

PORCUPINE MARINE NATURAL HISTORY SOCIETY

NEWSLETTER



Autumn 2011

Number 30



ISSN 1466-0369

Porcupine Marine Natural History Society

Newsletter

No. 30 Autumn 2011

Hon. Treasurer

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

Hon. Editor

Vicki Howe
White House
Penrhos
Raglan
NP15 2LF
07779 278841
viks@sun-fish.co.uk

Hon. Membership Secretary

Séamus Whyte
The Cottage
Back Lane
Ingoldsby
Lincolnshire
NG33 4EW
01476 585496
s.whyte@enviromuir.co.uk

Hon. Chairman

Andy Mackie
Department of Biodiversity & Systematic Biology
Amgueddfa Cymru - National Museum Wales
Cathays Park
Cardiff CF10 3NP
0129 20 573 311
Andy.Mackie@museumwales.ac.uk

Porcupine MNHS welcomes new members- scientists, students, divers, naturalists and lay people. We are an informal society interested in marine natural history and recording particularly in the North Atlantic and 'Porcupine Bight'. Members receive 2 newsletters a year which include proceedings from scientific meetings, plus regular news bulletins

Individual £10 Student £5

 www.pmnhs.co.uk

COUNCIL MEMBERS

Frances Dipper	frances.dipper@sustenergy.co.uk
Jon Moore	jon@ticara.co.uk
Tammy Horton	txh@noc.soton.ac.uk
Peter Tinsley	ptinsley@dorsetwildlife.co.uk
Sue Chambers	s.chambers@nms.ac.uk
Roger Bamber	roger.bamber@artoo.co.uk
Anne Bunker	abunker@marineseen.com
Paul Brazier	p.brazier@ccw.gov.uk
Peter Barfield	peter@seanature.co.uk

Julia Nunn	jdn@cherrycottage.myzen.co.uk
Seamus Whyte	s.whyte@enviromuir.co.uk
Vicki Howe	viks@sun-fish.co.uk
Angie Gall	angie.gall@cornwallwildlifetrust.org.uk
Roni Robbins	roni.robbs@artoo.co.uk
Andy Mackie	Andy.Mackie@museumwales.ac.uk
Fiona Crouch	ficr@MBA.ac.uk

 <http://www.facebook.com/groups/190053525989/>

 [@PorcupineMNHS](https://twitter.com/PorcupineMNHS)

Cover Image: Council member Tammy Horton in Lough Hyne - see p 65



Editorial

Greetings fellow Porcupine members. This is my first editorial and so I have been wondering what an editorial should really be? Looking back over previous newsletters it seems that it is a mix of stories, thoughts, opinions, news and sometimes comments on the contents of the newsletter. This seems relatively straightforward. For good measure I typed "how to write an editorial" into Google to see what came up. I then closed down my web browser – just too much information about nothing in particular. Get writing I thought!

And so.....

Firstly this newsletter is filled with a superb collection of papers written as a result of the conference held in Southampton in March this year. More about this in the conference report and a very big thank you to all authors for their prompt submissions, which are very much appreciated by the editing team.

Those who attended the conference will be aware that I asked for attendees to complete a small questionnaire as I am interested to know what Porcupine members think about the newsletter and what changes the members would like. For those that didn't attend the conference then please feel free to complete the enclosed questionnaire and send it back to me. Results and an overview of comments will be included in the next issue.

We have a new section called Fieldwork Forays which we are hoping will grow from the 2 articles within this issue. It is envisaged that this section will allow contributors to share short pieces on field work tips and techniques, good practice and lessons learnt, hopefully mixed in with some stories of mishaps, adventures and what you might do differently next time! The aim is to provide an opportunity to share the wealth of experience and knowledge our members have. This means that I am looking for contributions! Please?

Porcupine Marine Natural History Society Minutes of the 34th Annual General Meeting

Saturday 12 March 2011, at the National Oceanography Centre, Southampton.

