

NEWSLETTER OF THE PORCUPINE MARINE NATURAL HISTORY SOCIETY

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Newsletter of the Porcupine Marine Natural History Society



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Hon. Treasurer
Jon Moore
Ti Cara
Point Lane
Cosheston
Pembroke Dock
Pembrokeshire
SA72 4UN
01646 683679
jon@opru.co.uk

Hon. Editor
Frances Dipper
7 Rutland Green
Hilton
Huntingdon
Cambs
PE18 9NT
01480 830507
fdipper@dial.pipex.com

MEMBERSHIP

Executive Officer
Julia Nunn
Cherry Cottage
11 Ballyhaft Rd
Newtonards
Co. Down BT 22 2AW

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 2 to 3 newsletters a year and proceedings from scientific meetings

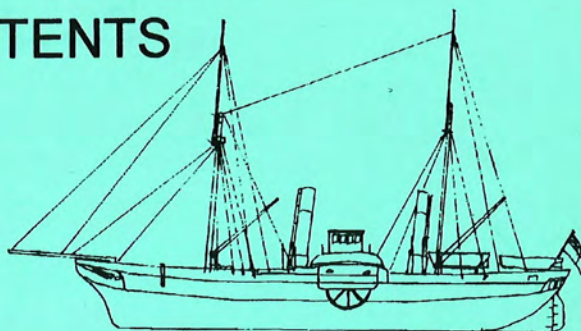
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COUNCIL MEMBERS

Mike Bailey mike@ecomaris.demon.co.uk
Roger Bamber r.bamber@nhm.ac.uk
Susan Chambers sjc@nms.ac.uk
Frances Dipper fdipper@dial.pipex.com
Frank Evans frankevans@zooplankton.demon.co.uk
Judy Foster-Smith judy.foster-smith@ncl.ac.uk
Antony Jensen Antony.C.Jensen@soc.soton.ac.uk

Ian Killeen ian@malacserve.demon.co.uk
Jan Light jan@aquamar.demon.co.uk
Jon Moore jon@opru.co.uk
Ivor Rees oss058@sos.bangor.ac.uk
Ralph Robson ralph@rgs.prestel.co.uk
Dale Rostron micro_D@compuserve.com
Shelagh Smith shelagh@smithurd.demon.co.uk

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EDITORIAL

Since the last newsletter, 'Porcupine' has continued to evolve and change. The AGM, a Council meeting and the Spring scientific meeting 'Marine Biodiversity: current research and conservation measures' were all held over the weekend of 19-21 March 1999. Many aspects of the Society were discussed at these meetings and 'New Porcupine' will eventually finish its metamorphosis and become, we hope, 'Stable Porcupine'. These Society developments are described below and in the Minutes of the AGM and of a further committee meeting in London. The main point you are likely to notice is that this newsletter is very fat! In order not to delay the publication of papers from the Southampton and Dunstaffnage scientific meetings, it was decided to publish these in this and subsequent newsletters. The possibility of a separate Journal has not been discarded but put on hold for the moment. Our newsletter is currently scanned for items of interest by the Zoological Record and is sent to a large number of relevant libraries so your contributions will be widely available to those interested. The Council hopes that these positive moves will continue to re-vitalise the society. Please send us any comments about the newsletter, planned and past meetings, well known watering holes etc. The society is you. Your contributions are essential.

Frances Dipper

Society developments: the new Executive Officer post

Porcupine's AGM was held at the Dunstaffnage Marine Laboratory on Sunday 21st March 1999. Council met on the evening before and discussed the recent status of the Society - in particular the lack of dynamism and enthusiasm in Society activities and the feeling that the impetus that had been developed at the April 1998 AGM had not fulfilled expectations. The discussion got so far as to consider whether the Society should be dissolved. This

suggestion was quickly quashed, but it was decided that new initiatives were required to generate activity. It was agreed that the Society needs a dynamic individual who can stimulate and maintain activity on at least three fronts:

- the newsletter and proposed journal
- the AGM and field meetings
- the web site

The problem was finding such an individual. It was then suggested that we could provide a financial incentive, since our lack of 1998 expenditure on publications had given us a healthy bank balance (see copy of audited accounts elsewhere in this newsletter). From this developed the idea of a new post - Executive Officer - and a one-off honorarium of £1000 (for time and all expenses) for one year. A description of the post and its requirements was prepared:

Responsibilities of the Executive Officer

- To stimulate and manage the growth and development of the Porcupine Marine Natural History Society, according to the aims of the Society and the guidance of its Council.
- To plan and co-ordinate the Annual Conference and any other meetings with the help of a local organiser.
- To ensure the regular production of the Newsletter and any other publications by stimulating and persuading people to produce copy and by assisting the Editor when required.

Requirements of the post

- The post requires an individual with the following characteristics:
- Familiar with, and a genuine interest in, the Society and its aims;
- Familiar with, and having the respect of, most of the Council Members;
- Good communicator and manager;
- Persuasive;
- Actively involved in marine recording.

Council then asked Dr Julia Nunn, who was attending the meeting and considered to be a good candidate, if she would be interested in the post. She indicated that she was interested and was willing to undertake the responsibilities of the post in her spare time (i.e. outside work hours).

The above proposals (i.e. the new post and the appointment of Julia Nunn) were put to the AGM on the 21st and were passed unanimously. Following the required nominations and acceptances, the posts of Treasurer and Editor remained with their present incumbents (Jon Moore and Frances Dipper). Ian Killeen, however, decided to stand-down from the post of Secretary, a position in which he has served the Society well for nine years. The AGM agreed that this post could remain vacant for up to a year, effectively taken over by the Executive Officer. Ian was voted onto Council and will remain an active member of the Society.

The new Executive Officer is already active in her new role and you will see more of her activities in this newsletter. As a final footnote, Council feel that there is very little to lose and potentially a lot to gain from this initiative. If the Society was dissolved, its assets would have to be distributed in some way - a potentially difficult and expensive process. Council also feels that the Society has a useful role in UK marine science and education and this initiative could help to secure that role. We hope that you agree and will support the new Executive Officer in her post. We welcome your comments, either to me or Julia. Our addresses are given elsewhere in this newsletter.

Jon Moore
Treasurer

MINUTES OF THE TWENTY-SECOND ANNUAL GENERAL MEETING OF PORCUPINE MARINE NATURAL HISTORY SOCIETY

held at Dunstaffnage Marine Laboratory
on Sunday 21st March 1999

In the chair: Judy Foster-Smith.

Apologies for absence: Jan Light, Ivor Rees, Mike Bailey, Frances Dipper, Christine Howson.

Minutes of the last AGM: were read and accepted. Proposed Shelagh Smith; seconded Jon Moore.

Matters arising: there were no matters arising.

Officers reports:

The Hon. Treasurer's Report was presented by Jon Moore: The accounts showed a surplus of £5140. This was principally due to the non-production of the Newsletter during the accounting year 1998/99, and no additional charges for meetings, and few outgoings. Accounts have been simplified. More funds will be transferred to the Deposit Account. Currently there is no formal policy regarding the dropping of 'members' who have not paid subscriptions for more than a year - some pay considerable arrears eventually. Sweatshirts remaining are held by Roger Bamber.

The report was accepted. Proposed Robin Harvey; seconded Sue Chambers.

The Hon. Secretary's Report was presented by Ian Killeen: the membership is stable at 197. The last meeting was held 18th/19th April 1998 at Southampton, and thanks are due to Emma Matthey for her organisation of the event.

The report was accepted. Proposed Frank Evans; seconded Shelagh Smith.

The Hon. Editor's Report was read by Ian Killeen on behalf of Frances Dipper: The production of the first 'newlook' Newsletter took longer than anticipated for which my apologies. Hopefully the next one will come out in time - summer 1999. Since the previous Newsletter was the first one that Porcupines had received since October 1997, it was not surprising that I was sent few contributions. Now, however, you all know that we are up

and running again, so PLEASE contribute to the Newsletter. In return you will hopefully get something that is worth reading. The proceedings of the last meeting in Southampton have not yet been published. However, it is still our intention to publish them and the proceedings of this meeting in our proposed 'Journal'. I am sorry I can't be with you in person and hope you all have a pleasant and stimulating meeting.

The report was accepted. Proposed Ian Killeen; seconded by Jon Moore.

It was commented that the Index for the previous volume should have been done (by Shelagh)!

The Council Meeting Report was presented by Ian Killeen: Ian outlined the recent problems for Porcupine, with the loss of momentum after the meeting in Southampton. The Council had considered that it was not possible to continue in the same way. Consequently, the Council proposed to appoint an Executive Officer and pay that person an honorarium for a one year period. A job description for this post was outlined (available from Ian).

The report was accepted. Proposed Frank Evans; seconded by Ralph Robson
Election of Officers:

Hon. Treasurer: Jon Moore Proposed Ian Killeen; seconded Robin Harvey
Executive Officer: Julia Nunn Proposed by Council

Hon. Editor: Frances Dipper Proposed Jon Moore; seconded Ralph Robson

Hon Secretary: Ian Killeen stood down after 9 years in the post. The meeting thanked Ian for his hard work on behalf of Porcupine. A new Hon. Secretary was not appointed for the immediate future.

Hon. Auditor: Nick Light Proposed Frank Evans; seconded Shelagh Smith

Council members: the following stood down: Dave Connor; Helgi Gudmundsson; Christine Howson; Martin Sheader; Mark Davies.

The following elections and re-elections were unopposed:

Mike Bailey
Roger Bamber
Susan Chambers
Frank Evans
Antony Jensen
Ian Killeen
Jan Light
Ivor Rees
Ralph Robson
Shelagh Smith
Dale Rostron

Any other business: Jon Moore outlined the new Recording Scheme, with details already in the Newsletter. Discussion centred on the methods for sending in records (cards/email/floppy disk); the requirement for a focus for the scheme; and articles about the schemes progress in the Newsletter as part of feedback. It was agreed to print 1000 recording cards.

London 15th May 1999: Meeting of the PMNHS Committee (and co-opted members)

Agenda: to discuss progress, and practical implementation of ways to revive & support Porcupine MNHS

Attendees

Executive Officer: Julia Nunn Treasurer: Jon Moore

Committee & co-opted members: Roger Bamber; Sue Chambers; Judy Foster-Smith; Ian Killeen; Ivor Rees; Ralph Robson; Dale Rostron; Shelagh Smith

Summary progress report

Given below is a summary list of the decisions made at this meeting

- production of A3 colour, glossy POSTER
- production of A4 fold-up LEAFLET with up-to-date information about Porcupine

MNHS

- design of new LOGO - to be used on poster, leaflet, Website, Newsletter cover, to head stationery,
- construction of independent WEBSITE if financially feasible
- update of membership list, including email addresses
- update of membership interests (letter to be circulated)
- NEWSLETTER - to be 3x per annum (see elsewhere for copydeadlines), at least for 1999/2000
- A standard format for the Newsletter will be implemented
- All Committee members to provide at least one article for the next Newsletter!
- Duties for Newsletter to be divided between Executive Officer (collection of copy) and Editor (editing copy; production of Newsletter etc.). ALL COPY MUST NOW BE SENT TO JULIA!
- currently considering support/production of a series of 'OCCASIONAL PUBLICATIONS'
- One CONFERENCE with AGM, with a date to be in first two weeks in March. Format: papers all day Friday; all day Saturday; conference dinner Saturday night; Sunday to be flexible - possibly for fieldwork, workshops, tours of local attractions like aquaria, labs (at discretion of organiser); theme to be the same each year, to generally encompass marine biogeography, species, communities, recording, with a local 'sub-theme' at organisers discretion; minimum fee, with lower cost to Porcupine members
- One FIELD MEETING per annum, in autumn (September or October) - see elsewhere for notice for 1999
- Plans for RECORDING SCHEME as outlined in previous issues of Newsletter

were endorsed - see elsewhere

- Support for small RECORDING PROJECTS - to be publicised with details in October issue of Newsletter
- Plan to investigate feasibility of supporting (with expertise) short WORKSHOPS/fieldwork for inexperienced members of the general public
- Next meeting of the Committee (and co-opted supporters) will be in Cardiff on Saturday 15th January

ERRATA

Corrections received from Frank Evans to pieces in last newsletter.

- The moonfish mentioned on P.8 was taken in 1997 not 1987.
- On P.7, I (FW) was mistaken in saying that J.W.S. ("Scout") Marr went down to Antarctic with Scott. It was Shackleton, as noted by Hardy in his book, "Great Waters", p.473



PORCUPINE RECEIPTS AND PAYMENTS ACCOUNT
for the year ended 31 December 1998

Year to 31.12.97			Year to 31.12.98
£	£		£ £
		RECEIPTS	
1065		Subscriptions- 1997 & prior	46
		1998	1468
_____	1065		_____
	95	Bank Interest (net of tax)	1514
	0	Sale of Sweatshirt	156
	10	Sale of PN Back Numbers	10
			25
	_____		_____
	1170	Total Receipts	1705
		PAYMENTS	
311		Newsletter- Printing	0
117		Postage & Envelopes	0
_____			_____
428		Total Newsletter Costs	0
0		Hon Sec/Treas Expenses	107
_____	428		_____
	_____		107
	742	SURPLUS FOR THE YEAR	1598
	2799	BALANCE BROUGHT FORWARD	3541
_____			_____
		BALANCE CARRIED FORWARD	
1821		Current Account	3355
1720		Deposit Account	1785
_____	3541		_____
	=====		5140
			=====

Jon Moore
.....
Hon Treasurer

N. Chip W
.....
Hon Auditor

12 March, 1999

PORCUPINE PIECES

Fisheries Records

Frank Evans
15 Thirlmere Avenue, North Shields, NE30
3UQ

Undoubtedly, in the marine recording field in which Porcupine is prominent, the most assiduous reporters in the country are the port fisheries teams of MAFF. Situated in both large and small fishing ports their fishery officers are to be found constantly sampling, recording and measuring fish on a full-time and regulated basis.

In my own area centred on North Shields there are three full-time fishery officers overseen by a District Inspector of Fisheries and also four administrators. In adjacent lesser ports there are two fishery officers and one administrator at Hartlepool, one fishery officer and one administrator at Amble and one fishery officer at Seahouses, all under the direction of the District Inspector at North Shields.

The work of the fisheries inspectorate is divided between recording and enforcement. Enforcement concerns the grading of fish and shellfish, compliance with marketing regulations, and the control of minimum size at landing. Recording is closer to our interest. The object of the recording is to discover the size of a fish stock together with the age distribution within the stock. This leads, when combined with further information from plankton sampling, to the prediction of the size and age composition of the stock in future years and hence to the setting of a total allowable catch for that species.

At North Shields the fishery officers fulfil a monthly target of sampling. In general only fish and shellfish having a local quota are sampled. This means that, here for

instance, cod are sampled but saithe (coley) are not. The full list of controlled Shields fish and shellfish is: cod, haddock, whiting, sole, spurdog, plaice, lemon sole, crabs, lobsters and nephrops (this last usually so written). Other species, for instance herring and sprat, are measured opportunistically should the quantities landed require it. Herring and sprat are rarely seen at North Shields nowadays and when they occur they are usually brought in by klondykers, foreign factory ships which have bought the catch offshore, yet I remember a year not so long ago when three million tons of sprat were landed at North Shields Fish Quay. Shellfish landings from Blyth to Sunderland are overseen centrally by North Shields officers but small Northumbrian ports are not omitted and catches are recorded and measured by other officers from such places as Seahouses and Craster.

Target sample numbers are set by scientists at Lowestoft. As an example, may we consider cod. Market records supply the daily total weight of cod landed (still measured in stones). Then each month ten samples are taken of trawled cod, four samples from seine netters and two from fish caught by cod nets (fixed bottom curtain nets). Within each sample, the lengths of many fish from successive weight categories are recorded. In order to discover the length-age relationship, otoliths are dissected from fish which have been measured and, in the case of lemon sole, sexed. For cod, over the course of a month, ten samples each of seventeen otoliths are taken from measured fish. These otoliths are transported to Lowestoft where the annual growth rings, matched to individual fish, are examined and recorded.

Fishery officers begin work at the fish quay quite early, at barely half past six, in order to clear most or all of the sampling work before the fish auction begins at seven thirty. Fish

are laid out in boxes, adjacent boxes representing individual boats. Notepads and pens react busily, recording the catch. With expert eye one fishery officer selects fish and begins the measurement of length using a simple measuring board. The extraction of otoliths accompanies this. Forget class dissections you may have done long ago; you are now watching an expert. Keyhole surgery leads a knife through the gill slits of a cod and soon skilful manipulation produces the small white stone from the middle ear. It is sealed into a compartment of a container tray ready for onward transport to Lowestoft together with the vital statistics of the fish from which it came. Afterwards the cod is apparently undamaged and marketable. At last, as the market forms, the MAFF men withdraw to their office on the quay where we may hope the kettle is boiling for them.

Of all the marine animals around our shores the commercial fish and shellfish are best recorded and quantified. It is something we may overlook as we focus on our own recording activities.

Featherstar prawns in Scotland

Marco Faasse, Schorerstraat 14, 4341
GN Arnemuiden, The Netherlands

The featherstar prawn (*Hippolyte prideauxiana* Leach, 1817) always lives in association with the featherstar *Antedon bifida* (Pennant, 1777) or *Antedon mediterranea* (Lamarck). Until recently it was only known from the Mediterranean, the Canary Isles, Madeira, the Atlantic coast of France (Brittany and the Cote d'Azur), SW England and Ireland (D'Udekem d'Acoz, 1996), the most northerly locations being Galway and Dublin (MacRae, 1998). It was a big surprise to find it in Loch Fyne in SW Scotland on 16/6/97 during a SCUBA dive (D'Udekem d'Acoz, in press). Just one specimen was found,

probably because the shrimp has excellent powers of camouflage. Another surprise came one and a half years later. The shrimp was found even further north, in Loch Carron in NW Scotland by Sue Scott in May 1998 (Macrae, 1998). In the article describing the find, it was suggested that the prawn's appearance so far north might be attributable to climate change, especially to the very mild winter of 1997/98. However, the winter of 1996/97 was rather cold, but apparently the prawn had survived in Loch Fyne. Sue Scott may well be right when she says: "But it may simply be that this tiny prawn is so well camouflaged in its host that, until now, it has gone unnoticed by divers in Scottish waters".

