillaris (O. F. Muller, 1771)	W	1702	Modiolus modiolus (L., 1758) [juv.]
P	380	Eusyllis blomstrandi Malmgren, 1867	W	1718	Modiolarca tumida (Hanley, 1843)
P	421	Exogone hebes (Webster & Benedict, 1884)	W	1807	Anomia ephippium L., 1758
P	484	Platynereis dumerilii (Audouin & Milne-Edwards, 1833)	W	1827	Myrtea spinifera (Montagu, 1803)
P	494	Nephtys spp. indet. [juv.]	W	1829	Lucinoma borealis (L., 1767)
P	495	Nephtys assimilis Oersted, 1843	W	1835	Thyasira spp. indet. [juv.]
P	496	Nephtys caeca (Fabricius, 1780)	W	1837	Thyasira flexuosa (Montagu, 1803)
P	499	Nephtys hombergii Savigny, 1818	W	1906	Mysella bidentata (Montagu, 1803)
P	502	Nephtys kersivalensis McIntosh, 1908	W	1951	Parvicardium ovale (G. B. Sowerby II, 1840)
P	579	Lumbrineris gracilis (Ehlers, 1868)	W	2006	Phaxas pellucidus (Pennant, 1777)
P	638	Protodorvillea kefersteini (McIntosh, 1869)	W	2019	Fabulina fabula (Gmelin, 1791)
P	672	Scoloplos armiger (O. F. Muller, 1776)	W	2023	Moerella pygmaea (Loven, 1846)
P	684	Aricidea catherinae Laubier, 1967	W	2049	Gari tellinella (Lamarck, 1818)
P	699	Paradoneis lyra (Southern,	W	2051	Gari fervensis (Gmelin, 1791)

		1914)			
P	712	Apistobranchus tullbergi (Theel, 1879)	W	2058	Abra spp. indet. [juv.]
P	718	Poecilochaetus serpens Allen, 1904	W	2059	Abra alba (W. Wood, 1802)
P	723	Aonides paucibranchiata Southern, 1914	W	2061	Abra nitida (O. F. Muller, 1776)
P	750	Polydora caeca (Oersted, 1843)	W	2062	Abra prismatica (Montagu, 1808)
P	762	Polydora socialis (Schmarda, 1861)	W	2072	Arctica islandica (L., 1767)
P	765	Prionospio fallax Soderstrom, 1920	W	2098	Chamelea gallina (L., 1758)
P	788	Spio armata Thulin, 1957	W	2104	Timoclea ovata (Pennant, 1777)
P	790	Spio filicornis (O. F. Muller, 1766)	W	2113	Tapes rhomboides (Pennant, 1777)
P	794	Spiophanes bombyx (Claparede, 1870)	W	2126	Dosinia spp. indet. [juv.]
P	796	Spiophanes kroeyeri Grube, 1860	W	2128	Dosinia lupinus (L., 1758)
P	831	Caulleriella zetlandica (McIntosh, 1911)	W	2147	Mya truncata L., 1758 [juv.]
P	834	Chaetozone setosa Malmgren, 1867	W	2149	Mya arenaria L., 1758 [juv.]
P	836	Cirratulus cirratus (O. F. Muller, 1776)	W	2157	Corbula gibba (Olivi, 1792)
P	846	Tharyx killariensis (Southern 1914)	W	2166	Hiatella arctica (L., 1767)
P	878	Diplocirrus glaucus (Malmgren, 1867)	W	2231	Thracia phaseolina (Lamarck, 1818)
P	885	Pherusa plumosa (O. F. Muller, 1776)	W	2233	Thracia villosiuscula (Macgillivray, 1827)
P	891	Macrochaeta clavicornis (M. Sars, 1835)	**Phoronids**		
P	907	Capitella capitata (Fabricius, 1780)	ZA	3	Phoronis spp. indet.
P	919	Mediomastus fragilis Rasmussen, 1973	**Echinoderms**		
P	921	Notomastus latericeus M. Sars, 1851	ZB	124	Ophiothrix fragilis (Abildgaard, 1789)
P	944	Praxillura longissima Arwidsson, 1906	ZB	154	Amphiura filiformis (O. F. Muller, 1776)
P	973	Praxillella praetermissa (Malmgren 1865)	ZB	157	Amphiura securigera (Duben & Koren, 1844)
P	990	Rhodine gracilior (Tauber, 1879)	ZB	166	Ophiura spp. indet. [juv.]
P	1014	Ophelina acuminata Oersted, 1843	ZB	212	Echinocyamus pusillus (O. F. Muller, 1776)
P	1027	Scalibregma inflatum Rathke, 1843	ZB	280	Leptopentacta elongata (Duben & Koren, 1845)
P	1093	Galathowenia oculata Zaks, 1922	ZC	1	Hemichordata indet.
P	1098	Owenia fusiformis delle Chiaje, 1842			
P	1107	Lagis koreni Malmgren, 1866			
P	1175	Terebellides stroemi M. Sars, 1835			
P	1178	Trichobranchus roseus (Malm, 1869)			