1. There were no apologies for absence
2. **Acceptance of the Minutes** of the 33rd Annual General Meeting, as published in the PMNHS Newsletter No. 28, was proposed by Tammy Horton, seconded by Anne Bunker, and they were accepted by the floor with no corrections or additions.
3. **There were no matters arising** from the Minutes of the 33rd Annual General Meeting.

4. Officers' Reports

The Hon. Treasurer's Report was presented by Jon Moore.

The accounts were presented to the AGM examined, and are published in the Newsletter. The balance in the Society's accounts carried forward as at 31 December 2010 was £10,033. The Hon. Treasurer will pursue an alternative place in which to obtain better interest for the deposit account.

The financial surplus accruing from the St Andrews meeting in 2010 will come into next year's accounts. The apparent loss on the Isles of Scilly field trip should be set against the advance income from the trip received in 2009.

The Society paid no corporation tax last year owing to its making a net loss in that year.

Acceptance of the Hon. Treasurer's Report was proposed by Julia Nunn, seconded by Vicki Howe, and carried with no votes against.

The Hon. Membership Secretary's Report was presented by Séamus Whyte.

Total membership had just broken 300, but many members were in arrears (reminders will be sent out). The meeting was reminded that we would prefer payment by standing orders, which would reduce the problem of arrears.

Membership at the start of the Conference stood at 258 full members, 14 student members, 10 subscribing libraries, 5 Hon. Life Members, 5 free (libraries) and 6 members of unknown status. 37 new members had joined in the last year. Acceptance of the Hon. Membership Secretary's Report was proposed by Angie Gall, seconded by Roger Bamber, and carried with no votes against.

The Hon. Editor's Report was presented by Peter Tinsley.

There had been two Newsletters in the previous year. The latest newsletter was available at the meeting to members (saving postage). The last two issues have been in full colour; at present the Society can cover the costs of full colour, so it is hoped to continue this standard. The Hon. Editor acknowledged help from Paul Brazier and Vicki Howe for enabling the latest Newsletter to appear in time for the Conference. He reminded speakers that articles from their talks would be appreciated for the Newsletter. A questionnaire had been put out at the meeting for feedback on the members' desires for the Newsletter.

Members were reminded that there is a 'Porcupine Newsletter Prize' of £50 available each year for the best article by student or amateur members published in the Newsletter (see www.pmnhs.co.uk/news/porcupineprize.php for details).

Acceptance of the Hon. Editor's Report was proposed by Tammy Horton, seconded by Sue Chambers, and carried with no votes against.

The Hon. Web-site Officer's Report was presented by Tammy Horton.

The site receives 100-300 visitors per month. Numbers pick up around December and January as the new annual meeting approaches. There had been 167 downloads of the Conference programme! The site now includes new contact pages for Council Members.

The Web-site is certainly well-used, with the advantage of being simple; it incorporates recording scheme updates; membership details (and how to join); information on meetings; the history of Porcupine (what we have done in the past); and links to pdf files for past

Newsletters

The Porcupine MNHS Facebook page was also mentioned; this is particularly a facility for photographs from field work, etc., replacing the Web-site gallery page which had to be removed owing to hacking.

Acceptance of the Hon. Web-site Officer's Report was proposed by Paul Kay, seconded by Seamus Whyte, and carried with no votes against.

The Hon. Records Convenor's Report was presented by Roni Robbins.

All historical and current (up to and including 2009) records are now entered into Marine Recorder. These records have now been sent to the NBN Trust and are now uploaded to the NBN Gateway. PMNHS is now a member of the NBN Trust.

PMNHS is now also a member of iSpot. For those of you that don't know, iSpot is "a website aimed at helping anyone identify anything in nature". It is supported both by OPAL and the Open University. This membership allows us to provide a link from their website to ours which will hopefully encourage new members. In addition to this, if any "Porcupines" join and help folk with their identifications (usually through photographs) it will also advertise our website. See <http://www.ispot.org.uk/>

The Hon. Records Convenor took the opportunity to remind and encourage members to continue to submit their records to the scheme: the success of the scheme depends on as much input from the membership as possible. If any of the members still don't understand what this scheme is about do ask or check our website.

