

# PORCUPINE MARINE NATURAL HISTORY SOCIETY

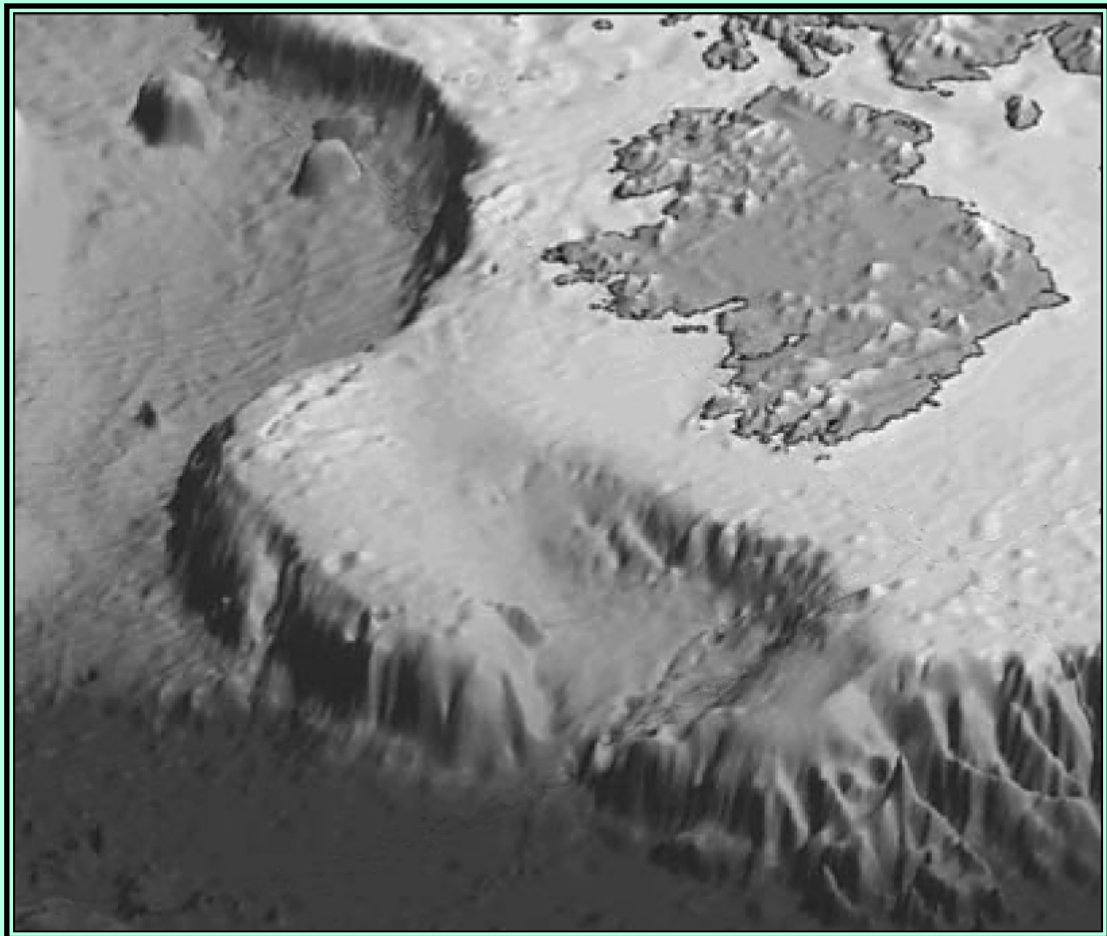
## NEWSLETTER



Summer 2008

Number 24

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# Porcupine Marine Natural History Society

## Newsletter

No. 24 Summer 2008

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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 newsletters a year which include proceedings from scientific meetings.

Individual £10    Student £5

 [www.pmnhs.co.uk](http://www.pmnhs.co.uk)

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*Dictyopteris membranacea* - P Tinsley

## Editorial

As a book author and editor, factual, grammatical and typographical accuracy are of great interest and importance to me. You may well find that I 'correct' silly things like beginning a sentence with 'And' when you send papers and articles to me. This probably doesn't matter a lot except to those of us who studied English Language the old fashioned way at school, but **scientific** accuracy is vitally important. This is highlighted in this issue in the review written by Frank Evans of Callum Robert's book 'The Unnatural History of the Sea'. Inaccurate or incomplete fishery statistics and inaccurate interpretation (or ignoring of) the data by politicians has caused incalculable harm to our marine environment.

In Porcupine Pieces, you will also find an interesting slant on the NMBAQ (National Marine Biological Analytical Quality Control) scheme. This is designed to help improve the quality of data from macrobenthic sampling programmes including accuracy of identifications. Whilst the views expressed by the author of this piece are entirely his own, they are worthy of debate.

Porcupine has its own recording scheme, and records are fed into Recorder and eventually find their way onto the NBN gateway. The latter is a wonderful facility but is only as good as the records it contains. Recently I read an interesting article in NBN News about what exactly constitutes a record, particularly where a specimen has not been collected. Digital underwater cameras are a great help to us in this respect but only if the crucial identification features of a particular species can clearly be seen. This is often, but by no means always, the case with fish and some fascinating new distributional records are coming to light through schemes such as the MCS Seasearch. It is still vital, however, that we maintain the scientific discipline of well preserved and well curated specimens if there is any doubt and if the record is of especial significance.

Now I just saw a green parakeet eating the cherries in my garden which lies just north of Cambridge. I think it's a rose-ringed parakeet, an alien from India and central Africa (see BBC Wildlife June 2008), and well known in Surrey, Kent and London. I have no photo or specimen; also no cherries; but who is going to believe a poor marine biologist.....

### COPY DEADLINES

October 15<sup>th</sup> for Winter 08/09 issue (No. 25).

## MINUTES OF THE COUNCIL MEETING

*held on Saturday 29th March 2008 at Bangor*

### Present

Julia Nunn, Frances Dipper, Jon Moore, Peter Tinsley, Roger Bamber, Anne Bunker, Paul Brazier, Peter Barfield, Roni Robbins, Andy Mackie, Lin Baldock

### Apologies for absence

Received from Séamus Whyte, Tammy Horton, Sue Chambers, Vicky Howe

### Minutes and Matters arising

The Minutes of the last meeting on 20<sup>th</sup> October 2007 were approved. Matters arising are covered in the agenda.

### 2008 Conference at Bangor

Paul Brazier gave an update, report and feedback so far: 75 attendees were registered, several extra had registered on the door; we had gained 13 new members. 10 posters were on display; 52 attendees were booked for dinner. Costs for catering (teas etc) were some £300. Lunch for the council was £250. Use of the laboratory was free thanks to John Turner, although there was a small cost for the technician. Total costs for the meeting were estimated at £1000. There had been a shortage of write-ups from the talks offered, but at least we have abstracts. Thanks were given to Paul Brazier, Ivor Rees, Kathryn and all others involved in running the Bangor meeting. The value to the organisers of the "conference pack" which had been passed-on was acknowledged.

### AGM 2008

Julia Nunn – general matters were discussed; in particular, the pending Council elections. Lin Baldock is stepping down permanently. Anne Bunker is stepping down as Hon. Website Officer, Vicky Howe and Andy Mackie are stepping down and available for immediate re-election. Tammy Horton is available to step up as Hon. Website Officer.

Only 2 newsletters had been issued during the year, but this did not infringe the constitution.

### Financial status

Jon Moore presented the accounts for approval; the summary was that the funds were £300 down on the year owing to the costs of the Newcastle meeting. £1414 in subscriptions had been taken for the year. Bank interest was up last year on the back of the DeepSea UK money. Production of only two newsletters had reduced costs, but postage was up. Auditing of the accounts was not yet complete, but would be before their publication in the Newsletter.

The Esmee Fairbairn Grant of £54,000 came in, in August; most was then paid out to Plymouth, NOCS, and Oban. The balance to Porcupine was not yet spent. We are due to pay corporation tax. We received some return of income tax on bank account interests up to 2005, less for 2006; we are due £342 on the Esmee Fairbairn surplus in account. It was agreed that subs do not need to go up, as the finances are very healthy. The balance of funds was of the order of £8000. The Council formally approved and agreed the accounts.

### Membership

The Hon Membership Secretary, Séamus Whyte, was absent – total membership stands at 224.

### Newsletter

Frances Dipper & Peter Tinsley – The Hon. Editors will continue to produce two newsletters per year (winter and summer) owing to lack of copy and of time of the editors. The online pdf version has colour. The Hon. Editor Frances Dipper feels that it is approaching time for a change of editorship. Consensus of the Council was that it is a good idea to have some turnover. Frances is planning to stand down at the next AGM.

Peter Barfield reported that the electronic newsletter archive had not progressed very far over the past year. Julia offered to supply the copies Peter was missing. Lin offered to help Peter scan and create the pdfs. Peter will make some of the Newsletters he has completed available to council members to check Council

members are happy with the output.

### **Recording scheme**

Roni Robbins reported that no records had been received from members (as has always been the history in this job). We had received an impressive set of barnacle data from Frank Evans covering many years. Collating the backlog of records published in the Newsletter is still going on. Whether we should prompt members for data similar to those supplied by Frank was discussed. Priorities for the Recording Scheme are data from Porcupine field trips and "orphan records" (people gathering data in isolation rather than in organizations).

### **Website**

Anne Bunker reported that Tammy Horton has done much to produce the new format Website, and Council agreed that the new website is excellent, and just what we wanted; particular commendation was given for the valuable speed in putting information about the conference on the site (Paul B). Thanks were expressed to Anne for all her past work.

### **Esmee Fairbairn Deep-Sea Conservation Project**

Jon Moore said that this project was going to be the subject of a talk from Jason at this meeting; there was an article describing the project in the last Newsletter.

### **The Porcupine Grants Scheme**

The deadline had been extended to the end of April. There had been one application only to date; it had been re-announced on the website and by e-mailing the members. Also an announcement had gone into new-members' packs given out by Paul at the Bangor meeting. An announcement was planned at the AGM and at the morning session.

### **Administrative matters**

Roger Bamber - The existence of the "other" Porcupine Newsletter (in Hong Kong) was being addressed; Roger had been in touch with their editors. It appears to have ceased production in 2002.

### **Field trip 2008**

Anne Bunker said that she would announce it all tomorrow at the AGM: plans are for 16-18 October in Pembroke.

### **Council Meeting Autumn 2008**

Arrangements - It was decided not to link that meeting in with the Autumn Field trip. Council will look to early November, via circulars by e-mail.

### **Conference 2009**

Options discussed were Scotland, maybe St Andrews, Manchester; SE England, Lowestoft, Exeter / Falmouth. It was decided to approach potential organisers at the meeting. Options suggested for 2010 were France or the Mediterranean.

### **Field trip for 2009**

Possibilities were discussed, especially for SE England, where we have often planned to go but not yet succeeded. A possible joint venture with SeaSearch would be pursued at the Bangor meeting.

### **A.O.B**

A letter from Peter Garwood relating to the NMBAQC scheme was discussed, and it was felt appropriate for the Newsletter. The meeting closed at 13.20.

## MINUTES OF THE 31st ANNUAL GENERAL MEETING

*Held on Saturday 29 March 2008, at Bangor University*

1. Apologies for absence were received from Séamus Whyte, Vicki Howe, Tammy Horton, Sue Chambers and Frank Evans.

2. The Minutes of the 30th Annual General Meeting, as published in the PMNHS Newsletter No. 22, were accepted by the floor with no corrections or additions.

3. There were no matters arising from the Minutes of the 30th Annual General Meeting.

### 4. Officers' Reports

The Hon. Treasurer's Report was presented by Jon Moore, the accounts (see elsewhere) being presented to the AGM unaudited. Audited accounts will be published in the Newsletter, and are not expected to differ. Acceptance of the Hon. Treasurer's Report was proposed by Keith Hiscock, seconded by Ann Bunker, and carried with no votes against.

The Hon. Membership Secretary's Report was presented by Julia Nunn in the absence of Séamus Whyte. Membership stands at 190 full, 8 student, 10 library, 4 life, 9 free (including 7 libraries plus honorary members) and 3 members of unknown status. There were no resignations, giving a total of 224 members. Acceptance of the Hon. Membership Secretary's Report was proposed by Peter Barfield, seconded by Lin Baldock, and carried with no votes against.

The Hon. Editor's Report was presented by Frances Dipper. There had been two Newsletters in the previous year, June 2007 (No.22) and Winter 2007 (No. 23). Five papers from Porcupine 2007 had been published in these editions. Some interesting 'Porcupine problems' and 'Porcupine Pieces' had been sent in by members and published in the newsletters with some resultant feedback. Members were encouraged to send in any interesting copy which can be very informal for these sections, and can include member news such as project information, requests for help etc. Acceptance

of the Hon. Editor's Report was proposed by Shelagh Smith, seconded by Judy Foster-Smith, and carried with no votes against.

The Hon. Web-site Officer's Report was presented by Anne Bunker, who is now standing down. Tammy Horton will be taking over and the membership agreed that Tammy should be thanked officially for the good job she had done in renovating the Website. Acceptance of the Hon. Web-site Officer's Report was proposed by Jon, seconded by Peter Tinsley, and carried with no votes against. Anne was thanked for her long service.

(e) The Hon. Records Convenor's Report was presented by Roni Robbins. This year records were received from Frank Evans. These were a collection of observations made by himself on the invasive barnacle *Eliminus modestus*. These records have been entered into Marine Recorder and are to be uploaded to the NBN gateway. Roni encouraged any other members who have such sets of data to submit them to our recording scheme. There is a backlog of field trip data that appeared in the newsletters that has been entered into Marine Recorder. All records back to 1997 have been entered but there are still some queries re the data sets which will be sorted out with the relevant Porcupine members. The opportunity was taken to remind and encourage members to continue to submit their records to scheme: the success of the scheme depends on as much input from the membership as possible. If any members still don't understand what this scheme is about they are welcome to ask. Acceptance of the Hon. Records Convenor's Report was proposed by Jon Moore, seconded by Judy Foster-Smith, and carried with no votes against.

The Hon. Chairman's Report was presented by Julia Nunn. Council has held two meetings in the past year, the first in October 2007 at Frances Dipper's house in Landbeach near Cambridge (thanks were given to Frances for her hospitality); the second here in Bangor yesterday. A very successful annual conference was held in Newcastle University and at the Dove Marine Laboratory in March last year (thanks to Judy Foster-Smith and her colleagues). Julia ran a field meeting

to the Burren in September 2007, with 12 people attending, mainly conchologists, but many with dual membership of Porcupine (thanks were given to Julia). The Deep Sea Conservation Project was discussed; the major involvement of the Society had already been covered by Jon in his report and Jason in his lecture. Acceptance of the Hon. Chairman's Report was proposed by Peter Tinsley, seconded by Roger Bamber, and carried with no votes against.

### **5. Porcupine Grants Scheme**

Details of the scheme are on the Website. The original deadline was February; it had now been extended for a second round of applications until 30 April.

### **6. Election of Officers and Council.**

Three members of Council, Lin Baldock, Andy Mackie and Vicki Howe, retired at the AGM; the last two of these were available for immediate re-election. There was one other new candidate proposed for election to Council, Sophie Henderson. The re-election of all those proposed was proposed by Shelagh Smith, seconded by Roger Bamber, and carried with no votes against.

The motion was proposed to retain all the Office Bearers, with one change: Anne Bunker stepping down and Tammy Horton standing for election as Hon. Website Officer. The motion was proposed by Julia Nunn and agreed by the floor with no votes against.

The Council for 2008-2009 is as follows.

#### **Office Bearers:**

Hon. Chairman – Julia Nunn

Hon. Secretary – Roger Bamber

Hon. Treasurer – Jon Moore

Hon. Editors – Frances Dipper  
- Peter Tinsley

Hon. Membership Secretary – Séamus Whyte

Hon. Records Convenor – Roni Robbins

Hon. Web-site Officer – Tammy Horton

#### **Ordinary Members of Council:**

Sophie Henderson

Peter Barfield

Paul Brazier

Sue Chambers

Anne Bunker

Vicki Howe

Andy Mackie

### **7. Future meetings**

The Autumn 2008 Field meeting will be in Pembroke, in October, organised by Anne Bunker.

The AGM in 2009 will be in Plymouth, organised by Jason Hall-Spencer and staff at Plymouth.

### **8. AOB**

There being no other business, the meeting closed at 12.50.

**PORCUPINE MNHS**  
**RECEIPTS AND PAYMENTS ACCOUNT**  
Year to 31 December 2007

Year to 31.12.06			Year to 31.12.07	
£	£		£	£
<b>RECEIPTS</b>				
30		Subscriptions	2004 & 2005	0
1382			2006	0
40			2007	1274
0			2008	20
	1452			1294
	134	Bank Interest (gross)		321
	(27)	Tax deducted		(64)
	<u>1559</u>	Total Receipts		<u>1551</u>
<b>PAYMENTS</b>				
796		Newsletter-	Printing	814
248			Postage	386
	1044	Total Newsletter Costs		1200
	470	Porcupine banner		0
	0	Web site expenses		90
	79	Council meeting expenses (travel/catering)		133
	<u>1593</u>			<u>1423</u>
	(34)	<b>SURPLUS BEFORE MEETINGS &amp; PROJECTS</b>		<u>128</u>
	(128)	Annual Conference – London (2005)		0
	612	Annual Conference – Isle of Man (2006)		0
	(60)	Field Meeting – Isle of Wight (2006)		0
	0	Annual Conference – Newcastle (2007)		(637)
	0	Deep Sea Conservation UK EFF grant received	53923	
		Less grants made	<u>51423</u>	2500
	<u>390</u>	<b>SURPLUS FOR THE YEAR</b>		<u>1991</u>
	6322	<b>BALANCE BROUGHT FORWARD</b>		<u>6712</u>
		<b>BALANCE CARRIED FORWARD</b>		
	1523	Current Account	3428	
	5189	Deposit Account	5275	
	<u><b>6712</b></u>			<u><b>8703</b></u>

Jon Moore, Hon Treasurer  
7<sup>th</sup> March 2008

*J. S. Moore*

Nick Light, Hon Examiner  
14<sup>th</sup> May 2008

*N. Light*

## PORCUPINE MARINE NATURAL HISTORY SOCIETY

### Porcupine Autumn Field Meeting – Pembrokeshire

**16-18<sup>th</sup> October 2008**

The aims of the field meeting are to:

- Record alien species and their abundance on the sheltered shores of the Milford Haven waterway.
- Compare with previous records for the area.
- Explore an exposed limestone shore on the Castlemartin peninsula.
- Write a short report of the alien species records for the Porcupine Newsletter.

	Time of low water (Milford Haven *)	Height of low water
Thursday 16 October	2.00 pm	0.6 m
Friday 17 October	2.41 pm	0.7 m
Saturday 18 October	3.23 pm	1.4 m

\* For Milford Haven MLWS is 0.73 m, MLWN is 2.45 m (2005 to 2025). For 2008 low is 0.24 m.

Everyone is welcome and no knowledge of alien species or rocky shore biology is required. There is a selection of local accommodation including hotels, B&Bs, self-catering cottages and the floors of several South Wales Porcupines.