P	1217	Pista cristata (O. F. Muller, 1776)			
P	1235	Polycirrus spp. indet.			

Abundance (Figure 7) shows lowest values at the innermost reaches, Station 1, and some of the outermost (Stations 12 and 35). As noted above these locations are at the extremes of sediment type (very muddy or clean sand). As with diversity, interannual variation is often high but shows no conspicuous systematic pattern across the study area as a whole. However, it is possible that greatest variation in abundance can be observed at the most disturbed stations, such as 6 and 6f (adjacent to some docks) and 7 and 8a (proximate to the terminal's loading jetties). Note also that these stations have the highest hydrocarbon loads (Figure 4).

Multivariate analysis of the complete macrobenthic infaunal data, from 2000, indicates five faunal assemblages, if one takes the somewhat arbitrary view of separating groups of stations at the level of 40% similarity (Figure 8). This figure also summarises the characterising sediment types and faunal diversity features of each grouping. The characterising species of these groups can be summarised as follows:

1. Station 1 *Capitella capitata, Abra alba*
2. Station 12 *Thracia phaseolina, Lumbrineris gracilis, Scoloplos armiger*
3. Stations 3 –5 , 8 – 11 etc. *Thyasira flexuosa, Rhodine gracilior, Mysella, Phoronis*
4. Stations 6, 6a, 6f, 32. *Mysella bidentata, Prionospio fallax, Apistobranchus tullbergi*
5. Stations 35-37. *Urothoe elegans, Leptocheirus hirsutimanus, Aonides paucibranchiata*

When these clusters are overlain on a map of the study area (Figure 9), it is apparent that these groupings are coherent and correspond to sediment character, which in turn is a consequence of geography and relative exposure to degree of physical disturbance from currents and wave action. Comparison of multivariate analyses of the six surveys carried out between 1990 and 2000 (not illustrated here) show a high degree of agreement with the clusters identified in the 2000 data. Minor differences over the years, indicated by arrows in Figure 9, consist solely of Station 32 variously showing greater affinity with the Garths Voe stations (6, 6a and 6f) or the main Sullom Voe stations (3-11, 17, 33 and 34). Similarly, Station 12 though typically distinguished from all other station clusters, shows greater or lesser affinity with the main Sullom Voe stations and those of Yell Sound (35-37). Recent increases in mud content at Station 12 have shown a corresponding increase in similarity with the Sullom Voe stations.

The fauna of Station 1 (
Table **5**) appears in recent years to be in the ascendancy. It is not apparent why this should be, as these changes are not reflected by changes in mud or hydrocarbon content. However, these changes are coming from a very low base!

Concluding remarks

This paper provides an outline resume of the findings of ten years of monitoring in Sullom Voe in the vicinity of the Sullom Voe oil terminal. The data are extensive and complex and so for this paper, detailed interpretation has not been undertaken. It is left to the reader to draw their own views from the information presented.

Table 4 Summary counts of species for previous six surveys and total since first survey

	1990	1992	1994	1996	1998	2000	Total all surveys
Annelids	149	157	157	147	147	155	352
Crustacea	73	89	82	81	81	65	228
Molluscs	62	95	86	84	83	83	207
Echinoderms	18	17	18	16	16	18	37
Others	39	31	38	34	56	54	188
Total	317	372	360	362	348	341	1012