Acceptance of the Hon. Records Convenor's Report was proposed by Vicki Howe, seconded by Doug Herdson, and carried with no votes against.

The Hon. Chairman's Report was presented by Andy Mackie.

The Conference at St Andrews last year was attended by 70 people; the meeting was deemed a success and all present had an enjoyable time. Thanks were given to Claire Peddie and Bill Austin for organizing that

meeting. The Field Meeting on the Isles of Scilly had been the best attended for a long time, experienced good weather, and was very productive. Thanks were given to Angie Gall and her team for their organization, and to the Scillonian Club for their hospitality.

This coming year there will be a Connemara field trip organized by Julia Nunn for end of September, in collaboration with the Conchological Society. Another field trip is being planned for early September to look at some muddy shores and chalk shores in Kent, a county which has been somewhat neglected; Fiona Crouch will be coordinating that trip with Becky Hitchin of the Kent Wildlife Trust. Members are reminded to keep their eyes on the website for further information on both trips.

The Hon. Chairman thanked Tammy Horton, Roni Robbins and Roger Bamber for organizing this year's successful and well-attended conference (108 delegates being registered), with its high standard of talks.

Acceptance of the Hon. Chairman's Report was proposed by Sue Chambers, seconded by Tammy Horton, and carried with no votes against.

5. Porcupine Grants Scheme

This is the fourth year of the scheme. No actual proposals were received last year. This year we received four very good applications. The total Grants budget was only £2000, so we are funding two projects this year. The first is Rainer Piper's study of the provenance of North Sea *Pampas argenteus*, using stable isotope analysis; the second is a large project, which has additional funding support from other sources, undertaking an underwater survey of north Cornwall, which includes many experts, and is organised by Emily Priestley. The Grants sub-committee foresaw a large potential for copy for the Newsletter and kudos for the Society.

Attendees were reminded to see the webpage for applications for next year's round of grants.

6. There was no proposed change to the Constitution.

7. Election of Officers and Council.

Two members of Council, Fiona Crouch and Vicki Howe, retired at the AGM, and both were available for immediate re-election. There were no other new candidates proposed for election to Council. The re-election of Fiona Crouch and Vicki Howe was proposed by Roger Bamber, seconded by Roni Robbins, and carried with no votes against.

Vicki Howe was proposed for election to Hon. Editor, with Peter Tinsley standing down and proposed for election as an Ordinary Member of Council, both by Roger Bamber. These motions were seconded by Andy Mackie, and carried with no votes against.

The motion was put to retain all the other Office Bearers as in post from last year. The motion was proposed by Roger Bamber, seconded by Sue Chambers, and carried with no votes against.

The Council for 2011-2012 is as follows.

Office Bearers:

Hon. Chairman – Andy Mackie

Hon. Secretary – Roger Bamber

Hon. Treasurer – Jon Moore

Hon. Editor – Vicki Howe

Hon. Membership Secretary – Séamus Whyte

Hon. Records Convenor – Roni Robbins

Hon. Web-site Officer – Tammy Horton

Ordinary Members of Council:

Peter Barfield

Paul Brazier

Anne Bunker

Sue Chambers

Fiona Crouch

Frances Dipper

Angie Gall

Julia Nunn

Peter Tinsley

8. The field meetings for 2011 were discussed in the Hon. Chairman's Report.

9. The 2012 Conference and AGM are planned for Hull; details will appear on the Web-site in due course.

10. There being no other business, the meeting closed at 12.47.

Dates to Remember - 2012

Annual Conference.