If you would like to come along please contact:

Anne Bunker - 01646 621 277  
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 01646 624000 (work) a.bunker@ccw.gov.uk

## OTHER MEETINGS

**13-18 September 2008.** Marine survey and identification course, Medina Valley Centre, Isle of Wight [www.medinavalleycentre.org.uk](http://www.medinavalleycentre.org.uk)

**17 September 2008. What future for the Solent's saltmarshes?** Contact Solent Protection Society Tel: 01453 511175 E-mail: [secretary@solentprotection.org](mailto:secretary@solentprotection.org) or visit [www.solentprotection.org](http://www.solentprotection.org)

**20-21 January 2009 Coastal Futures conference.** Contact: Bob Earll [bob.earll@coastms.co.uk](mailto:bob.earll@coastms.co.uk); visit [www.coastms.co.uk](http://www.coastms.co.uk)



# FIELD REPORTS

## Porcupine Society Field Trip 28-30<sup>th</sup> March 2008 Inland Sea, Anglesey

Paul Brazier [p.brazier@ccw.gov.uk](mailto:p.brazier@ccw.gov.uk)

The sheltered waters of the Inland Sea, a stretch of sea lying between Anglesey and Holy Island, north Wales are quite unusual. The narrow strait is culverted at both the north and south ends, constraining the tidal flow and shifting the timing of the high and low tides relative to the open coast. Whilst the tide starts to flood at Holyhead (just round the corner), the Inland Sea continues to drain up until 2-3 hours after low water Holyhead – the equivalent of 3.5 metres above chart datum. The daily tidal range in this lagoon-like environment is only 1 metre, but the full tidal range is nearly 2m, accounting for the neap and spring tides. A full mathematical evaluation of the tidal regime is given in Hill (1994).



South of Ynys Benlas - Paul Brazier

The Inland Sea is a Site of Special Scientific Interest (SSSI) for its intertidal habitats (eelgrass beds, sediment flats) saltmarsh and birds, it is within the Ynys Mon (Anglesey) Area of Outstanding Natural Beauty (AONB) and is a local nature reserve. There are plenty of pieces of evidence around the shores that

remind us of previous activities, including walls, dams and fencing; and of more recent activities such as fish netting and Pacific oyster farming.

Access to the shores of the Inland Sea is limited to Four Mile Bridge and a public footpath that runs the length of the east side. Through the kind permission of Anglesey Aluminium, who own the western half of the Inland Sea, Porcupine members were able to access this rarely visited part, to appreciate the relatively undisturbed shores.

Due to the enthusiastic turn out of Porcupine members and friends, three locations were visited in and around the Inland Sea. Ivor Rees took leadership of a team who headed south into the Cymyran Sound, to investigate some exceptionally sheltered inlets (SH 281 780). Here, free living channel wrack *Pelvetia canaliculata*, bladder wrack *Fucus vesiculosus* and knotted wrack *Ascophyllum nodosum* ead *scorpioides* live adjacent to and within the saltmarsh creeks. This habitat is not known from anywhere else in Wales and is typically associated, in the UK with Scottish sea lochs. This team subsequently dispersed northwards along a public footpath to investigate and record species along the eastern edge of the Inland Sea, north of Four Mile Bridge (SH 280 784). Kathryn Birch and Julia Nunn were the primary recorders, collating the observations from boulders and muddy gravels by the other members of the team. Robin Shrubsole enthusiastically collected sediment samples and added further to the species list that was recorded *in-situ*. Tim Worsfold also collected washings of seaweeds and sediments from this team to subsequently work up back at the laboratory.



Tim Worsfold in action - Paul Brazier

The author led the team to access the west side of the Inland Sea via land owned by Anglesey Aluminium. The team headed past numerous lagoons (SH 265 798) that had previously been investigated in a Porcupine field trip in September 2002. (Brazier 2002). The dense mat of Widgeon grass *Ruppia cirrhosa* and *R. maritima* seen previously showed no signs of growth at this early stage in the year (for marine angiosperms). A pleasant walk along the fringes of *Spartina* saltmarsh brought the team to a small rocky outcrop where most of the rocky species recording was completed. Surprisingly, where we expected little disturbance, we found that most of the boulders had been turned relatively recently, such that the underboulder fauna had become desiccated and the algae that had been on the upper surfaces had turned anoxic underneath the boulder. This detracted from some of the interest of the boulders, yet the great drapes of nemertean eggs (thank you Robin and Tim) under the turned boulders demonstrated that not all species were disturbed! In addition, Tim Worsfold could not resist rummaging in a muddy back water behind an old dry-stone wall (not so dry at high tide!), whilst numerous species of interest were discovered in the fine sand flats that reached out into the Inland Sea and around Ynys Benlas (SH 270 797).



Nemertean eggs - Paul Brazier

A full account of all the species records cannot be presented here in full. A total of 162 taxa were recorded from 16 phyla.

At all sites sampled, the rocky outcrops were densely covered in lichens, especially the orange lichens *Caloplaca marina* and *Xanthoria parietina*, *Verrucaria maura* and *Ramalina* spp.

The sheltered nature of the habitats meant that less steep rock was covered largely with channel wrack *Pelvetia canaliculata* and knotted wrack *Ascophyllum nodosum*. Steeply sloping and vertical rock was poorly colonised by algae or animals and were instead blackened by the black lichens *Verrucaria maura* and *Verrucaria mucosa*. The few barnacles that were present were predominantly the Australasian barnacle *Elminius modestus*.

The very high density of sacs of eggs under boulders, on cobbles and on gravelly sediment raised the question of their parent! Robin and Tim made closer observations and researched the possibilities. The conclusion being that they are most likely to be eggs of a nemertean (*Amphiporus lactifloreus* was recorded by Robin in the field).

Notably few sponges were found, with only breadcrumb sponge *Halichondria panicea* and *Hymeniacidon perleve* being recorded. A low diversity of ascidians was also noted, but for this group of animals, the abundance, particularly of *Ascidella aspersa* was, in places (low shore rocks and algae), extremely high.

Recording of molluscs was somewhat biased by the personal interests within the group, there were a number of interesting molluscan finds, including brackish water species *Ventrosia ventrosa* and *Alderia modesta*. A high number of records fit under the loose term 'sea slugs', including *Retusa obtusa*, *Runcina coronata*, *Alderia modesta*, *Limapontia capitata*, *Akera bullata*, *Onchidoris bilamellata* and *Facelina bostoniensis*.



*Onchidoris bilamellata* - Paul Brazier

The algae recorded were not exceptionally

diverse, but the less common red alga *Laurencia obtusa* was found as floating balls with no obvious means of attachment to the rock. The eelgrass *Zostera angustifolia/marina* and *Zostera noltii* remained small, since most of the leaves were sloughed off during the winter and it was too early for much growth. In the back waters, the eelgrass beds were very thickly covered by algal epiphytes that unfortunately, were not successfully identified.

A most unusual feature on the sediments around Ynys Benlas were humps of *Vaucheria* that raised the level of the sediment. This proved to be a rich hunting ground, from where Tim recorded 31 taxa.

All of the data will be added to Marine Recorder, on behalf of the Porcupine marine natural history society.



Lunchtime - Paul Brazier

## References

Brazier, P. 2002. Porcupine Marine Natural History Society autumn field trip, Rhoscolyn, Anglesey, Wales. 21-22 Sept 2002. *Porcupine Marine Natural History Society Newsletter* 22, 15-23

Hill, A.E. 1994. Fortnightly Tides in the lagoon with variable choking. *Estuarine, Coastal and Shelf Science* 38, 423-434.

<b>Species Name</b>	<b>Authority</b>	<b>Notes</b>
<b>PORIFERA:</b>		
<i>Halichondria panicea</i>	(Pallas, 1766)	
<i>Hymeniacidon perleve</i>	(Montagu, 1818)	
<b>CNIDARIA:</b>		
<i>Actinia equina</i>	(Linnaeus, 1758)	
<i>Anemonia sulcata</i>	Pennant, 1777	
<i>Dynamena pumila</i>	(Linnaeus, 1758)	
<i>Laomedea flexuosa</i>	Alder, 1857	
<i>Obelia geniculata</i>	(Linnaeus, 1758)	
<b>NEMERTEA:</b>		
<i>Nemertea</i> (eggs)		
<i>Amphiporus lactifloreus</i>	(Johnston, 1828)	
<i>Lineus viridis</i>	(O F Müller, 1774)	
<b>NEMATODA</b>		
<b>ANNELIDA: Polychaeta:</b>		
<i>Lumbrineris gracilis</i>	(Ehlers, 1868)	
<i>Lumbrineris latreilli</i>	Audouin & Milne-Edwards, 1833	
<i>Scoloplos armiger</i>	(O F Müller, 1776)	
<i>Pygospio elegans</i>	Claparède, 1863	
<i>Streblospio shrubsolii</i>	(Buchanan, 1890)	
<i>Cirratulus cirratus</i>	(O F Müller, 1776)	
<i>Capitella</i> sp	Blainville, 1828	
<i>Heteromastus filiformis</i>	(Claparède, 1864)	
<i>Notomastus</i> sp	Sars, 1851	
<i>Arenicolidae</i> (juv)		
<i>Arenicola marina</i>	(Linnaeus, 1758)	
<i>Euclymene oerstedii</i>	(Claparède, 1863)	
<i>Pholoe inornata</i> (sensu Petersen)	Johnston, 1839	
Phyllodocidae (egg sacs)		
<i>Fabricia stellaris</i>		
<i>Fabriciola baltica</i>	Friedrich, 1940	
<i>Pomatoceros</i> sp	Philippi, 1844	
<i>Spirorbidae</i>		
<i>Janua pagenstecheri</i>	(Quatrefages, 1865)	

ANNELIDA: Oligochaeta:

Tubificidae

<i>Heterochaeta costata</i>	Claparède, 1863	
<i>Tubificoides benedii</i>	(Udekem, 1855)	
<i>Tubificoides pseudogaster</i> (agg)	(Dahl, 1960)	
<i>Eulalia viridis</i>	(Linnaeus, 1767)	
<i>Exogone hebes</i>	(Webster & Benedict, 1884)	
<i>Exogone naidina</i>	Oersted, 1845	
<i>Hediste diversicolor</i>	(O F Müller, 1776)	

CHELICERATA:Arachnida:

Acariformes indet.

HEXAPODA: Insecta:

Chironomidae (larva)

CRUSTACEA:

<i>Semibalanus balanoides</i>	(Linnaeus, 1767)	
<i>Elminius modestus</i>	Darwin, 1854	
Copepoda indet.		
Myodocopida indet.		
<i>Corophium acutum</i>	Chevreux, 1908	<i>Apocorophium acutum</i>
<i>Corophium arenarium</i>	Crawford, 1937	
<i>Corophium insidiosum</i>	Crawford, 1937	<i>Monocorophium insidiosum</i>
<i>Corophium volutator</i>	(Pallas, 1766)	
<i>Caprella acanthifera</i>	Leach, 1814	
<i>Praunus flexuosus</i>	(O F Müller, 1776)	
<i>Sphaeroma rugicauda?</i>	Leach, 1814	<i>Lekanesphaera rugicauda</i>
<i>Sphaeroma hookeri</i>	Leach, 1814	<i>Lekanesphaera hookeri</i>
<i>Idotea granulosa</i>	Rathke, 1843	
<i>Apherusa jurinei</i>	(H Milne-Edwards, 1830)	
<i>Ligia oceanica</i>	(Linnaeus, 1767)	
<i>Porcellana platycheles</i>	(Pennant, 1777)	
<i>Carcinus maenas</i>	(Linnaeus, 1758)	
Mysidacea indet.		
<i>Stenothoe monoculoides</i>	(Montagu, 1815)	
Talitridae		Talitrid
<i>Orchestia gammarellus</i>	(Pallas, 1766)	
<i>Dexamine spinosa</i>	(Montagu, 1813)	
Gammaridae (juv)		
<i>Gammarus duebeni</i>	Liljeborg, 1852	Both brackish and freshwater

<i>Gammarus locusta</i>	(Linnaeus, 1758)
<i>Abludomelita obtusata</i>	(Montagu, 1813)
<i>Melita palmata</i>	(Montagu, 1804)
Aoridae (female)	
<i>Microdeutopus anomalus</i>	(Rathke, 1843)

#### MOLLUSCA:

<i>Retusa obtusa</i>	(Montagu, 1803)
<i>Runcina coronata</i>	(Quatrefages, 1844)
<i>Limapontia capitata</i>	(O F Müller, 1774)
<i>Alderia modesta</i>	(Lovén, 1844)

A brackish-water littoral species.

<i>Akera bullata</i>	O F Müller, 1776
<i>Onchidoris bilamellata</i>	(Linnaeus, 1767)
<i>Patella vulgata</i>	(Linnaeus, 1758)
<i>Facelina bostoniensis</i>	(Couthouy, 1838)
<i>Ovatella myosotis</i>	(Draparnaud, 1801)
<i>Nucula nucleus</i>	(Linnaeus, 1758)
<i>Mytilus edulis</i> (juv)	(Linnaeus, 1758)
<i>Mytilus edulis</i>	(Linnaeus, 1758)
<i>Osilinus lineatus</i>	(da Costa, 1778)
<i>Chlamys varia</i>	(Linnaeus, 1758)
<i>Lasaea adansoni</i>	(Gmelin, 1791)
<i>Gibbula cineraria</i>	(Linnaeus, 1758)
<i>Gibbula umbilicalis</i>	(da Costa, 1778)
<i>Parvicardium exiguum</i> (shell)	(Gmelin, 1791)
<i>Parvicardium exiguum</i>	(Gmelin, 1791)
<i>Cerastoderma edule</i>	(Linnaeus, 1758)
<i>Ensis siliqua</i> (shell)	(Linnaeus, 1758)
<i>Scrobicularia plana</i> (shell)	(da Costa, 1778)
<i>Scrobicularia plana</i>	(da Costa, 1778)
<i>Abra tenuis</i>	(Montagu, 1803)
<i>Venerupis senegalensis</i>	(Gmelin, 1791)
<i>Mya arenaria</i> (shell)	(Linnaeus, 1758)
<i>Littorina littorea</i>	(Linnaeus, 1758)
<i>Littorina mariae</i>	(Sacchi & Rastelli, 1966)
<i>Littorina obtusata</i>	(Linnaeus, 1758)
<i>Littorina saxatilis</i>	(Olivi, 1792)
<i>Hydrobia ulvae</i>	(Pennant, 1777)
<i>Ventrosia ventrosa</i>	(Montagu, 1803)
<i>Rissoa membranacea</i>	(J Adams, 1800)
<i>Pusillina inconspicua</i> (shell)	(Alder, 1844)

A brackish-water species.

<i>Cingula trifasciata</i>	(Montagu, 1803)	Synonym <i>Cingula cingillus</i>
<i>Onoba aculeus</i>	(Gould, 1841)	
<i>Onoba semicostata</i>	(Montagu, 1803)	
<i>Skeneopsis planorbis</i>	(O Fabricius, 1780)	
<i>Omalogyra atomus</i>	(Philippi, 1841)	
<i>Rissoella diaphana</i>	(Alder, 1848)	
<i>Turbonilla lactea</i>	(Linnaeus, 1758)	
<i>Lepidochitona cinerea</i>	(Linnaeus, 1767)	
<i>Buccinum undatum</i> (shell)	Linnaeus, 1758	
<b>BRYOZOA:</b>		
<i>Alcyonidium hirsutum</i>	(Fleming, 1828)	
<i>Flustrellidra hispida</i>	(Fabricius, 1780)	
<i>Bowerbankia</i> sp	Farre, 1837	
<i>Umbonula littoralis</i>	Hastings, 1944	
<i>Cryptosula pallasiana</i>	(Moll, 1803)	
<b>ECHINODERMATA:</b>		
<i>Amphipholis squamata</i>	(Chiaje, 1829)	
<b>TUNICATA:</b>		
<i>Ascidiella aspersa</i>	(O F Müller, 1776)	
<i>Botryllus schlosseri</i>	(Pallas, 1766)	
<b>RHODOPHYCOTA:</b>		
<i>Osmundea hybrida</i>	(De Candolle) Nam	
<i>Laurencia obtusa</i>	(Hudson) Lamouroux	
<i>Polysiphonia</i> sp	Greville	
<i>Polysiphonia lanosa</i>	(Linnaeus) Tandy	
<i>Rhodothamniella floridula</i>	(Dillwyn) J Feldmann	
<i>Dumontia contorta</i>	(S Gmelin) Ruprecht	
<i>Gracilaria</i> sp	Greville	
<i>Chondrus crispus</i>	Stackhouse	
<i>Catenella caespitosa</i>	(Withering) L Irvine	
<i>Chylocladia verticillata</i>	(Lightfoot) Bliding	
<i>Lomentaria clavellosa</i>	(Turner) Gaillon	
<i>Ceramium</i> sp	Roth	
<i>Ceramium ciliatum</i>	(Ellis) Ducluzeau	
<i>Ceramium secundatum</i>	Lyngbye	
<i>Porphyra</i> sp	C Agardh	

#### CHROMOPHYCOTA:

<i>Cladostephus spongiosus</i>	(Hudson) C Agardh
<i>Asperococcus</i> sp	Lamouroux
<i>Colpomenia peregrina</i>	(Sauvageau) G Hamel
<i>Petalonia</i> sp	Derbès et Solier
<i>Ascophyllum nodosum</i> subsp <i>scorpioides</i>	(Linnaeus) Le Jolis
<i>Ascophyllum nodosum</i>	(Linnaeus) Le Jolis
<i>Fucus serratus</i>	Linnaeus
<i>Fucus spiralis</i>	Linnaeus
<i>Fucus vesiculosus</i>	Linnaeus
<i>Pelvetia canaliculata</i>	(Linnaeus) Decaisne et Thuret

#### CHLOROPHYCOTA:

<i>Enteromorpha</i>	Link	
<i>Ulva</i> sp	Linnaeus	
<i>Blidingia marginata</i>	(J Agardh) P Dangeard ex Bliding	
<i>Prasiola</i> sp	C Agardh	
<i>Chaetomorpha linum</i>	(O F Müller) Kützing	
<i>Cladophora rupestris</i>	(Linnaeus) Kützing	
<i>Rhizoclonium tortuosum</i>	Roth	<i>Rhizoclonium riparium</i>

#### ANGIOSPERMA:

<i>Zostera marina</i>
<i>Zostera angustifolia</i>
<i>Zostera noltii</i>
<i>Salicornia</i> sp
<i>Spartina</i> sp

#### LICHENS:

<i>Verrucaria mucosa</i>
<i>Caloplaca marina</i>
<i>Ramalina siliquosa</i>
<i>Xanthoria parietina</i>



## ***Haustorius arenarius* (Crustacea: Amphipoda) on offshore sub-tidal sandbanks around Wales**

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On the coasts of Britain and Ireland the sub-family Haustoriinae (Crustacea: Amphipoda) is represented by a single species, *Haustorius arenarius* Slabber (Lincoln, 1979). Substantial populations of it have most often been recorded living buried intertidally on moderately exposed sand beaches or on intertidal sandbanks in the lower reaches of estuaries (Watkin, 1942; Dahl, 1952; Vader, 1969; Withers, 1977). In offshore surveys, records even of single individuals are relatively sparse.