Table 5 Station 1 macrobenthic composition between 1990 and 2000

	1990	1992	1994	1996	1998	2000
Priapulus caudatus	0	0	0	0	0	1
Pholoe minuta	0	0	0	0	0	1
Glycera tridactyla	0	0	0	0	0	5
Kefersteinia cirrata	0	0	0	0	0	2
Nephtys spp. Indet	0	0	0	0	0	2
Malacoceros fuliginosus	0	0	0	6	0	0
Polydora cornuta	0	0	0	0	1	0
Notomastus latericeus	1	0	0	0	0	0
Capitella capitata	0	17	1	16	0	158
Mediomastus fragilis	0	0	4	0	0	0
Scalibregma inflatum	0	0	0	0	0	52
Lagis koreni	13	0	0	2	0	2
Tubificoides benedii	0	0	1	0	0	0
Abra alba	0	1	3	32	3	61
Corbula gibba	0	2	0	0	6	3
Fabulina fabulina	0	0	0	0	0	1
Total taxa	2	3	4	4	3	11
Total individuals (0.3m2)	14	20	9	56	10	288

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Fortune, F. and Moore, J. (2001). Survey of rocky shores in the region of Sullom Voe, Shetland, July 2001. *A report for SOTEAG*.

Fortune, F., Moore, J., Harding, M., Rodger, G. and Davies, I. (2001). Survey of the dogwhelk, *Nucella lapillus* in the vicinity of Sullom Voe, Shetland, July 2001. *A report for SOTEAG*.

The editor would like to apologise for the poor quality of the following figures. This is due to technical problems – soon to be rectified.