It may be worthwhile to note that another shrimp *Hippolyte leptometrae* (Ledoyer, 1969), until now only known from the Mediterranean Sea and the Bay of Biscay, probably lives in association with featherstars of the genus *Leptometra* (see D'Udekem d'Acoz, 1996). *Leptometra celtica* (Barrett & MacAndrew, 1858) lives in shallow water (20 m) in W Scotland (Picton, 1993), so maybe one day this featherstar shrimp will turn up here as well.

Macrae, (1998). Prawns go up in the world - A Mediterranean prawn turns up in Scotland. *BBC Wildlife Magazine* 16 (11): 49. (Colour photo)

Picton, (1993). *A field Guide to the Shallow-water Echinoderms of the British Isles*. Immel Publishing, London, 96pp.

D'Udekem d'Acoz, C. d' (1996). The genus *Hippolyte* Leach, 1814 (Crustacea: Decapoda: Caridea: Hippolytidae) in the East Atlantic Ocean and Mediterranean Sea, with a checklist of all species in the genus. *Zool. Verh.* 303: 1-133.

Udekem d'Acoz, C. D' (in press). *Inventaire et distribution des crustacés décapodes de l'Atlantique nord-oriental, de la Méditerranée et des eaux continentales adjacentes au nord de 25° N*. Museum national d'Histoire Naturelle / Service du Patrimoine Naturel, Paris.

Two additions to the UK marine fauna: *Desdemona ornata* Banse, 1957 (Polychaeta, Sabellidae) and *Grandidierella japonica* Stephensen, 1938 (Amphipoda, Gammaridea).

Phil Smith¹, Julian Perrett², Peter Garwood³ and Geoff Moore⁴

¹ Aquatic Environmental Consultants, The Limes, Creedy Park, Crediton, Devon, EX17 4EB.

² Encompass Ecological Consulting, 11 Lansdowne Terrace, St. Leonards, Exeter, Devon, EX2 4JJ.

³ Identichaet, 8 Lesbury Road, Heaton, Newcastle upon Tyne, NE6 5LB.

⁴ University Marine Biological Station, Millport, Isle of Cumbrae, KA28 0EG.

Surveys of intertidal sites in Southampton Water (Figure 1) in 1997/98 produced numerous specimens of a fabriciine sabellid polychaete and of a gammaridean amphipod, neither of which could be assigned to recognised UK species. The sabellid was found to agree with the description of *Desdemona ornata* Banse, 1957, whilst the amphipod was identified as *Grandidierella japonica* Stephensen, 1938.

***Desdemona ornata* Banse, 1957**

D. ornata is a small sabellid, 2-4 mm long, and it has been found in Southampton Water with two native species, *Manayunkia aestuarina* (Bourne, 1883) and *Fabricia sabella* (Ehrenburg, 1837). The most conspicuous feature by which *D. ornata* can be recognised is the markings towards the base of each radiole (Figure 2), which, in formalin preserved specimens, appear reddish-brown in colour. It also differs from *M. aestuarina* and *F. sabella* in having seven to nine abdominal chaetigers, as opposed to three in each of the two native species. A full description of *D. ornata* in English is given by Day (1967).

The first record for this species in the UK

appears to be from surveys at Bury (Southampton Water) in August 1997, where the maximum density was 300 m⁻². *D. ornata* appears to thrive at moderately organically enriched sites, with high densities recorded at two sites downstream from a sewage discharge at Bury on Southampton Water. The maximum density recorded at Bury was 3500 m⁻² in December 1997. In September 1998, a mid-upper shore site at Dibden had a density of 12000 m⁻², whilst at the same site *M. aestuarina* occurred at a density of 1000 m⁻² and *F. sabella* at 1600 m⁻².

Apart from the records from Southampton Water, the only other UK record we are aware of is a single specimen from the Kingsbridge estuary (south Devon) in November 1998. *D. ornata* is essentially a littoral species in Southampton Water, with only a single specimen having been found sublittorally. A brief check of the literature has shown that the species has been recorded from Australia (Hartmann-Schröder 1982) as well as South Africa. In view of the attention which has been given to the fauna of Southampton Water in the past, it seems safe to assume that *D. ornata* is a recent arrival, as its presence is unlikely to have gone unnoticed.

***Grandidierella japonica* Stephensen, 1938**

There is some disagreement over the family to which the genus *Grandidierella* belongs, reflecting difficulties in defining some gammaridean families (see Chapman & Dorman 1975; Barnard & Thomas 1987). For the purposes of this note, suffice it to say that the genus is most likely to be confused with genera of the Aoridae, as treated by Lincoln (1979).

G. japonica is a moderate sized species, reaching a length of 8mm, excluding the antennae, and it shows a marked sexual dimorphism, particularly in the size and shape of gnathopod 1. In Southampton Water it often occurs with native aorids, particularly *Aora gracilis* (Bate, 1857). In overall appearance and in the details of the male gnathopod 1, *G. japonica* is most similar to species of *Microdeutopus* Costa,

1953, and could easily be mistaken for a member of that genus by the non-specialist. It is, however, distinguishable from all UK aorids as it has uniramous 3rd uropods (Figure 3a). Figure 3b shows the typical appearance of a male *G. japonica* in preserved samples, with antennae and pereopods 5, 6 and 7 missing, and figure 3c shows the detail of the head and gnathopod 1 of a male. A full description is given by Chapman & Dorman (1975).

The first record of *G. japonica* in the UK was from surveys at Dibden, Southampton Water in July 1997, where the maximum density recorded was approximately 100 m⁻². At other sites in the area which had been monitored approximately monthly since February 1997, the first records were generally in October 1997. Most of the surveys in Southampton Water have been of littoral sites, but the single sublittoral grab sampling survey, in September 1998, showed that *G. japonica* has also colonised shallow sublittoral sites (0.5-3m below chart datum) in the Dibden/Weston Shelf area. It reached a maximum density of 130 m⁻² sublittorally, compared with 1500 m⁻² intertidally at this time. No specimens were collected from the dredged channel (10-12m below chart datum).

The highest densities were recorded at Dibden littoral sites in January 1998, with a maximum of 5800 m⁻², making it one of the most abundant amphipods. The only species to be recorded at higher densities at Dibden in January 1998 was *A. gracilis* (maximum 11400 m⁻²). These two species appear to have very similar habitat requirements, although the absence of *A. gracilis* from more estuarine sites in Southampton Water (eg. Eling and Bury) suggests that *G. japonica* has a greater tolerance of fluctuating salinities.

G. japonica has successfully colonised many sites in Southampton Water, and the only littoral sites at which it has not

been recorded are near Hythe. These mudflats are contaminated with oil and metals (especially copper) and are often anaerobic with a high sulphide content. It seems likely that *G. japonica* is sensitive to one or more of these pollutants, whilst other data suggest that it may be favoured by moderate organic enrichment from sewage discharges.

In California *G. japonica* was first recorded in 1966, and was thought to have been introduced from Japan with oyster spat (Chapman & Dorman 1975). It has been used for assessing the toxicity of sediments (Nipper *et al* 1989), and a 10 day toxicity test using this species has been published by the American Society for Testing and Materials (ASTM 1999). It is therefore possible that this species could also be used in a similar way in the UK, as it should be relatively easy to keep in the laboratory.

Both *D. ornata* and *G. japonica* are evidently adept at travelling considerable distances with the assistance of man, although where each came from to reach Southampton Water is unknown. Whilst they represent interesting additions to the UK marine fauna, and both have shown indications of successful breeding, it remains to be seen whether their presence is transitory or permanent. The aim of the present report is to alert other workers to the possibility of finding these two immigrant species, in Southampton Water or possibly around other major ports.

Acknowledgements:

The studies of Southampton Water were funded by Associated British Ports (Southampton).

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Nipper, M.G., Greenstein, D.J. and S.M. Bay (1989). Short- and long-term sediment toxicity test methods with the amphipod *Grandidierella japonica*. *Environmental Toxicology and Chemistry*, 8: 1191-1200.

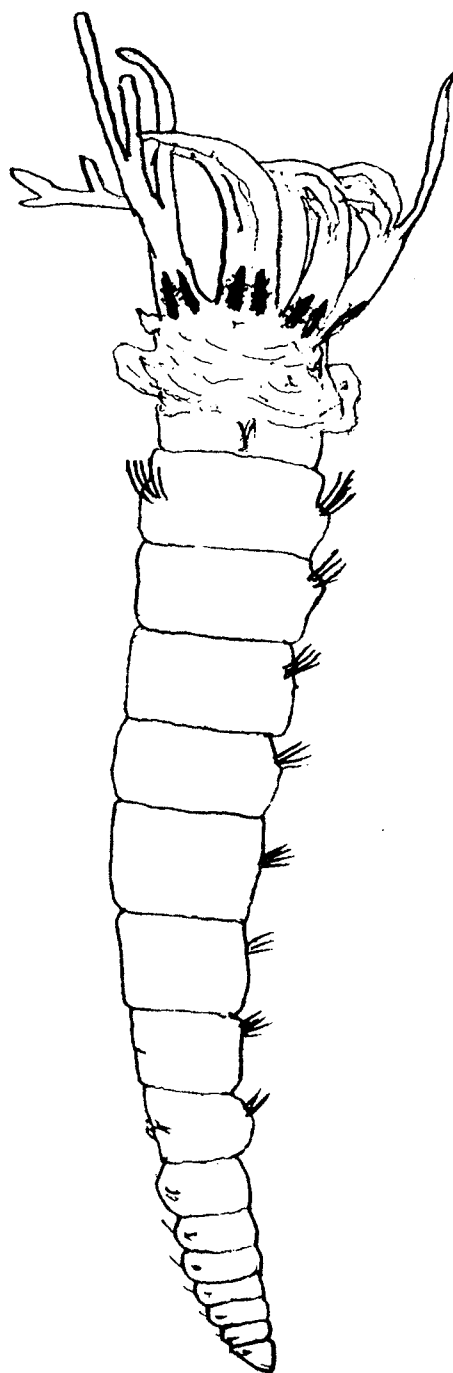


Figure 2. *Desdomona ornata*

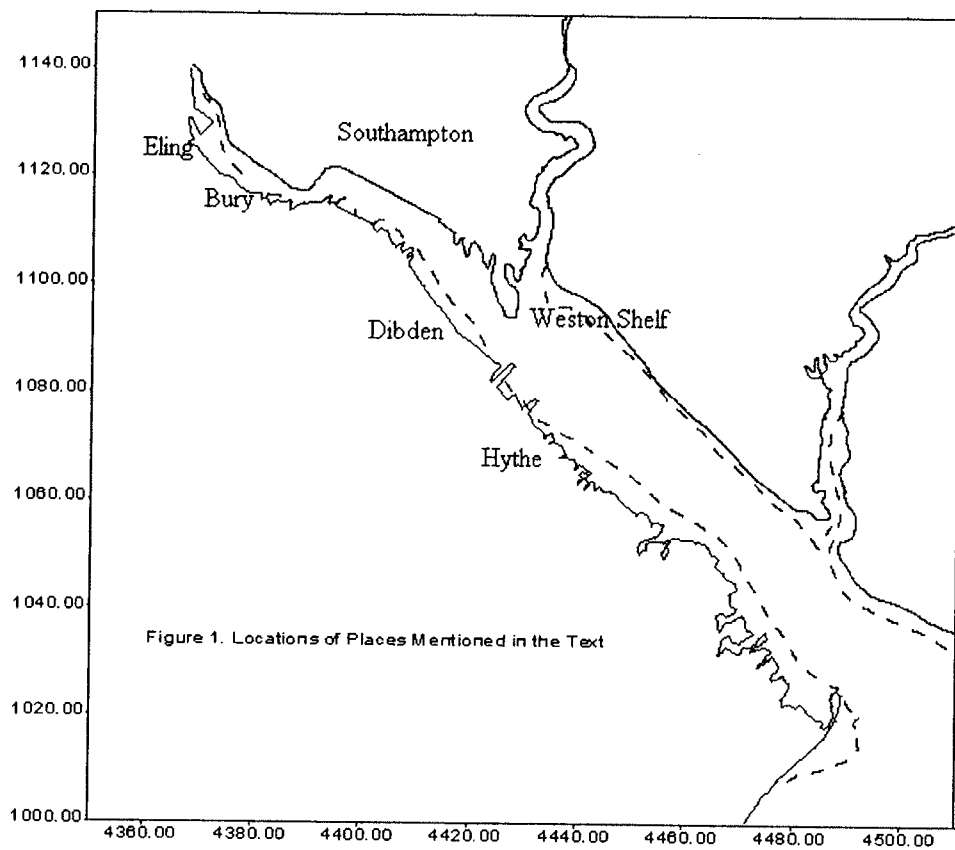


Figure 1. Locations of places mentioned in the text

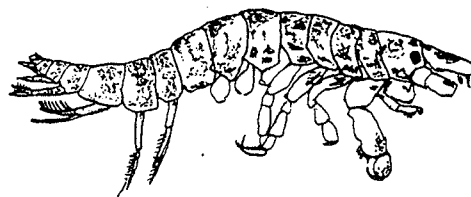


Figure 3c. Male *G.japonica*

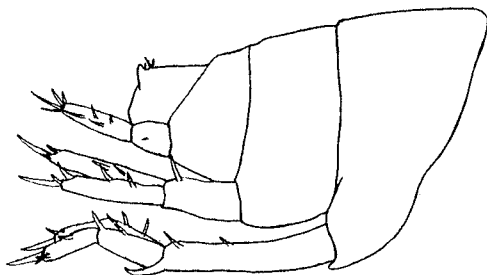


Figure 3a. *Grandidierella japonica*; details of uropods

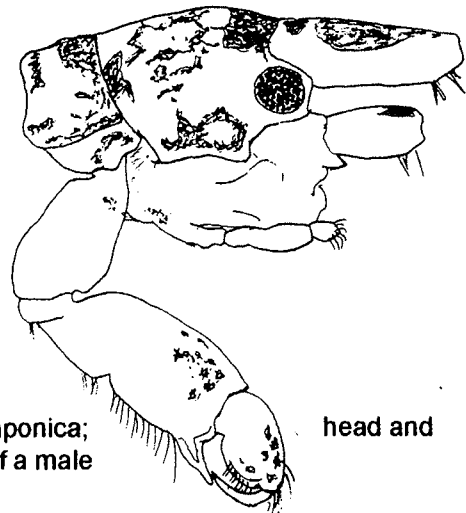


Figure 3c. *G.japonica*; gnathopod 1 of a male

head and

PORCUPINE PROBLEMS Information requests

Information request 1. From: Marco Faasse, Schorerstraat 14, 4341 GN Arnhemuiden, The Netherlands.

Marthasterias glacialis - *Inachus* sp.?

Last year friends of mine showed some slides of spiny starfish (*Marthasterias glacialis*), with spider crabs on their (the starfishes') arms. The spider crabs looked like some *Inachus* species, although identifications from slides are often doubtful. They (my friends) assured me this association wasn't at all rare at their dive sites in western Ireland. The strange thing is that this kind of association has never been described in the literature, as far as I know. Associations of *Inachus phalangium* with the snakelocks anemone (*Anemonia viridis*) and the breadcrumb sponge (*Halichondria panicea*) are well known.

Parazoanthus anguicomus

This whitish zooanthid is mainly a deepwater species, so it is difficult to study. Luckily, it occurs in relatively shallow depths (ca. 20 m) in western Ireland and western and northern Scotland. However, Rockall is the only location described in the literature available to me (R.L. Manuel: British Anthozoa). As I want to do some simple research on the associated species of this zoanthid, I would be grateful to anyone who could provide information on shallow occurrences of this species.

Please send information on either of the above two topics to Marco Faasse at the above address.

Information request 2. From: Ivor Rees, School of Ocean Sciences, Menai Bridge, Anglesey LL59 5EY. e-mail oss058@sos.bangor.ac.uk

Diogenes pugilator (the south-paw hermit crab).

Together with Lex Pearce, who recently completed an MSc thesis on the morphological and behavioural adaptations of this surf zone burrowing species, I am seeking records of it's distribution in Britain and Ireland. It is found mainly at or just below LW spring levels on moderately exposed flat sandy beaches, where it burrows into the sand. In our experience they are more likely to be encountered on recreational visits to the shore in July and August than when doing more organised surveys. On calm days at this time of the year they are often active on the sand surface in only ankle to knee deep water at the tide edge.

It appears to be a southwestern species. Records we have so far, which include the ones in the MNCR database, do not extend up the English Channel beyond Portland and up the Irish Sea beyond SW Anglesey. There are also some obvious gaps in our information, from places where they might be expected such as N Cornwall and N Devon, but we would be pleased to get information from anywhere in the British Isles. It would be useful, but not essential, to know whether the particular beach where they were found is flat and whether at low tide the breakers normally spill rather than curling over.

Information request 3. From: Jane Lilley, Lance's Cottage, Parkgate Rd., Newdigate, Surrey RH5 5DY

Goldsinny wrasse (*Ctenolabrus rupestris*). Goldsinny wrasse are common, shallow-water fish often seen by divers. Books describe their colour as reddish-brown, reddish-orange, golden pink-brown etc., stating or implying that the colour is uniform apart from the paler belly

and black spots on the tailstalk and dorsal fin. When seen by divers, some fish are certainly plain coloured, in various shades from beige to red and brown, but many show one of two common patterns. The first is described by Frances Dipper in 'British Sea Fishes', but apparently not mentioned in other 'popular' books: narrow darker and lighter horizontal lines along the flanks, apparently produced by rows of scales with darker centres and lighter margins, or *vice versa*; or possibly by the upper side of each scale being lighter or darker than the lower. A pale stripe running from the snout, through the eye and backwards to the gill cover is also quite common. The second common pattern is chequered, with darker (redder or browner) and paler patches arranged in two broad horizontal bands along the upper and central parts of the body and sometimes a less distinctive third band almost reaching the belly. Within each band, five or six squarish dark patches alternate with paler areas which are usually rather narrower. The patches in adjacent bands roughly alternate to give a chequered effect, though the positioning is not exact, especially towards the tail. I have the strong impression, though little definite evidence, that the fish can alter the contrast between the patches in a second or two, possibly increasing the intensity of the pattern at times of sexual or territorial excitement. This pattern is present to some extent, in most sizes of fish, at many sites around south and west Britain, from April to August. I have too few observations to be sure about the rest of the year. Often plain and chequered individuals are seen together, usually in a group but occasionally in a pair. This may be significant or just coincidence.