Hull 23-25 March 2012

Fieldtrip

Guernsey 5-10 April 2012

Further details soon

PORCUPINE MNHS
RECEIPTS AND PAYMENTS ACCOUNT
Year to 31 December 2010

ACCOUNTS

Year to 31.12.09			Year to 31.12.10	
£	£		£	£
RECEIPTS				
1364		2004 to 2009	0	
20		2010	1382	
0		2011	65	
<u>1384</u>			<u>1447</u>	
0		Sales (Sweatshirts & books)	10	
119		Bank Interest (gross, both accounts)	11	
(23)		Tax deducted	(1)	
<u>1480</u>		Total Receipts	<u>1467</u>	
PAYMENTS				
(764)		Newsletter- Printing	(458)	
(319)		Postage	(173)	
<u>(1083)</u>		Total Newsletter Costs	<u>(631)</u>	
(151)		Web site expenses	(6)	
(136)		Council meeting expenses (travel/catering)	(292)	
<u>(1370)</u>			<u>(929)</u>	
110		SURPLUS BEFORE MEETINGS & GRANTS	<u>538</u>	
(60)		Annual Conference – Pembroke (field) (2008)	0	
558		– Plymouth (2009)	0	
0		– St Andrews (2010)	0	
624		– Scillies (field) (2010)	(95)	
0		Deep Sea Conservation UK Project expenses	(23)	
(1699)		Porcupine grants	(617)	
<u>(577)</u>			<u>(735)</u>	
(467)		SURPLUS/DEFICIT FOR THE YEAR (before tax)	(197)	
(471)		Corporation Tax	0	
<u>(938)</u>		SURPLUS/DEFICIT FOR THE YEAR (after tax)	<u>(197)</u>	
11,168		BALANCE BROUGHT FORWARD	<u>10,230</u>	
BALANCE CARRIED FORWARD				
4745		Current Account	4543	
5485		Deposit Account	5490	
<u>10,230</u>			<u>10,033</u>	

Jon Moore, Hon Treasurer
7th February 2011

Nick Light, Hon Examiner
11th February 2011

J. J. Moore

Nick Light



PORCUPINE PIECES

Invertebrate life of Brownsea Island Lagoon and its importance to the birds of Poole Harbour

By Kathryn E. Ross

Centre for Conservation Ecology and
Environmental Change, Bournemouth University

kross@bournemouth.ac.uk

Poole Harbour is internationally designated as a Special Protection Area on account of the large numbers of wildfowl and waders that use this area. 3500 ha of intertidal mudflat host a myriad of invertebrate species that provide energy for these birds, especially over the winter months. One notable feature of Poole Harbour that makes it desirable to certain bird species, is the occurrence of a saline lagoon on Brownsea Island. This lagoon was created when an area formerly known as St Andrews Bay was reclaimed from the sea by the construction of a sea wall in the 1850s, and subsequently flooded as the water pumping mechanism fell into disuse. Regrettably, this lagoon has not been included in many of the national lagoon surveys conducted in the 1980s and 90s, and very little is known about its ecology. Although the lagoon only comprises 18ha, it is heavily used by birds, especially the pied avocet *Recurvirostra avocetta* and black-tailed godwit *Limosa limosa*.

With the threat of sea level rise casting a shadow over the future of this fragile habitat, the creation of new saline lagoon around Poole Harbour will be an important management strategy for the future of Poole Harbour's birds. A new lagoon at the RSPB reserve at Arne is currently being constructed, but to ensure this new habitat meets the ecological requirements of its invertebrate and avian inhabitants, more research is needed on the existing lagoon at Brownsea.



Photo: Brownsea Island Lagoon, with artificially constructed 'tern islands' in the foreground, purpose built by the Dorset Wildlife Trust for breeding terns and gulls.

My PhD project involves quarterly surveys of the benthic macrofauna, taking core samples of 10 cm diameter to a depth of 15 cm, sieved through a 0.5 mm mesh. I will be looking at the seasonal variation in the salinity and concurrent changes in the biota. This will be coupled with behavioural studies of the avocet population that utilises the lagoon from late September to early March each year, to demonstrate the ecological importance of the lagoon to this species in Poole Harbour.