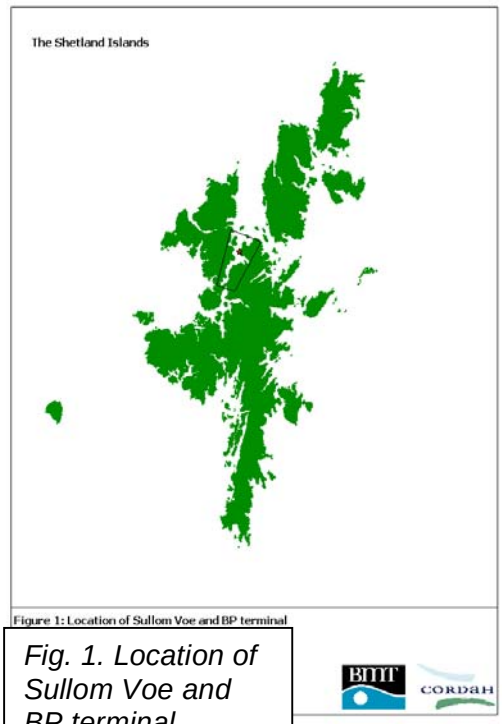

Fig. 1. Location of Sullom Voe and BP terminal

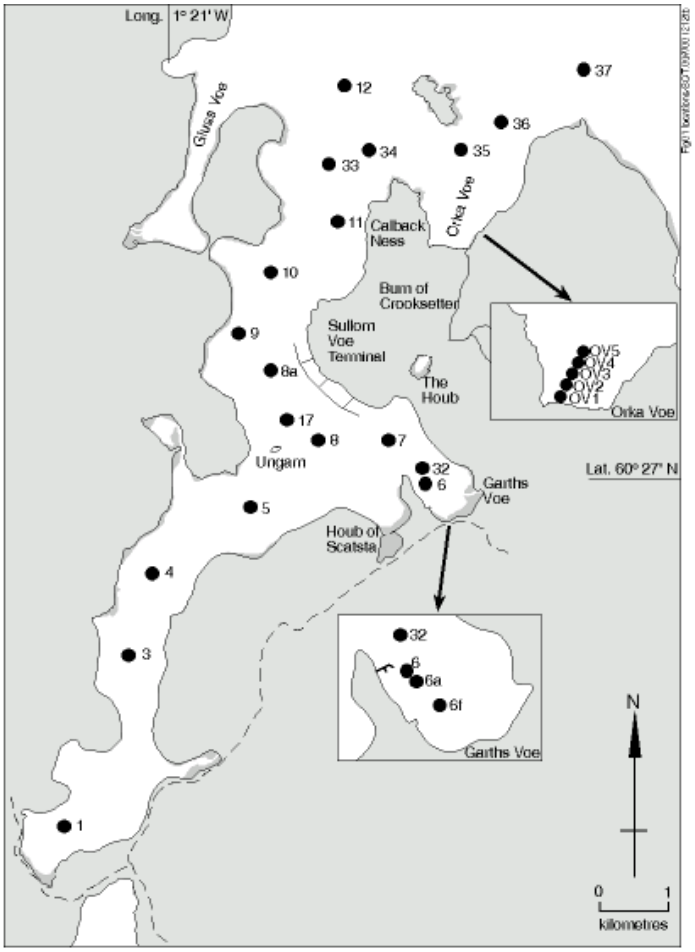

Figure 2. Location of sampling stations in Sullom Voe

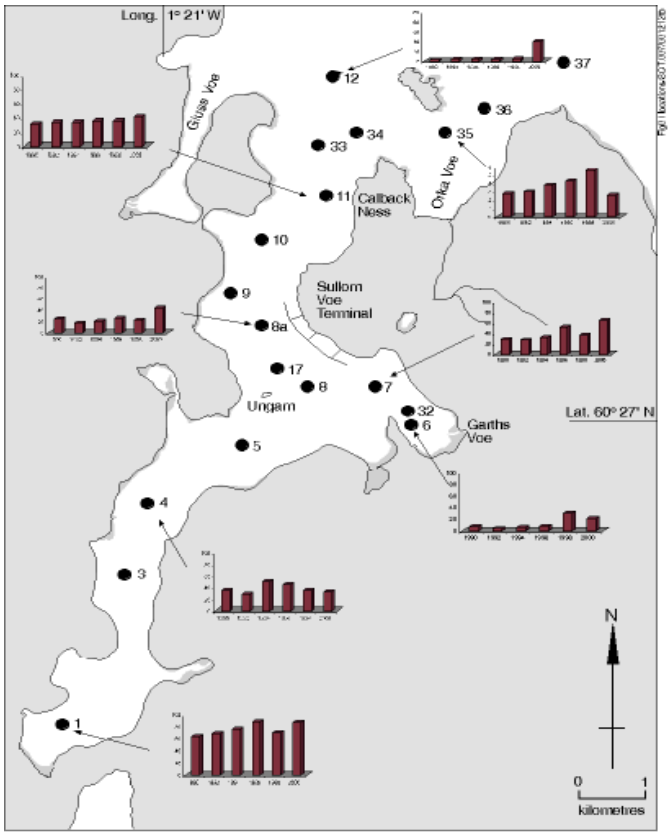

Fig. 3. % mud content at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey

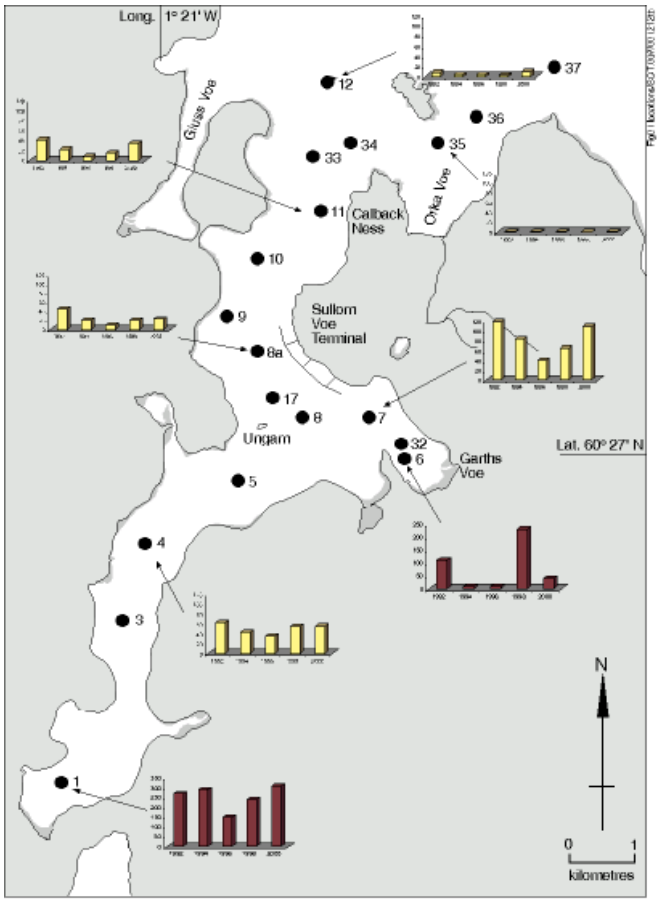

Fig. 4. Aliphatic hydrocarbon content at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey

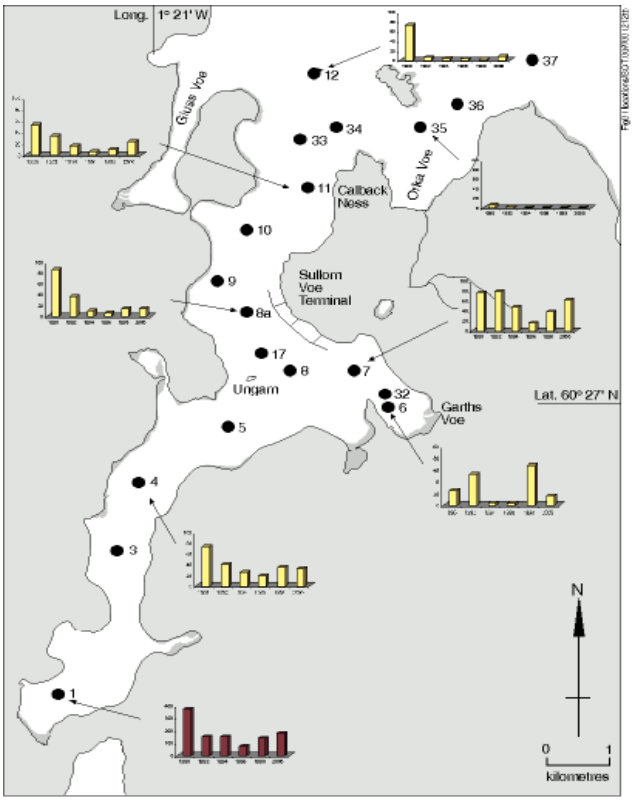

Fig. 5. UCM (unresolved complex mixture) content at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey.

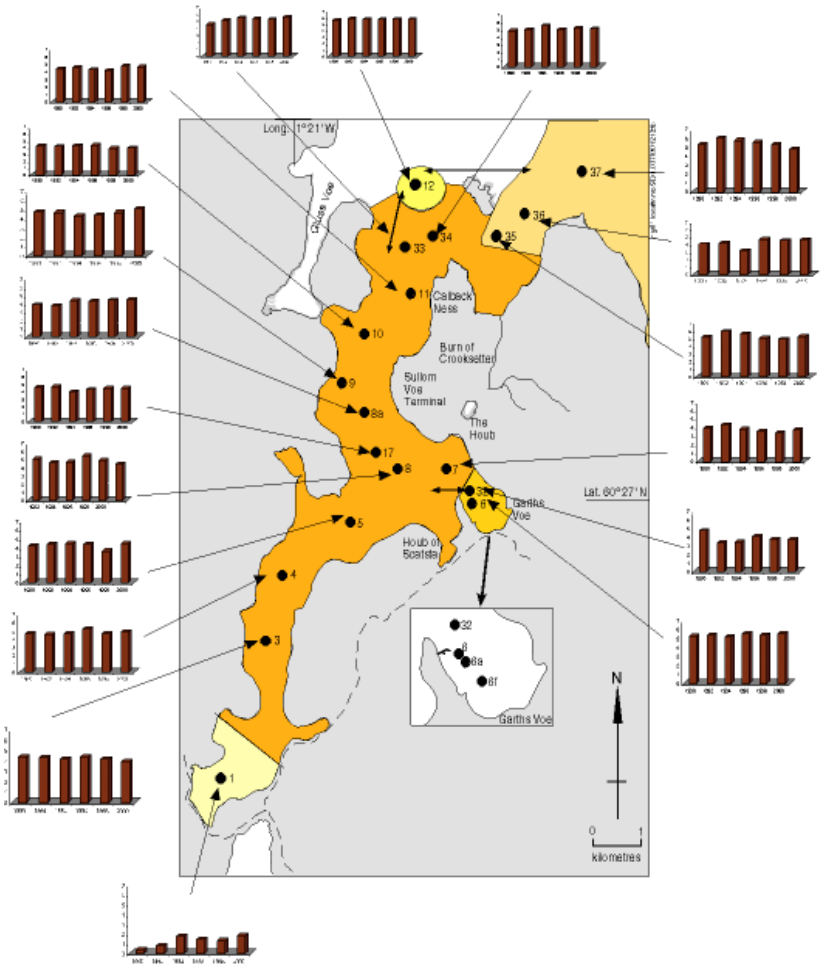

Fig. 6. Shannon-Weiner diversity index at stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey.