I have never come across a description of this pattern in 'popular' literature, though it is sometimes seen in published photographs (e.g. M. Murphy 1992. Ireland's Marine Life: A World of Beauty,

P.94). Can anyone clarify when and why this pattern develops, whether it is present in both sexes or any other aspect of it? I would welcome comments and photos to the above address.

OTHER SOCIETIES AND RECORDING SCHEMES



MarLIN

Welcome to the start of MarLIN - a new approach to sharing information on the distribution and biology of marine wildlife and encouraging the collection of further information from around Britain and Ireland. The concept of a Marine Life Information Network has been developing since the spring of 1997. Originally, the proposal was called UK Marine Biology and gained the support especially of the Marine Biological Association at Plymouth and the Joint Nature Conservation Committee.

There are three main programme objectives:

- To provide a structure for linking available data on marine life around Britain and Ireland;
- To improve the access, display and interpretation of information in support of environmental management, protection and education.
- To be the most comprehensive and easily used source of information about marine habitats, communities and species around Britain and Ireland and their sensitivity to natural events and human activities.

From March 1998 to March 1999, the 'Development' phase of the programme has been undertaken. During this period, we have been particularly involved in letting potential collaborators and interested parties know about our plans, establishing standards and

encouraging contribution to the cost of running the programme. We are still working to ensure that relevant organisations understand what we are developing and that, if they see benefits for their organisations, contribute to the cost. Since March 1998, we have been working with partners through the establishment of a Steering Group and technical sub-groups.

Much has already been established through early funding of a project to assess ecosystem and species sensitivity. This work is a contract with the Department of Environment Transport and the Regions and has provided a solid start to the programme through staffing a key part of the work and enabling the set-up of computer systems. The work is now being enhanced with funds from English Nature and Scottish Natural Heritage.

At the beginning of April 1999, we entered the 'Establishment' phase: a three year programme of work especially to establish the network of information providers and the software to display and interrogate information.

As a programme, MarLIN intends to utilise the full capabilities of modern information technology. As such the internet is an important medium for dissemination of information, and the MarLIN web site acts as a focal point for those seeking access to the information that MarLIN is drawing together. The web site is steadily expanding, with new pages and demonstration interfaces coming on-line as they are developed. Comments and suggestions are gratefully received and can be directed to the MarLIN team through the site itself. You can access the MarLIN web site at: www.marlin.ac.uk.

MarLIN is also involved in the development of the National Biodiversity Network (NBN), providing a focus for marine recording through its role as a national data custodian. Through the Local Record Centres, the NBN will focus on the use of volunteer/amateur recorders, and as such intends to provide opportunities for training recorders. MarLIN will take an active role in facilitating the

training of marine recorders. The MarLIN Team hope that there will be opportunities in the future to take advantage of the wealth of expertise and taxonomic knowledge held within the Porcupine membership, particularly when considering the training of recorders or developing new recording schemes. For more information on the NBN visit their web site at: www.nbn.org.uk.

July 19-21st 1999 sees the first MarLIN conference, entitled Using Marine Biological Information in the Electronic Age. We hope the meeting will appeal to Porcupine members. For further details see the MarLIN web site or write to/phone: Dr Bob Earll, CMS Ltd, Candle Cottage, Kempsey, Gloucestershire GL18 2BU, UK 01531 890415.

Please keep up-to-date with what we have done and are planning to do through the web site and contact us if you would like to help in the development of the programme.

MarLIN would like to thank its current funding organisations: Countryside Council for Wales, Crown Estate Commissioners, Department of Agriculture for Northern Ireland, Department of Environment, Transport and the Regions, English Nature, Joint Nature Conservation Committee, Ministry of Agriculture, Fisheries and Food, Scottish Natural Heritage, and The Marine Biological Association of the UK.

Alison Hood
Communications and Liaison Officer
MarLIN
The Marine Biological Association of the UK
Citadel Hill
Plymouth
UK
PL1 2PB

marlin@mba.ac.uk
Phone: 01752 633336
Fax: 01752 633102

THE BRITISH MARINE LIFE STUDY SOCIETY

Andy Horton

The British Marine Life Study Society (BMLSS) was conceived out of frustration of being unable to find out more information about the small fishes, crabs and other invertebrates of the rock pools around the British Isles. We identified a gap between where the popular books left off and the scientific papers began. Our first step was to invite existing organisations to produce this information and we offered to contribute. The response was decidedly discouraging inasmuch at least one reply indicated that they intended to produce this information, but not yet as they had not got the resources to do so.

The Beginnings

Anyrate, we decided to go it alone, as we thought it would be easier to produce the information ourselves. We got a bad shock as it proved much trickier and more expensive in a lot of respects. The scope was widened to include all marine life around the British Isles and not just the organisms found between the tides. The BMLSS officially started on 6 June 1990 and the first issue of *Glaucus* was published and distributed on 26 September 1990. Somewhere we must have a list of the starting members, but I remember that Ron Barrett provided valuable help in the first two years.

Scope

Although, we are an informal society, I thought it important that the aims and purposes were fully established at the start. We are a wildlife study society publishing information and are not a conservation or campaigning group and this is forbidden in the Constitution. The BMLSS is an Institute of Biology Affiliated Society.

Progress

In 1993 when *Glaucus* was properly printed, we thought that it was now worthwhile, but the standard did not improve until Jane Lilley joined and did most of the sub-editing. In those days our primitive computer did not even have a spell checker! The **Shorewatch Project** commenced under the current name in January 1995, and **Torpedo Electronic News** in August 1996. The first issue of the bi-monthly **Shorewatch Newsletter** was issued on 27 February 1997. Alan Pemberton started the Scottish web site in June 1996 and it was chosen as a new Scientist "Web Site of the Day" in November of the same year. The English web site did not commence until 1 January 1997, and has since been recommended both by Encyclopaedia Britannica and the BBC.

The Future

For the whole of its ten years the BMLSS has shown a large annual deficit. Income is almost entirely from member's subscriptions and I have put in a subsidy every year. From the outset we guessed that it would hard to attract enough members so the future lies in co-operating with all other groups to achieve the aims. We believe that work of such groups like the BMLSS and the Porcupine Society are essential for biological recording in the 21st century.

Uniform Resource Locators:

BMLSS (England)

URL=

<http://ourworld.compuserve.com/homepages/BMLSS/>

BMLSS (Scotland)

URL= <http://www.ed.ac.uk/~evah01/bmlss.htm>

SEABED MAPPING PROGRAMME IN THE IRISH SEA

In April this year, the Irish Government announced a 7 year programme aimed at mapping the entire Irish seabed area (ca. 850,000 km²) at a cost of 21 million Irish pounds. The programme will be under the direction of the Geological Survey of Ireland who propose to use the Irish National research vessel R.V. Celtic Voyager for the shelf area and a chartered vessel for the deep water Rockall Trough and Rockall and Hatton Banks. The core of the programme will be multi-beam sonar and geophysical (gravity and magnetic), geological, oceanographic and biological data sets will also be acquired. Processing of the geological and geophysical data will be carried out by Geological Survey staff whilst biological and oceanographic data will be contracted out to Irish third level educational institutes. Advice and expertise will also come from the Marine Institute and others within the state. Contractors will be invited to tender for the deep-water data acquisition part of the programme. For further information, contact Mr Deepak Inamdar (e-mail) or Mr Raymond Kcary (e-mail kcaryray@tcc.irlgov.ic).

OIL POLLUTION RESEARCH UNIT: LABORATORY CLOSURE

Members may be sorry to hear that OPRU's marine environmental laboratory and offices in Pembrokeshire are closing (indeed will have closed by the time you receive this newsletter). Cordah Limited, which owns OPRU and has its head office in Aberdeen, is relocating the business, facilities and staff to Penicuik, near Edinburgh. The laboratory closure is part of a restructuring process, due to changes in the requirements for environmental consultancy, both nationally and internationally.

The OPRU operation began in 1967, based at the Field Studies Council's Orielton Field Centre near Pembroke, where it carried out some of the earliest studies on the effects of oil pollution on the marine environment and developed many of the marine biological

survey and monitoring techniques still used today. Following this, it developed into many other fields and became a well established environmental consultancy. Cordah Limited acquired the Unit in 1996 and now plans to develop the business from its new Scottish base. A small Pembrokeshire outpost of the Unit will remain, in the form of Jon Moore (also Porcupine Treasurer), who will work from home.

Jon Moore, Ti Cara, Point Lane, Cosheston, Pembroke Dock, 01646 683679, jon@opru.co.uk

FIELD STUDIES COUNCIL COURSES

PORCUPINES may be interested to know that the Field Studies Council, (Registered Charity No: 313364) exists with the mission of providing "Environmental Understanding for All". In 1999 it offers over 600 Special Interest Courses based at 12 Centres in England and Wales, plus some 40 overseas Study Tours. Broad categories which may be of particular interest to **PORCUPINES** include: *Ecology and Conservation; Environment Training; Geology and Diving, and General Natural History.*

Several courses relate to **MARINE NATURAL HISTORY**, such as "Identifying Seaweeds", "Exploring the Seashore", "Diving the Skomer Marine Reserve and Pembrokeshire Islands" and "Identifying Seashore Invertebrates" at Dale Fort on the Pembrokeshire Coast.

"Fossicking on Rocky Shores" is a course on offer at nearby Orielton in Pembrokeshire. "The Seashore of Wales: its Natural History and Traditions" is based at Rhyd-y-creuau centre, also in Wales. "Exploring the Sea Shore: Marine Ecology and Identification", is available at Nettlecombe Court, Somerset. At Slapton

Ley in South Devon "Coastal Zone Planning and Policy", "Integrated Local Coastal Management" and "Intertidal Seaweeds" are courses on offer.

More **GENERAL** courses (without a specific Marine theme) include "First Aid for Remote Places", "Ecological Survey Techniques", "World of the Microscope", "Habitats and their Conservation", "Biological Recording Techniques", "Natural History Photography", "Biological Mapping with DMap" and "Recorder and DMap for Recorder".

Flatford Mill Field Studies Centre, Suffolk, offers **ACCREDITED** courses leading to **IDQs** (Identification Qualifications). These include their "Biological Surveying" courses, and "Masters Level Course in Environmental Education".

These are just a few of the excellent courses available from this well-established independent educational charity. Brochures detailing "Courses 99" and "FSC Overseas Experiences 1999" are obtainable from: FSC Head Office, Preston Montford, Montford Bridge, Shrewsbury, Shropshire SY4 1HW. Tel: (01743) 850674.

Helen Weideli



COPY DEADLINES

Copy for the newsletter can be sent at any time to Julia Nunn or Frances Dipper. Copy deadlines (for the Porcupine year up until the AGM in March) are as follows:

1st September

1st January

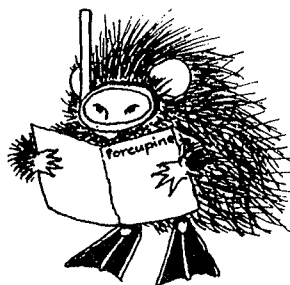
Please note that the next newsletter is likely to be a short one concerned mainly with further details of the Porcupine meeting in March 2000 and other Porcupine business. Short notes and news are welcome for this issue, preferably by September 1st but later copy may be accepted if short (and on disc). The 1st January deadline is for the next major newsletter which will include further papers from the last two Porcupine scientific meetings.

COPY INSTRUCTIONS

When sending copy to either Julia Nunn or Frances Dipper, please send both a hard copy and a disc, unless the text is very short. Illustrations are generally photocopied although new software will soon allow us to accept photos and illustrations on disc. At the moment these only work if they are .tif or .pcx files. Most common formats can be read but not Apple Macintosh files. If in doubt please ring FD before sending discs.

For those without computers or other technical aids I can type out short articles as long as I can read your writing!

PORCUPINE MEETINGS



Pembrokeshire Field meeting - October 23rd-24th 1999

Porcupine's annual field meeting is to be held in Pembrokeshire. A number of possible study sites of interest have been suggested. The front runners at the moment are:-

- The intertidal shores and caves at Barafundle, South Pembrokeshire - including a variety of limestone bedrock habitats, with extensive lower shore overhangs, widely recognised (in Pembrokeshire at least) as being extremely rich in species but which has not been fully described.
- The Pickleridge lagoon behind Dale Flats, near Dale, mid Pembrokeshire - a fairly large lagoon which is considered to be quite good, in a Welsh context (Roger Bamber, pers. comm.), but which has not been fully described. A small boat and remote sampling gear would be used to sample the more remote regions.

As usual, a primary aim of the meeting will be to collect samples and specimens, and then repair to a laboratory to spend time sorting and identifying material, with a view to the production of a species list for the site. The other primary aim will be to enjoy the company, sample the food and drink of Pembrokeshire and generally have a good

time.

Orielton Field Centre, near Pembroke, have offered laboratory space and facilities for the weekend. They can also provide B&B accommodation at very reasonable rates. Guest House accommodation is also available in Pembroke.

Would anyone who may wish to come to the meeting please let me know; preferably by the end of August so that I can gauge the level of interest.

Jon Moore, Tí Cara, Point Lane, Cosheston, Pembroke Dock], 01646-683679, jon@opru.co.uk.

PORCUPINE 2000. The Marine Natural History of the NE Atlantic Approaches to identification. Plymouth, 17th to 19th March 2000

The Porcupine Marine Natural History Society is pleased to announce that next year's spring meeting will be held in Plymouth and will run from Friday 17th to Sunday 19th March. Oral and poster presentations are being solicited which focus on all aspects of identification within the marine environment.

Confirmed presentations already include the following:

- Identification by volunteer recorders - National Biodiversity Network developments by MarLIN - Keith Hiscock
- Identifying marine biotopes - Bob foster-Smith
- Identifying conspicuous seabed species in site - a comparison of divers, cameras and ROV - Jon Moore
- The challenge of Identification at the National Marine Aquarium - Doug Herdson (National Marine Aquarium)

- Quality in taxonomy - Roger Bamber (Natural History Museum)
- Finding and identifying molluscs - Julia Nunn & Shelagh Smith
- Online exchange of electronic information - Mike Kendall (CCMS Plymouth marine Laboratory)
- Problems of identification in the Deep Sea - Gordon Patterson (Natural History Museum)
- Superceeding paper keys - Nigel Grist (Unicomarine)
- From morphology to molecules: New methods for assessing biodiversity - Alex Rogers (Southampton Oceanographic Centre)
- Abstracts (ca.500 words) in Word format, on disc or e-mail, to:
- Steve Widdicombe, Plymouth marine Laboratory, Prospect Place,

Plymouth, PL1 3DH
E-mail: S.WIDDICOMBE@PML.AC.UK

OTHER MEETINGS AND COURSES

Marine Biology Course, Nottingham University

2 year part time certificate in higher education in Marine Biology commencing September 1999 at Nottingham University. Meeting on Thursdays 19.00 to 22.00. Assessment is by course work.

The course carries 120 University credits (Level 1) which is the equivalent to the 1st year of a degree. There are no formal entry requirements, just an interest in the subject.

The course modules will cover: Life on the seashore

Life in the sea

The diversity of life

The animal kingdom

The ecology of the sea

Marine ecosystems

Exploitation and conservation of the marine environment.

The contact for a leaflet, details, etc is Heather Blackburn on 0115 951 3734, ce-ugs@nottingham.ac.uk or try www.nottingham.ac.uk/cont-ed.

The fees are quite high since the government removed subsidies but may be reduced for low income earners.

Conchological Society of Great Britain and Ireland Isles of Scilly marine field meeting. 23-30 September 1999.

Leaders: Tom and Celia Pain and Jan Light.

Porcupines are invited to join this field meeting, which is already well subscribed, and we look forward to an enjoyable and fruitful expedition. The object of the meeting is to visit a wide range of shores to obtain full coverage for the DOMMIC (Distribution of the Marine Molluscs in the Channel) mapping project. Although the details of the programme are not yet resolved, it is our intention to work three shores around Hugh Town on the first recording day, 24th September. Meet at the public conveniences on the green at the eastern end of the Town Beach, Hugh Town (SV 90451065) at 10.00 a.m. If for some reason you fail to make contact on the first working day, messages can be left for Tom and Celia Pain who are staying at the Star Castle Hotel, Hugh Town. If you are interested in coming along and/or need additional information email Jan at jan@aquamar.demon.co.uk or 'phone 01483 417782.

Underwater Photography Workshop - GOZO 2000

Paul Kay BSc (Hons) FRPS HSE Pt 4 - Photographer
Marine Wildlife Photo Agency

I intend to host an underwater photography workshop in conjunction with Calypso Diving of Marsalforn on Gozo (of the Maltese Islands). The location has been chosen because of its clear waters, easily accessible dive sites, plentiful subjects underwater - both wildlife and

scenic - and of course, the excellent services of Calypso Diving (a local BSAC/Padi school with seafront facilities).

The precise dates have yet to be finalised but are likely to be in late May to early June 2000. Although the weather can never be guaranteed this year (late May'99) it was very warm, and very sunny with calm clear seas.

This Workshop is aimed at anyone wishing to learn more about the techniques of underwater photography. It will be structured, but also be sufficiently flexible so that any specific areas of interest can be covered. Video will also be catered for and I would welcome some videographers

The techniques to be covered will include: Macro Photography, Lighting Techniques, Wide-Angle Photography, Balanced Light Photography (mixing flash and daylight), and Shooting with a Purpose. For Videographers, I intend that the week will result in them producing a short documentary. This will involve specific tasks and I will explain the techniques and methods to be used - a real challenge and very good way of disciplining the shooting.

In all there are places for 11 people available for this week. Costs are as yet to be finalised, but will cover flights, accommodation (self catering apartments I hope - this gives great flexibility) diving (6 days unlimited and unaccompanied), vehicle hire and photography/videography tuition. The only additional costs will be food and drink which is readily available within Marsalforn at reasonable prices.