A preliminary survey of the lagoon in April 2010 revealed a salinity gradient from 22 ppt at the north-western end to 29 ppt at the south-east end near to the sluice connection with the sea and a fairly heterogeneous sediment composition consisting of sand or sandy mud, with interspersed patches of finer sediment. It bears all the hallmarks of a 'true' lagoon with a unique community of marine/brackish and freshwater species that are able to tolerate the variable salinity, as well as a number of lagoon specialists.

All species found in the survey are presented below. In total, 23 species were found in the core samples, with 4 additional species recorded in samples of seaweed and in net samples taken around the sluice. Fauna consisted of 9 annelids, 10 crustacea, 3 mollusca and 4 other species including insect larvae and the Schedule 5 protected starlet sea anemone *Nematostella vectensis*.

Several lagoon specialist species were found in the surveys. These are either of international

importance or nationally scarce, including the high densities of *Nematostella vectensis*, particularly in the less coarse substrate and the prosobranch mollusc *Ventrosia ventrosa* (formerly *Hydrobia ventrosa*). The lagoon cockle *Cerastoderma glaucum*, the amphipod crustacean *Corophium insidiosum* and isopod crustacean *Idotea chelipes* were also found.

The oligochaete *Tubificoides benedii* had the highest mean density of all species, followed by the polychaetes *Aphelocheata marioni*, *Polydora cornuta*, and the common ragworm *Hediste diversicolor*. High densities of the crustacean *C. insidiosum* were also recorded. The prawn *Palaemonetes varians* was recorded in pond-net sweeps at most of the sites sampled and was in high abundance in the vicinity of the sluice. *Desdemona ornata*, a non-native polychaete worm which has been recently introduced to the region, was also recorded in the lagoon core samples.

Algae were patchily distributed throughout the lagoon. The green alga *Chaetomorpha linum* was the most common species. Tufts of the red alga *Gracilariopsis longissima* and the green sea lettuce *Ulva lactuca* were also observed. At the more saline southern end of the lagoon, other red algae including *Aglaothamnion ?hookeri*, *Ceramium pallidum*, *Ceramium secundatum*, *Polysiphonia denudata* and *Polysiphonia elongata* were found attached to stones and shells, along with the invasive brown seaweed *Sargassum muticum*. Several invertebrate species were found associated with the algae: *Abra tenuis*, *Cerastoderma glaucum*, *Corophium volutator* and *Idotea chelipes* were found on the *Chaetomorpha*; *Ventrosia ventrosa* and *Corophium insidiosum* were associated with the *Ulva*; and *Idotea chelipes* were found in high densities amongst the *Gracilariopsis*.

Although the diversity of organisms found in the core samples was not staggeringly high, very high invertebrate densities and biomass were detected compared with the harbour's mudflats, which suggests that Brownsea may be a more important source of food for the Poole Harbour's birds than suggested by its size alone. However, with the large number of birds utilising this area, the energy requirements exceed the biomass availability, suggesting

that competition for resources in this area is intense and feeding must be supplemented from other areas of the harbour. However, the shallow water in the lagoon allows for constant access to the invertebrate resource throughout the tidal cycle, even when other areas of the harbour mudflats are not exposed. The high densities of *Corophium insidiosum* are probably an important food source for the avocets, as the species tend to feed only in the limited number of areas of Poole Harbour where *Corophium volutator* is abundant.

In conclusion, Brownsea Island Lagoon is an important resource for the birds of Poole Harbour, but its conservation importance is enhanced by the unique invertebrate species that inhabit it. The creation and management of new saline lagoon will be essential for preserving this habitat and the ecological function it provides, for the future.

For further information see Herbert, R. J.H., Ross, K., Hübner, R. and Stillman, R. A., (2010). *Intertidal Invertebrates and Biotopes of Poole Harbour SSSI and survey of Brownsea Island Lagoon*. Technical Report. Sheffield: Natural England.

Taxa recorded at Brownsea Island Lagoon in April 2010.