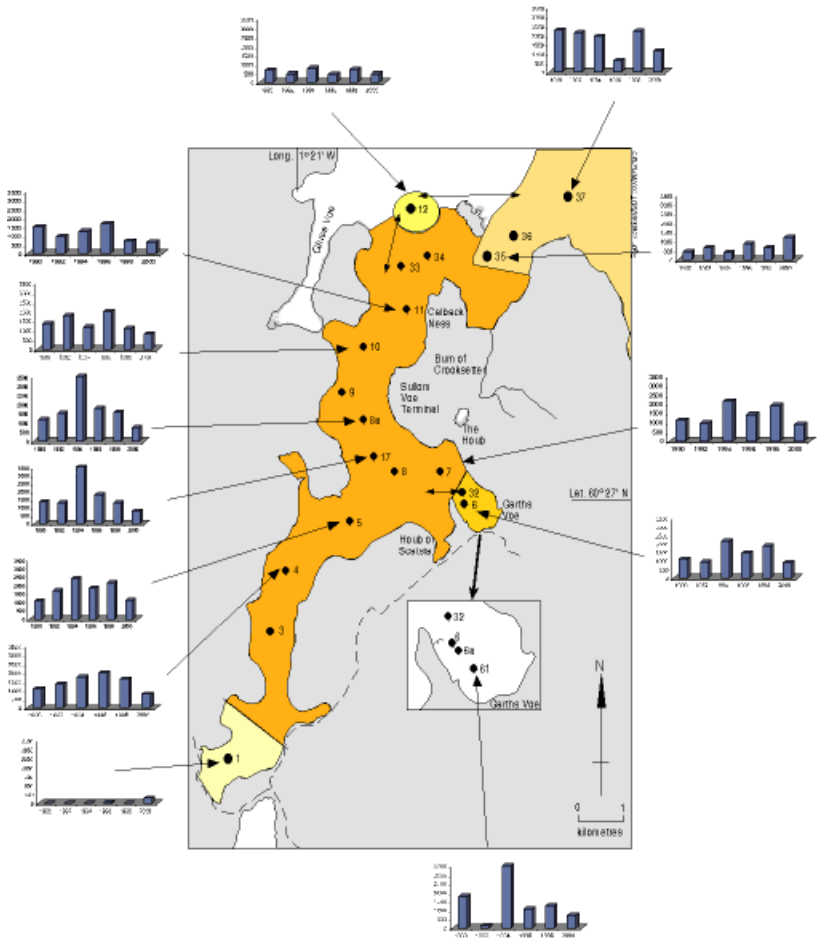

Fig. 7. Numerical abundance of macrofauna at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey.

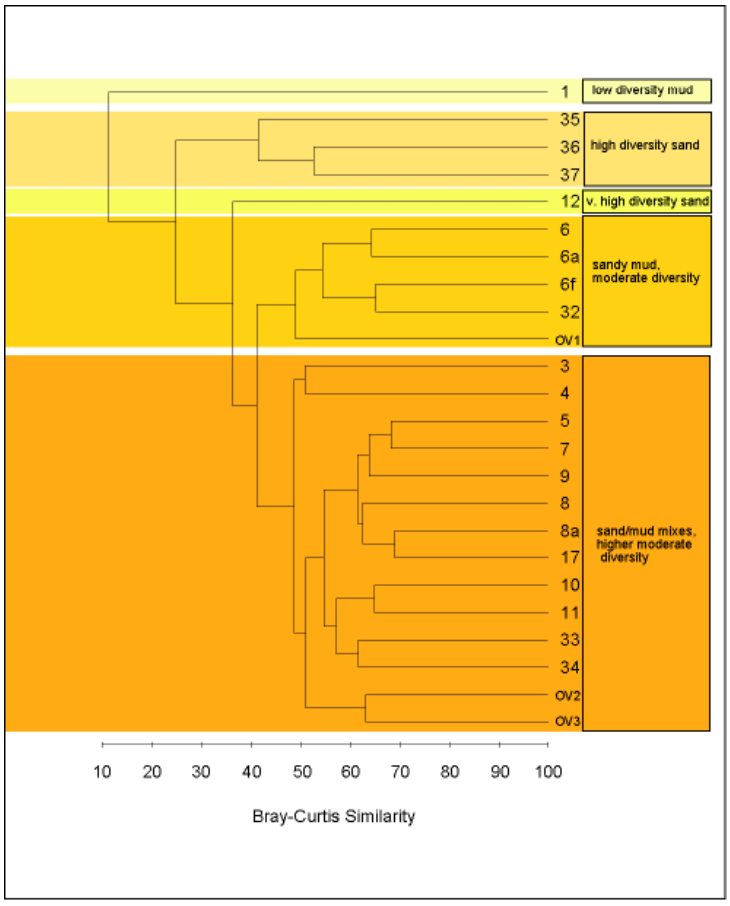

Fig. 8. Dendrogram of fourth root transformed macrobenthic stations totals data with the station groupings (at 40% similarity) highlighted. Sullom Voe chemical and macrobenthic monitoring survey.