The only prerequisites for the course are basic diving qualification (** or equivalent) diving experience (plus a reasonable number of open water dives) and ownership of the still or video camera to be used on the course. Ring me if you have any queries.

Paul Kay

Tel/Fax 00 44 (0) 1248 681361 or Mobile 00 44 (0) 402 411614
Email: paul@marinewildlife.co.uk or website <http://www.marinewildlife.co.uk>

2 Fron Pant, Pool Street, Llanfairfechan, North Wales LL33 0TW

34th European Marine Biology Symposium, The Azores (13-17 September 1999)

You are invited to attend the 34th European Marine Biology Symposium to be held at Ponta Delgada, The Azores, between 13-17th September 1999.

The host is the Department of Biology, University of the Azores and the main themes are:

Ecology and Evolution on Island Shores
The Open Ocean
The Deep Ocean
Open session (other topics)

Please submit Abstracts for oral and poster contributions, nominating your preferred topic, to meet the deadline of May 31st 1999.

Full details are available on the web site: <http://www.uac.pt/db/embs34>

Mail: 34th EMBS Secretariat, Department Biology, Marine Biology Section, University of the Azores, Rua da Mae de Deus 58, 9502 Ponta Delgada CODEX, The Azores, Portugal. Tel: +351 96 653044 (ext 1237), Fax: +351 96 653455, e-mail: embs34@alf.uac.pt

ECSA local meeting: The Estuaries and Coasts of South Wales.

Cardiff University 13-14th April 2000, with optional field trip on 15th April.
Contact: Dr Madeleine Havard, Continuing Education and Professional Development, Cardiff University, 38 Park Place, Cardiff, CF10 3UB. Tel: 01222 874133.

**New Directions in Marine Science
An Interdisciplinary Forum for Young
Scientists by Young Scientists**

30 September - 1 October 1999 at
Dunstaffnage Marine Laboratory

Guest speakers include Dr B J Bett -
Southampton Oceanography Centre

Presentations and Posters. Organised
for postgraduate students predominantly
in Scotland, Northern England and
Northern Ireland but all welcome

All correspondence and enquiries to:
Bhavani Narayanaswamy - and Steve
Craig -

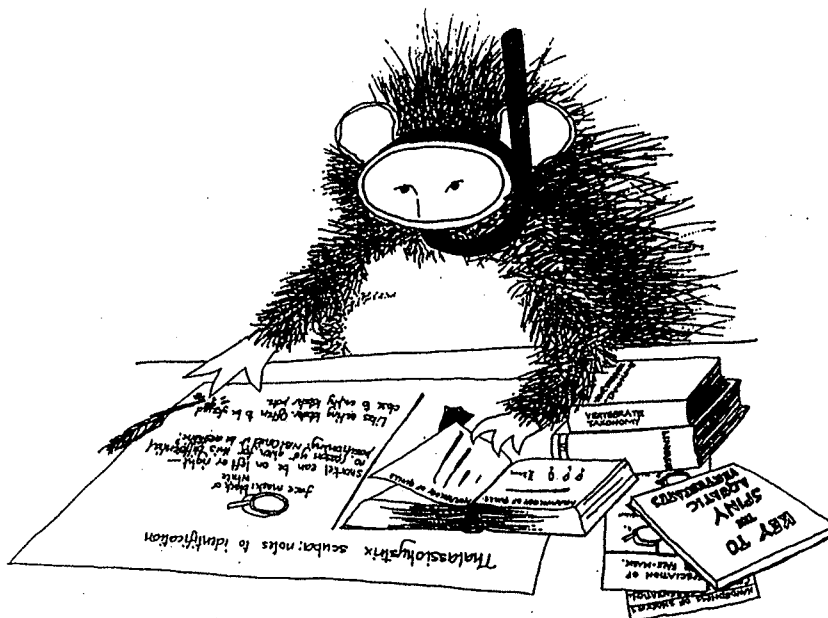
**Workshop on Introductory Coastal
Taxonomy**

Organised by the Estuarine and Coastal
Sciences Association, the UK National Marine
Biology AQC Scheme and the University
Marine Biological Station, Millport.

Venue: UMBS, Millport, Isle of Cumbrae
Date: 25th to 29th October 1999
Cost: Ca. £250 (all inclusive)

The workshop will cover the main benthic
organisms, zoo- and phytobenthos, in
intertidal and subtidal habitats and will involve
extensive field and practical laboratory work.

Contact: Dr T. Fernandes, Dept of Biological
Sciences, Napier University, 10 Colinton rd.,
Edinburgh EH10 5DT. Tel: 0131 455 2508.
E-mail:
t.fernandes@napier.ac.uk



MARINE BIODIVERSITY: CURRENT RESEARCH AND CONSERVATION MEASURES

Papers from the Porcupine Spring 1999 meeting held at Dunstaffnage Marine Laboratory on 19-21 March.

Since the production of a separate Porcupine journal has, for the moment, been put on hold (see editorial), authors of papers presented at the above meeting were invited to submit their papers for inclusion in this and subsequent newsletters. Due to the considerable length of this newsletter a number of papers already submitted have been held over until the next issue. These include:

Rostron, D.M. Temporal changes in Milford Haven Waterway

Nunn, J.D. The marine mollusca of Strangford Lough, Co.Down

Phorson, J.E. Ostracoda records for NE England

Papers from the Southampton meeting (April 1998), "The Biogeography of the north-east Atlantic", will also be published in following issues. Authors are invited to submit their manuscripts now to Julia Nunn or Frances Dipper. We apologise for the delay in publishing these papers.

The Echinoderms of the eastern Channel, Bristol Channel and Irish Sea

Jim Ellis

CEFAS, Lowestoft Lab., Pakefield Rd, Lowestoft, Suffolk, NR33 0HT

Echinoderms are often one of the most dominant invertebrate groups in many soft and hard bottom marine assemblages. The phylum contains representatives from a broad range of trophic groups, including detritivores, filter-feeders, grazers, scavengers and active predators, and as such echinoderms play an important role in the structure and organisation of many benthic communities. Additionally, echinoderms can:

- * Compete with commercially important demersal fish for food resources.
- * Predate on commercially important shellfish.
- * Provide an important food resource for some demersal fish.
- * Serve as useful biological indicators of pollution and physical disturbance.
- * Form the basis of commercial fisheries for food and marine curios.

Although the biogeographical ranges of echinoderms occurring in British waters have been well documented, estimates of relative abundance over broad geographical areas are lacking. Many benthic studies have collected samples on a localised spatial scale and have often used gears inappropriate for larger echinoderms. Grab samples are suitable for the sampling of infaunal brittlestars and burrowing urchins, however the larger epifaunal urchins and starfishes are better sampled by either diving census, dredge or beam trawl. The current study has monitored the benthic by-catch of groundfish surveys to describe the relative abundance, distribution and diversity of echinoderms over extensive regions of the eastern English Channel, Bristol Channel and Irish Sea. Biological material was collected with a 4-metre beam trawl, which was deployed at 200 sites and with tows of approximately 30 minutes

duration. The results of these studies are summarised as follows:

- * Echinoderms accounted for approximately 29% (by biomass) of fauna captured in the 4-m beam trawl. The mean catch per unit effort of echinoderms ranged from 0.8-kg hr⁻¹ in the north-eastern English Channel to 329-kg hr⁻¹ in the southeastern Irish Sea.
- * Twenty-four echinoderm species were recorded, including 12 species of starfishes. The most frequently encountered species were common starfish *Asterias rubens*, shore sea urchin *Psammechinus miliaris*, sand star *Astropecten irregularis* and the brittlestar *Ophiura ophiura*.
- * The biomass of echinoderms was dominated by *Asterias rubens* and the common brittlestar *Ophiothrix fragilis*.
- * Many echinoderms have been noted to aggregate and maximum catches (numbers hr⁻¹) ranged from approximately 2.4 million for *Ophiothrix fragilis*, 114,000 for *Ophiura ophiura*, and 46,000 for *Asterias rubens*. Aggregations of adult echinoderms have previously been related to the local abundance of food, reproductive requirements, defensive behaviour and increased efficiency of filter feeding.
- * The echinoderm fauna was most diverse in the St. George's Channel and western Irish Sea (6.7-7.0 species haul⁻¹). In contrast, the echinoderm fauna of the northeastern English Channel was generally less diverse (1.9 species haul⁻¹).
- * The largest catches of *A. rubens* occurred in inshore waters less than 20 metres in depth. *Astropecten irregularis*, the sea potato *Echinocardium cordatum* and *Ophiura ophiura* were also more abundant in shallower areas (depth < 25

metres).

- * The goose-foot starfish *Anseropoda placenta*, common sunstar *Crossaster papposus*, Bloody Henry starfish *Henricia oculata* and common sea urchin *Echinus esculentus* were more abundant in deeper waters, and the number of species of echinoderm recorded per haul increased significantly with depth.
- * Several species of echinoderm had similar patterns of distribution and relative abundance. For example, *Ophiura albida*, *Ophiura ophiura*, *Asterias rubens*, and *Echinocardium cordatum* occurred primarily in coastal waters, whereas *Crossaster*

papposus, *Ophiothrix fragilis*, *Henricia oculata* and *Anseropoda placenta* occurred in deeper waters.

- * Both depth and type of substrate were determined to be important factors affecting the distribution of echinoderms.



Lag Veneer: a missing piece in the benthic biotopes jigsaw?

Ivor Rees (NB Not presented at Oban meeting)

School of Ocean Sciences, University of Wales Bangor, Menai Bridge, Anglesey,
LL59 5EY

The term 'lag' is widely used, in the geological context, to refer to the thin layer of coarser debris left at an unconformity after the finer components of previous deposits have washed away. Lag, which also armours underlying strata against erosion, may be derived from the eroded deposit or from other sources. The term also includes biogenic materials as in the case of a shelly lag, where large bivalve shells and fragments of them lying on the surface in tide swept areas shelter muddy sands underneath. The contention made here is that ecological classifications ought to treat lag dominated seabed areas as a relatively distinct primary category. In the past these types of seabed have often been regarded as inconvenient mixtures, somehow to be fitted into divisions based on an initial dichotomy between rock and sediment biotopes.

For at least the last 100 years, each

passing generation of benthic ecologists has adopted slightly differing approaches to classifying marine benthos. The terminology of habitats, communities or biotopes may have varied, but a need to categorise nodes on the ecological continua remains. The history of classification schemes shows how each was influenced by the range of experience of the authors and particularly by the equipment used to gain information about the seabed. A review of past classification schemes for NW European seas was recently prepared by Hiscock (1998), as background to the Marine Nature Conservation Review

Not including the zonation schemes for rocky shores, most of the classification schemes were until recently derived from impressions of the seabed gained by remote sampling with grabs or dredges. Classification schemes from Petersen (1915) onwards usually concentrated on the near level extensive offshore seabed sediments, these being amenable to sampling by grabs from research vessels. Until marine

conservation and scientific diving entered the equation little consideration was given to the fringe habitats and especially those situations where the rocky substrata of the shore happen to extend below low water. Just as grab sampling leads to emphasis on the soft sediment infauna so descriptions of benthic biotopes gained by diving tend to be coloured by the visual impacts made by the larger epifauna.

A third suite of methods is increasingly being used to help give insight in the area of overlap between the above two approaches to biotope description. These are the methods that employ remote cameras, video and acoustic ground discrimination systems. In the case of AGDS and side-scan sonar they allow heterogeneous habitats with complex mosaics to be into coherent context. Relative to remote physical sampling the imaging methods also allow useful information to be gained in situations where the ground is both too hard to sample effectively by grabs and where it may also be beyond the depth range most divers can routinely work to.

To understand the argument why lag veneers may merit treating as a distinct class of biotope, it is worth considering some very simplistic concepts. The first of these is that in still water mineral and biogenic particles naturally settle out, so ocean and shelf sea basins are mainly floored by sediments. This is the case unless the supply of sediment is very limited, slopes are very steep or waves and currents continually sweep the sediment away (cf. comments by the Walrus to the Carpenter). An equally important second concept is that the forces capable of sweeping harder substrata clear of fine sediment fluctuate markedly with time. The temporal scales on which conditions change range from the geological to semi-diurnal in the case of tides. It is generally in the longer term that events associated with glaciations and sea-level change have particular importance in creating lag dominated seabed.

Over very extensive areas of NW European

shelf seas, including most of the Irish Sea, the underlying solid rocks were overlain by deposits of glacial till and peri-glacial outwash deposits when sea levels were much lower than at present. Ice rafting also served to carry boulders, cobbles and other coarse materials well beyond the limits reached by the permanent ice-sheets. Surf zone erosion and reworking of the heterogeneous glacial deposits took place as relative sea levels subsequently rose. In many places clay and sand washed away leaving a veneer of boulders, cobbles and gravel armouring the till against further erosion. In large areas of the Southern Irish Sea with strong tidal currents and especially towards bed load parting zones (Stride, 1963) much of the seabed at depths from LW to over 100 metres still lacks significant cover of recent sediments. The main influences now on these relict "lag veneer" habitats are probably scouring by sand carried as bedload and biological activity in the form of both biodeposition and bioturbation in the spaces between the stones and underneath them.

Typically the Irish Sea lag veneers appear on seabed photographs as having mainly sand scoured well embedded cobbles and gravel with shelly coarse sand packing the spaces between the stones. For examples see Plates 4a and 4c in Mackie *et al* (1995). Only where the slightly larger boulders stand a bit proud of the surrounding "pavement", though still being well embedded, do the stones carry crusts of serpulids, and barnacles. What is visible may however be regarded as only the outer stratum of a structurally complex biotope. When actual samples are obtained from such hard ground, the cobbles are often found to have a rim of *Sabellaria spinulosa* round them that helps to cement the "pavement" together. This forms a second stratum to the biotope. Next there tends to be a range of organisms that manage to live in the sediment packed into the crevices between the cobbles. This often includes *Glycymeris glycymeris*, the edge of whose shells can sometimes be seen on photographs just showing at the sediment surface. Underneath the outer armouring,

the *Sabellaria* concretion and the coarse outer crevice wedged material there is often a fourth stratum of heterogeneous muddy, gravelly sand holding a fauna with a diversity that belies the superficial rather barren appearance of the bed. Some of this infauna seems to slightly penetrate the stiff clay of the till itself, so that the muddy matrix may be formed from a mixture of fines trapped from outside the sediment and bioturbated material from the underlying clay. These lag veneer biotopes may thus often be much more complex than superficial impressions indicate.

It is from consideration of the distinct structural complexity, based on a combination of seabed images and actual samples as they appear when first brought on deck that lag dominated seabeds are put forward as meriting a distinct category in biotope classifications. Areas with lag veneers of various sorts are far too widespread in NE Atlantic shelf seas at the present day for them to be dismissed as merely as mixtures. In their species lists they may share commonly occurring taxa with both true rock and active sediment biotopes, but they do not really conform to either. Acknowledgement that the lag biotopes are sufficiently distinct to merit their own broad category of their own

Like the true rock biotopes the surface of lag is largely swept clear of loose superficial fine sediment, but it also has the infauna characteristic of sediment biotopes beyond that to be found just in crevices. It is sometimes overlooked that when Jones (1950) created his classification he noted the influence of relict features on the species composition offshore communities. Like a crucial piece in a large jigsaw puzzle, recognition of a place for lag veneer biotopes may allow the true sediment and the true rock biotopes to fit more comfortably together into a common classification scheme such as that developed for the MNCR by Connor et al (1997).

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Abundance and Distribution of Macrobenthos in the Faeroe-Shetland Channel

by

B E Narayanaswamy , J D Gage¹, P A Tyler² and J P Hartley³

¹ SAMS, Dunstaffnage Marine Laboratory, P.O. Box 3, Oban, Argyll, PA34 4AD, UK

² School of Ocean and Earth Science, Southampton Oceanography Centre, European Way, Southampton, SO14 3ZH, UK

³ Hartley-Anderson Ltd. Blackstone, Dudwick, Ellon, Aberdeenshire, AB41 8ER, UK

Introduction

The Færoe-Shetland Channel has a highly complex and variable environment owing to its unusual hydrographic regime. The channel is the convergence point for five bodies of water, each with different ranges of temperature and salinity.

The channel is situated between the Færoese plateau and the Scottish continental shelf. To the south-west, Atlantic water flows into the channel across the Wyville-Thomson Ridge and also through the Færoe-Bank Channel. To the north-east, the channel is connected to the Norwegian Sea through which Norwegian Sea Deep Water enters.

Although the Færoe-Shetland Channel was the site of some of the earliest sampling of the deep-sea bed, overall, little benthic biological work has been undertaken in the Channel compared to work on the physical oceanography which spans over 100 years. The Færoe-Shetland Channel forms part of an area of the U. K. continental margin, now licensed for oil/gas exploration and called the Atlantic Frontier. The present research work is investigating the physical and chemical parameters influence the abundance and distribution of the macrobenthos.

Methods

The samples were collected aboard the R. S. *Charles Darwin* during the Atlantic Margin Environmental Survey (AMES) in July/August 1996 and was commissioned by the Atlantic Frontier Environmental Network

(AFEN). Fifteen stations of the AMES survey along a bathymetric transect in the Færoe-Shetland Channel, and ranging from 150 m – 1000 m depth, are investigated in the present study. Three sampling gears were used, the Megacorer, the USNEL Box corer and the Day grab, in this order of preference owing to problems encountered with the different sediment types. The Megacorer and box corer worked well in the deeper, soft mud sediments while the Day grab was used for the sandy sediments occurring at the shallower stations. The samples were sieved through 500 µm and 250 µm mesh stacked sieves, and the resulting residues preserved in formalin.

The sorting, counting and identifying of the >250 µm<500 µm samples have been undertaken by myself. A flotation technique involving Ludox was used in order to remove the fauna from the sediment. The fauna were sorted and counted into four main groups, annelids, molluscs, crustaceans and echinoderms. The remaining fauna was labelled as 'Other'.

Results - Abundance

Although I am interested in the macrofauna as a 'whole', before I amalgamated the two data sets I decided to look at each fraction independently. This was to see if there were any trends, and if so, did the same trends appear in both size fractions. The answer to which is, yes there were some trends and they were different in the two fractions.