ACTINIARIA

Nematostella vectensis

NEMATODA

ANNELIDA

Aphelocheata marioni

Capitella capitata

Desdemona ornata

Hediste diversicolor

Polydora cornuta

Pygospio elegans

Streblospio shrubsolii

Tubificoides benedii

Tubificoides pseudogaster

CRUSTACEA

Ostracoda sp.

Praunus inermis

Amphipoda

Corophium insidiosum

Corophium volutator

Melita palmata
Isopoda
Idotea chelipes
Lekanesphaera rugicauda
Decapoda
Palaemonetes varians

MOLLUSCA

Abra tenuis
Ventrosia ventrosa

INSECTA

Chironomidae
Insecta indet

Comments on the “Structure, function and evolution of polychaete crotchets”, and annelid phylogeny

Andrew S.Y. Mackie

*Department of Biodiversity & Systematic Biology,
Amgueddfa Cymru — National Museum Wales,
Cathays Park, Cardiff CF10 3NP*

In issue 28 of the *Newsletter*, Gibson (2010) presented a ‘Viewpoint Article’ concerning polychaete chaetae. I know (Gibson, pers. comm.) that the author likes to produce pieces that are “a bit off the wall”, however, as a polychaete researcher, I feel I should draw readers’ attention to a number of points – lest they be misled.

The article is clearly speculative; “may”, “probably”, “appear to” and “possibly” occur 21, 10, 6 and 2 times respectively. Why is this so? Well, examination of the literature shows that explicit investigations of polychaete chaetae, chaetogenesis and chaetal function are relatively infrequent considering their importance for the group. In her bibliographic work, Hartman (1951) listed only 23 papers (including 11 by Geneviève Bobin in the 1930s and ‘40s) under the heading “Parapodia, Cirri and Setae”. This was not an accurate assessment, since other accounts (e.g., Pruvot 1913) did exist, and taxonomic papers generally included at least some light microscopical descriptions of chaetae, but the overall impression given was correct. Nevertheless, chaetae are not quite as poorly researched as might appear from Gibson’s article (e.g., see Merz & Woodin 2006).

Classification & Phylogeny

Before discussing some of Gibson’s statements, it is important to say that the terms “errant” and “sedentary” do not have any phylogenetic significance in most recent polychaete studies. They relate to Annélides Sédentaires of Lamarck (1818) and Annélides Errantes of Audouin & Milne Edwards (1832), essentially dividing the polychaetes into active mobile forms and more sedentary, often tube-dwelling, forms. Quatrefages (1865a), following on from these (and other pioneers), developed a more complete classification scheme. Claparède (1865) was very critical of many aspects of this and a fierce and entertaining debate ensued (Quatrefages 1865b; Claparède 1867). Despite this, Quatrefages’s scheme formed the basis for subsequent works (e.g., Fauvel 1923, 1927) and was used and modified until the early 1970s, sometimes later. However, as noted by Dales (1962): “division of the Polychaeta into the ‘Errantia’ and ‘Sedentaria’ has never been regarded as other than one of convenience” (but see below). Excellent histories of polychaete classification can be found in Fauchald & Rouse (1997) and Rouse & Pleijel (2007).

Therefore, the classification schemes in use do not necessarily reflect the ‘true’ relationships between taxa. *Homo sapiens* as a species likes to organise and place things in some sort of order. The tools now available (cladistics, molecular analyses) augment our morphological and anatomical studies, and we can develop and refine our phylogenies. Gibson states “Molecular biology suggests they [polychaetes] are predominantly monophyletic whereas their general morphology suggests they are polyphyletic.” This is incorrect and somewhat confusing.