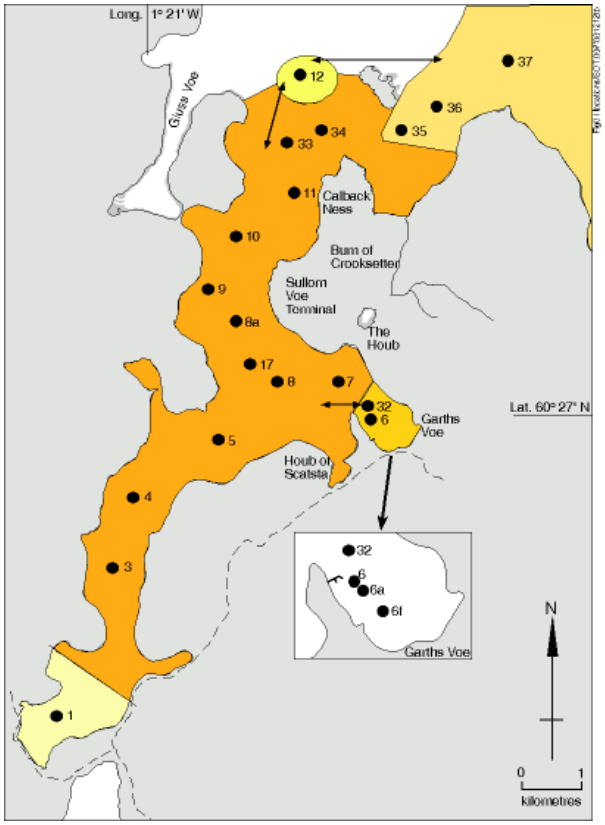

Fig. 9. Station cluster groups superimposed on chart of Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey

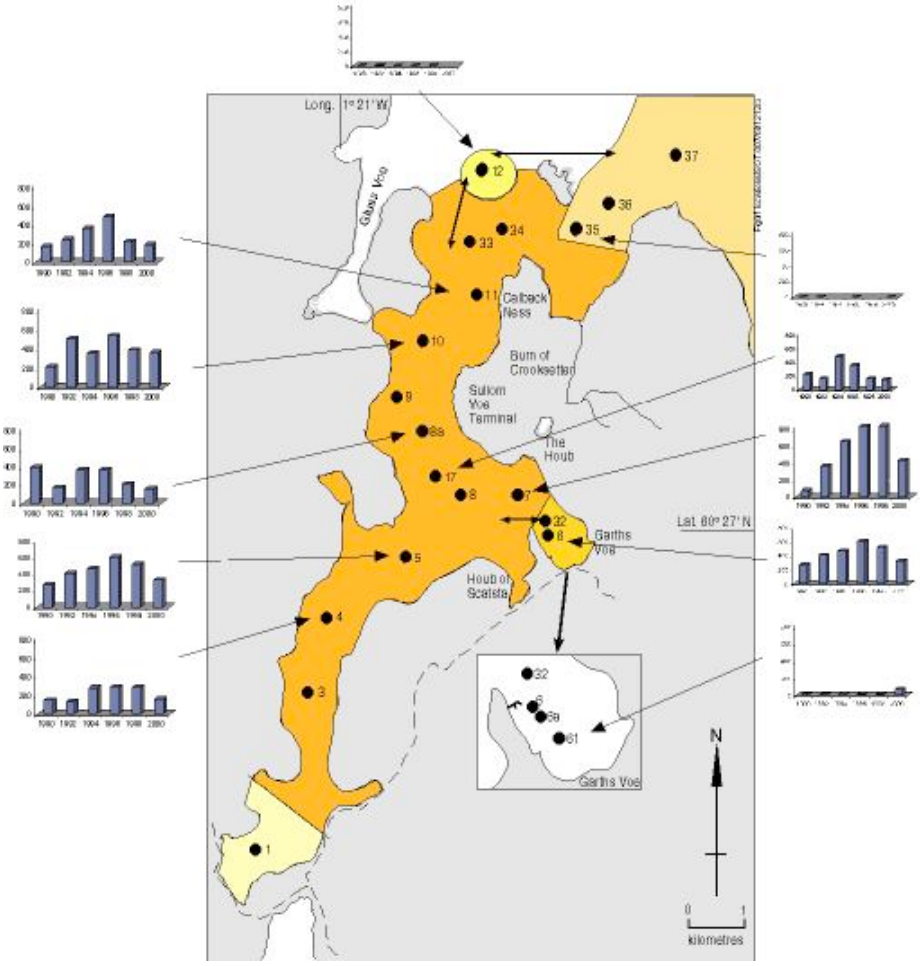

*Fig. 10. Abundance of **Thyasira** spp (predominantly **T.flexuosa**) at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey*

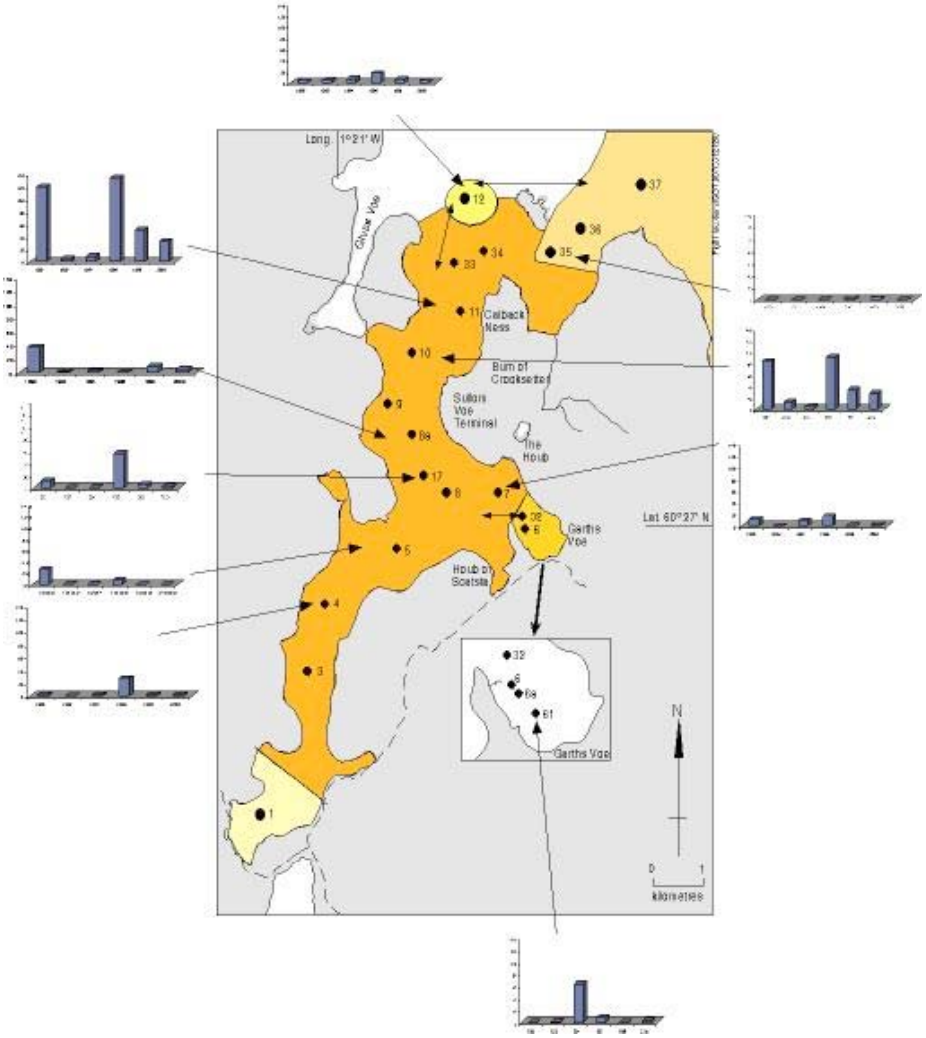

*Fig. 11. Abundance of **Ampelisca** spp (predominantly **A.tenuicornis**) at selected stations in Sullom Voe. Sullom Voe chemical and macrobenthic monitoring survey.*