With regards to the smaller fraction, the

abundance of macrofauna appears to decrease with increasing depth. The greatest number of individuals is found at the shallowest station. In the >500 μm fraction abundance increases with increasing depth to around 800 m, and thereafter decreases. Combining the two fractions found little difference between the picture seen for the total and that of the >500 μm fraction. Peaks in abundance were observed at 150 m, 250 m, 550 m and 700 m.

Discussion

Abundance in both size fractions correlates well with depth, but negatively with respect to the smaller size fraction and positively with the larger fraction. The combination of the two results cancels each other out. Both fractions also correlated significantly with maximum water temperature recorded. Peaks in abundance in the >250 μm <500 μm fraction appeared to also tie-in with coarser sediments. As depth increased the sediment grains became finer, and this could be one explanation as to why abundance in the smaller fraction decreases with depth. Decreasing density of macrofauna with increasing depth has been observed in other deep-sea areas (Thiel, 1975). The body size of individuals is also thought to decrease with increasing depth (Sanders *et al.*, 1965; Carey, 1981; Smith and Hinga, 1983). However, Smith and Hinga (1983) also found that macrofaunal size can increase with depth, whilst Polloni *et al.* (1979) found that it did not vary with depth. Different taxa exhibit different trends with depth, which could account for the varying conclusions reached regarding macrofaunal size and depth.

Etter and Grassle (1992) found that variability of species diversity seemed to be linked to sediment characteristics. However, irrespective of how strong the correlation between the two parameters is, this need not imply causality. With regards to sediment grain size, increasing numbers of burrowing macrofauna may re-distribute the

sediment of specific size classes (Etter and Grassle, 1992).

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The Loch Linnhe Artificial Reef

Tom Wilding

Dunstaffnage Marine Laboratory, P.O. Box 3, Oban Argyll, PA 34 4AD

Artificial reefs are man-made structures, placed on the seabed, in order to simulate a natural reef in some way. They are used world-wide for a variety of purposes including sea defence, habitat protection and to form the basis for sustainable aquaculture. Early artificial reef projects tended to use, amongst other materials, redundant cars, tyres, railway carriages and decommissioned oilrigs and platforms. The short life span of many of these materials, associated pollution problems and the perception of reef construction as an excuse for dumping (in contravention of international conventions) has limited their use within Europe. In the UK, the main construction materials used are natural aggregates and concrete and range from the 210,000 tonne Torness sub-tidal sea defence system to the 50 tonne experimental Poole Bay reef.

Foster Yeoman Ltd operates a granite quarry on the Morvern Peninsular, south west of Fort William, and produces a range of granitic aggregate products. Processing of the primary material (from the quarry face) generates considerable quantities of dust. Fractions of this material, which currently have a low value, pose a disposal problem. Research in 1996, funded by the Argyll Marine Resource Initiative (MRI) (Wilding & Sayer, 1996), identified cheap construction materials as an essential prerequisite for economically viable artificial reefs on the west coast of Scotland. In 1997 Foster Yeoman Limited funded further research (Wilding & Sayer, 1997) which concluded that the quarry by-products could be used in the manufacture of concrete blocks suitable for use in the construction of an artificial reef. During this phase of research, contacts were initiated with the Mallaig and North-West Fishermen's

Association and, following discussion, possible sites identified and subsequently surveyed. A site on the east side of the isle of Lismore appeared to meet the appropriate criteria, with depths ranging from 10-30 metres. Lines of communication were established with local static gear fishermen and Lismore residents.

Reefs are an essential and fundamental part of marine ecosystems and research into natural reefs and their associated flora and fauna has been conducted at the CCMS-DML1 for many years. However, natural reefs are difficult to study because of their highly variable nature meaning that relating cause to effect is difficult. Artificial reefs facilitate research by eliminating much of the variation associated with natural reefs. In addition, they offer the potential for controlled and managed static gear fishing and the proposed reef will demonstrate this potential at an experimental level that is relevant to the scale necessary for commercial ranching. The proposed reef will consist of twenty four 2000 tonne modules arranged in varying patterns, in order to establish which reef design is superior for any given parameter under investigation including lobster production. Modules will be made up of small blocks of two designs; one solid and one with voids, providing different degrees of habitat complexity and refuges for mobile species.

Lochaber Limited, Argyll and the Islands Enterprise, Foster Yeoman Limited and CCMS-DML with matching funds from PESCA, have funded the current pre-deployment research for the period May 1998 to April 2000. The objectives of this phase are to:

- develop and maintain dialogue with local

- site users and people;
- characterise the proposed deployment area;
- demonstrate the physical and chemical integrity of the proposed construction materials;
- obtain the necessary licences and consents.

The Loch Linnhe Artificial Reef will be one of the largest experimental artificial reefs in the world and will be a unique facility likely to attract international scientific and commercial interest. It will assist in our understanding of fundamental issues relating to the development and maintenance of biological communities and marine biodiversity. In addition it will address the scientific and socio-economic issues associated with sustainable fisheries management and the environmental effects of marine construction projects.

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CCMS-DML * Centre for Coastal and Marine Science * Dunstaffnage Marine Laboratory

Biotopes in Loch Creran, Argyll

Robin Harvey

Dunstaffnage Marine laboratory, P.O. Box 3, Oban, Argyll, PA34 4AD

Loch Creran is a fully marine sea loch, draining into the upper Firth of Lorn near Oban via a narrow entrance sill of around 4 m mean depth. There are two main basins, the upper connecting to the lower through the Creagan narrows with a mean depth of only 2 metres. Depths within the lower basin reach almost 50 m, and the upper 36 m. The loch has a long history of human activity, ranging from oyster culture in the 19th century, to seaweed processing, salmon farming and renewed oyster culture in the 20th century. Perhaps the most fascinating feature of its flora and fauna is the presence of large erect colonies of the serpulid worm *Serpula vermicularis*. At one time these could be found at low water of spring tides, but in recent decades they appear to have died out at this level, although they are still common in the sublittoral. The worm colonies effectively create small reefs, which are most abundant at depths of 3-13 metres on an otherwise muddy bottom scattered with lamellibranch shell fragments. A variety of sessile organisms use the colonies as a perch, including bryozoans, ascidians and sponges, while motile species include crinoids, *Psammechinus miliaris*, *Ophiothrix fragilis* and many amphipods. It appears that Loch Creran is now the only known locality in the UK for this particular growth form of *Serpula*, as it has not been seen alive at a site in Loch Sween, Argyll (Bosence, 1973) for some years. The only other reported localities in the World are in some inlets on the west coast of Ireland (Minchin, 1987; Ten Hove, H.A. & Van den Hurk, P., 1993).

Studies of the distribution of *Serpula* and other species in L. Creran have been conducted since the 1980's by a group led by Colin Moore of Heriot Watt University (Moore et al., 1998). They found that reefs

up to 60 cm high and covering over 10% of the seabed occurred in a band around the loch, which was best developed along the southern shore of the lower basin. The distribution was discontinuous, with a 1 km stretch of seabed around the effluent pipe of a seaweed processing factory being devoid of all macrofauna. Here, the sediment surface was covered by mats of the bacterium *Beggiatoa*, indicating organic enrichment. The presence of serpulid reefs was an important factor in establishing the loch as a Marine Consultation Area. This designation requires users of the loch to consult with Scottish Natural Heritage (SNH) before proceeding with any potentially harmful development. In 1998, SNH contracted the Dunstaffnage Marine Laboratory (DML) to carry out a much broader survey of biotopes in the whole of L. Creran. Acoustic surveys of bottom hardness and roughness were completed using the RoxAnnTM system installed on the DML vessel RV Seol Mara. The maps generated were then used to plan a programme of ground-truthing, using diving, grab sampling, Remotely Operated Vehicle (ROV) with video, and a simpler video camera system. This survey confirmed that the best developed reefs are restricted to the lower basin, where, coincidentally, the majority of the industrialisation of the loch has occurred.

Serpula vermicularis reefs feature in a series of UK Biodiversity Action Plans for marine habitats and species, due to be published in the summer of 1999. In addition to the *Serpula* reefs, the survey determined the distribution of several other biological features in the loch, which are the subject of Biodiversity Action Plans:

* Soft mud habitats with sea pens such as

Virgularia mirabilis and *Pennatula phosphorea*, and the spectacular fireworks anemone *Pachycerianthus multiplicatus*. These occur in both basins of the loch, with the least disturbed examples occurring in the upper basin. This is inaccessible to fishing boats, as the tidal narrows at Creagan are little more than 1 m deep, and the bridge spanning the narrows is too low to allow clearance for boat masts.

* Beds of the horse mussel *Modiolus modiolus*, which are best developed at the western end of the upper basin.

* Tidal rapids at the entrance to the loch, and at the Creagan narrows leading to the upper basin.

There are also *Zostera* beds along the northern shore of the main basin. These have apparently declined significantly during this century, but were not examined in detail during the present survey.

Traditional fishing activities in L. Creran are largely restricted to some creeling for *Nephrops* in the lower basin. Scallop trawlers have occasionally operated in this area, with the potential for severe damage to the serpulid reefs and muddy habitats. Mooring chains from boats have a similar effect, though on a smaller scale (Moore *et al.*, 1998). There are a number of popular dive sites around the loch, providing sheltered water and colourful underwater scenery, with the added interest of a possible meal of queen scallops! One of the UK Sea Life Centres is located on the southern shore of the loch, providing a popular attraction for the many tourists visiting the area.

The outbreak of Infectious Salmon Anaemia at some west coast sea farms has affected activities on the loch, with all farms currently being 'fallowed' for a period of 6 months. There was, however, no indication that salmon farming

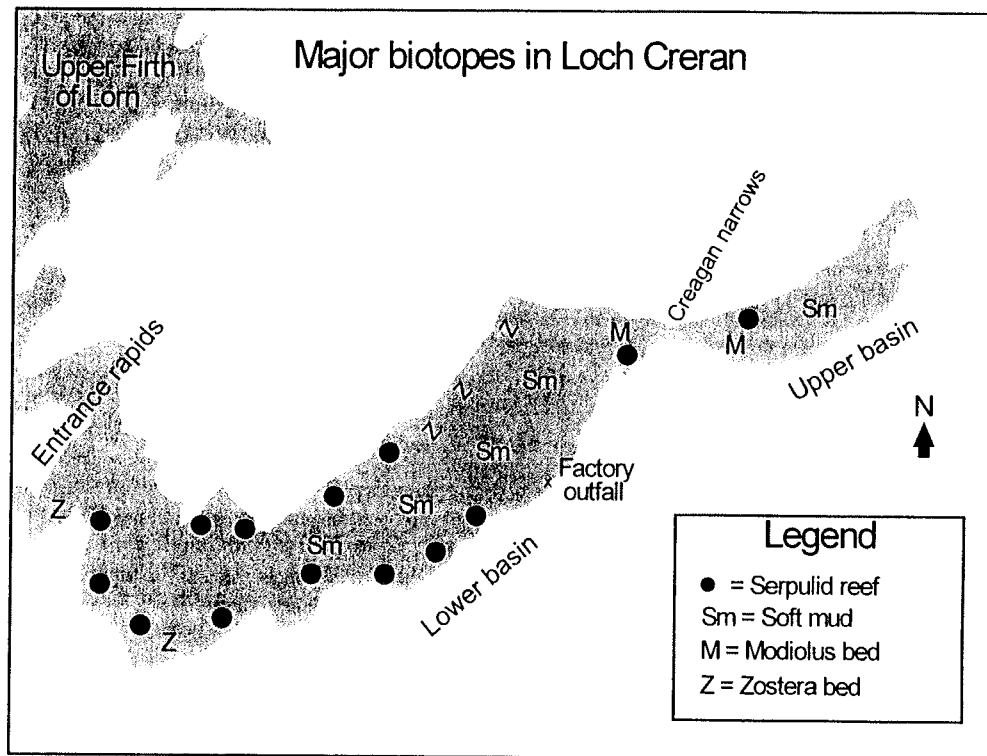
activities had adversely affected the serpulid reefs, as most farms are located in water depths greater than those which support the reefs (Moore *et al.*, 1998). The temporary cessation of fish farming activities will help to reduce organic loadings in the vicinity of fish cages, and research is underway at DML to investigate the timescale for recovery of the seabed fauna following the cessation of organic inputs at other farm sites.

Clearly, Loch Creran is one of our most interesting sea lochs, with the best examples of serpulid reefs in the World, and a wide range of habitats and species within a relatively small and accessible area. Given the high scientific, industrial and amenity interest in the loch, it is desirable that some form of management forum be established for it. This need not necessarily be statutory e.g. an EU Special Area of Conservation (SAC), but could be along the lines of the Voluntary Marine Conservation Areas which have been established elsewhere. Naturally, L. Creran will figure prominently in the marine section of the Argyll & Bute Local Biodiversity Action Plan, which is now under development. The rich marine life in the waters of Argyll and Bute has now been further recognised in a proposal for a possible SAC covering the area from the north end of the Isle of Jura to the Isle of Seil. This has exceptionally well developed examples of communities in strong tidal streams, and includes the famous Gulf of Corryvreckan.

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The sublittoral marine Mollusca in Loch Sunart

Julia D. Nunn (NB Not presented at Oban meeting)

Cherry Cottage, 11 Ballyhaft Rd, Neutownards, Co. Down, BT22 2AW

Introduction

Loch Sunart is a long fjordic inlet that lies between Ardnamurchan and Morwen at approximately the midpoint of the Scottish west coast. It is about 31km long, with a maximum depth of 124m below Chart Datum. The loch system contains many different marine and brackish habitats, as it is subject to a wide variety of exposures, current, wave action and salinity. Physical conditions and human influences present in loch are discussed in detail in Davies (1990), and summarised in Davies & Connor (1993).

The loch has been widely dived both by Marine Nature Conservation Review (MNCR) teams (Davies, 1990; Davies & Connor, 1993; Howson, 1996) and by amateur divers (Mackinnon & Lumb, 1988) taking part in a programme of Seasearch Phase I surveys. During a Seasearch week of diving in Loch Sunart in October 1997 (Seasearch, 1997), the molluscan fauna was studied in detail by the author.

Methods

The overall aim of the survey team was to carry out Seasearch Phase I recording at both previously visited and new sites in Loch

Sunart. The divers comprising the team were all unpaid volunteers, although an MNCR team boat was made available. Independently of this enterprise, the author carried out a project to extend knowledge of the presence and distribution of marine Mollusca in the sublittoral habitats of Loch Sunart. Sites were selected by the survey team leaders Angela Williams & Mark Woomb's using relevant charts, taking into consideration the prevailing weather conditions, and in conjunction with other members of the team, especially those who had previously dived the area. The area surveyed within Loch Sunart was principally near the western entrance, although a wide variety of habitats was sampled (see Figure 1).

All Mollusca observed during each dive were noted. Samples of molluscs, algae, bryozoans, hydroids etc. were removed from each dive site in plastic bags. The samples were laid out in trays and left for a few hours and then overnight in still sea water. As the water deoxygenated and

warmed, opisthobranchs, and small molluscs left the cover of the habitat and moved to the surface of the water where they were easily seen, removed and identified. The samples were then soaked in freshwater for 3 hours or more, shaken and removed from the water. Detached Mollusca in the freshwater were collected and preserved in 70% alcohol. A list of species was prepared for each site on a presence basis only.

All 11 dives discussed here were undertaken by the author (JDN) and Graham Day (GVD). All samples were taken by JDN. Occasional records, confirmed by JDN, were noted by GVD. Identification of molluscan species was principally by the author. The identification of a number of difficult species was confirmed by Shelagh Smith (*Pyramidellidae*, *Raphitoma purpurea*, *Parvicardium* spp., *Nucula nucleus*, *Abra alba*, *Mya truncata* juv.) or Bernard Picton (*Adalaria proxima*, *Onchidoris bilamellata*).

Eleven sites were surveyed in October 1997, which are listed in Table 1, and shown in Figure 1. Depths are uncorrected for Chart Datum.

Table 1: Sites surveyed in Loch Sunart

No.	Name	Latitude/Longitude	max. depth		date	type
			JDN	GVD		
1	South of Silverhill, Glenmore Bay	56° 40.85'N 05° 55.63'W	9.9m	9.7m	26.10.97	S
2	South of Rhubha Bhuailte	56° 42.22'N 05° 47.04'W	13.3m	14.6m	26.10.97	S
3	Auliston Point (E)	56° 39.05'N 05° 59.60'W	15.1m	25.0m	27.10.97	B
4	Sligneach Beag (S)	56° 40.17'N 05° 59.53'W	14.2m	18.9m	27.10.97	B
5	Sgeir a Choir, West Risga	56° 40.30'N 05° 54.60'W	20.2m	25.6m	28.10.97	B
6	East Oronsay	56° 39.86'N 05° 54.60'W	12.5m	12.6m	28.10.97	B
7	Laudale Narrows: Glas Eilean	56° 40.81'N 05° 39.92'W	11.2m	10.9m	29.10.97	B
8	Pinnacle, W of Rubha Aird Earraich	56° 42.05'N 05° 45.06'W	14.6m	17.9m	29.10.97	B
9	SE Rubha Aird Shlignich	56° 40.53'N 05° 58.13'W	15.8m	22.8m	30.10.97	B
10	NE Sligneach Mor	56° 40.25'N 05° 58.65'W	15.1m	26.8m	30.10.97	B
11	NE Oronsay	56° 40.14'N 05° 55.40'W	14.4m	19.5m	31.10.97	B

S = shore dive B = boat dive

Results

The present survey by the author, has increased the number of new molluscan species recorded from Loch Sunart by the 32 species shown in Table 2A, to a total of 141 in the sublittoral (based on available reports). Two other species new to Loch Sunart were recorded by other members of the Seasearch survey team (Seasearch, 1997) (Table 2B).

Eighty three species in total were recorded by the author together with 22 shells, of which 11 represent possible future new live records (Appendix 1). Ten species, normally found in the littoral, have been recorded from the sublittoral for the first time (Table 2C). This work has also added substantially to the distribution of previously recorded species. 177 species have now been recorded from the area at all depths by all workers.