During a benthos survey of a series of offshore sub-tidal sandbanks around the Welsh coast in summer 2001 (Darbyshire *et al*, 2002), a significant population of *Haustorius arenarius* was found living on one of the eleven banks sampled. Far more specimens were collected from this sandbank than could be regarded as vagrant individuals washed out to sea from beach or estuarine habitats. This find prompted consideration of the habitat features found in common between some offshore tide-swept sandbanks and situations just below high water neap tide levels on moderately exposed beaches.

The sandbank off Wales where *Haustorius*

*arenarius* was found in greatest numbers was Bais Bank. This lies in St George's Channel, 6 km off the north coast of Pembrokeshire (Latitude 51° 56'N; Longitude 5° 23'W) (Fig 1). It is a detached sub-tidal sandbank, of the rectilinear or 'banner' type. Such banks develop where headlands or islands deflect strong tidal streams (Pingree, 1978; Carter, 1988; Dyer & Huntley, 1999). The crest of Bais Bank is 8 - 10 m below chart datum, but there are depths of 44 - 53 m between the bank and the adjacent, predominantly steep, rocky coast. The bank is 7 km long, but less than 1 km wide at the 20 m contour. Echosounds showed the presence of mega-ripples superimposed on the bank crest and, even on a neap tide, some turbulence over the bank was readily apparent at the sea surface. The bank sediment is very well sorted medium sand, most samples having >85% by weight in the 2 Phi class (Darbyshire *et al*, 2002).

Bais Bank was sampled on 28th July 2001 using a long-arm Van Veen grab (0.1m<sup>2</sup>) and an ICES pattern small mesh 2 m beam trawl fitted with a chain mat (Darbyshire *et al*, 2002). The 5 grab stations were arranged in a line at right angles to the long axis of the bank while the 5 beam trawl tows were made along the axis. Specimens of *Haustorius arenarius* were collected in the 2 beam trawl tows that were closest to the bank crest, the other 3 tows being on the flanks of the bank. The 2m beam trawl was towed at 1.5 - 2 knots and timed for 5 minutes on the seabed on each deployment. It yielded a total of 30 specimens, even though digging into the sediment and retention by the 5 mm knotless netting cod-end liner would have been incomplete. Single *H. arenarius* individuals were also found in 3 out of the 10 grabs taken on the bank. The implication is that, in places, possibly in the megaripples, there could have been as many as 1 - 5 individuals / m<sup>2</sup>. The other macrofauna on Bais Bank was extremely sparse, in keeping with the very unstable medium sand habitat. The most numerous infaunal species was the polychaete *Protodriloides chaetifer* (Darbyshire *et al*, 2002). Excluding brachyuran larvae and unidentified nemerteans, the median number of individuals of all species recovered from 2 grabs at each station, washed on 0.5 mm mesh

sieves, was only 12 (i.e. roughly equivalent to only 60 individuals / m<sup>2</sup>).

A single *Haustorius arenarius* was identified from 6 grab samples from Turbot Bank, which is south west of the entrance to Milford Haven and two were found in 24 grab samples from Helwick Bank off Gower on the same cruise. Two more individuals were collected from 8 grab samples taken on the western end of Helwick Bank in 2003, as part of the Outer Bristol Channel Marine Habitat Study (Mackie *et al*, 2006). Three more specimens were collected in just one other grab from over 250 in the Outer Bristol Channel. This particular grab was at a location in the NOBEL sand wave field and had very well sorted medium sand. No *H. arenarius* were noticed in beam trawls made over the Helwick and Turbot Banks or in any of the 51 beam trawls in the Outer Bristol Channel project. This suggests that while *H. arenarius* does occur very sparsely at several sandbank locations off southwest Wales, they were much more frequent on Bais Bank than on other offshore banks or sand wave fields.

The study by Fincham (1971) of the ecology of *Haustorius arenarius* in the Isle of Man showed a distribution pattern broadly representative of open coast beach situations. At Port Erin the distribution was exclusively intertidal, the population being centred above mid tide level and extending right up to the highest point of emergence of the water table on the beach. A rather similar pattern had been shown at Millport, Isle of Cumbrae (Watkin, 1942). Of sub-tidal records, many have been in locations subject to reduced salinity, such as where the distribution was shown to extend below low water on estuary channel sandbanks (Perkins, 1956).

Tide swept, linear sub-tidal sandbanks have some environmental similarities with moderately exposed sand beaches. Darbyshire *et al* (2002) also noted that several of the polychaete worms found on the Welsh sub-tidal sandbanks were ones more often recorded intertidally from sand beaches. Sediment characteristics, particularly the sorting and, hence, the porosity of the sand in both habitats would suit a burrowing amphipod feeding by using the maxillae to filter water

percolating through the interstices of the sediment (Dennell, 1933). This should apply whether the flow is driven by wave swash, as on a beach, or by tidal current shear forcing water through the sand ripples on a sub-tidal bank. In both habitats the sediment is subject to frequent disturbance (Green *et al*, 1995), reducing the number of benthic species, including predators, able to maintain populations. These unstable sparsely populated habitats may even function as refugia for some of the few species able to live there.

The most common predators of amphipods on the Welsh sandbanks were lesser weaver fish *Echiichthys vipera*. On Bais Bank a combined total of 490 *E. vipera* were caught in 4 tows with the 2 m beam trawl and four tows of a heavier 4 m beam trawl. Weavers accounted for 92%, by number, of all the fish caught in both gears at this bank.

On superficial examination the specimens from Bais Bank conformed to *Haustorius arenarius* as illustrated by Sars (1890) and Chevreux & Fage (1925). However, for some limbs there initially seemed to be slight morphological differences from the figures shown by Lincoln (1979). However, when the Bais Bank specimens were subsequently compared with limbs of freshly collected specimens from a sand beach at Aberffraw, Anglesey, no obvious differences were apparent. Slightly different orientations to the segments of detached limbs after flattening, or disarticulation, in the museum preparations used for the drawings in Lincoln (1979) probably accounted for the apparent discrepancy. Fresh limbs of *H. arenarius* articulate in more than one plane and do not naturally lie flat for viewing under a microscope. Slight uncertainty still exists in relation to some of the characters suggested by Bousfield (1965) for separating *H. arenarius* from the American congener *H. canadensis*. About half of the Bais Bank trawl caught specimens were at, or above, the 13 mm maximum size quoted by Lincoln (1979) for *H. arenarius*, the largest one being 16 mm. *H. canadensis* is slightly larger than *H. arenarius*, reaching 18 mm (Bousfield, 1965). Genetic divergence has been demonstrated amongst sand-hoppers (Talitridae) occupying fragmented habitats of differing ecological

quality (Ketmaier *et al*, 2003). Sand-hoppers have a particularly low ability to disperse between beaches that are discontinuous. Some offshore sub-tidal sandbanks are also relatively isolated, which could allow some populations of *H. arenarius* to slightly diverge from the more familiar beach inhabiting ones. This could include growing to slightly larger sizes on some offshore tide swept sandbanks.

Only two other species in the genus *Haustorius* are known on the eastern side of the north Atlantic, but both live much further south on Mediterranean and North African beaches, (Bellan-Santini, 2005). On the American side of the Atlantic, in addition to *H. canadensis* which has many similarities with *H. arenarius*, there are a number of closely related genera, often with several species (Barnard, 1969; Bousfield, 1965; 1970; 1973). Some of these American species live offshore on the continental shelf down to about 100 m, while others occupy separate ecological niches on beaches and in estuaries (Croker, 1967). The difference between the diversity of taxa in the Haustoriinae at similar temperate latitudes on opposite sides of the Atlantic seems noteworthy, as is the spread of habitats occupied by the single *Haustorius* species found in Britain and Ireland. Perhaps, sharing ancestry with *H. canadensis*, the British species may be a geologically recent colonist and, without related competitors, has occupied the wider habitat range.

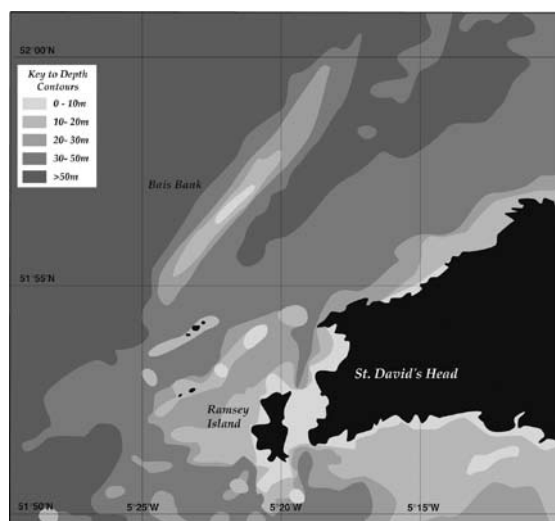


Figure 1. Location of Bais Bank off north Pembrokeshire, where a significant population of *Haustorius arenarius* was found

## REFERENCES

- Barnard, J.L. 1969. The Families and Genera of Marine Gammaridean Amphipoda. *United States National Museum, Bulletin*, 271, 535 pp.
- Bellan-Santini, D. 2005. European species of *Haustorius*; (Crustacea: Amphipoda: Haustoriidae), with description of a new Mediterranean species. *Journal of Natural History*, 29, 1101-1110.
- Bousfield, E.L. 1965. Haustoriidae of New England (Crustacea: Amphipoda). *Proceedings of the United States National Museum*, 117, 159-239.
- Bousfield, E.L. 1970. Adaptive radiation in sand burrowing Amphipod Crustaceans. *Chesapeake Science*, 11, 143-154.
- Bousfield, E.L. 1973. *Shallow-Water Gammaridean Amphipoda of New England*. Cornell University Press.
- Carter, R.W.G. 1988. *Coastal Environments. An Introduction to the Physical, Ecological and Cultural Systems of Coastlines*. Academic Press, London. 617 pp.
- Chevreaux, E. and Fage, L. 1925. *Amphipodes*. Fauna de France 9. Lechevalier, Paris.
- Croker, R.A. 1967. Niche diversity in five sympatric species of intertidal amphipods (Crustacea: Haustoriidae). *Ecological Monographs*, 37, 173-200.
- Dahl, E. 1952. Some aspects of the ecology and zonation of the fauna of sandy beaches. *Oikos*, 4, 1-27.
- Darbyshire, T., Mackie, A.S.Y., May, S.J. and Rostron, D. 2002. *A Macrofaunal Survey of Welsh Sandbanks*. National Museum of Wales & Countryside Council for Wales. CCW Contract Report No. 539, 113 pp.
- Dennell, R. 1933. The habits and feeding mechanisms of the amphipod *Haustorius arenarius*. *J.Linn.Soc. (Zool.)*, 38, 363.
- Dyer, K.R. and Huntley, D.A. 1999. The origin, classification and modelling of sand banks and ridges. *Continental Shelf Research* 19: 1285-1330.

Fincham, A.A. 1971. Ecology and population studies of some intertidal and sublittoral sand-dwelling amphipods. *J.mar. biol.Ass.U.K.* 51, 471-488.

Green, M. O., C. E. Vincent, et al. 1995. Storm sediment transport: observations from the British North Sea shelf. *Continental Shelf Research*, 15, 889-912.

Ketmaier, V., Scapini, F., and Matthaeis, E. D. 2003. Exploratory analysis of talitrid population genetics as an indicator of the quality of sand beaches. *Estuarine, Coastal and Shelf Sea Science*, 58S, 159-167.

Lincoln RJ 1979. *British Marine Amphipoda: Gammaridea*. British Museum (Natural History), London.

Mackie, A. S. Y., James, J.W.C., Rees, E.I.S., Darbyshire, T., Philpott, S., Mortimer, K., Jenkins, G. & Morando, A. 2006. *The Outer Bristol Channel Marine Habitat Study. Studies on Marine Biodiversity and Systematics from the National Museum of Wales*, BIOMOR reports 4, 249 pp. & Appendix 228 pp.

Perkins, E.J. 1956. The fauna of a sand-bank in the mouth of the Dee estuary. *Ann. Mag. Nat. Hist.* Ser. 12, 9, 112-128.

Sars, G.O. 1890. *An account of the Crustacea of Norway*. Vol 1. 711 pp. & 240 + VIII Plates. Bergen Museum, Bergen.

Vader, W. Verspreiding en biologie van *Haustorius arenarius*, de zandvlokreeft, in Nederland (Crustacea, Amphipoda). *Zool. Bijdr.* 11. 49-58.

Watkin, E.E. 1942. The macrofauna of the intertidal sand of Kames Bay, Millport, Buteshire. *Transactions of the Royal Society Edinburgh*. B60, 543-561.

Withers, R.G. 1977. Soft-shore macrobenthos along the south-west coast of Wales. *Estuarine and Coastal Marine Science*, 5, 476-484.

## QUALITY CONTROL IN MACROBENTHIC ANALYSIS

or

### Am I the only one who is worried?

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Picture this: you have been involved in the identification of marine invertebrates for some time, and feel that you are beginning to get the hang of the job. You soon realise that identification of benthic marine invertebrates is actually quite a tricky pastime. It relies on a developing literature which is often not entirely appropriate, often downright inadequate, and even when readily available and of a good standard, generally does not deal very well with the small individuals which often make up most of the fauna of benthic samples. In a surprising number of instances, there is no *correct* identification, opinions vary, even amongst experts. You learn that, with experience, separation of taxa improves. In many cases the actual names given to those taxa are not critical, but where comparisons are to be made between surveys or samples, then maximising consistency between identifiers is important. You think to yourself that this should be addressed by developing literature aimed at identification rather than pure taxonomy, and workshops to share experience.

Then the NMBAQC scheme is born, aimed at standardising as far as possible the methodology and the results obtained by a variety of contractors working on the NMMP sites around the country. For those working with macrobenthic invertebrates, its approach is fourfold, analysis of a single sample supplied to each participant and checked by the scheme organisers (Macrobenthic Module), a series of specimens provided to the participants for identification (Ring Test), re-analysis of 3 of samples (Own Sample), and the checking of a voucher series of specimens provided by each participant (Lab Reference). It makes good sense and should help pinpoint groups which are causing problems, which can then form the subjects of workshops organised under

the auspices of the scheme, and promote consistency.

The scheme evolves and contractors working outside the NMMP programme are encouraged to join. It is realised that allowing the participant to choose which samples to send as the Own Sample component is not a particularly good idea, and the scheme organiser is, sensibly, given that task. Then it is decided that the participating contractors should provide the fauna for the 3 own samples separated into individual taxa in labelled vials, sometimes distinguishing the 0.5mm component and the 1.0mm component. Because of the random selection of the 3 samples, this extra process needs to be done for all NMMP samples.

Time to think again. NMMP samples are not particularly interesting or exciting, and the extra hoops you are required to jump through under the scheme make the analysis tedious, without adding anything to the end product, though facilitating the checking process. You decide to bow out of Environment Agency work, and concentrate on other things. An easy decision to make if you have been in the business for some time and have the possibility of other work.

Then the NMBAQC scheme starts to cast its net a little wider, moving beyond the UKCSEMP and WFD programmes, the offspring of the NMMP for which it was designed, and is taken up by BEQUALM to be spread across Europe. In the UK all government laboratories and their contractors are now required to join. Suddenly it is being portrayed as an accreditation scheme, and belonging to it is encouraged as a sign of competence or even demanded as proof of expert status. Membership of the NMBAQC or an equivalent quality assurance scheme used to be the options for the NMMP work. Suddenly *only* the NMBAQC scheme is deemed acceptable for contractors undertaking certain work for which it was *not* designed.

You think to yourself that whilst the scheme was confined to its original remit, then it was something that could be avoided, but as it begins to spread out into the mainstream of macrobenthic analysis, you get worried

that it is turning into a monster. Because it is the only formal scheme to address quality of macrobenthic analysis, it is easy to see why it is attractive from the point of view of those commissioning or managing such analysis in a world of competitive tendering. But nobody seems to ask whether the scheme is suitable for other sample sets. Is it really likely that a standardised, and therefore inflexible, scheme can be effective for different types of samples, taken with different aims and objectives?

I find myself in this position, and feel that now is an opportune moment for those involved in macrobenthic analysis to have some meaningful discussion of the quality control aspect. The views of those who are at the sharp end of the process, who undertake the analysis, and who are often forced to join and therefore fund the NMBAQC scheme, seem to have been totally ignored. Certainly mine have been, despite many conversations and a few letters over the years. The main problem lies with the Own Sample module which, together with the Ring Test, currently form the minimum requirement to be considered as being a participant in the scheme.

There are many points that need to be considered. For example, should all quality assurance be undertaken under the umbrella of the NMBAQC scheme? If so, then it needs to be more flexible, and should be operated by truly independent experts. If not, what are the basic requirements for other parallel schemes? Can quality assurance be undertaken in a more effective way, which does not add unduly to normal working practices, but yields simple, quick and cheap assessment of, and reassurance to, the participants? Should the organisations intimately involved in the development and running of the NMBAQC scheme be able to insist that contractors join? Is it right that the NMBAQC should be portrayed as an accreditation scheme?

Let me stress that I have absolutely no problem with the way the NMBAQC scheme is being operated by UNICOMARINE, and my reservations apply only to the invertebrate section, and within that, predominantly to the Own Sample module. I would like to think that I have a good relationship with those directly involved in the practicalities of the scheme,

and my concerns are with the application of the scheme beyond the sites and programmes for which it was originally designed.

*The views expressed above are entirely my own, though well known to many whose ears I have bent on the subject, over the years. My intention is to stimulate some debate on the future of quality assurance in macrobenthic analysis. Those who work in the field, but are currently outside the scheme need to be alerted that a juggernaut has been set in motion, and perhaps now is the time to control it, while it still can be controlled. Please let your views be known, and if I am shown to be completely out of step with everyone else, then I promise to keep quiet.*

**First records of the shrimp  
*Periclimenes sagittifer* (Norman,  
1861) (Decapoda: Caridea:  
Palaemonidae: Pontoniinae), a  
new species in British mainland  
waters.**

*Doggett, M. & Whyte, P.*

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**Abstract**

This paper details the first recorded instance of the shrimp *Periclimenes sagittifer* in British mainland waters at Swanage Pier, Dorset. The species is present in greatest numbers on the southwest Atlantic coast of Portugal and was known previously to extend as far north as the Channel Islands. As recently as 2002, *P.sagittifer* was recorded for the first time in the Azores. This species may be extending its range or may simply have gone unnoticed until now.

**Introduction**

Kingdom: Animalia  
Phylum: Arthropoda  
Class: Malacostraca  
Order: Decapoda

Superfamily: Palaemonoidea

Family: Palaemonidae

Genus: *Periclimenes*

*Periclimenes sagittifer* is also known as the snakelocks anemone shrimp or anemone partner shrimp as a result of its symbiotic relationship with the snakelocks anemone *Anemonia viridis* (previously *sulcata*). *P.sagittifer* inhabits the anemone where it lives protected from predators within the anemone's stinging tentacles (Calado *et al.*, 2007).