The results of the thorough cladistic analyses of Rouse & Fauchald (1997), using morphological data and rooted using Sipuncula, supported a monophyletic Polychaeta if Siboglinidae (formerly Pogonophora and Vestimentifera), Aeolosomatidae and Potamodrilidae were included; the Clitellata (Oligochaeta and Hirudinea) were a sister group. Rouse & Fauchald produced a new polychaete classification that did not use Linnean categories, and this formed the core of the schemes used in Beesley

et al. (2000) and Rouse & Pleijel (2001). The Rouse-Fauchald classification was a major step forward, however, the authors acknowledged its weaknesses too. Bartolomaeus *et al.* (2005) reviewed and critically discussed polychaete phylogenies derived from morphological data and concluded there was “at least strong support for the Annelida as well[sic] as for several of its taxa above the level of traditional families; the monophyly of the Polychaeta, however, remains questionable.”

The 1990s saw an increased application of molecular techniques to various phylogenetic studies of polychaete and annelid relationships (e.g., Winnepeinninckx *et al.* 1995; McHugh 1997; Kojima 1998). Rouse & Fauchald (1998) and Westheide *et al.* (1999) reviewed the different approaches to examining annelid phylogeny. Morphological and molecular methods both pointed to a paraphyletic Polychaeta; clitellates (oligochaetes and leeches), pogonophorans, vestimentiferans and echiurans falling within the polychaete clade. Subsequent molecular analyses (e.g., McHugh 2000, 2005; Bleidorn *et al.* 2003; Halanych & Janosik 2006; Rousset *et al.* 2007; Struck *et al.* 2007, 2008; Dordel *et al.* 2009) have added to our understanding and there is now a general consensus that Annelida is a monophyletic group, encompassing what we have ‘traditionally’ referred to as polychaetes, oligochaetes, leeches, pogonophorans, vestimentiferans, echiurans and sipunculans. The affinities of myzostomids have long been disputed. The more recent molecular analyses support a relationship with the annelids – despite some conflicting results (Bleidorn *et al.* 2007, 2009). Therefore, the Class ‘Polychaeta’ cannot be retained; Polychaeta and Annelida are synonymous. Westheide (1997) suggested that ‘Polychaeta’ could be described as “non-clitellate” annelids. An alternative would be to continue to use “polychaetes”, or Olga Hartman’s more descriptive “polychaetous annelids”, in a general and practical way until relationships within the Annelida are stabilized.

Rouse & Pleijel (2007) concluded that, at present, we “have no knowledge whatsoever about the root position of annelids”. Zrzavý *et al.* (2009) have contributed to the phylogeny

debate with combined morphological-molecular analyses of 87 taxa representing all polychaete families, and concurred: “The most problematic issue is the tree root position. The all-taxa analyses (that included mollusc and brachiopod outgroups) supported that the root is situated between chaetopterids, magelonids, and/or oweniids and the rest of the Annelida.” A recent phylogenomic analysis of 34 taxa (Struck *et al.* 2011; see also Arendt 2011) found evidence for two major annelid clades – which the authors labelled ‘Errantia’ and ‘Sedentaria’, with Orbiniidae now within the former, and Clitellata and Echiura included in the latter. The basal region of the annelid tree was outside these two clades and comprised *Chaetopterus*, myzostomids and sipunculans. Much work remains to be done and, to this end, *WormNet II: Assembling the Annelid Tree of Life* is a new international project that will use the latest molecular techniques to improve our understanding of relationships within the Annelida (<http://gump.auburn.edu/halanych/lab/projects.html>; see “Current Halanych grants”).

Within a wider examination of metazoan relationships, Dunn *et al.* (2008) found support for a clade composed of two sister clades: an annelid clade (including echiurans and sipunculans), and a clade comprising nemerteans, phoronids and brachiopods. This annelid-brachiopod clade was sister to the molluscs. The relationship between annelids and a clade including brachiopods is interesting in relation to chaetae (which are similar in annelids and brachiopods; Gustus & Cloney 1972) since it implies that chaetae have been lost in nemerteans and phoronids – or chaetae have separate origins in annelids and brachiopods. Chaetae have also been lost in certain annelid groups such as leeches and sipunculans, and some other annelids (e.g., see Bleidorn 2007). Conway Morris & Peel (1995; see also Conway Morris 1998) acknowledged the ‘similarity’ between the sclerites of the extinct ‘slug-like’ halkieriids (and enigmatic *Wiwaxia* from the Early Cambrian) with chaetae, and proposed that annelids and brachiopods could have arisen from halkieriid-like ancestors. However, there continues to be debate concerning relationships between halkieriids,