Four new Sea Area records (SA 29) have been added to the Sea Area atlas: *Raphitoma purpurea*, *Onchidoris depressa* (live, post-1950) and *Doto koenneckeri*, *Doto lemchei* (new live) (Seaward, 1990). The latter two species (*Doto koenneckeri*, *Doto lemchei*) may be new records for Scotland, but this would require further research to confirm.

There were dense beds of *Limaria hians* at Site 7, but the molluscan community was relatively impoverished, supporting only 13 species in total. Sites 6 and 8 were dominated by brittlestar beds and were also impoverished for Mollusca (11 and 8 species respectively). Sites 2-5 also were relatively poor for Mollusca (14-19 species). By contrast, the remaining four sites were rich in molluscan species (sites 1, 9, 10, 11), each containing 29-31 species

An unusual association recorded between several species of pectinid was not seen (Davies, 1990). The species *Palliolium*

Table 2A : Marine Mollusca new to Loch Sunart (this survey)

<i>Tricolia pullus</i>	<i>Margarites helcinus</i>	<i>Jujubinus montagui</i>
<i>Lacuna parva</i>	<i>Rissoa interrupta</i>	<i>Rissoa lilacina</i> var. <i>rufilabrum</i>
<i>Alvania beanii</i>	<i>Pusillina sarsi</i>	<i>Lamellaria latens</i>
<i>Lamellaria perspicua</i>	<i>Raphitoma linearis</i>	<i>Raphitoma purpurea</i>
<i>Doto koenneckeri</i>	<i>Doto lemchei</i>	<i>Doto tuberculata</i>
<i>Goniodoris castanea</i>	<i>Onchidoris bilamellata</i>	<i>Onchidoris depressa</i>
<i>Onchidoris muricata</i>	<i>Adalaria proxima</i>	<i>Polycera quadrilineata</i>
<i>Jorunna tomentosa</i>	<i>Coryphella verrucosa</i>	<i>Cuthona amoena</i>
<i>Cuthona caerulea</i>	<i>Cuthona foliata</i>	<i>Cuthona viridis</i>
<i>Facelina auriculata</i>	<i>Nucula nucleus</i>	<i>Modiolarca tumida</i>
<i>Musculus discors</i>	<i>Parvicardium ovale</i>	

Table 2B : Marine Mollusca new to Loch Sunart (Seasearch, 1997)

<i>Diodora graeca</i>	<i>Tritonia hombergii</i>
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Table 2C : Marine Mollusca first recorded in sublittoral in Loch Sunart (this survey)

<i>Emarginula fissura</i>	<i>Skeneopsis planorbis</i>	<i>Rissoa parva</i>
<i>Alvania punctura</i>	<i>Onoba semicostata</i>	<i>Capulus ungaricus</i>
<i>Hinia incrassata</i>	<i>Elysia viridis</i>	<i>Kellia suborbicularis</i>
<i>Venerupis senegalensis</i>		

striatum and *Pseudamussium septemradiatum* were not recorded, possibly because they live in Loch Sunart at a greater depth than available to the author, or the relevant sites were not dived. The other species of pectinid were observed, but not in a distinct community.

A checklist of the marine Mollusca in Lochs Sunart and Teacuis has been compiled with comments and maps of the distribution which is available from the author.

Notes on selected species

***Jujubinus montagui* (W Wood, 1828)**

A single specimen on stones lying on coarse muddy gravel between boulders. Few records in the JNCC MNCR database, mainly from Scotland & SW England.

***Lacuna vincta* (Montagu, 1803)**

Apparently restricted to the entrance to Loch Sunart.

***Rissoa lilacina* var. *rufilabrum* Alder, 1844**

This was the commonest small mollusc in the samples from the western entrance to Loch Sunart. A northern and western species in Scotland and Ireland. Few records in the JNCC MNCR database, all from Scotland.

***Alvania beanii* (Hanley in Thorpe, 1844)**

An uncommon species - there are only a few records from the west coasts of Ireland and Scotland.

***Capulus ungaricus* (Linnaeus, 1758)**

An uncommon species, usually found attached (as in this case) to large specimens of *Modiolus modiolus*. Probably widespread around Loch Sunart, wherever there are mature beds of the horse mussel. Few records in the JNCC MNCR database, all from Scotland.

***Raphitoma linearis* (Montagu, 1803)**

Occasional on red algae. Probably more widely distributed on the west coast of Scotland than currently known. Few records in the JNCC MNCR database, scattered throughout the British Isles.

***Raphitoma purpurea* (Montagu, 1803)**

A rarely found species. A single specimen was found under a boulder. Few records in the JNCC MNCR database, from Scillies, Cornwall, Dart, Loch Inshort. It has also been found by the author at several sites in Ireland. A new, post-1950 Sea Area 29 record (Seaward, 1990).

***Elysia viridis* (Montagu, 1804)**

Common where found, but its usual food *Codium* spp. was absent at all these sites.

***Doto hystrix* Picton & Brown, 1981**

Found on its obligate food source *Polyplumaria frutescens*.

***Doto koenneckeri* Lemche, 1976**

A new live record for Sea Area 29 (Seaward, 1990). Possibly a new record for Scotland.

***Doto lemchei* Ortea & Urgorri, 1978**

Few records in the JNCC MNCR database, mainly from Ireland. A new live record for Sea Area 29 (Seaward, 1990). Possibly a new record for Scotland.

***Goniodoris castanea* Alder & Hancock, 1845**

An uncommon species. Few records in the JNCC MNCR database, scattered throughout the British Isles.

***Onchidoris depressa* (Alder & Hancock, 1842)**

Feeds on encrusting bryozoans. Often overlooked because of its cryptic nature. Few records in the JNCC MNCR database, mainly from Scotland. A new live post-1950 record for Sea Area 29 (Seaward, 1990).

***Onchidoris muricata* (O F Muller, 1776)**

Common on *Laminaria hyperborea* at depths 2-5m.

***Adalaria proxima* (Alder & Hancock, 1854)**

Single pale yellow specimen on *Laminaria hyperborea* in 5m.

***Coryphella lineata* (Loven, 1846)**

A common species at the western entrance to Loch Sunart.

***Cuthona foliata* (Forbes & Goodsir, 1839)**

Uncommon species, probably overlooked. Few records in the JNCC MNCR database, mainly from Scotland.

***Cuthona viridis* (Forbes, 1840)**

Uncommon species, probably overlooked. Few records in the JNCC MNCR database, mainly from Scotland and Northern Ireland.

***Modiolus modiolus* (Linnaeus, 1758)**

Common species in mature beds amongst small boulders on the sublittoral sediment slopes of Loch Sunart.

***Limaria hians* (Gmelin, 1791)**

Dense interwoven nests at Laudale Narrows. Also present in small pockets under and amongst boulders elsewhere in Loch Sunart.

***Chlamys distorta* (da Costa, 1778)**

Single specimens attached to large stones or under boulders.

***Chlamys varia* var. *nivea* (Macgillivray, 1825)**

Common in places attached to boulders. Juveniles distributed more widely in additional habitats such as on kelp.

Discussion

The present survey has increased the number of molluscan species recorded from Loch Sunart by 32, to a total of 141 in the sublittoral. 83 species in total were observed, principally in the depth range 0-15m. At least 177 species of Mollusca have now been recorded from Loch Sunart and Loch Teacuis (all depths). There was a

clear distinction between the richest sites (1, 9, 10, 11) with 29-31 species, and the remaining sites with only 8-19 species.

A number of the species recorded here have a low number of records on the JNCC MNCR database (20 or less): *Jujubinus montagui*, *Rissoa lilacina* subsp. *rufilabrum*; *Alvania beanii*; *Capulus ungaricus*; *Raphitoma linearis*; *Raphitoma purpurea*; *Doto lemchei*; *Goniodoris castanea*; *Onchidoris depressa*; *Cuthona foliata*; *Cuthona viridis*.

The molluscan fauna was representative of the range of species present on the west coast of Scotland. The majority are widespread in the British Isles. A number of typical northern species are present: *Tonicella marmorea*, *Margarites helcinus*, *Tectura testudinalis*, *Adalaria proxima*, *Coryphella verrucosa* and (not seen by author) *Pseudamussium septemradiatum*. Three further species, *Alvania beanii*, *Rissoa lilacina* subsp. *rufilabrum* and *Doto tuberculata*, are generally found on the western coasts of both Scotland and Ireland. The two species which may be new to Scotland, *Doto koenneckeri* and *Doto lemchei*, are southern/western species. Both are present on the north coast of Ireland.

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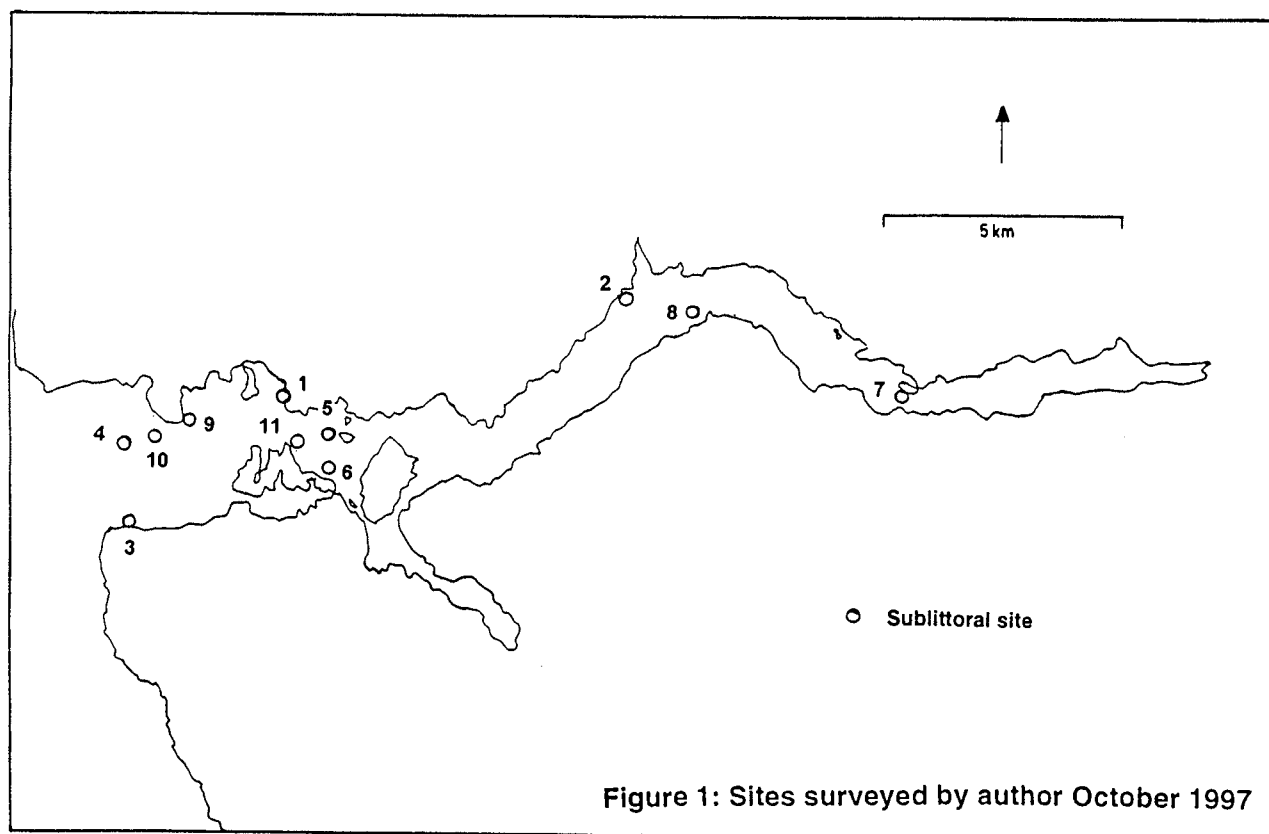


Figure 1: Sites surveyed by author October 1997

APPENDIX 1

Brief list of marine Mollusca recorded from Loch Sunart in October 1997

Taxonomy according to Howson & Picton (1997)

<i>Leptochiton asellus</i>	<i>Tonicella marmorea</i>	<i>Emarginula fissura</i>
<i>Diodora graeca</i>	<i>Tricolia pullus</i>	<i>Margarites helycinus</i>
<i>Gibbula magus</i>	<i>Gibbula tumida</i>	<i>Gibbula cineraria</i>
<i>Jujubinus montagui</i>	<i>Calliostoma zizyphinum</i>	<i>Tectura testudinalis</i>
<i>Tectura virginea</i>	<i>Lacuna parva</i>	<i>Lacuna vincta</i>
<i>Skeneopsis planorbis</i>	<i>Rissoa interrupta</i>	<i>Rissoa lilacina</i> var. <i>rufilabrum</i>
<i>Rissoa parva</i>	<i>Alvania beanii</i>	<i>Alvania punctura</i>
<i>Onoba semicostata</i>	<i>Pusillina sarsi</i>	<i>Capulus ungaricus</i>
<i>Trivia arctica</i>	<i>Trivia monacha</i>	<i>Lamellaria latens</i>
<i>Lamellaria perspicua</i>	<i>Buccinum undatum</i>	<i>Hinia incrassata</i>
<i>Raphitoma linearis</i>	<i>Raphitoma purpurea</i>	<i>Elysia viridis</i>
<i>Aplysia punctata</i>	<i>Tritonia hombergii</i>	<i>Dendronotus frondosus</i>
<i>Doto fragilis</i>	<i>Doto hystrix</i>	<i>Doto koenneckeri</i>
<i>Doto lemchei</i>	<i>Doto maculata</i>	<i>Doto tuberculata</i>
<i>Goniodoris castanea</i>	<i>Onchidoris bilamellata</i>	<i>Onchidoris depressa</i>
<i>Onchidoris muricata</i>	<i>Diaphorodoris luteocincta</i>	<i>Adalaria proxima</i>
<i>Limacia clavigera</i>	<i>Polycera quadrilineata</i>	<i>Archidoris pseudoargus</i>
<i>Jorunna tomentosa</i>	<i>Coryphella browni</i>	<i>Coryphella lineata</i>
<i>Coryphella verrucosa</i>	<i>Flabellina pellucida</i>	<i>Cuthona amoena</i>
<i>Cuthona caerulea</i>	<i>Cuthona foliata</i>	<i>Cuthona viridis</i>
<i>Eubranchus exiguus</i>	<i>Facelina auriculata</i>	<i>Facelina bostoniensis</i>
<i>Nucula nucleus</i>	<i>Mytilus edulis</i>	<i>Modiolus modiolus</i>
<i>Musculus discors</i>	<i>Modiolarca tumida</i>	<i>Limaria hians</i>
<i>Pecten maximus</i>	<i>Aequipecten opercularis</i>	<i>Chlamys distorta</i>
<i>Chlamys varia</i> var. <i>nivea</i>	<i>Heteranomia squamula</i>	<i>Pododesmus patelliformis</i>
<i>Lucinoma borealis</i>	<i>Kellia suborbicularis</i>	<i>Parvicardium exiguum</i>
<i>Parvicardium ovale</i>	<i>Parvicardium scabrum</i>	<i>Abra alba</i>
<i>Timoclea ovata</i>	<i>Venerupis senegalensis</i>	<i>Mya truncata</i>
<i>Hiatella arctica</i>		

Additional species seen as shells only:

<i>Mangelia coarctata</i>	<i>Odostomia acuta</i>	<i>Chrysallida indistincta</i>
<i>Partulida spiralis</i>	<i>Turbonilla lactea</i>	<i>Turbonilla rufescens</i>
<i>Retusa truncatula</i>	<i>Gari fervensis</i>	<i>Tapes rhomboides</i>
<i>Tapes decussatus</i>	<i>Thracia convexa</i>	

The free-living serpulid, *Ditrupa arietina*, on the outer continental shelf

Jan Light

Dept. of Geology, Royal Holloway University of London, Egham, Surrey, TW20 0EX.
E-mail: jan@aquamar.demon.co.uk

As part of my research into the composition of carbonate sediments on the West Shetland Shelf and the invertebrates whose skeletal remains contribute to these sediments, analyses of samples from stations (ca. 60) along 3 transects across shelf, have shown high concentrations of tubes and fragments of *Ditrupa arietina* in depths from 130 m to 200 m.

Ditrupa arietina is a free-living serpulid with a boreal to subtropical distribution and in the eastern Atlantic is reported from Iceland to Senegal including the Mediterranean. Most authors follow Fauvel (1953) and recognise one species, *Ditrupa arietina* Muller, 1776, but Ten Hove and Smith (1975) recognise a separate species, *D. gracillima* Grube 1878. The worms are distinguished from other serpulids by their anatomy, behaviour and distinctive tusk-shaped calcium carbonate tube (25-35 mm length). The tube is open at both ends, broadening anteriorly but with a constriction prior to the tube mouth. In the absence of soft parts, it is this restriction and the irregular outline of the tube, caused by variations in the tube wall thickness, giving rise to annuli, which are diagnostic in identifying extant and fossil *Ditrupa* shells. Nevertheless, *Ditrupa arietina* has a history of mistaken identity, having often been placed in the class Scaphopoda ('tusk shells') within the phylum Mollusca. In the 18th and 19th centuries in particular, but also more recently, specimens have often been misidentified as scaphopods, principally *Dentalium* and vice versa: Fauvel has mistaken *Dentalium* for *Ditrupa* and his record for *Ditrupa* from 1500 m depth is

suspect, because it well exceeds the known depth limit for *Ditrupa* of 650 m (Ten Hove and Smith 1975).

The animals have been observed to filter-feed in aquaria (Ten Hove and Smith 1975) although observed life positions have implied that deposit-feeding might take place (Hong 1984). The worms are able to burrow in fine sediments using the branchial crown. The radioles are flexed outwards and used as excavators, then anchored to create a depression into which the rest of the worm is drawn. This process is continued until the worm's anterior region re-emerges at an angle of 45 to the sediment surface with the posterior of the tube exposed at the other end. This is one cited natural posture (Ten Hove and Smith 1975); animals have also been observed lying on the surface (Wilson 1976; Gambi 1986).