The larval development of *P.sagittifer* consists of eight zoeae and megalopa stages and is described in detail by Santos *et al.* (2004). Chemical cues from *A.viridis* and conspecifics are likely to play an important role in larval settlement (Santos *et al.*, 2004). In shelter selection studies of decapod crustaceans associated with *A.viridis*, *P.sagittifer* has been observed to select the anemone up to 95% of the time compared to the surrounding substrata (Calado *et al.*, 2007); these observations illustrate the close, long-lasting association of the two species (Wirtz, 1997; Calado *et al.*, 2007). The only other species to show a similar degree of association with *A.viridis* was the spider crab, *Inachus phalangium*, that selected the shelter of the anemone during 90% of all observations (Calado *et al.*, 2007).

*P.sagittifer* feeds on trapped planktonic food and detritus captured by the tentacles of its host anemone. It has large chelae with which it can also clip off pieces of its host's tentacles and feed on them (Grippa & Udekem d'Acoz, 1996).

*P.sagittifer* is often found either alone in its host anemone or in heterosexual pairs as predicted by Baeza & Thiel (2003 in Calado *et al.*, 2007). *P.sagittifer*, together with other *Periclimenes* members of the "*amethysteus* group" are particularly territorial and readily deploy their large chelae during territorial encounters with conspecifics (Calado *et al.*, 2007).

In southwest Portugal, *P.sagittifer* is a common sight on snakelocks anemones; around 30% of anemones host a shrimp (Calado *et al.*, 2007). Although largely transparent

and only 2-3cm long, the shrimp has some clear distinguishing features. The chelae are blue and white striped whilst the thorax is covered with small blue spots. Its abdomen is ornated by pinky-white stripes, one of which is v-shaped and points toward the tail. Finally the telson is edged by a further blue and white arrow shaped stripe pointing back toward the thorax.

### Sighting details

An individual *P.sagittifer* (Norman, 1861) shrimp was observed on the oral disc of a solitary *A.viridis* under the new Swanage Pier in Swanage, Dorset, UK (grid reference SZ 035 787; 50° 36.501'N, 001° 57.056'W) (Plate 1). Seasearch diver Polly Whyte made the sighting on 22 September 2007 at 1242h GMT. Water depth was approximately 3m and the temperature was approximately 17°C (Suunto Vyper dive computer).



Plate 1: The actual shrimp observed in its host anemone beneath Swanage Pier, © Matt Doggett.

The authors recorded the sighting, identified the species and records have been sent to the Marine Life Information Network (MarLIN) at the MBA, Plymouth and to Seasearch. The sighting has been acknowledged as the first recorded sighting in UK mainland coastal waters by Dr. Roni Robbins of London Natural History Museum and Chris Wood, National Seasearch co-ordinator at the Marine Conservation Society.

### Discussion

The shrimp observed beneath Swanage Pier was positioned on the oral disc of its host anemone. This contrasts with the study by Calado *et al.* (2007) in which the specimens of *P.sagittifer* were never observed on the

oral disc but mainly on the tentacles and column of its host. Whilst it is possible that the shrimp moved to the centre in response to the approaching divers, detritus was present on the oral disc upon which the shrimp may have been feeding. Other species frequently observed with *A.viridis* such as *Eualus occultus*, *Necora puber*, *Eualus cranchii* and *Clibanarius erythropus* are often located near the base, possibly as they take shelter from approaching divers (Calado *et al.*, 2007). The presence of our specimen on the oral disc enforces its close association with *A.viridis* and further careful observations can determine whether its presence on the oral disc is a common occurrence. It is possible that a lack of detritus under aquarium conditions might explain why the shrimp were never previously observed on the oral discs.

Although our observation is the first recorded UK sighting, anecdotal evidence does exist of a previous observation near Brixham, Devon approximately 3-5 years previously by Chris Proctor. No images exist and the sighting was not recorded. Further dives have been conducted beneath Swanage Pier by the authors since the original sighting but as yet, have failed to yield further observations.

These sporadic sightings along the British south coast suggest that *P.sagittifer* is likely to be at the extreme northern most extent of its present range. As a result of the observation the species has been added to the Seasearch list of climate change indicator species moving northward, which already included its host anemone *A.viridis*.

In 2002, *P.sagittifer* was also recorded for the first time in the Azores and was observed to inhabit various hydroids, algae and the black coral *Antipathes wollastoni* (d'Udekem d'Acoz & Wirtz, 2002). It is hoped that further information can be provided by UK divers to provide a clearer picture of the distribution of *P.sagittifer* and indicate whether or not the species is extending its range. The finding proves the important role that divers can play in providing information regarding marine ecosystems and their inhabitants.

## References

Baeza, J.A & M. Thiel, (2003). Predicting territorial behaviour in symbiotic crabs using host characteristics: a comparative study and proposal of a model. *Marine Biology*, Vol. **142**: 93-100.

Calado, R., Dionísio, G. & Dinis, M.T. (2007). Decapod crustaceans associated with the snakelocks anemone *Anemonia sulcata*. Living there or just passing by? *Scientia Marina*, **71**(2): 287-292.

Grippa, G.B. and C. d'Udekem d'Acoz. – 1996. The genus *Periclimenes* Costa, 1844 in the Mediterranean Sea and the Northeastern Atlantic Ocean: review of the species and description of *Periclimenes sagittifer aegylios* subsp. nov. (Crustacea, Decapoda, Caridea, Pontoniinae). *Atti. Soc. it. Sci. nat. Museociv. nat. Milano*, **135**: 401-412.

Santos, A., Calado, R., Bartilotti, C. & Narciso, L. (2004). The larval development of the partner shrimp *Periclimenes sagittifer* (Norman, 1861) (Decapoda: Caridea: Palaemonidae: Pontoniinae) described from laboratory-reared material, with a note on chemical settlement cues. *Helgoland Marine Research* **58**(2): 129-139.

d'Udekem d'Acoz, C. & Wirtz, P. (2002). Observations on some interesting coastal Crustacea Decapoda from the Azores, with a key to the genus *Eualus* Thallwitz, 1892 in the Northeastern Atlantic and the Mediterranean. *Arquipélago (Ciênc. Biol. Mar./Life Mar. Sci.)* **19A**: 67-84.

Wirtz, P. – 1997. Crustaceans symbionts of the sea anemone *Telmatactis cricoides* at Madeira and Canary Islands. *Journal of the Zoological Society of London*, **242**: 799-811.

## Information Requests and Observations



### Unusual records from Seasearch 2007 data

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Despite less than perfect diving weather, 2007 was the most productive year ever for Seasearch records with 1,332 records received. We also had the highest number of Survey Forms, 453, and, since these normally contain multiple habitat descriptions and species lists, it represents a huge volume of data from all over the UK, with some also from Ireland and the Channel Islands.

The data contains a number of interesting sightings of things either apparently new to our waters or new to the area where they were found. All of the sightings below are backed up by photographic records. Most are of mobile species and whether they represent one-off occurrences or shifts in distribution only time will tell.

All of the Seasearch data can be accessed through the National Biodiversity Network website, [www.searchnbn.net](http://www.searchnbn.net). There is also a downloadable Annual Report for 2007 and 15 area summaries on the Seasearch website [www.seasearch.org.uk](http://www.seasearch.org.uk).

*Periclimenes sagittifer*, anemone prawn. Commonly found with snakelocks anemones in the Channel Islands and further south, the 2007 Seasearch record is the first on the NBN from the north side of the English Channel, astonishingly from Swanage Pier - (see p21)

*Alpheus macrocheles*, snapping prawn. Another southerly species with the few previous NBN records from well offshore. A cryptic species so the record from Lyme Bay may be more about knowing what to listen for and how to find it!

*Palinurus elephas*, crawfish. A recent

addition to the BAP species list and normally found on west coasts. The Seasearch record in 2007 from the Farne Islands is the first on the NBN from anywhere on the North Sea coast of England or southern Scotland.



*Photo - Christine Norris*

*Parablennius ruber*, red or Portuguese blenny. Recently recorded from a number of exposed westerly locations in Scotland, Ireland and Isles of Scilly. Two Seasearch records in 2007 from different sites in the Isles of Scilly.

*Parablennius gattorugine*, tompot blenny. A common species on southerly and westerly coasts, the record from North Norfolk is the first record for Eastern England south of Sunderland.

*Parablennius rouxi*, striped blenny. Previously recorded from the Mediterranean and Atlantic coast of Portugal, the Seasearch record from Bigbury Bay, Devon is the first for the UK.

In addition to these mobile species, Seasearch divers also recorded a number of nationally scarce and rare species in new places, including a new site for sunset cup-corals, *Leptopsammia pruvoti*, in the Isles of Scilly and new sites for the pink soft coral *Alcyonium hibernicum*, in Devon.

## Large incursion of *Apolemia*, 'String Jelly'

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In the autumn of 2007 a phenomenal incursion of a species of *Apolemia* was recorded between the Isles of Scilly and Plymouth. It was probably *A. uvaria*, a Mediterranean species and if so it is yet another 'southern' species extending its range northwards and likely to be recorded more often in the future. Since the widespread publicity in the media, we now know that there have been scattered sightings of small numbers in recent years by fishermen and swimmers.



Photo - Neil Hope [www.divingimages.co.uk](http://www.divingimages.co.uk)

*Apolemia uvaria* was first described in 1815 by Lesuer. It is arguably the largest known invertebrate, forming strings (hence, the common name, 'String Jelly') several metres long, capped with a very small float. However, this far north, and often in rough water, most are inevitably broken into lengths well under a metre. In Norwegian seas, one of the species of *Apolemia* is known to have caused problems in a salmon farm. These were blue in colour and appropriately called 'Blue Fire'. The Cornish examples were all described as pink, although the colour may not be of specific significance. Another common name is 'Stinging Hydroid' which is very apt, because it can certainly sting, as many divers can testify. It is, indeed, a hydrozoan related to such siphonophores as the Portuguese Man-of-War (*Physalia physalia*).

Attention was first drawn to the presence of *Apolemia* by Rory Goodall, when

he saw the strange creatures in vast numbers between Penzance and the Isles of Scilly. He informed Joana Doyle, Marine Conservation Officer of Cornwall Wildlife Trust and Ray Dennis, who compiles the marine sightings database for Cornish and Scillonian waters. Ray subsequently arranged for Paul Gainey, a local expert, to see this phenomenon. Paul describes them as being present in tens of thousands, varying in length, but mostly about 25 cms long, and all releasing minute reproductive medusae. Each long chain is headed by one small bladder.

*Apolemia* would normally feed on quite small zooplanktonic creatures. The accompanying picture shows a hapless small fish that must have been too close to a strand. The problems in the Norwegian fish farm, mentioned above, were presumably due to sheer numbers. The small stinging jellyfish *Pelgia noctiluca* devastated a salmon farm in Northern Ireland by weight of numbers. There is indeed "strength in numbers".

## The Unnatural History of the Sea

Callum Roberts, *Gaia publishers, London,*  
([www.octopusbooks.co.uk](http://www.octopusbooks.co.uk)), 448pp., 2007. ISBN-  
10: 1-85675-294-1. £7.99

*Reviewed by Frank Evans*

Ask any North Sea trawlerman and he will tell you that there are still plenty of cod in the sea. What he means is that from a declining stock he is still catching plenty of cod, just as fishermen did on the Grand Banks not long before the collapse of that fishery. In this book Professor Callum Roberts has provided extensive evidence of the reduction of fishery after fishery wherever man has had the power to bring this unfortunate event about.

We are not just considering modern times. Middens in the Caribbean bear the hallmarks of the overexploitation of reef fish more than thirteen hundred years ago as the native populations there increased, while from the same times in England intensive fishing occurred as early as the eleventh century. Again, this is revealed in an examination of fish bones from Viking middens in Coppergate in the town of York where a dramatic change took place in a few decades from migratory fish taken in fresh water to entirely marine species. Since freshwater fish are more easily taken, e.g. by traps, this can only be ascribed to a declining fishery and a move to newer, more demanding, grounds. Roberts points to sedimentation and reduced river flows throughout medieval Europe caused by forest clearance, deep ploughing and the construction of weirs and mill dams, leading to failed migrations and impoverished water quality.

The book extends across an international canvas and considers not only fish but other marine animals and portrays too, some of the important side effects of intensive slaughter. As an early example Roberts traces the demise of Stellar's sea cow. This huge, sad sirenian, once found from Japan to Californina, became extinct only partly from over-exploitation but, surprisingly also because of the popularity of sea otter pelts. Otter numbers were reduced to feed the market, resulting in an increase in sea urchins, resulting in turn in the disappearance

of kelp forests and consequent starvation for the sea cows, whose diet the kelp was.

Off the Californian coast abalone (*Haliotis*), once abundant, have almost disappeared. They are regarded as gourmet food and as numbers dwindled the price rose spectacularly, fuelling the drive to collect the animals, most recently by divers. So scarcity proved to be no controller of a fishery, contrary to what is generally believed.

Among the best-known examples of recklessly exploitative fishing are the sealing and whaling industries. The nineteenth century introduced whaling as the first global industry but even earlier, in the eighteenth century, Holland had employed nearly six thousand whaling ships over a fifty year period to catch right whales. At its whaling height, in 1817 the town of Newcastle was illuminated by more than two hundred street lamps burning whale oil. Even now the northern right whale survives by a thread following this historic assault. And yet genetic studies suggest that the primal population of large whales may have been nine or a dozen times the estimates obtained from whaling records. This is a major theme of the book, that unexploited populations of commercial sea creatures everywhere were far greater than is currently supposed.

Sealing followed the same pattern of destruction. The extreme vulnerability of seals to capture proved instrumental in their downfall. Walruses were early victims. Their bodies provided almost everything that the Inuit of Canada needed and they later supplied billiard cue tips for Europeans as well as much else.

While many demersal fisheries declined slowly, one of the most spectacular collapses was in North Sea herring. In 1954 a very senior fisheries scientist told me that there was no record of any pelagic fishery anywhere in the world being over-fished. A year after came the first herring crash, to be followed later by a total ban on herring fishing in the North Sea. In 1957 a wiser fisheries scientist wrote that the North Sea herring had fed much of Europe for hundreds of years but the fish could not, in addition, feed Europe's livestock. Until the ban, lasting for three years from 1977, there

was no control whatsoever on catches nor was it believed that one was necessary. Only now is the stock recovering.

Questions concerning demersal stocks and the effects of trawling arose much earlier than the herring disaster and the opinions of a Royal Commission in 1863 headed by Thomas Huxley have often been cited. Lacking landing data the commission concluded that no action needed to be taken against trawling nor were stocks under threat. Given the puny fishing gear of the time this was, perhaps, not unreasonable but the conclusions have frequently been cited later, under far more dangerous conditions.

Of all the fishing gear employed over the centuries the trawl and its relative, the dredge, have proved the most damaging. Roberts writes that the spread of trawling caused the greatest human transformation of marine habitats ever seen, converting biologically rich, complex and productive habitats to the immense expanses of sand, gravel and mud that predominate today. And when, beginning in 1903, a seventy percent annual return of tagged plaice was recorded, it finally began to be realised that fish stocks may not be inexhaustible.

However, regulation anywhere was difficult. In the North Sea a dozen nations fished outside the national three mile limits. Scientific estimates of fish stocks were rescripted by politicians and even, sometimes, by fisheries scientists themselves as the Danes did over industrial fishing for herring. Nowadays we have the European Common Fisheries Policy but the procedure is unchanged from the earlier management procedures of individual countries. Scientists deduce from catch data and sampling the total stock of a particular species in the fishery and decide a total allowable catch for the next season. This figure is passed to the politicians and fishermen's representatives for a final decision. Invariably a more generous total allowable catch is negotiated and quotas assigned. All go home satisfied, the politicians happy with the compromise, the fishermen, outwardly grumbling but secretly pleased to have got as much as they did and the scientists to return to their laboratories to

pick up their salaries, personally unaffected by the decisions made. The first two groups remain blissfully unaware of the final arbiter, the fish. All too often the catch quotas set are not met and may just as well never have been decided. And even if a quota for one species is fulfilled another species may be pursued but the first continues to be fished as a bycatch although not landed. It is, of course, dumped. Overfishing continues.

Roberts has a simple solution to one aspect of the problem. Leaving decisions on fishing regulation to politicians is the first fundamental flaw of fisheries management. We shall return to this. Meanwhile, pressure on the fishing grounds increases as stocks dwindle. The Irish purse seiner *Atlantic Dawn*, built in 2000 and costing over fifty million pounds, is 144m long, longer than the tankers on which I served my seagoing apprenticeship sixty years ago. To pay the mortgage on such a ship the waters of tropical countries, previously little exploited, are being pillaged while the politicians of such small countries flourish on fees from the proceeds as their inshore fisheries fail. All the while we are nevertheless "fishing down the food web" and are eating today what our grandparents used as bait. Roberts mentions in several places that fine book: "The Fish Gate" by Michael Graham but does not cite his Great Law of Fishing contained therein: "Fisheries that are unlimited become unprofitable." Roberts might have added the rider: "Fisheries that are poorly regulated become unprofitable, only a bit slower." The truth of Graham's law is all around us.

As fishers search for new grounds away from the devastated coastal seas, they are moving into more fragile, easily damaged, locations. Huge deep-water trawlers with massive gear search out seamounts, canyons and ridges at great depth, bringing up fish whose life history is little known and whose rate of replacement is a mystery. True to human nature this is of little interest to the skipper, who has a bank debt and a crew to pay. The result is a denuded fauna and a damaged sea bed as witnessed in the devastating grooves scored through the fields of cold water coral, *Lophelia*, revealed by underwater photography. The transformation into barren plains of the

formerly rich, meadow-like sea beds of shallow waters is extending.

At the high ocean surface fishing may take several forms. Enormous curtain nets and long lines are set, catching fish and such unwanted creatures as turtles, dolphins and albatross. But should a net or line go adrift it will continue to fish indefinitely. And it is known that many species will congregate under floating objects in mid-ocean. I myself once observed over three hundred big dorado under a boat in midatlantic. Now let us suppose a log is floating freely in the tropics, far from shore. Fish, sharks, turtles congregate and then along comes a purse-seiner who sets his net and captures them all. How did the seiner know the location of the log? Well, he put it there himself a week before, complete with satellite transmitter. Many such logs are now adrift in the world's oceans.

The surface-dwelling oceanic white-tipped shark, once filling the photographs in Thor Heyerdahl's book, "The Kon-Tiki Expedition" is now a rarity, cruelly slaughtered for its fins, a further example of the denudation of the ocean.

Roberts repeatedly turns to unexploited fish populations to demonstrate their reduction due to fishing. He cites the cod stocks in Canadian Atlantic waters at the time of the arrival of John Cabot (1505) as standing at an estimated seven million tons, while by 1992 there were but twenty two thousand tons left. His message is that the presumed baseline somewhere around 1900 is a severe underestimate of the unexploited condition of the oceans and that consequently the setting of maximum sustainable yields at the conventional level of half the primal condition leads to error. But he further suggests that all consideration of individual species alone is mistaken and that fisheries science should more resemble economics in its approach to a complex scene.

Before his final conclusion Roberts lists seven desirable reforms to fisheries management. Let us list them:

1. Reduce the amount of fishing.
2. Eliminate risky decisions.

3. Eliminate catch quotas.
4. Require fishers to keep what they catch.
5. Use the best available fishing technology to reduce bycatch.
6. Ban or restrict the most damaging fishing gear.

So far, so unexceptional. While much of this might be fought over by interested parties, none of these proposals is beyond discussion. It is the seventh proposal which is outstanding. It is:

7. Implement extensive networks of marine reserves that are off-limits to fishing.

The key word is "extensive". We are not discussing here such small voluntary closed areas as that described by Richard Stanford in Lyme Bay (*Porcupine Newsletter* 15, 2004). In order to seriously affect fish stocks, very large areas would have to be closed off, something between twenty and forty percent of the world's oceans. We may visualise this in the North Sea to give it scale. Roberts believes that fish numbers would gradually recover, that areas outside the reserves would yield more fish through outward migration and that less and different controls would be required of fishermen. However, his ideas are not fully accepted within the scientific community itself, but more importantly they will not be accepted by either fishermen or politicians, fishermen because they can still make a living from the sea and politicians because they will not yield the power of controlling fishing for immediate returns.

We have had two major experiments of zero fishing over large areas and in each case fish stocks soared. They were called the First World War and the Second World War and both experiments were ignored.

What then? Roberts is clear in his view. Without marine reserves he is convinced that marine life will continue its long slide towards jellyfish and slime. It is a gruesome prospect. His book is a valuable warning at a very affordable price and is well recommended.

My thanks to Judy and Bob Foster-Smith for comments on the manuscript.

## PORCUPINE 2008 BIODIVERSITY HOTSPOTS AND COLDSPOTS

Papers from the PMNHS meeting held at Bangor University from 21<sup>st</sup> to 23<sup>rd</sup> March 2008

### Marine influences on hotspots and anomalies in Sea Lavender *Limonium* spp distributions on North Wales coasts

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The Sea Lavenders *Limonium* spp. (Plumbaginaceae) occur in localised and semi-discrete colonies on both supra-littoral splash or spray influenced rocks and in salt marshes. Such a close connection with the coast strongly suggests that their patterns of distribution, including both hotspots and absences, may be explicable through links to processes in the marine environment. As the various *Limonium* taxa are neither so common as to be universally distributed nor are they extremely rare, they are suitable subjects for exploring such influences on "hot" or "cold" spots. This paper looks towards cross fertilisation in ecological concepts between fields more familiar to terrestrial botanists and to marine scientists.

A pair of primarily salt marsh species of *Limonium* that are morphologically distinct, at least locally, *Limonium vulgare* and *L. humile*, are found on the coasts of Anglesey. However, a few apparent hybrids between the two have been reported (Roberts, 1982). Microscopic examination of pollen and stigmas is required for confident determination where the two species merge (Rich & Jermy, 1998), but in Anglesey they seem sufficiently different on both leaf and inflorescence morphologies for general distribution patterns to be derived adequately from field observations. A third taxon group, the Rock Sea Lavender group, *Limonium binervosum* agg., is readily distinguished from the previous two by having a extra pair of main leaf veins. Nevertheless, within this aggregate the taxonomic status of various more or less distinguishable forms remains uncertain. In the British Isles as a whole, Ingrouille & Stace, (1986) recognised 9 species, 17 sub-species and 16 named varieties of them. They examined material from at least 8 Anglesey locations and recorded two species sites here. This contrasts with the seven taxa they listed for Pembrokeshire. The substantial difference may be of note given that both counties on the western seaboard of Wales have coasts of similar lengths with somewhat similar ranges of maritime

habitats. More recently, Ingrouille (2006) considered that the complex classification he erected within the *L. binervosum* aggregate two decades earlier might no longer be appropriate for such agamospermous taxa. This applies even though many of the forms which have been recognised satisfy most criteria for being species or sub-species. At the time when the consensus was that there were the separate species of Rock Sea Lavender, of which several were endemics with very restricted distributions, several were given Biodiversity Action Plan status. This was later withdrawn when the taxonomic consensus swung the other way. This is a good example of conservation "hotspots" being critically dependant on changing taxonomic status.

Around Anglesey targeted searches were made in 2006 and 2007 to locate and record the distribution of as many as possible of the Sea Lavender colonies, thus updating the information used by Bonner (2006). Distributions shown here in figures A to C are by National Grid monads. Filled circles or squares are in monads where the taxon was recorded in 2006 – 2007 and half filled symbols indicate monads where there were previous records. Most of these were monads not re-visited in 2006 – 07, but in some they could not be re-found. Circles are where they occurred in salt marsh habitats and squares are where the habitat was rock, including crevices in rock walls.

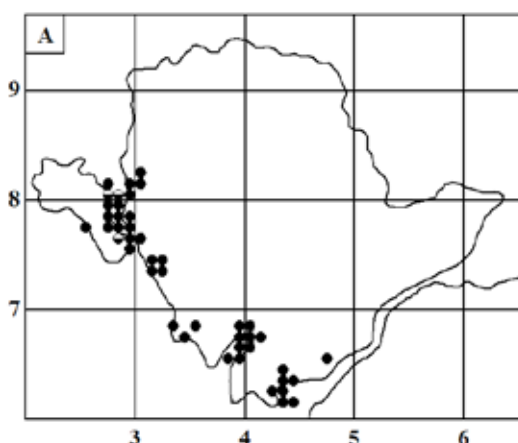


Figure A. Distribution of *Limonium humile* around Anglesey

The most abundant species, *Limonium humile*, (figure A) is widely distributed in the inlets on the south-west facing side of the island but absent on the north-east facing side, even though there

are apparently suitable salt marshes. In the Menai Strait *L. humile* is abundant just inside the south-west entrance, but apart from an isolated colony 4.5 Km in, does not extend far up the strait. The lack of spread in this channel is probably due to the timing of tidal currents. There are differences in tidal amplitudes and times of high water at the two ends of the strait so the flow begins to run south-westwards more than an hour before local high tide (Campbell et al, 1998). Thus, at the times when sea water covers the marshes drifting seeds would not go further up the strait. Furthermore there is a substantial net residual flow south-westwards. Elsewhere in the inlets of the south-west Anglesey coast, highest water levels, often coinciding with onshore winds would favour more seed retention. Tidal movements were shown by Boorman (1971) to play a key role in the export of Sea Lavender seeds from salt marshes.

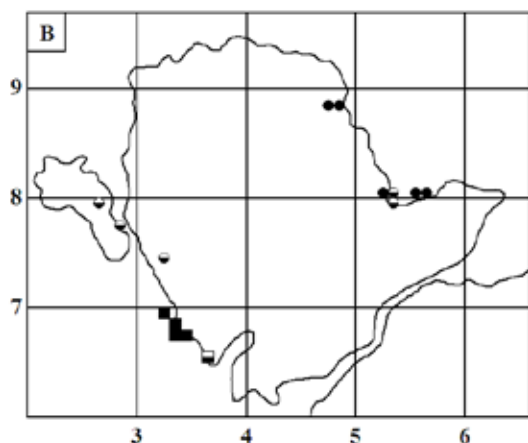


Figure B. Distribution of *Limonium vulgare* around Anglesey

In contrast to *Limonium humile*, *L. vulgare* (figure B) is found on both sides of the island. Anomalously however it mainly occupies quite different habitats on the two coasts. On the north-east side, as would be expected, it occurs almost exclusively in salt marshes, but it is really abundant only in one small estuary, Traeth Dulas. This is a semi- enclosed tidal inlet with a narrow entrance, so once established, conditions should have favoured the long-term maintenance of the population. This contrasts with the smaller and more widely separated colonies in Red Wharf Bay, where conditions would have been more conducive to seed export, and loss from some monads seems to have occurred in recent decades. In some west coast marshes there are just a few earlier records of *L. vulgare*. Unusually however, on part of the south-west coast it grows exclusively in the crevices of splash zone rocks and amongst boulders. The particular section of coast where this occurs has a frontage of only about 5.5 km, within which there

are about 6 discrete colonies. Given the atypical habitat, the very restricted spread and the particular vigour of these rock habitat plants, questions arise as to whether they might be genetically distinct from the salt marsh variety. If this is so from where, when and how did they get here?

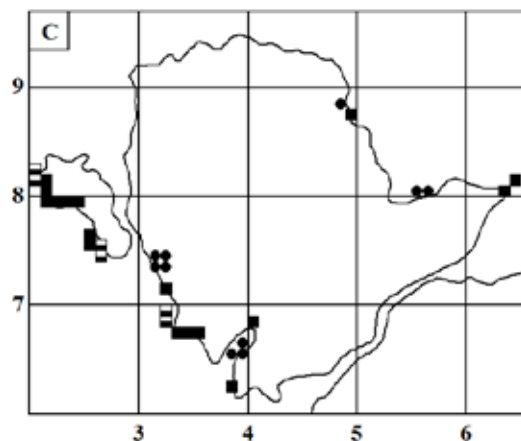


Figure C. Distribution of *Limonium binervosum* agg around Anglesey

Forms of *Limonium binervosum* agg, (figure C) occur in both rocky coast and high level sandy salt marsh situations, and on both sides of Anglesey, but they are absent from both the predominantly rocky north coast and from the Menai Strait. The hottest spot for them is the west coast of Holyhead Island, particularly the section between Trearddur Bay and South Stack. Several morphologically distinguishable variants can be found. In places more than one of these variants occurs adjacent to each other, a feature that may be relevant to the history of colonisation. Rising sea levels and ecological roll back during the post-glacial transgression could have a bearing on colony isolation. Not yet explicable is the occurrence of flourishing colonies in the sandy salt marshes at the mouth of the Cefni Estuary and on the tip of Llanddwyn Island, but an absence in apparently suitable habitats around Traeth Abermenai.

None of the Sea Lavenders currently have distributions that extend further north than the extreme south west of Scotland and the north coast of Ireland (Preston et al, 2002). It must be assumed that climatic conditions did not ameliorate enough for them to colonise North Wales until some time after about 10,000 BP and probably after rising sea levels had separated Britain from the continent. Present day distributions often in discrete colonies with plenty of seedlings in them, suggest that successful medium and especially long range dispersal has been relatively infrequent. Nevertheless there must at times have been some longer distance spread of propagules to found the present colonies. With a few exceptions the flowering plants of the salt

marshes and sea cliffs of the British Isles have been assumed to be “native”, that is they colonised these islands naturally after the last glaciation. The terms “archaeophyte” and “neophyte” are applied to those species introduced deliberately or accidentally before and after 1500 AD respectively. Given the known frequency of introductions of non-native marine invertebrates and seaweeds, often by small boats and trade routes during pre-historic to medieval times, a real possibility exists for anthropogenic influences on salt marsh species distributions. This would particularly have been so when small trading vessels were beached in salt marsh creeks for loading and unloading. A case can be made for reviewing some distributions in the light both of sea currents and historic events. Even if, as considered by Ingrouille (2006), the degree of variation between colonies of *L. binervosum* agg. is in keeping with potential genetic change over the 10,000 years since the last ice age, advection by some means or another will have played a part in determining modern distributions.

### Acknowledgement

I would particularly like to thank Ian Bonner, the BSBI recorder for Anglesey, for access to earlier records and for much encouragement and advice.

### References

- Bonner, I.R. 2006. *Anglesey (VC 52) County Rare Plants Register*. CCW & BSBI, Bangor, 86 pp.
- Boorman, L.A. 1971. Studies of salt marsh ecology with special reference to the Genus *Limonium*. *Journal of Ecology* **59**, 103-120.
- Campbell, A.R., Simpson, J.H., & Allen, G.L. 1998. The dynamical balance of flow in the Menai Strait. *Estuarine, Coastal and Shelf Science*, **46**, 449-455.
- Ingrouille, M.J. 2006. What use is sex? Rock sea-lavenders (*Limonium binervosum* agg.) revisited. In Bailey, J. & Ellis, R.G. (eds). *Current taxonomic research on the British & European flora*. Botanical Society of the British Isles, London, pp 71-88.
- Ingrouille, M.J. & Stace, C. 1986. The *Limonium binervosum* aggregate (Plumbaginaceae) in the British Isles. *Botanical Journal of the Linnean Society*, **92**, 177-217.
- Preston, C.D., Pearman, D.A., & Dines, T.D. 2002. *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford.
- Rich, T.C.G. & Jermy, A.C. 1998. *Plant Crib 1998*. Botanical Society of the British Isles, London, 391 pp.
- Roberts, R.H. 1982. *The Flowering Plants and Ferns of Anglesey*. National Museum of Wales, Cardiff, 88 pp.

## Speciation of *Dodecaceria fimbriata* and *D. berkeleyi*: convergent evolution or continental drift?

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### Species diversity verses parallel evolution

Fauchald (1984) favoured an ecological (biogeographical) explanation for the global distribution of present day polychaetes. He pointed out that sufficient geological time has elapsed since polychaetes first appeared in the Cambrian for species to have reached the habitats they now occupy. That is, the remnants of their distribution from the time of the break-up of the super-continent of Pangaea have been long lost. The limits to the distribution of marine species must therefore be environment. This argument supposes there are no significant physical barriers to dispersal, as there is on land, in the marine environment. The barriers must be physiological.

Ecological (ecogeographical) distribution will be influenced by competition between species. The less well adapted would be excluded from a region even though they might otherwise occupy it. The resulting distributions will depend in part upon which species first invades a newly created region: it is dynamic.

For species that are morphologically similar a difficulty is often to know whether they are closely related or whether parallel (convergent) evolution has occurred. This problem is particularly acute for polychaetes since they have so few hard parts which can form the basis of a comparison. Chaetae are useful in this respect but their structure normally varies along the body and with their age. When populations in different regions of the world are similar they may have been separated by continental drift. However, they may still have a common gene pool due to dispersal of larvae.

### Dodecaceria

The littoral, secondary rock boring marine cirratulid polychaete *Dodecaceria fimbriata*<sup>1</sup> occurs in northern Europe and along east coast North America (Gibson, 1979). Originally these two populations were thought to be separate species. Their identical morphology and methods of reproduction were used to show they are one species (Gibson, 1979). *D. berkeleyi* found

in New Zealand appears to be morphologically and reproductively identical to *D. fimbriata* (Gibson, 1978). Since the two species are not found elsewhere in the world this suggests parallel evolution.

If *D. fimbriata* and *D. berkeleyi* show parallel evolution but are the same species they would have to have had a world wide distribution at some time. They would, in this respect, be relic species and there is no indication of this. An alternative might be that they have been separated by continental drift. If this were so they would be expected, due to the absence of the interchange of genes, to have subsequently diverged into recognisably different species. In contrast the populations of *D. fimbriata* on either side of the North Atlantic have not diverged probably due to gene flow. They may still share the same gene pool. Epitokes, eggs and asexual products may be carried cross the Atlantic in, very probably, the Gulf Stream. Asexual products have been picked up in plankton hauls (Chadwick, 1927).

### Continental drift

For the New Zealand species, *D. berkeleyi*, to be the same species as the European species, *D. fimbriata*, North America (Laurentia) could have been attached to South America and Africa (Gondwana) in the Precambrian some 500 million years ago (Figure). New Zealand would have been a part of this complex. The future North America would have separated during the Caledonian orogeny at about this time. (South America separated from African some 400 million years later.)

The Precambrian land mass appears to have existed in the southern hemisphere with the present day southern extremities of South Africa and South America lying at about 30 degrees south. This complex would have included Antarctica, Australia, India and presumably New Zealand. When Laurentia split from Gondwana it would have moved north to collide with Europe. It was then separated from Europe by the mid Atlantic tectonic split that parted South America from Africa, some 100 million years ago.

### Cambrian explosion and speciation

Polychaetes first appeared during the Cambrian explosion<sup>2</sup> (Fauchald; Rouse & Pleijel) some 500 million years ago when the southern complex existed (Lamb & Sington). When the land mass split, a population of *Dodecaceria* would have been left in New Zealand and another could have been carried north to Europe on what was to become the east coast of North America. The reason the two species are so similar, if not identical, may therefore be that they belonged to the same original population.

If this scenario were correct, *D. berkeleyi* might be expected to be found in South Africa, Australia and South America all of which belonged to the Gondwana complex. So far as is known it is not. There are, however, other species of *Dodecaceria* (Gibson, 1978) which subsequently reached different parts of the world. These species could have excluded *D. fimbriata* and *D. berkeleyi* through competition. This would support an argument for a cosmopolitan distribution of a single species of *Dodecaceria*.

### Living fossils?

For *D. berkeleyi* and *D. fimbriata* to be the same species they would have to have remained unchanged since the Cambrian. Alternatively, they could have evolved in which case they would have "shadowed" one another: have taken the same evolutionary path.<sup>3</sup> This would in effect amount to convergent evolution.

Whether the two species are the same could be resolved by DNA finger printing.

### Summary

*D. fimbriata* and *D. berkeleyi*, based on morphological and reproductive similarities, could be the same species. The problem is that the two are found at opposite "poles" of the earth. One way the original population could have been separated to end up occupying this distribution is by continental drift that occurred in the Cambrian. They may have changed very little since then. Alternatively they show parallel evolution.

### Acknowledgements

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### References

- Chadwick H. C., (1927) The occurrence of *Dodecaceria concharum* at Port Erin, *Report of the Oceanic Department of the University of Liverpool*, **41**, 28-29.
- Fauchald K., Polychaete distribution patterns, or: can animals with Palaeozoic cousins show large-scale geographical patterns? *The proceedings of the First International Polychaete Conference*, (Editor P. A. Hutchings) *The Linnean Society of New South Wales*, 1984, pp 1-6.
- Gibson P. H., (1978) Systematics of *Dodecaceria*, *Zoological Journal of the Linnean Society*, **63**, 275-287.
- Gibson P. H., (1979) The specific status of the two cirratulid polychaetes, *Dodecaceria fimbriata* and *Dodecaceria caulleryi*, compared by their morphology

and methods of reproduction, *Canadian Journal of Zoology*, **57**, 1448-1451.

Lamb S. & Sington D., *Earth Story*, BBC Books, 1998.

Rouse G. W. & Pleijel F., *Polychaetes*, Oxford University Press, 2001.

Sterelny K., *Dawkins vs Gould*, Icon Books, 2001.

### (Endnotes)

- 1 *D. fimbriata* is characterised by reproducing by asexually fragmentation of the atoke, gametic reproduction of an epitoke, and surviving salinities of under 34 ppm. The species is can be confused with *D. concharum* which is however parthenogenetic and can not survive hyposaline conditions. *D. concharum* has half the chromosome number of *D. fimbriata* and appears to have evolved from *D. fimbriata* though direct development of its oocytes. This split must have occurred after the separation of Laurentia from Gondwana (according to the present thesis).
- 2 Examples are *Canadia* and *Stephenoscolex* from the Burgess Shales of British Columbia of some 500 million years ago.
- 3 Different evolutionary paths raise a problem over whether there is such a thing as chance. That is, whether evolution depends on events jogging species into unforeseeable directions. This is the view taken by Gould and his acolytes. The opposing view, determinism, argues that what appears to be chance is simply an admission of ignorance of the mechanisms controlling complex events. This is the view of Dawkins and his supporters (Sterelny). It is that evolution will repeat itself: evolution will follow the same series of events supposing the same conditions. The determinist argument appears to support convergent evolution.