Evidence from grab samples and towed video north and west of Scotland (Wilson 1982) suggests that *Ditrupa arietina* may live in discrete patches at high densities (>1500/m²) on the outer continental shelf. Numerous dead tubes occur with the living animals and may constitute nearly 100% of the total number of tubes collected at some stations. On the outer region of the North Gascony continental shelf, carbonate sands are reported with a high *Ditrupa* content and an associated fauna of *Hyalinoecia tubicola*, *Antalis entalis*, *Polinices montagui*, *Pandora pinna* and *Caryophyllia smithii* (Glemarec et al. 1973). This assemblage has very close affinities with the macroinvertebrates collected with *Ditrupa* on the Scottish shelf.

In the Mediterranean, off the Catalan coast (Barcelona to Montpellier) a study into the population dynamics of *Ditrupa arietina* has shown that maximal densities at each sampling

site were always >1000/m² and up to 11000/m². These are exceptionally high numbers for the Mediterranean which is largely oligotrophic and has an otherwise low abundance of macrobenthos (Gremare et al. 1998).

There are few data on the population stability of *Ditrupa arietina* but a study of these Mediterranean populations suggests a 2-year life cycle with an annual breeding event in the spring. Here the animals live in depths between 10 m and 30 m. Because juveniles anchor by a mucus tube to sediment grains, recruitment success is dependent on effective settlement and establishment of post-larvae on sediments in an optimum environment. In some years high mortality has been linked to storm activity. Two mechanisms leading to population crashes could operate. Changes in sediment granulometry with the incorporation of increased fines may impede settlement, or given the mode of life of *Ditrupa*, sediment transport on the outer zone of a continental shelf may swamp established populations. This mechanism is believed to be important on the storm-dominated West Shetland Shelf and may account for the high numbers of dead tubes observed in the sediments. My faunal analysis of the composition of the biogenic sediments in that environment shows that *Ditrupa arietina* grains may contribute up to 85% of the carbonate content.

In addition to their primary contribution to the sediments, the tubes of living and dead *Ditrupa* act as foci for settlement of a wide range of calcium carbonate producing invertebrates, as well as foraminiferans. Encrusting organisms which are associated with *Ditrupa* tubes include the solitary scleractinian *Caryophyllia smithii*, *Verruca stroemia*, several sessile serpulid and bryozoan species and the encrusting foraminiferans *Cibicides* spp. In particular for *Caryophyllia*, the tubes offer a substrate in areas of weak current where other potential colonising surfaces are scarce (Wilson 1976). Many of the dead tubes in samples bear small boreholes - often more

than one per tube and in rare instances as many as five! Partly because of the lack of agreement between authors about the natural life position of the worms, it is open to speculation as to whether infaunal naticids such as *Polinices mantagui*, or muricid gastropods (*Trophon* spp.) are the likely agents of such predation.

Ditrupa sands occur on the outer shelf north of Shetland and are known to extend down the west coast of Scotland.

Notwithstanding the Mediterranean study, given the abundance of *Ditrupa arietina*, it is surprising that more attention has not been paid to this important inhabitant of outer shelf environments.

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MOLLUSCA OF THE SEAS AROUND OBAN

By Shelagh M Smith

Woodleigh, Townhead, Hayton, Carlisle, CA4 9JH

INTRODUCTION

The area is centered on Oban on the west coast of Scotland, about half way up the great sea loch complex commencing with the Firth of Lorn in the southwest and extending northeast into Loch Linnhe. In order to include some especially interesting data, the southern limit of the area has been drawn at Luing, 56°12'N, the northern at the upper limit of Loch Linnhe and including its subsidiary Loch Eil. The eastern boundary is the mainland coast as it reaches up the tributary sea lochs and the western limit has been set in the Sound of Mull at 05°48'W.

The seas around Oban have been known for many years for the richness of their fauna and flora, but most of the work done has not been detailed or has been addressed to small areas. The earliest serious molluscan work was that of G A F Knight (1893), who with A Somerville did a prodigious amount of dredging around the west coast of Scotland, much of which, apart from that of the Clyde, was not published under their names but was done so by J T Marshall (with slight acknowledgement) in his "Additions to British Conchology" (1890 -1917). Data here was listed by species rather than by area and therefore these papers are not included in the Bibliography. Specimens

obtained at this time are lodged in the National Museums of Scotland, with Somerville as the collector and donor, and in the Melville-Tomlin collection in the National Museum of Wales. There is also some material in the Kelvingrove Museum, Glasgow. It therefore has been possible to verify identifications of some of the rarer species and to find examples not included in published lists. By reference to museum specimens it has also been possible to correct published data. Major more recent previous work includes that by Gage (1972, 1974) in Loch Creran, a selection of whose specimens are in the National Museums of Scotland. Material obtained by staff of the Dunstaffnage Marine Laboratory has also been made available to us, in particular from Loch Melfort, and, to a lesser extent, Loch Spelve. There are also several reports to the then Nature Conservancy Council (Luing: Smith, 1983. Luing: Buehr, 1984. Mull: Smith & Gault, 1983. Mull: Bishop, 1984. Loch Linnhe, etc: Connor, 1990. Loch Etive: Holt, 1991). Except for the last two, identifications of Mollusca were checked by Smith, but for these last, apart from a few species, and nudibranchs identified by Picton, identifications have not been verified any some are very doubtful. A careful survey, for its time, of nudibranchs of the Oban area was also undertaken by divers (Brown & Smith, 1979, Brooke & Brown, 1981). Further data concerning Mollusca on the shores has been published (Clachan Sound: Smith & Nunn, 1985, 1992) (Smith, 1996). There is also a considerable amount of unpublished data, held

in the Conchological Society's files, on the Mollusca of the shores.

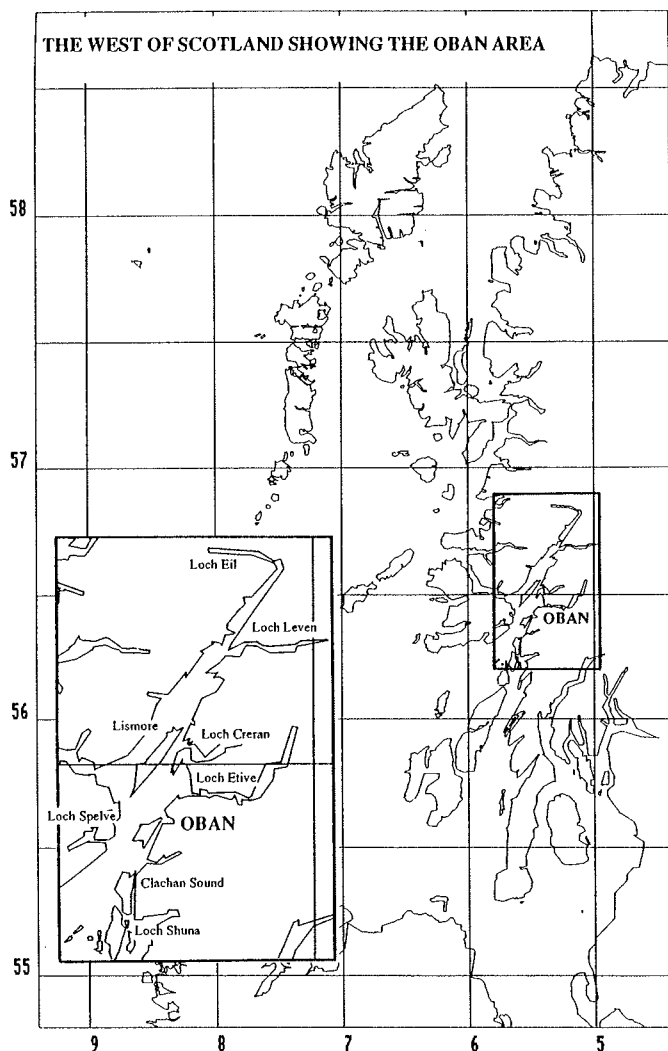
Following upon various ad hoc dredgings from the Dunstaffnage Marine Laboratory's vessel "Seol Mara", mostly by Smith, which took place between 1986 and 1992, a more intensive dredging was undertaken during the Conchological Society's expedition to the Oban area in August 1993. The results of this suggested that much more work would be very valuable, and in July 1994 in four days 39 stations were dredged,

the largest stones were scrubbed and thrown overboard, most of the catch was retained for laboratory sorting. Many samples occupied several buckets. There were also large collections of algae, mostly *Laminaria hyperborea* and its epiphytes and samples of *Modiolus modiolus* and *Serpula vermicularis* beds. This separation of Mollusca took many hours of work, a labour of love on the part of the authors, work which probably could not be done, in the present economic climate, as part of a paid project. Further dredging by Smith took place in

1995, 1997 and 1998.

The vast majority of specimens obtained by Smith in the course of shore work and dredging and by the authors in the recent dredgings, have been retained, both in their private collections and in collections in the National Museums of Scotland. For most samples, specimens have been counted and quantified and therefore repeat material from the same station can show if any changes took place. As so many specimens even of common species have been kept, particularly when they have been numerous, there is also a record of size range.

Data has thus been obtained from over 300 stations. About 380 species of Mollusca have been found in the Oban area, all but 22 live since 1979, when the present recording effort began. This may be compared with the Clyde (Allen, 1962, and later records) where a similar number



covering the seas from Bach Island in the south to Shuna Isle in the north, and from the mainland coast as far west as the eastern end of the Sound of Mull. A great quantity of material was obtained: while some of the finer sediments were in part sieved on board "Seol Mara", and some of

of species have been recorded, but over 70 of these are of old records or only found as dead shells. Although many are found, in suitable habitat from the south at Luing right to the north at the head of Loch Linnhe, but a considerable number do not extend that far, as there appears to be a cut-off point at

about 56°36'N at the north end of Lismore, possibly due to lack of Atlantic water.

DESCRIPTION OF THE AREA

This report covers part of the Firth of Lorn, Loch Linnhe and the sea lochs Loch Melfort, Loch Feochan, Loch Etive, Loch Creran, Loch Leven and Loch Eil, together with the intra-island channels including Cuan Sound, Clachan Sound, Kerrera Sound, the Lynn of Lorn and part of the Sound of Mull. This very convoluted coastline produces a great variety of habitat, some exposed to the southwest but much of it sheltered, with shores ranging from cliff to rock platform, boulder beaches, gravel, sand and mud. Most rocky shores are well covered with algae. Salinity ranges from that of the open sea through various brackish conditions to the virtually fresh shores at the heads of Lochs Creran and Etive. There are some small lagoon-like pools. Tidal streams and rapids are a feature of the area. Clachan Sound is one of the smallest and almost dries at low water. Its reputation as a rich and diverse site, not only for Mollusca, together with its accessibility, renders it fragile. It also suffers from naturally inclement conditions such as too much fresh water during prolonged wet weather. At the other end of the spectrum is the massive Falls of Lora where Loch Etive debouches over a sill into the sea with a drop at low tide of 2m and there are tidal streams of up to 12kts. Further north, currents in Loch Creran reach 5kts and there are similar streams in Appin. Off the coast of Mull and between Mull and Lismore there are also streams of up to 5kts. The sea bed is varied. While some areas are composed of flattish plains of mud, silt or muddy gravel and shell gravel in depths ranging from 30m to over 200m, there are many small islands and pinnacles of rock reaching almost to the surface. In current areas these produce overfalls. There are also boulder beds, gravel beds, shell gravel and in the

shallower parts, kelp forests. As with the rest of the west coast inshore seas, there is fish farming, particularly around Oban and in Loch Etive and Loch Creran, together with some mussel farming. There is also potting for crustaceans.

Dredging has shown that places change with time. Dunstaffnage Channel, in 1992 mostly shellsand and small boulders, had by 1995 become so overgrown with *Laminaria hyperborea* that it was not possible to reach the substrate. The muds off Dunstaffnage which were productive in early 1992 became clogged and anaerobic with dead leaves washed down from Loch Etive and apparently not recovered by 1994. Although a considerable amount of work has been done around Middle Reef in Oban Bay, Although each haul has been different this may indicate a dredge in a slightly different environment. Similar caveats apply to the considerable amount of work which has been done in Loch Creran.

INTERESTING SPECIES

While most species are common or fairly common and thus not of particular note, some require mention, not the least because they may well have been overlooked elsewhere, or the correct habitats not investigated.

Acanthochitona fascicularis (L, 1767). A specimen from Loch Shuna has been identified by Kaas (pers. comm.), and plates have been found in the Sound of Mull. This is well away from its normal range and Baxter suggests that the identification may not be sound.

Propilidium exiguum (Thompson, 1844). There is a cluster of records indicating that it is not uncommon living in muddy gravel in the Sound of Lorn off Oban. Elsewhere it has only been recorded from well offshore on the Hebridean slope.

Alvania abyssicola (Forbes in Forbes & Hanley, 1850) and *Alvania cimicoides* (Forbes, 1844). These both occur in muddy gravel in 20-100m, in the Firth of Lorn and have not been found living anywhere near.

Hyala vitrea (Montagu, 1803). This is another species living in mud or silty gravel in the Firth

of Lorn and which is surprisingly rare elsewhere.

Calyptrea chinensis (L., 1758). This species has been recorded from Clachan Sound (Smith, 1998), probably introduced with oysters, and therefore likely to become established.

Amauropsis islandicus (Gmelin, 1791). Juvenile specimens live in the shell gravel in 10-15m in Dunstaffage Channel near Oban. This appears to be an unusual habitat for what is usually regarded as an offshore species.

Aclis gulsonae (Clark, 1850). This has been reported from Dunstaffage Channel living in shell gravel in 10-125m (Killeen & Smith, 1992).

Graphis albida (Kamacher in G Adams, 1798). This was found living associated with the *Serpula vermicularis* reefs in Loch Creran in 1993.

Eulima glabra (da Costa, 1778). Several specimens were found living in silt in 30m over which a strong current was running, near Oban in 1994. Apparently parasitic on ophiuroids, it has in the past been recorded from several sea lochs.

Melanella frielei (Jordan, 1895). This occurs with the above. Although it has been reported from several other localities on the west coast of Scotland, it seem chiefly to live below 1000m, which raises the possibility that more than a single species may be placed under this name.

Pyramidellidae. A number of the rarer species occur sporadically, but most are regarded as being under-recorded because they are difficult to find rather than truly rare. The area is, however, comparatively rich in *Eulimella* spp., living in muddy shell gravel in 30-100m.

Adalaria loveni auctt. a species of *Adalaria* has been found in the Oban area which appears to be neither *A. loveni* (Alder & Hancock, 1862) nor *A. proxima* (Alder & Hancock, 1854).

Aldisa zetlandica (Alder & Hancock, 1854). This species is usually found well offshore on the shelf and slope, but one specimen has been obtained from Loch Etive in 1990.

Onchidella celtica (Forbes & Hanley,

1852). This pulmonate, a southern species, usually found on the upper shore amongst barnacles was found in a dive sample from Loch Shuna, Luing in 1985. It has also been found under water in Loch Carron, and there is an old record, for long considered an error, from Loch Fyne. There are few bivalves of note.

Thyasira gouldi (Philippi, 1836). This has been established as still living in Loch Etive, and also present in Loch Eil. In this area it seems to prefer soft black mud with an input of organic material.

Thyasira pygmaea (Verrill & Bush, 1898). This species has been recognised as common living in muddy gravel in 20-100m. Previously it may have been confused with *Thyasira ferruginea* (Locard, 1886).

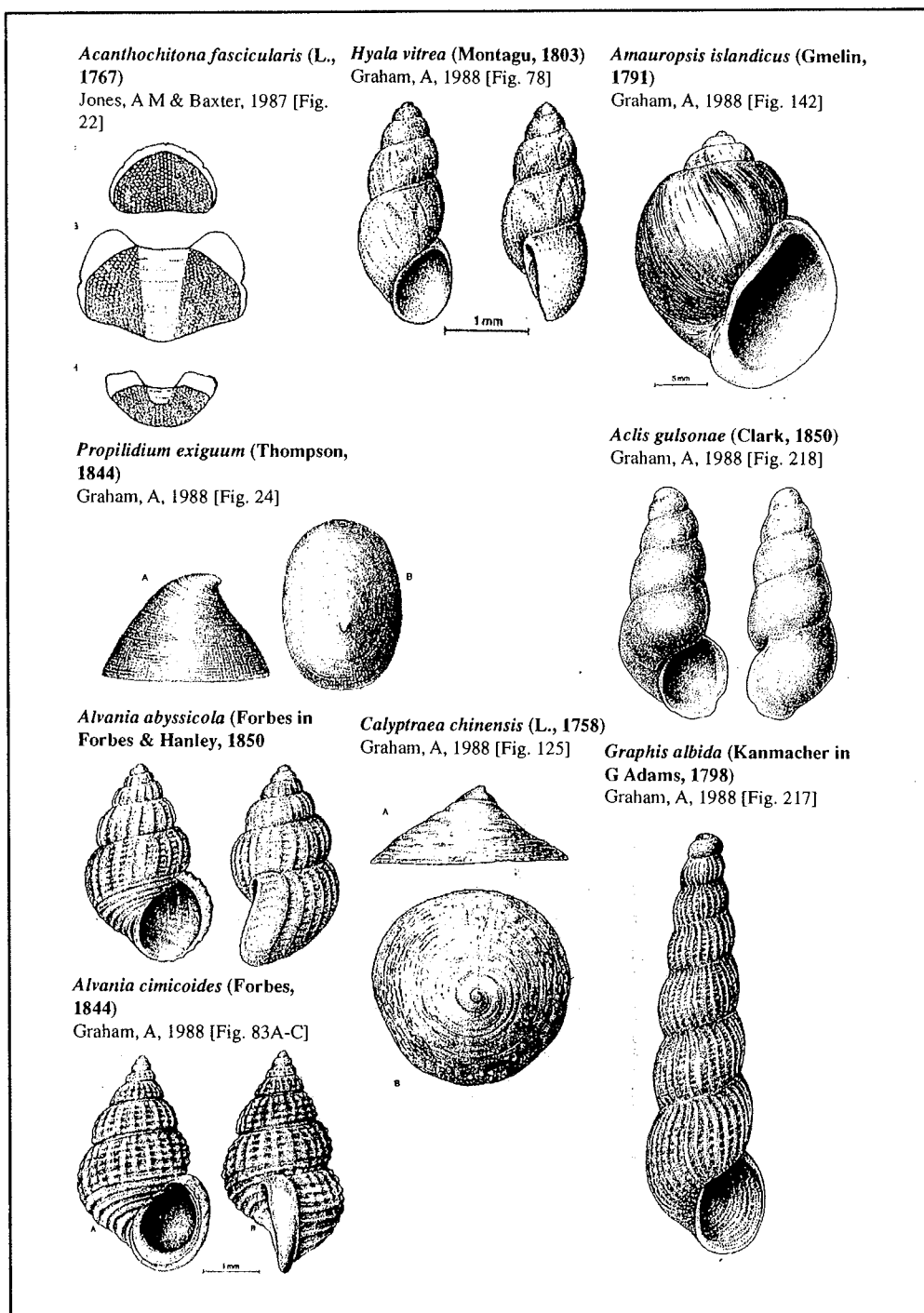
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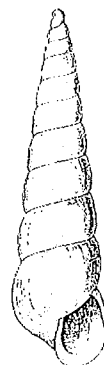
Eulima glabra (da Costa, 1778)
Graham, A, 1988 [Fig. 221]