## Marinas and harbours as biodiversity hotspots

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### Abstract

Biodiversity is a function of species richness and abundance of individuals. Marinas and harbours contain a variety of habitats and consequently support a large number of species in a small area, generating high biodiversity. Species richness is increased by the arrival of a new species, provided that the ecological niche of the new arrival does not completely overlap that of an established species leading to the latter's displacement. The vector that most frequently transports marine species into new ecosystems is shipping, and the point of ingress is usually a harbour or marina. The introduction of

an invasive species, usually considered a threat to native biodiversity, can in some situations increase biodiversity by increasing both species richness and abundance making marinas and harbours biodiversity hotspots.

### Introduction

Biodiversity is a neologism meaning biological diversity. It is a measure of the relative diversity among organisms present in different ecosystems. The 1992 UN Earth Summit in Rio defined biodiversity as "the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems". This definition was adopted by the UN Convention on Biological Diversity.

Diversity can be quantified by a diversity index, e.g. Simpson, Shannon and Berger-Parker diversity indices, or by species evenness, e.g. Pielou's evenness index. Simpson's diversity index is often used to quantify the biodiversity of a habitat; it is calculated as:

$$D = \frac{\sum_{i=1}^S n_i(n_i - 1)}{N(N - 1)}$$

where  $S$  is the number of species,  $N$  is the total percentage cover or total number of organisms and  $n$  is the percentage cover of a species or number of organisms of a species. Thus diversity, as represented by the Simpson diversity index, is a function of species richness (number of species present) and abundance of individuals. We will employ the same function to define biodiversity in this paper. Consequently, biodiversity hotspots should support large numbers of species and individuals.

### How marinas and harbours increase species richness

Species richness is a function of the number of habitats available. In the marine environment, habitats are defined by substrate type and hydrographic factors. Marine biodiversity is higher in benthic than in pelagic systems, and along coasts rather than in the open ocean (Angel, 1993). Marinas and harbours are coastal features that support a large number of benthic habitats. They contain a variety of substrata with varying degrees of exposure. The edges of the marinas form littoral habitats. The bottoms of marinas and harbours are sub-littoral and usually contain silt and soft sediment, with a variety of benthic fauna and infauna. Pontoons provide permanently submerged hard substrate and a range of light conditions, from well lit on the side to heavily

shaded underneath; large differences have been noted in the composition of epibiotic assemblages on shaded and unshaded pilings in marinas, attributed to the degree of shading (Glasby, 1999). There may be physical or chemical gradients related to inputs and to depth e.g. salinity, temperature and dissolved oxygen. Therefore we would expect a wide variety of organisms, i.e. marinas and harbours tend to generate high species richness.

A few examples from surveys carried out in New Zealand will demonstrate the species richness typical of marinas and harbours (Table 1). These surveys were part of a nationwide investigation of native and non-native marine biodiversity in international shipping ports and marinas of first entry for yachts entering New Zealand from overseas. A wide range of sampling techniques were used to collect marine organisms from a variety of habitats: divers scraped fouling from hard substrata, benthic organisms were sampled using a sled and grabs, mobile predators and scavengers were sampled using baited traps, and a gravity corer was used to sample for dinoflagellate cysts.

*Table 1 Species recorded in surveys of New Zealand ports and marinas*

<sup>1</sup> Total of species or higher taxa; <sup>2</sup> Cryptogenic species (those whose geographic origins are uncertain); <sup>3</sup> Non-indigenous species

Site	Date	T o t a l species <sup>1</sup>	Crypto. Species <sup>2</sup>	Non-indig. Species <sup>3</sup>	Species new to NZ	Reference
Port of Wellington	D e c . 2001	336	26	14	16	Inglis <i>et al.</i> , 2006g
Port of Picton	D e c . 2001	215	25	9	14	Inglis <i>et al.</i> , 2006b
Port of Nelson	J a n . 2002	196	15	14	6	Inglis <i>et al.</i> , 2006a
Port of Timaru	F e b . 2002	282	27	16	21	Inglis <i>et al.</i> , 2006e
Port of Lyttelton	M a r . 2002	246	22	20	14	Inglis <i>et al.</i> , 2005a
Port of Tauranga	M a r . 2002	316	40	12	22	Inglis <i>et al.</i> , 2006d
Port of Taranaki	A p r . 2002	270	20	15	9	Inglis <i>et al.</i> , 2006c
Opua Marina	N o v . 2002	122	14	12	5	Inglis <i>et al.</i> , 2005c
Port of Gisborne	J a n . 2003	205	17	14	6	Inglis <i>et al.</i> , 2006i
Port of Napier	J a n . 2003	199	14	10	7	Inglis <i>et al.</i> , 2006j
Port of Dunedin	F e b . 2003	275	38	18	25	Inglis <i>et al.</i> , 2006h
Port of Bluff	M a r . 2003	330	28	12	20	Inglis <i>et al.</i> , 2005b
Port of Auckland	A p r . 2003	173	24	13	2	Inglis <i>et al.</i> , 2006f

## How marinas and harbours increase abundance

Marinas and harbours provide a sheltered environment, usually protected by a breakwater that can almost form an enclosed water body. There is limited water exchange with the open sea, particularly for marinas. Entrainment of water in enclosed marinas may limit the dispersal of planktonic propagules by advective currents. The reduced dispersal enhances recruitment close to the adult population, which increases the abundance of individuals up to the carrying capacity of the ecosystem.

Floerl and Inglis (2003) compared recruitment of sessile invertebrates to available surfaces in marinas with and without a permanent breakwater, and to coastal reference sites that were not used for mooring boats. Measurements of current velocities and water flow patterns at each site showed that permanent breakwalls created complex patterns of circulation that retained water within the marina basin for up to 12 hours per day. They found that, despite large regional and temporal variability in fouling, most organisms recruited in greatest numbers to surfaces in partially enclosed marinas, and were often several orders of magnitude more abundant in the partially enclosed marinas than in the unenclosed marinas or the coastal reference locations. Thus partially

enclosed marinas hold planktonic propagules close to the parent population, increasing propagule pressure for available settlement surface and increasing the abundance of individuals.

So marinas are biodiversity hotspots because they support a diverse variety of abundant indigenous species. This species richness may be enhanced by the arrival of non-indigenous species.

### The contribution of non-indigenous species

Marinas welcome numerous recreational boats from a variety of places. Each boat can act as a vector to transport new species to the marina. Large international ships can transport “more exotic” species into commercial harbours. If the new species becomes established in the commercial harbour, and the harbour is adjacent to a marina, the new species will eventually become established in the marina. Each new introduced species enhances the species richness of the facility.

Surveys carried out in New Zealand as part of a nationwide investigation of marine biodiversity in international shipping ports and marinas found numerous non-indigenous species, typically representing between 4-10% of the total number of species present (Table 1). A survey of harbours and marinas in New England in August 2000 (Pederson *et al.*, 2001) revealed at least 10% of the total species found on marina pontoons were introduced species (Table 2).

Marinas are excellent places to search for non-indigenous species, and the fact that they are very convenient to sample has made them the focus for “Rapid Assessment Surveys”.

Table 2 Percentage of introduced species found in Rapid Assessment Surveys

Percent of total species that are introduced and cryptogenic species			
Location (no. sites)	Introduced	Cryptogenic	Total
Northeast (21)	10%	12%	267
Maryland 2003 (6)	11%	10%	242
Maryland + Rhode Island (33)	11%	12%	302
Rhode Island 2000 (13)	13.5%	20%	148
Massachusetts 2000 (21)	10%	12%	260
Boston Harbour (4)	14%	16%	92

For example, in August 2003, a team of up to fifteen taxonomic experts examined floating docks and piers at twenty locations throughout the New England coast from Maine to Staten Island to identify native and non-native species.

A rapid assessment survey of communities colonizing pontoons in twelve marinas from East Sussex to Cornwall in September 2004 found over eighty taxa of algae and a similar number of invertebrate taxa; twenty (12.5%) were identified as non-native species of which two were new to the UK (Arenas *et al.*, 2006).

A rapid assessment survey of communities colonizing pontoons in twelve marinas from East Sussex to Cornwall in September 2004 found over eighty taxa each of algae and invertebrates recorded; twenty (12.5%) were identified as non-native species of which two were new to the UK (Arenas *et al.*, 2006).

The addition of a single new species increases the biodiversity of an ecosystem by increasing species richness. The results of the rapid assessment surveys indicate that dock/pontoon systems contain significant proportions of non-indigenous species, which will increase the native species richness. However, invasive non-indigenous species are ranked second in the factors that threaten native biodiversity. How can these two statements be reconciled? The vast majority of immigrant species that arrive in a harbour or marina die out because they are not suited to local conditions. A few, however, appear to be superbly adapted to their new environment and may produce a superabundance of individuals. Such a species can actually increase biodiversity if it can coexist with the native



Plate 1

species in a stable environment; this requires niche differentiation and a stable population growth rate. We believe that some non-indigenous species can increase biodiversity, and we will use the solitary ascidian *Styela clava* Herdman, 1882 to illustrate our argument.

*S. clava* is an immigrant to European waters; it was first recorded in 1953, but is now widespread in European coastal waters (Davis *et al.*, 2007) and in New Zealand waters (Davis and Davis, 2006). The arrival of *S. clava* will increase the species richness of the receiving ecosystem; but will the increase in its abundance displace other species? In fact, increased abundance of *S. clava* can increase the abundance of other organisms, particularly fouling organisms. Settlement space is a limiting resource for fouling organisms, and *S. clava* can provide additional surface area for other organisms to settle. An adult animal can provide in excess of 10x its footprint (surface area of hapteron attachment) as surface area for other organisms to settle and grow. Plate 1 shows a fouled individual, and Plate 2 shows the majority of the fouling organisms that were attached to it (mainly *Ascidella aspersa* and *Ciona intestinalis*); sediment, containing infauna, is often trapped between the macro-fouling. Thus *S. clava* increases the abundance of individuals of indigenous species as well as enhancing species richness; in effect, it increases biodiversity by increasing the carrying capacity of the ecosystem. Thus in terms of both species richness and abundance of individuals, immigrant species such as *S. clava* can help to transform harbours and marinas into biodiversity hotspots.



Plate 2

## Conclusions

Harbours and marinas contain a variety of habitats and consequently support a large number of species in a small area, generating high biodiversity. Species richness is increased by the arrival of a new species, provided that the new arrival does not displace established species. The results of rapid assessment surveys indicate that dock/pontoon systems in harbours and marinas contain significant proportions of non-indigenous species. Consequently, these ecosystems will have greater biodiversity than the surrounding areas and can therefore be considered biodiversity hotspots.

## References

- Angel, M. V. 1993 Biodiversity of the pelagic ocean. *Conservation Biology* **7**: 760-772.
- Arenas, F., Bishop, J. D. D., Carlton, J. T., Dyrinda, P. J., Farnham, W. F., Gonzalez, D. J., Jacobs, M. W., Lambert, C., Lambert, G., Nielsen, S. E., Pederson, J. A., Porter, J. S., Ward, S. and Wood, C. A. 2006. Alien species and other notable records from a rapid assessment survey of marinas on the south coast of England. *Journal of the Marine Biological Association of the UK* **86**: 1329-1337.
- Davis M. H. and Davis M. E. 2006. *Styela clava* (Tunicata: Ascidacea) a new edition to the fauna of New Zealand. *Porcupine Marine Natural History Society Newsletter* **20**: 23-28.
- Davis M. H., Lützen J. and Davis M. E. 2007. The spread of *Styela clava* Herdman, 1882 (Tunicata, Ascidacea) in European waters. *Aquatic Invasions* **2**: 378-390.
- Floerl, O. and Inglis G. J. 2003 Boat harbour design can exacerbate hull fouling. *Austral Ecology* **28**: 116-127.
- Glasby, T. M. 1999. Effects of shading on subtidal epibiotic assemblages. *Journal of Experimental Marine Biology and Ecology* **234**: 275-290.

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2005a. Port of Lyttelton: Baseline survey for non-indigenous marine species (Research Project ZBS 2000/04). Biosecurity New Zealand Technical Paper No: 2005/01

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2005b. Port of Bluff: Baseline survey for non-indigenous marine species (Research Project ZBS 2000/04). Biosecurity New Zealand Technical Paper No: 2005/09

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2005c. Opuia Marina: Baseline survey for non-indigenous marine species (Research Project ZBS 2000/04). Biosecurity New Zealand Technical Paper No: 2005/14

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006a. Port of Nelson: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/02

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006b. Port of Picton: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/03

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006c. Port of Taranaki: Baseline survey for non-indigenous marine species (Research Project ZBS2000/4). Biosecurity New Zealand Technical Paper No: 2005/04

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006d. Port of Tauranga: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/05

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006e. Port of Timaru: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/06

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006f. Port of Auckland: Baseline survey for non-indigenous marine species (Research Project ZBS 2000/04). Biosecurity New Zealand Technical Paper No: 2005/08

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006g. Port of Wellington: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/09

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006h. Dunedin Harbour

(Port Otago and Port Chalmers): Baseline survey for non-indigenous marine species (Research Project ZBS2000/4). Biosecurity New Zealand Technical Paper No: 2005/10

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006i. Port of Gisborne: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/11

Inglis, G., Gust, N., Fitridge, I., Floerl, O., Woods, C., Hayden, B. and Fenwick, G., 2006j. Port of Napier: Baseline survey for non-indigenous marine species (Research Project ZBS2000/04). Biosecurity New Zealand Technical Paper No: 2005/13

Pederson, J., Bullock, R., Calder, D., Carlton, J. T., Chapman, J. W., Cohen, A., Dean, H., Dyrinda, P., Harris, L., Lambert, C., Lambert, G., Mathieson, A., Tyler, S. and Winston, J., 2001. Draft Rapid Assessment Survey of Massachusetts, August 7–11, 2000. Massachusetts Institute of Technology Sea Grant College Program, Cambridge, Massachusetts. 52pp.

Pederson, J., Bullock, R., Carlton, J., Dijkstra, J., Dobroski, N., Dyrinda, P., Fisher, R., Harris, L., Hobbs, N., Lambert, G., Lazo-Wasem, E., Mathieson, A., Miglietta, M-P., Smith, J., Smith III, J. and Tyrrell, M., 2005. Marine Invaders in the Northeast. Rapid assessment survey of non-native and native marine species of floating dock communities, August 2003. Report of the August 3-9, 2003 Survey. MIT Sea Grant College Program Publication No. 05-3. Published by the MIT Sea Grant College Program, Cambridge, Massachusetts. 46pp.

## Rathlin Island: A Sponge Biodiversity Hotspot?

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There have been few studies on British and Irish sponge biodiversity in recent years with the fauna of many areas last being studied by Bowerbank (1864, 1866, 1872, 1874, 1879), and in Ireland Stephens (1912, 1916, 1917, 1921). There are around 375 sponge species reported from UK and Irish waters but only about 100 of these are well-known (Ackers, Moss & Picton, 1992; Howson & Picton, 1997). There are a few areas where better accounts of the sponge biodiversity are available, namely Plymouth (Burton, 1930, 1957), Lundy (Hiscock, Stone & George, 1984), Lough Hyne (Van Soest & Weinberg, 1980) and Kilkieran Bay (Könnecker, 1973) but the sponge biodiversity of much of the British Isles, including Northern Ireland remains poorly known.

Rathlin Island has been noted as being of particular biological importance with some 530 species of algae, marine invertebrates and fish recorded from here (60% of the marine species known from Northern Ireland), including many of particular interest (Erwin *et al.*, 1990). It has been identified as one of the key areas for sponges in Europe (Van Soest, Picton & Morrow, 1999) and is designated as a Special Area of Conservation. Prior surveys by the Ulster Museum had shown it to have a particularly high sponge biodiversity and discovered several species not previously reported from the UK and other species which appear never to have been described in the scientific literature (Bernard Picton, pers. obs.).

Specimens were collected by SCUBA diving around Rathlin Island, Northern Ireland. Specimens were selected by eye with the divers attempting to sample species that looked different from those previously sampled. The aim was to sample as many different species as possible, rather than gaining any quantitative information. Once selected, three photographs of each specimen were taken *in situ* using housed digital SLR cameras. A small piece (approx 1cm<sup>2</sup> of tissue) was then removed. After collection the samples were kept in seawater for a few hours before being transferred to 95% Industrial Methylated Spirits for storage. Specimens were identified from tissue sections and spicule preparations (see Picton & Goodwin 2007a and 2007b for detailed methodology).

In total 128 sponge species were recorded. A further 6 species have been previously recorded from Rathlin but were not collected in this survey, bringing the total species known from Rathlin to 134. Of these, 29 are previously undescribed species; 3 are new to Britain and Ireland (*Plocamionida tylotata* Brøndstedt 1932, *Myxilla (Styloptilon) ancoratum* Cabioch 1968, *Antho (Antho) brattegardi* Van Soest and Stone 1986); 9 are new to Northern Ireland (*Axinella pyramidata* Stephens 1916, *Halicnemis patera* Bowerbank, 1862, *Hymedesmia hibernica* Stephens 1916, *Hymedesmia peachii* Bowerbank 1882, *Hymedesmia primitiva* Lundbeck 1910, *Clathria (Microciona) laevis* Bowerbank 1866, *Raspailia aculeata* (Bowerbank 1866), *Tricheurypon viride* (Topsent, 1889), and *Hexadella racovitzai* Topsent, 1896). A further 19 species require further investigation.

Fourteen new species have been described so far: *Axinella parva*, *Spongosorites calcicola*, *Crella plana*, *Phorbas punctata*, *Lissodendoryx (Ectyodoryx) jenjonesae*, *Antho (Antho) granditoxa*, *Hymenaphia breeni* and *Hymenaphia elongata* (Picton & Goodwin 2007a) and six new species of *Hymedesmia* (Goodwin and Picton *in press*). A paper describing *Eurypon* (9 species) is currently in preparation. Records were also made of the poorly known species *Axinella pyramidata*, *Myxilla (Styloptilon) ancoratum*, *Antho (Antho) brattegardi*, *Clathria (Microciona) laevis* and *Plocamionida tylotata* (Picton & Goodwin 2007a).

In total 134 sponge species are now known from Rathlin Island. This number represents approximately a third of the number of sponges currently known for the British Isles and is far greater than the number of species recorded in intensive surveys of the sponges of other areas. In comparable studies in Lough Hyne, County Cork, 90 species have been recorded (Lilly *et al.*, 1953, Van Soest & Weinberg, 1980, Picton, 1991), and a study of Kilkieran Bay on the west coast of Ireland (Könnecker, 1973) identified 66 species as being present in the area. This demonstrates that Rathlin Island is one of the most important sites in the British Isles, and probably in Europe, for sponges. In biogeographical terms the sponge fauna of Rathlin is interesting, combining both boreal and Mediterranean species. Populations of other invertebrate groups on Rathlin represent species at the limits of their range (for example the colonial anemones *Parazoanthus axinellae*, a southern species and *Parazoanthus anguicomis*, a northern species, co-exist here (Erwin *et al.*, 1990). It is probably that this is also the case for some of the sponge species, studies of other areas in the British Isles would help put this into a biogeographical context.

The number of new and rare species was unexpectedly large, although this is in part due to richness of the

communities sampled, the sampling methodology may have been a contributing factor. Sponge samples have been collected from this area previously (Erwin *et al.*, 1990) but there has never been a survey targeted solely at Porifera, and inadequate resources meant that sponge material collected was sometimes not identified to species level, particularly for genera such as *Hymedesmia* where this can be time consuming. Dedicated sampling for sponges allowed the collection of many more sponges than would have been possible on a general survey where sponges, particularly crusts, tend to be overlooked.

Most prior sampling of UK and Irish sponge populations has been by dredging, frequently from deep water. Sampling by SCUBA diving resulted in collection of material from the little sampled circalittoral depth range (30-50m). Additionally, habitats such as overhangs and crevices in bedrock were sampled which would have been difficult to get specimens from by other methods. Scuba diving surveys have been shown to provide good records of sponge biodiversity (Boury-Esnault, 1971; Pansini, 1987; Wiedenmayer, 1977), particularly in areas where many species are small and in habitats which are difficult to sample by other means (Perez, Vacelet, Bitar & Zibrowius, 2004; Vacelet & Perez, 1998).

The use of digital underwater photography to get information on appearance of specimens *in situ* provided additional characteristics to confirm identification. For many of the rarer species these are the first records of live appearance. Some species have a very distinctive external appearance and in some cases it is possible to identify to species level solely on the basis of this.

Rathlin was last extensively sampled during the Northern Ireland Sublittoral Survey (Erwin *et al.*, 1990). Since this time populations of the conspicuous pink sponge *Hexadella racovitzae* have increased. *Hexadella racovitzae* is common in the Mediterranean but was only reported for the British Isles in 1996 (Morrow & Picton, 1996). It has since also been recorded from Kerry head shoals, Kerry; Aran Islands, Galway (Picton & Costello, 1998). There was one prior record from Rathlin Island (Picton & Costello, 1998) but in this survey seven specimens were recorded. As it is large and conspicuous it is unlikely to have been missed in prior surveys. It may be that the increased numbers are due to warmer water temperatures, these readily identifiable sponges may prove to be a good monitoring organism. However, before sponges can be used for monitoring purposes good baseline data is essential. For example, re-examination of Ulster Museum voucher specimens revealed that *Styloptilon ancoratum* which was frequent in this survey but

appeared not to have been previously recorded from the British Isles, had been collected during prior Rathlin surveys but was not identified at the time. The Rathlin sponge biodiversity data set will provide a good baseline for future monitoring.

There is a need for other similar studies of the UK and Irish sponge fauna. Many sponge species remain poorly known and there is little information on their distribution and ecology. As well as contributing to knowledge on marine biodiversity knowledge regarding sponge communities may be useful in marine monitoring. Sponges have great potential for the monitoring of benthic communities; many species are long lived and sensitive to even small changes in environmental parameters (Fowler & Laffoley, 1993). It has been demonstrated that shifts in species composition in sponge/ascidian communities can be used to indicate disturbance (Carballo & Naranjo, 2002). As sponges bioaccumulate various environmental contaminants (Perez 2000) they may be useful as biomonitors of contaminants such as polychlorobiphenyl (Perez, Wafo, Fourt & Vacelet, 2003).

Sponges produce a variety of chemicals for, amongst other uses, defence against predators (McClintock, Amsler, Baker & Van Soest, 2005), as anti-foulants (Tsoukatou *et al.*, 2002). There is increasing interest in the potential of these for medical use, although historically such work has focused on tropical species, it was previously believed that sponge toxicity decreased with latitude due to lower predator numbers (Bakus & Green, 1974), this is now known not to be the case (Becerro *et al.*, 2003). The common British intertidal sponge *Hymeniacidon perleue* (Montagu, 1818) has recently been found to produce chemicals which act as highly potent growth inhibitors on human breast and lung cancer cells (White, Lottin, Barrow & Nicholson, 2005). British sponges, and their medicinal properties, are largely unexplored and have untapped potential for the discovery of new drugs (White *et al.* 2005). Knowledge of sponge taxonomy and biogeography is vital for this "bio-prospecting" work, it is essential in order to identify which species produce particular chemicals and may help target investigation of closely related species. Further studies on UK and Irish sponge biodiversity are vital for this new area of research. The Ulster Museum has recently secured funding from Esmée Fairbairn, Scottish Natural Heritage and Countryside Council for Wales for a project investigating the sponge fauna of the Firth of Lorn in Scotland and the Pembrokeshire Coast of Wales. This will give us more information on species distributions and put the findings of the Rathlin project into context.

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## References

- Ackers R G, Moss D, Picton B E. 1992.** *Sponges of the British Isles (Sponge V)*. Ross-on-Wye: Marine Conservation Society.
- Bakus G J, Green G. 1974.** Toxicity in Sponges and Holothurians - Geographic Pattern. *Science* **185**: 951-953.
- Becerro M A, Thacker RW, Turon X, Uriz M J, Paul V J. 2003.** Biogeography of sponge chemical ecology: comparisons of tropical and temperate defenses. *Oecologia* **135**: 91-101.
- Boury-Esnault N. 1971.** Spongiaires de la zone rocheuse de Banyuls-sur-Mer. 2. Systématique. *Vie et Milieu* **22**: 287-350.
- Bowerbank J S. 1864.** *A Monograph of the British Spongiadae, Volume I*. London: Robert Hardwicke. 290pp.
- Bowerbank J S. 1866.** *A Monograph of the British Spongiadae, Volume II*. London: Robert Hardwicke. 388pp.
- Bowerbank J S. 1872.** Contributions to a general history of the Spongiadae. 1. *Proceedings of the Zoological Society of London* **1872**: 115-129.
- Bowerbank J S. 1874.** *A Monograph of the British Spongiadae, Volume III*. London: Robert Hardwicke. 367pp.
- Bowerbank J S. 1879.** *A Monograph of the British Spongiadae, Volume IV*. London: Robert Hardwicke. 250pp.
- Burton M. 1930.** Additions to the sponge fauna at Plymouth. *Journal of the Marine Biological Association of the United Kingdom* **16**: 489-507.
- Burton M. 1957.** Porifera. In *Plymouth Marine Fauna*, pp. 26-32. Ed. F R Russell. Plymouth: Marine Biological Association.
- Carballo J L, Naranjo S. 2002.** Environmental assessment of a large industrial marine complex based on a community of benthic filter-feeders. *Marine Pollution Bulletin* **44**: 605-610.
- Erwin D G, Picton B E, Connor DW, Howson C M, Gilleece P, Bogues M J. 1990.** *Inshore marine life of Northern Ireland*. Belfast: HMSO. 148 pp.
- Fowler S, Laffoley D. 1993.** Stability in Mediterranean-Atlantic sessile epifaunal communities at the northern limits of their range. *Journal of Experimental Marine Biology and Ecology* **172**: 109-129.
- Goodwin C E, Picton B E P. In press.** Demosponges of the genus *Hymedesmia* (Poecilosclerida: Hymedesmidae) from Rathlin Island, Northern Ireland with a description of six new species. *Zoological Journal of the Linnean Society*.
- Hiscock K, Stone S M K, George J D. 1984.** The Marine Fauna of Lundy, Porifera (sponges): a preliminary study. *Reports of the Lundy Field Society* **34**: 16-37.
- Howson C M, Picton B E. 1997.** *The species directory of the marine fauna and flora of the British Isles and surrounding seas*. Belfast and Ross-on-Wye: Ulster Museum and The Marine Conservation Society. 508 pp.
- Könnecker G. 1973.** Littoral and benthic investigations on the west coast of Ireland. 1. (Section A: Faunistic and ecological studies). The sponge fauna of Kilkieran bay and adjacent areas. *Proceedings of the Royal Irish Academy* **73B**: 451-472.
- Lévi C. 1960.** Les démosponges des côtes de France. 1. Les Clathriidae. *Cahiers de Biologie Marine* **1**: 47-87.
- Lilly S J, Sloane J F, Bassindale R, Ebling F J, Kitching J A. 1953.** The ecology of the Lough Ine rapids with special reference to water currents. IV. The sedentary fauna of sublittoral boulders. *Journal of Animal Ecology* **22**: 87-122.
- McClintock J B, Amsler C D, Baker B J, Van Soest R W M. 2005.** Ecology of Antarctic marine sponges: an overview. *Integrative and Comparative Biology* **45**: 359-368.
- Morrow C C, Picton B E. 1996.** An aplysillid sponge *Hexadella racovitzae* Topsent, 1896, new to the British Isles with notes on its habitat and distribution. *Irish Naturalists Journal* **25**: 218-221.

- Pansini M. 1987.** Littoral demosponges from the banks of the Strait of Sicily and the Alboran Sea. In *Taxonomy of Porifera from the northeast Atlantic and Mediterranean Sea*, vol. 13. pp.149-186. Eds J B E Vacelet and N Boury-Esnault. Berlin: Springer-Verlag.
- Perez T. 2000.** Evaluation of coastal areas quality by sponges: state of the art. *Bulletin de la Société Zoologique de France* **125**: 17-25.
- Perez T, Wafo E, Fourt M, Vacelet J. 2003.** Marine sponges as biomonitor of polychlorohiphenyl contamination: Concentration and fate of 24 congeners. *Environmental Science & Technology* **37**: 2152-2158.
- Perez T, Vacelet J, Bitar G, Zibrowius, H. 2004.** Two new lithistids (Porifera: Demospongiae) from a shallow eastern Mediterranean cave (Lebanon). *Journal of the Marine Biological Association of the United Kingdom* **84**:15-24.
- Picton B E. 1991.** The sessile fauna of sublittoral cliffs. In *The Ecology of Lough Hyne*, pp. 139-142. Eds C Little and A Myers. Dublin: Royal Irish Academy.
- Picton B E, Costello M J. 1998.** *BioMar biotope viewer: a guide to marine habitats, fauna and flora of Britain and Ireland*, Dublin: Environmental Sciences Unit, Trinity College.
- Picton B E, Goodwin C E. 2007a.** Sponge Biodiversity of Rathlin Island. *Journal of the Marine Biological Association of the United Kingdom* **87**: 1441:1458.
- Picton B E, Goodwin C E. 2007b.** Sponge Biodiversity of Rathlin Island. Project report for EU BSP and EHS. Belfast: Ulster Museum, Department of Zoology. 176 pp.
- Soest R W M van, Picton B E, Morrow C C. 1999.** Sponges of the North East Atlantic. In *World Biodiversity Database CD-ROM series*, Windows/Mac version 1.0. Amsterdam: ETI, University of Amsterdam.
- Soest R W M. van, Stone S M K. 1986.** *Antho brattegardi* sp.n. (Porifera: Poecilosclerida), with remarks on and a key to the clathriids of Norwegian waters. *Sarsia* **71**: 41-48.
- Soest R W M van, Weinberg S. 1980.** A note on the sponges and octocorals from Sherkin Island and Lough Ine, Co. Cork. *Irish Naturalists Journal* **20**: 1-15.
- Stephens J. 1912.** Clare Island Survey: Marine Porifera. *Proceedings of the Royal Irish Academy* **31**: 1-41.
- Stephens J. 1916.** Preliminary notice of some Irish sponges. The Monaxellida (suborder Sigmatomonaxellida) obtained by the Fisheries Branch of the Department of Agriculture and Technical Instruction, Ireland. *Annals and Magazine of Natural History* **8**: 232-242.
- Stephens J. 1917.** Sponges collected by the dredging expeditions of the Royal Irish Academy and the Royal Dublin Society. *Proceedings of the Royal Irish Academy* **34**: 1-16.
- Stephens J. 1921.** Sponges of the coast of Ireland. 2. The Tetraxonida (concluded). *Annual Report of Fisheries, Ireland, Scientific Investigations* **1920**: 1-75.
- Tsoukatou M, Hellio C, Vagias C, Harvala C, Roussis V. 2002.** Chemical defense and antifouling activity of three Mediterranean sponges of the genus *Ircinia*. *Zeitschrift Fur Naturforschung C-a Journal of Biosciences* **57**: 161-171.
- Vacelet J, Perez T. 1998.** Two new genera and species of sponges (Porifera, Demospongiae) without skeleton from a Mediterranean cave. *Zoosystema*, **20**, 5-22.
- White A W, Lottin J R P, Barrow D, Nicholson, R I. 2005.** Anti-proliferative extracts from a Welsh sponge. British Pharmaceutical Conference, Manchester. *Journal of Pharmacy and Pharmacology BPC science abstracts supplement 2005*: 70.
- Wiedenmayer F. 1977.** *Shallow-water sponges of the western Bahamas*. Basel & Stuttgart: Birkhäuser. 287 pp.

## Analysis of species distributions by Sea Area, using data from taxonomic and 'grey' literature: Amphipoda

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### Introduction

A glance at an atlas of marine fauna by Marine Census or Sea Areas (e.g. Seaward, 1982) shows repeating distribution patterns that reflect the influence of warm or cold waters. It is generally known that warm water species have a western distribution in the British Isles and this is reflected in the recent division of marine ecoregions (Spalding *et al.*, 2007) between the 'North Sea' and 'Celtic Seas', with a boundary running north-south along Great Britain (Scottish north coast to central Channel). Cold water species, however, often appear to have a northern, rather than an eastern distribution. Lincoln (1979) lists records of Amphipoda by Sea Area but does not provide maps by species; he also discusses biogeography and lists species by geographic sub-regions ('faunules'). Dauvin & Bellan-Santini (2004) analysed species lists from several European regions and identified species that belonged to different faunules but did not quantify the patterns discussed above.

There appears to be a need to objectively test whether the available distribution data support the observed patterns and the consequent prediction that species richness would be highest in the southwest and lowest in the southeast. This will provide a predictive framework for other benthic taxa, once demonstrated for a manageable and moderately well-known group (Amphipoda: Gammaridea) and inform future research into the factors that affect such distribution patterns and the nature of the data required to define the patterns. The aim of this study is therefore to investigate possibilities for the use of data derived from a range of sources in order to quantify distribution patterns. This is done through the compilation of records from published and unpublished data and the analysis of different data combinations by use of standard methods.

### Methods

In order to identify biogeographical boundaries, Sea Area records of gammaridean amphipods were collected. Sea Area locations are shown numbered on Figures 1, 2 and all subsequent maps. The study was restricted to shallow water and intertidal species,

so excluded Sea Areas with no intertidal zone (4, 8, 10 and 40) and species known only from water depths below 50m (as Sea Areas 13, 24 & 25 have no seabed below 50m). Three separate data matrices were prepared: records from Lincoln (1979), those from the Unicorn database (all records from samples analysed at Unicomarine since 1985) and combined records from all accessible sources (Lincoln, Unicorn and other literature – see Addendum).

Records were first analysed as presence/absence data, using Bray-Curtis similarity (Clarke, & Gorley, 2001) in order to determine whether the available data would allow the identification of faunules and determine their boundaries. This was done separately for the three data sets, excluding Sea Areas without records.

As the coverage of data used may not have been even enough for fine resolution through cluster analysis, Sea Areas were then grouped into four regional blocks (shown on Figure 1 and others), chosen to reflect estimated biogeographic patterns and to ensure good data coverage for each major block. The four blocks were defined as southwest (SW), northwest (NW), northeast (NE) and southeast (SE). Although the SE block included only three sea areas, it had high sampling effort (Figure 3). The number of species recorded from each regional block was calculated, as well as the number recorded from each combination (permutation) of regional block records. Sea Area maps were produced for species that represented each permutation.

### Results

Cluster analysis (Bray-Curtis similarity) of Sea Area records taken only from Lincoln (1979) showed no discernable pattern. Results for Unicorn data appeared to reflect sampling effort, rather than true biogeographic patterns (Figure 3) but the effect was not so marked as might be expected. This can be seen in the relative uniformity of species recorded for most areas (Figure 1), despite greater differences in sampling effort (Figure 2).

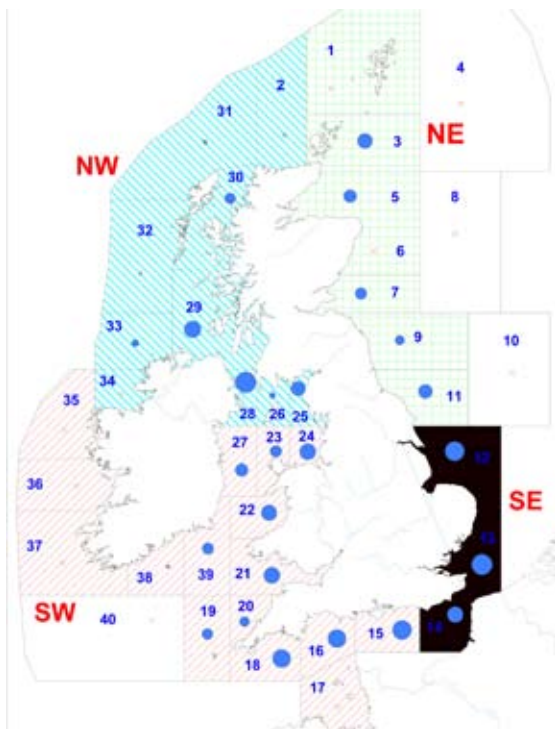


Fig. 1. Relative numbers of species recorded for each sea area (represented by sizes of circles) in data held on the Unicorn database at Unicomarine.

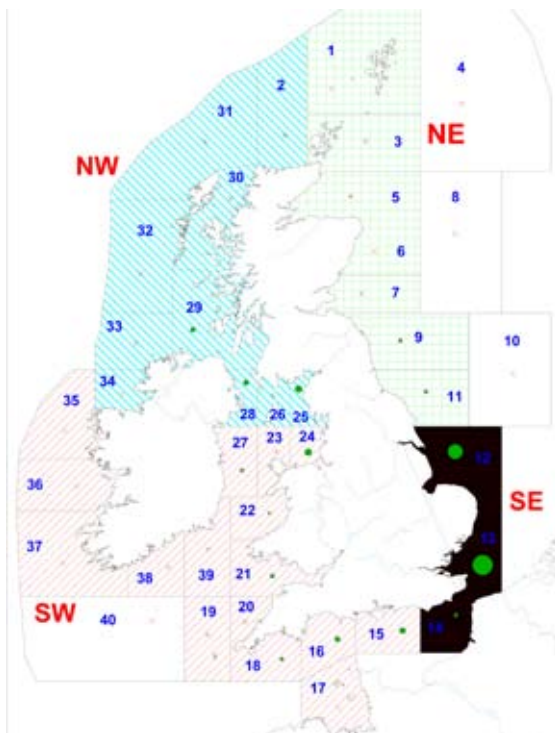


Fig. 2. Relative numbers of samples available for each sea area (represented by sizes of circles) in data held on the Unicorn database at Unicomarine.

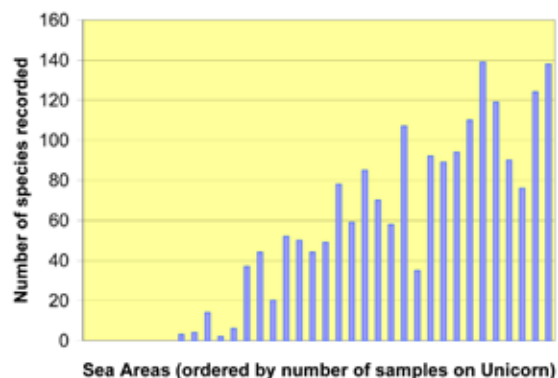


Fig. 3. Numbers of species recorded for each sea area (represented by column lengths) in data held on the Unicorn database at Unicomarine, with sea areas ordered by numbers of samples available.