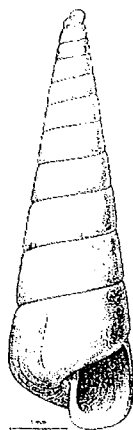
Eulimella laevis (Brown, 1827)
Graham, A, 1988 [Fig. 268]



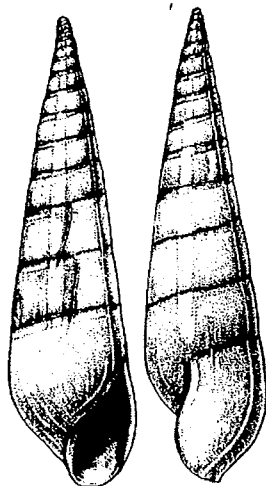
Eulimella ventricosa (Forbes, 1844)
Graham, A, 1988 [Fig. 269]



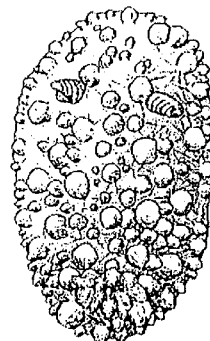
Eulimella scillae (Scacchi, 1835)
Graham, A, 1988 [Fig. 267]



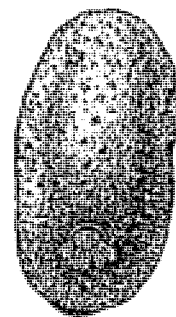
Melanella frielei (Jordan, 1895)
Bouchet & Warén, 1986



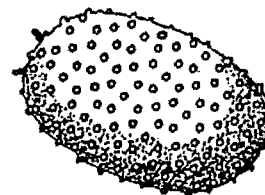
Adalaria loveni (Alder & Hancock, 1862)
Thompson, T E, 1976 [Fig. 70]



Aldisa zetlandica (Alder & Hancock, 1854)
Thompson, T E, 1976 [Fig. 91]



Onchidella celtica (Forbes & Hanley, 1852)
Smith, S M, 1987 [Fig. 1]



Computer-aided identification of polychaetes

Peter Gibson, Elaine Robson* and Alistair Armitage**

University of Edinburgh & Napier University, *Heriot-Watt University,

**Napier University

Introduction

Having identified many polychaetes in my time, largely when monitoring pollution commercially, I am acutely aware of the need for speed without sacrificing accuracy (P.G.). Where several people are carrying out identifications on samples from the same site there is never total agreement. There is, therefore, every reason to think that automated procedures will be as successful. The identification of chaetae by visually is of necessity dependent upon keys and easily recognised structures. Quantitative computer descriptions may well provide a subtlety that cannot easily be achieved through using diagrams and photographs. The only other work I am aware of concerned with quantitative aspects of chaetae is that by Vogt & Kudenov (1994) on *Euphrosine* (*Mém. Mus. natn. Hist. nat.* **162**: 291-298, 1994). They measured the lengths of the arms of the forked notochaetae of *E. borealis* and *E. bicirrata* using an eyepiece graticule. The species were separated using discriminant analysis.

Methods

Preparation

Five preserved species, *Capitella capitata*, *Dodecaceria concharum*, *D. fimbriata*, *Aonides paucibranchiata* and *Nereis diversicolor*, from various sources were used. Unspecified 20 mm lengths of the body of each were dissolved in 5% KOH and the remaining chaetae washed, stained with acridine orange and mounted in DPX on microscope slides.

Scanning electron microscopy

One mm TS slices of the body of both species of *Dodecaceria* with and without KOH treatment followed by coating were examined by SEM for signs of erosion.

Image capture

Using a compound microscope with a CCTV camera, images of the crotchets at 200x magnification were captured with a frame grabber (*Snappy*) linked to a desktop PC. The images were stored as bitmap files on a zip drive. The bitmaps were converted to binary images and had "debris" and stray pixels removed. The images were analysed using available software (*Image Tool*). Specifically written software and other mathematical and graphical packages (e.g. *Microsoft Excel*) were added (plugged-in) to *Image Tool* to look at specific features.

Results

Preparation of chaetae

The crotchets for four of the species stained with acridine orange but the chaetae of *Nereis diversicolor* were too slender to take up sufficient stain and are not considered further.

Scanning electron microscopy

No signs of KOH erosion were seen at 5K magnification.

Image Tool

Eight of the most promising parameters did not on their own provide enough information to separate all the species (Table 1). The most useful was area. For example, *Dodecaceria concharum* which is easily confused with *D. fimbriata* is clearly far stouter. The two species can, of course, be separated by an identifier using the presence of a tooth at the proximal end to the terminal depression. In this instance the computer is as capable as an identifier. Many of the parameters do not have any obvious meaning for these four species but may have for the chaetae of other species. For example, roundness (Table 1) may be

significant when applied to the uncini of terebellids. For a perfect sphere this is unity so the degree of departure from this may well distinguish between species. The number of teeth and the presence of a manubrium is likely to be reflected in the difference between roundness and compactness (Table 1). A manubrium will increase the length of the major axis which is used in compactness. The presence of large numbers of teeth may effect the measure of roundness which uses the perimeter.

Polynomial curve

Obvious structural information (e.g. teeth, hooks) used by identifiers frequently lie at the distal region of

chaetae and presumably have functional significance. The problem is that their detail is often difficult to resolve at low magnification. The chaetal shaft has subtleties of shape that although obvious to identifiers are difficult to compare between species because they cannot be described other than by diagrams or photographs. This is not so for the computer system. To assess the shape of the shaft, the binary image was aligned horizontally and 10% of each end of the was removed (Fig. 1). The partial perimeters of the remaining shaft were processed to fit a polynomial curve using *Microsoft Excel*. A quadratic curve gave an adequate fit (higher orders, cubic and quartic, added nothing appreciable). A procedure such as this will allow comparisons to be made between chaetae of different species.

Table 1. Eight parameters measured with *Image Tool* for the crotchet of four species and rounded to two significant figures (units in pixels). Definitions given by *Image Tool* shown below.

	<i>D. concharum</i>	<i>D. fimbriata</i>	<i>C. capitata</i>	<i>M. paucibranchiata</i>
Area				
Mean	12,000	5,000	6,400	4,300
n (SD)	19 (390)	21 (1,200)	11 (1,500)	17 (100)
Perimeter				
Mean	1,000	700	1,100	720
n (SD)	19 (140)	21 (79)	11 (62)	17 (80)
Major axis				
Mean	450	320	470	320
n (SD)	19 (64)	21 (37)	11 (15)	17 (30)
Minor axis				
Mean	35	20	22	18
n (SD)	19 (9.0)	21 (3.9)	11 (4.6)	17 (5.3)
Elongation				
Mean	14	16	22	18
n (SD)	19 (3.2)	21 (3.8)	11 (4.9)	17 (3.8)
Feret diameter				
Mean	120	79	90	73
n (SD)	19 (19)	21 (9.6)	11 (11)	17 (12)
Roundness				
Mean	0.20	0.13	0.07	0.10
n (SD)	19 (0.03)	21 (0.03)	11 (0.02)	17 (0.02)
Compactness				
Mean	0.3	0.25	0.2	0.23
n (SD)	19 (0.03)	21 (0.03)	11 (0.02)	17 (0.23)

Compactness: $\sqrt{4/\pi} \times \text{area all divided by the major axis}$.

Roundness: $\sqrt{4\pi/\text{area all divided by the perimeter}}$.

Elongation: Longest axis divided by the shortest axis.

Feret diameter: Widest point of the shorter axis. For a chaeta this would be, in effect, measuring the diameter with a pair of callipers.

Centroids

A problem with the polynomial curve was that the image has to be rotated to the horizontal. This is avoided by using the centroid, the "centre of gravity". Distances between the centroid and equal points, of known distance apart, along the perimeter were measured. A graph of these distances characterises the shape of the chaeta (Fig. 2). The position of points A and B on the curve (Table 2) have special significance. Their size in combination with the area measurements (Table 1) allows the four species to be separated using the key below. This may be somewhat trivial but it demonstrates the use of chaetal image analysis. A computer expert system could achieve this automatically using isolated chaetae.

Skeleton

The pixels of binary images were eroded from the perimeter inwards to leave a single line that formed a "Skeleton" which retains the chaetal processes (Fig. 3). How to measure the size and position of these has yet to be found but would appear to have promise.

Discussion

We are feeling our way in the belief, not

shared by everyone, that image analysis is a promising means of identifying polychaetes. We are concerned with a range of quantifiable feature other than those such as a teeth that are normally used by identifiers. These other features, such as the curvature of the shaft, are not easily measured by eye but are amenable to computer analysis. Possibly, classes of chaetae can be used to identify families or other taxa. Also, one might determine biodiversity empirically by the use of chaetae. The combination of chaetal types may be indicative of pollution levels. That is, one need not necessarily know the species present. The approach traditionally taken in monitoring, where all specimens are identified, is slow whereas image analysis will be a cost effective alternative. Also, it may offer potential for exploiting measures that until now have not been feasible. They could lead to comparisons and groupings that have not been exploited.

Acknowledgements

Some procedures have been developed by students as a part of projects and some work has been paid for out of departmental funds of Napier University.

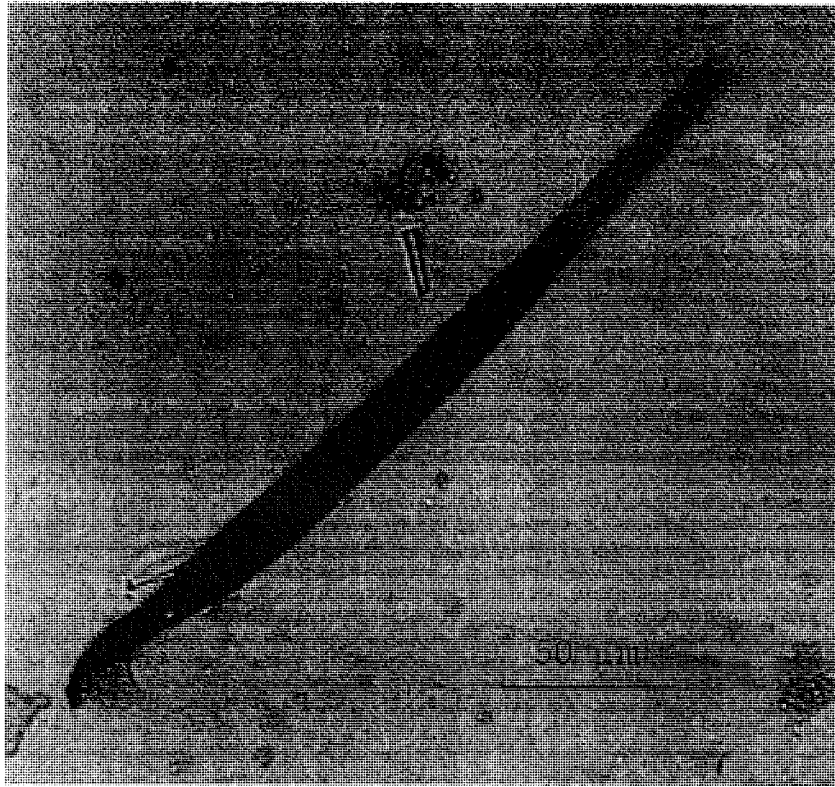
Key

1. B at least four times size of A 2
 B less than half the size of A 3
2. B greater than 0 *A. paucibranchiata*
 B approximately equal to 0 *C. capitata*
3. Crotchet area large *D. concharum*
 Crotchet area small *D. fimbriata*

Table 2. Comparison of the four species using measurements made from the centroid to the perimeter of the chaetae at equal distances around the perimeter (see Fig. 2 for positions of points A-D) (units in pixels).

	Positions points on graphs			
	A	B	C	D
<i>A. paucibranchiata</i>	13	3	124.5	94
<i>C. capitata</i>	5.5	0.5	103	126
<i>D. fimbriata</i>	8	6	128.7	119.5
<i>D. concharum</i>	6	6.5	116	119

a



b



c



Fig. 1. A crotchet of *Dodecaceria concharum* seen as (a) a grey-scale image (bar is 50 m), (b) a binary image lying horizontally on the screen and (c) separate upper and lower edges when processed as partial perimeters.

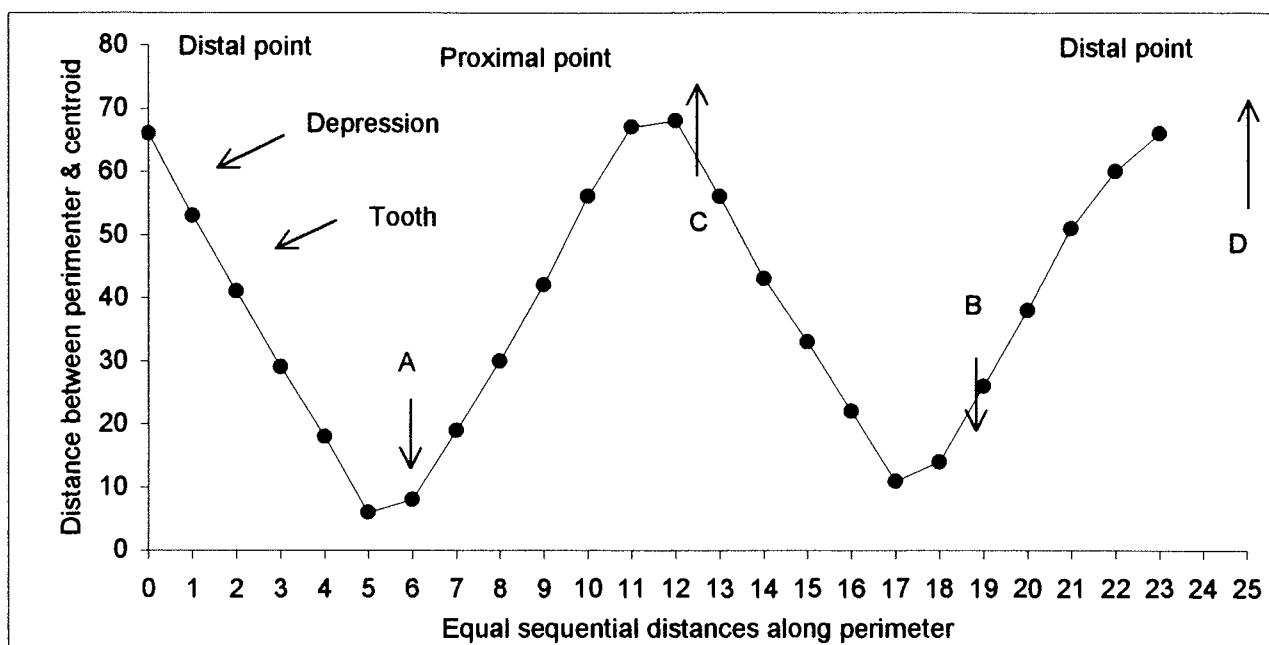


Fig. 2. Graph of measurements made between the centroid to the perimeter and equal sequential distance along the perimeter of a diagram of a crotchet of *Dodecaceria fimbriata* (arbitrary units-of distance). see Centro.xls in porcup subfile on the present disk

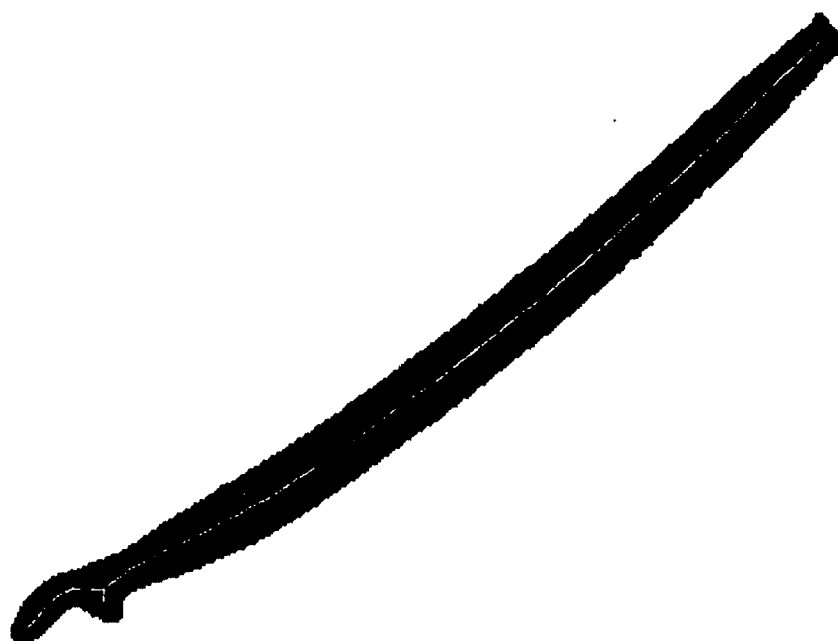


Fig. 3. A binary image of a crotchet of *Dodecaceria fimbriata* showing the central axial skeleton of pixels.