The number of species recorded from each sea area using the combined data appeared fairly uniform (Figure 4) but still showed limited records for some areas (e.g. northwest Scotland) that were likely to be due to low sampling effort.

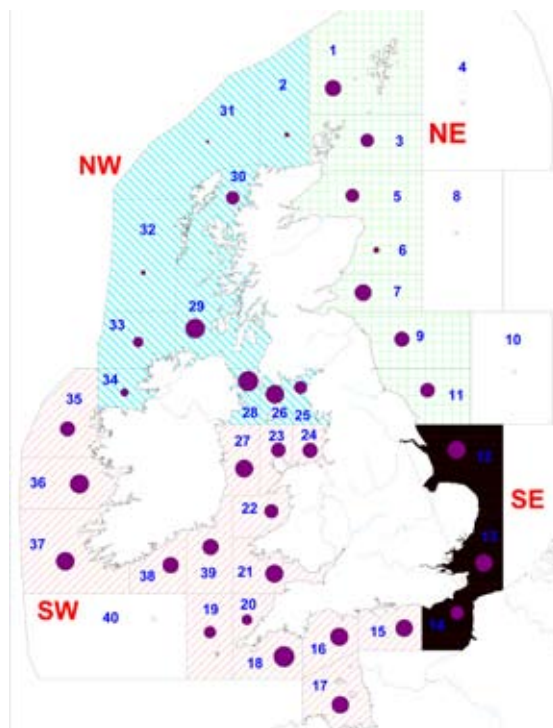


Fig. 4. Relative numbers of species recorded for each sea area (represented by sizes of circles) in all data sourced for this study.

Provisional faunules could be identified as cluster groups and plotted on a sea area map. They showed similarity between neighbouring areas but there appears to be insufficient data to allow detailed identification of faunule boundaries.

A decreasing scale of biodiversity was seen in the

species records by major regional blocks, from the relatively species rich SW, through NW and NE to the relatively species poor SE (Figure 5).

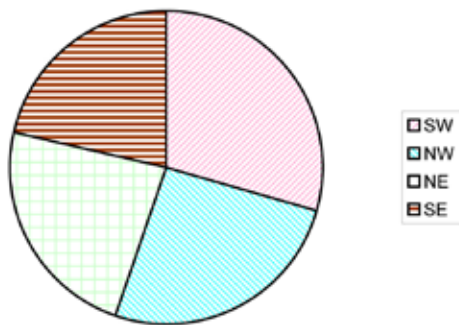


Fig. 5. Number of species recorded from each major regional block.

A similar pattern was seen in the numbers of species with different distribution permutations (Figure 6). The largest group (to the left of the chart) represents those species (47%) that have been recorded from all four regional blocks. The second largest group (10%) was for those species found in all areas except the SE (XSE in Figure 6). The third largest group (8%) included those species recorded only from the SW (NB: in Figure 6 'SW' represents SW only).

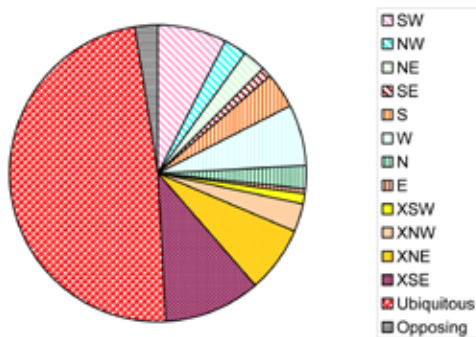


Fig. 6. Numbers of species recorded from different permutations of distribution between regional blocks. The key lists permutations in sequence, as they appear clockwise in the chart, beginning with the '12:00' position.

Improved detail could be seen on Sea Area maps produced for individual species chosen to represent each permutation. One example is shown below (Figure 7) to represent 'distributed in all regions but the SE', the most common regional distribution permutation (other than ubiquitous).

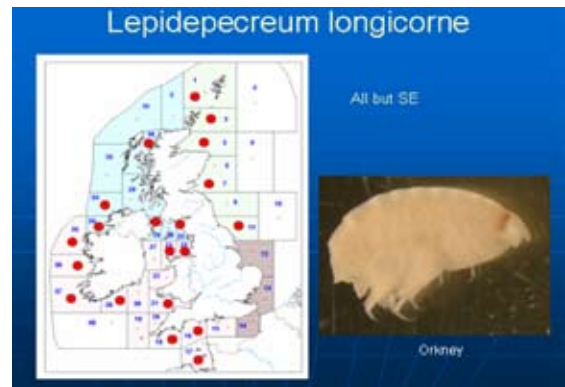


Fig. 7. Sea area distributions and photograph for *Lepedepecreum longicorne*.

## Discussion

While it was not possible to confidently identify regional faunule boundaries with the data collated to date, this analysis provides quantitative evidence for a commonly observed pattern in the marine biogeography of the British Isles: that is, species richness is highest in the southwest and lowest in the southeast. These patterns could be explained in terms of sensitivity to low winter temperatures or high summer temperatures, respectively for warm or cold water species:

- (i) highest species richness in the southwest, as a result of warm water species, followed by the northwest and northeast,
- (ii) moderately increased species richness in the northwest and northeast, as a result of cold water species,
- (iii) low species richness in the southeast, by default.

The concepts are illustrated by the following figure.

Fig. 8. Stylised warm and cold water faunal influences around the British Isles; numbers of species involved are indicated by thickness of arrows, which do not necessarily imply short-term movement of animals.

There are other potential explanations for the observed patterns. There may be low larval dispersal to the southeast, due to the greater movement of water over deeper areas. Another explanation might be that habitat diversity is low in the southeast. The fact that the area is deficient in deep water habitats was factored out as far as possible, through the elimination of deep water species and offshore Sea Areas from the analyses. The low diversity of some other habitats, such as hard substratum communities remains a potential explanation for the pattern, although the absence of certain biogenic habitats could be considered a function of low species richness in itself.

Distributions are imperfectly known for most marine invertebrates and many sea areas lack comprehensive records. In order to achieve both a confirmation and an explanation of the pattern presented here, better standardisation of data would be required. A more thorough data review would eliminate many of the gaps in coverage. Additional data sources have been discovered since the completion of the analyses described here, and there are undoubtedly others. For example, regional reports for the Marine Nature Conservation Review could be used, as well as additional unpublished data sets, such as those held by statutory bodies and consultancies. Standardisation of data in terms of habitats sampled and numbers of samples collected would eliminate many of the variables in explanation. It may also be possible to statistically confirm the patterns by use of data for other taxonomic groups.

## Conclusion

The analyses have shown that biogeographic patterns can be identified and quantified through the compilation of data from a range of sources. Further work is required to refine knowledge of the patterns and to determine optimum methods for the collection and use of data for studies of distribution in marine macrofauna. Figures have been provided for relative species richness between regions that are available for testing by use of other taxonomic groups. It is hoped that more standardised data compilation methods will one day allow more detailed analysis of distribution patterns, with clarification of causes and changes with time.

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## References

- Clarke, K. R. and Gorley, R. N. 2001. *Primer v5: User Manual/Tutorial*. PRIMER-E, Plymouth.
- Dauvin, J. C. and Bellan-Santini, D. 2004. Biodiversity and the biogeographic relationships of the Amphipoda: Gammaridea on the French coastline. *Journal of the Marine Biological Association of the United Kingdom* **84** (3): 621-628.
- Lincoln, R. 1979. *British marine Amphipoda: Gammaridea*. British Museum (Natural History), London 658pp.
- Seaward, D. R. 1982 (ed.). *Sea area atlas of the marine molluscs of Britain and Ireland*. Nature Conservancy Council, Shrewsbury.
- Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdaña, Z. A., Finlayson, M. F., Halpern, B. S., Jorge, M. A., Lombana, A., Lourie, S. A., Martin, K. D., McManus, E., Molnar, J., Recchia, C. and Robertson, J. 2007. Marine ecoregions of the world: a bioregionalization of coastal and shelf areas. *BioScience* **57** (7): 573-583.
- Addendum (literature sources of amphipod records used in analyses)**
- Ashelby, C.W. 2006. Records of the introduced amphipod *Grandidierella japonica* Stephensen 1938 (Crustacea: Amphipoda: Gammaridea: Aoridae) from the Orwell Estuary, Suffolk. *Suffolk Natural History*, 42, 48-54.
- Baldock, L., 2004. Species list from field visit of PMNHS to Osmington Mills, Dorset on 22<sup>nd</sup> March 2004. *Porcupine Marine Natural History Society Newsletter*, 15, 25-28.
- Bamber, R.N., 1987. A comparison of epifaunal arthropods from sixteen potential community associations at Cullercoats. *Porcupine Newsletter*, 4(2), 45-48.
- Bamber, R.N., 1987. The marine biota of Druridge Bay, Northumberland. *Porcupine Newsletter*, 4(7), 161-168.
- Barclay, I.M.T., 1982. New records of *Bathyporeia* (Amphipoda) from West Scotland. *Journal of the Marine Biological Association of the United Kingdom*, 62, 229-231.
- Beare, D.J. & Moore, P.G., 1994. Observations on the biology of a rare British marine amphipod: *Monoculodes gibbosus* (Crustacea: Amphipoda: Oedicerotidae). *Journal of the Marine Biological Association of the United Kingdom*, 74, 193-201.
- Bell, M.C., 1995. *Pectenogammarus planicrurus* – there is life in gravel beaches. *Porcupine Newsletter*, 6(2), 41-47.
- Buckley, P., Dussart, G. & Trigwell, J.A., 2004. Invasion and expansion of Corophiidae (Amphipoda) in the Stour estuary (Kent, UK). *Crustaceana*, 77 (4), 425-433.
- Conlan, K.E., 1990. Revision of the crustacean amphipod genus *Jassa* Leach (Corophioidea: Ischyroceridae). *Canadian Zoological Journal*, 68, 2031-2075.
- Costello, M. J., Holmes, J. M. C., McGrath, D. and Myers, A. A. 1989. A review and catalogue of the Amphipoda (Crustacea) in Ireland. *Irish Fisheries*

*Investigations, Series B* **33**: 1-70.

De Grave, S. & Myers, A.A., 1997. The occurrence of *Pontocrates arcticus* in Ireland and confirmation of *Gammarus chevreuxi* as an Irish species (Crustacea: Amphipoda). *Irish Naturalists Journal*, 25, 383.

De Grave, S. & Myers, A.A., 1999. Records of macrobenthic Crustacea from maerl habitats in Irish waters. *Bulletin of the Irish Biogeographical Society*, 23, 101-123.

De Grave, S. & Wilkins, H.K.A., 1994. *Corophium multisetosum* (Crustacea), an amphipod new to Ireland. *Irish Naturalists Journal*, 24 (9), 366-367.

De Grave, S. & Wilkins, H.K.A., 1994. Re-discovery of *Phoxocephalus holbolli* (Kroyer) (Crustacea: Amphipoda) in Ireland. *Irish Naturalists Journal*, 24 (9), 377-378.

Eno, N.C., Clark, R.A. & Sanderson, W.G., 1997. *Non-native marine species in British waters: a review and directory*. Joint Nature Conservation Committee, 152 pp.

George, J.D., Chimonides, P.J., Evans, N.J. & Muir, A.I., 1993. *Fluctuations in the macrobenthos of a shallow-water cobble habitat off North Norfolk, England*. In: 28th EMBS Symposium. Biology and Ecology of Shallow Coastal Waters, 167-179.

Herbert, R., 1991. Autumn field meeting at Osborne Bay, Isle of Wight, 8 September 1991. *Porcupine Newsletter*, 5(3), 53-58.

Jansen, T., 2001. A taxonomic revision of *Westwoodilla* Bate, 1862 (Crustacea: Amphipoda), including descriptions of two new species. *Steenstrupia*, 27(1), 83-136.

Kilgallen, N.M., Myers, A.A. & McGrath, D., 2006. A review of the genus *Tryphosella* (Crustacea: Amphipoda) from Britain and Ireland, with the description of a new species *Tryphosella lowryi*. *Journal of the Marine Biological Association of the United Kingdom*, 86(5), 1067-1081.

Kilgallen, N.M., Myers, A.A. & McGrath, D., 2006. Re-establishment of *Orchomenella crenata* (Crustacea: Amphipoda) as a distinct species, with a first record of its occurrence in the British Isles. *Journal of the Marine Biological Association of the United Kingdom*, 86(6), 1389-1400.

King, R.A. & Holmes, J.M.C., 2004. A new species of *Ischyroceras* (Crustacea: Amphipoda) from Ireland, with a review of *Ischyroceras anguipes* and *Ischyroceras minutus* from the North-East Atlantic. *Journal of Natural History*, 38 (14), 1757-1772.

King, R.A., Myers, A.A. & McGrath, D., 2004. The *Ampelisca aequicornis* group of species (Amphipoda:

Ampeliscidae) with a key, and a description of *Ampelisca eclimensis* sp.nov. from Ireland. *Journal of the Marine Biological Association of the United Kingdom*, 84, 155-164.

Lincoln, R. 1979. *British marine Amphipoda: Gammaridea*. British Museum (Natural History), London 658pp.

Lee, R. & Bramley, J., 1998. The diversity of marine amphipods at Whitstable Bay, Kent. *Transactions of the Kent Field Club*, 15 (2), 83-100.

McGrath, D. & Myers, A.A., 1989. The drift amphipod *Hyale grimaldii* in Irish and British waters. *Journal of the Marine Biological Association of the United Kingdom*, 69, 913-918.

Mettam, C., 2003. Porcupine field excursion to Aberthaw 16 March 2003. *Porcupine Marine Natural History Society Newsletter*, 12-18.

Moore, P.G., 1982. Little known Amphipoda from the Clyde Deeps. *Journal of the Marine Biological Association of the United Kingdom*, 62, 237.

Moore, P.G., 1984. *The fauna of the Clyde Sea area Crustacea: Amphipoda*. Occasional Publication No. 2. University Marine Biological Station, Millport.

Moore, P.G., 1984. *Acanthonotozoma serratum*, an Arctic amphipod new to Britain. *Journal of the Marine Biological Association of the United Kingdom*, 64, 731-732.

Moore, P.G., 1984. The amphipod *Monoculodes gibbosus* (Crustacea) in British waters. *Journal of the Marine Biological Association of the United Kingdom*, 64, 271-278.

Myers, A.A., 1974. *Amphitholina cuniculus* (Stebbing), a little-known marine amphipod crustacean new to Ireland, *Proceedings of the Royal Irish Academy*, 74, 463-469.

Moore, P.G. & Beare, D.J., 1993. Taxonomic confusion in the genus *Pontocrates* (Crustacea: Amphipoda) and the presence of *P. arcticus* in Britain. *Journal of the Marine Biological Association of the United Kingdom*, 73, 609-615.

Myers, A.A. & Costello, M.J., 1984. The amphipod genus *Aora* in British and Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 64, 279-283.

Myers, A.A. & Costello, M.J., 1986. The Amphipod sibling pair *Leucothoe lilljeborgi* Boeck and *L. incisa* Robertson in British and Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 66, 75-82.

Myers, A.A. & McGrath, D., 1979. The British and Irish species of *Siphonocetes* Kroyer (Amphipoda

- Gammaridea). *Journal of Natural History*, 13, 211-220.

Myers, A.A. & McGrath, D., 1980. A new species of *Stenothoe* Dana (Amphipoda, Gammaridea) from Maerl deposits in Kilkieran Bay. *Journal of Life Sciences of the Royal Dublin Society*, 2, 15-18.

Myers, A.A. & McGrath, D., 1981. Taxonomic studies on British and Irish Amphipoda. The genus *Photis* with the re-establishment of *P. pollex* (= *P. macrocoxa*). *Journal of the Marine Biological Association of the United Kingdom*, 61, 759-768.

Myers, A.A. & McGrath, D., 1982. Taxonomic studies on British and Irish amphipoda. Re-establishment of *Leucothoe procera*. *Journal of the Marine Biological Association of the United Kingdom*, 62, 693-698.

Myers, A.A. & McGrath, D., 1982. Taxonomic studies on British and Irish amphipoda. The genus *Gammaropsis*. *Journal of the Marine Biological Association of the United Kingdom*, 62, 93-100.

Myers, A.A. & McGrath, D., 1983. The genus *Listriella* (Crustacea: Amphipoda) in British and Irish waters, with the description of a new species. *Journal of the Marine Biological Association of the United Kingdom*, 63, 347-353.

Myers, A.A. & McGrath, D., 1984. A revision of the North-East Atlantic species of *Erichthonius* (Crustacea: Amphipoda). *Journal of the Marine Biological Association of the United Kingdom*, 64, 379-400.

Myers, A.A. & McGrath, D., 1991. The *Ampelisca diadema* group of species (Amphipoda: Gammaridea) in British and Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 71, 265-279.

Myers, A.A. & McGrath, D., 1994. *Ampelisca dalmatina* and *A. provincialis* (Amphipoda: Gammaridea) in Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 74, 403-412.

Myers, A.A. McGrath, D. & Costello, M.J., 1987. The Irish species of *Iphimedia* Rathke (Amphipoda: Acanthonotozomatidae). *Journal of the Marine Biological Association of the United Kingdom*, 67 (2), 307-321.

Myers, A.A., McGrath, D. & Cunningham, P., 1989. A presumed male of the parthenogenetic amphipod *Corophium bonnellii* (Milne-Edwards). *Journal of the Marine Biological Association of the United Kingdom*, 69, 319-321.

O'Reilly, M., Hamilton, E. & Heaney, L., 2001. New records of amphipods and leptostracans from the Forth Sea area, with notes on their copepod parasites (Siphonostomatoida: Nicothoidae). *Glasgow Naturalist*, 23 (6), 35-42.

Robinson, G., Chambers, S. & Mair, J., 2004. Records of benthic marine invertebrates from offshore waters west of Shetland and Orkney. *Porcupine Marine Natural History Society Newsletter*, 16, 13-24.

Shearer, M. & Bamber, R.N., 1988. The fauna of land-locked lagoons and saltmarshes – Aldeburgh to shingle street. *Porcupine Newsletter*, 4(4), 79-84.

Smith, P., Perrett, J., Garwood, P. & Moore, G., 1999. Two additions to the UK marine fauna: *Desdemona ornata* Banse, 1957 (Polychaeta, Sabellidae) and *Grandidierella japonica* Stephensen, 1938 (Amphipoda, Gammaridea). *Porcupine Newsletter*, 8-11.

Wildish, D.J., 1987. Estuarine species of *Orchestia* (Crustacea: Amphipoda: Talitroidea) from Britain. *Journal of the Marine Biological Association of the United Kingdom*, 67, 571-583.

Worsfold, T.M., 2005. Records of *Photis reinhardi* and *Amphilochoides boeckii*, two marine amphipods new to Ireland, from Belfast Lough. *Irish Naturalists' Journal*, 28 (3), 123-125.

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Brown, M. T. and Lamare, M. D. 1994. The distribution of *Undaria pinnatifida* (Harvey) Suringar within Timaru Harbour, New Zealand. *Japanese Journal of Phycology* **42**: 63-70.

Dipper, F. A. 2001. *Extraordinary Fish*. BBC Worldwide Ltd. 96pp.

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