Wiwaxia, and annelids, brachiopods and molluscs (e.g., Conway Morris 2006; Conway Morris & Caron 2007; Vinther & Nielsen 2005; Vinther 2009). *Wiwaxia*, in particular, has been interpreted variously as having annelidan or molluscan affinities (e.g., Butterfield 1990, 2006; Eibye-Jacobsen 2004).

Another group of Palaeozoic fossils, the Machaeridia, have recently been recognized as early annelids (Vinther *et al.* 2008). These animals had dorsal calcareous plates and chaetae. These calcareous plates were not considered homologous to chaetae and the relationship of the machaeridians with the annelids of today was not resolved. In the cladistic analyses they could be related to aphroditaceans and chrysopetalids, other crown group annelids, or be an annelid stem group related to other Early Cambrian fossils (Vinther *et al.* 2008; Caron 2008). Following Eibye-Jacobsen (2004), *Wiwaxia* and the halkieriids were allied to the molluscs.

Despite the uncertainty, many consider an annelidan ancestor likely to have been an epibenthic creeping organism with chaetae that were used for locomotion and, the dorsal ones, for defense. This recalls the hypothetical adult annelid body plan of Westheide & Purschke (in Westheide *et al.* 1999). Struck *et al.* (2011) 'reconstructed' morphological traits from the results of their phylogenomic analyses and concluded that the ancestral annelid "had a pair of anterior appendages (that is, grooved palps), which functioned in food gathering and sensory perception" and "only internalized supporting chaetae and simple chaetae". Gibson supported "a version of Hatschek's Trochozoon theory" and polychaete diversification as a result of "numerous invasions of the seabed". However, there is disagreement concerning Hatschek's ideas. The theory, whereby a benthic bilateral ancestor (with a pelagic feeding larva) evolved from a holopelagic form *resembling* present-day pelagic larvae has been modified by others (e.g., Nielsen & Nørrevang 1985; Nielsen 1995; Nielsen 2005). An alternative view is that pelagic feeding (planktotrophic) larvae evolved from direct-developing benthic ancestors and this has been determined to have more support in the accounts of, for example,

Rouse (2000a, b) and Raff (2008). The latter estimated that the "evolution of planktonic larvae followed the origins of basal bilaterian phyla by approximately 100 Myr."

Compound chaetae

According to Gibson, "Simple chaetae are likely to have evolved from compound chaetae through the loss of the distal, outer, article [blade]." If this were so then we might 'expect' the oldest fossil annelids to possess compound chaetae. Annelids are relatively poorly represented in the fossil record (e.g., see Foote & Sepkoski 1999; Beesley *et al.* 2000; Rouse & Pleijel 2001), particularly those from the Palaeozoic Era (ca. 540-250 Mya). The earliest recognizable 'polychaete' fossils date from the first Palaeozoic period, the Cambrian (540-490 Mya), with those from the famous Burgess Shale in western Canada at around 510 Mya (Conway Morris 1979, 1998). Conway Morris & Peel (2008) have since described an older species from northern Greenland that dates to the Lower Cambrian (Atdabanian). These fossils are described as having capillary chaetae; some with flattened notochaetae also. *Burgessochaeta setigera* had bifurcate chaetae in both parapodial rami (e.g., see Eibye-Jacobsen 2004) but, as yet, there are no observations of compound forms (Merz & Woodin 2006). The detailed structure of machaeridian chaetae from the Early Ordovician (ca. 480 Mya) is not known (Vinther *et al.* 2008; Vinther & Briggs 2009; Vinther & Rudkin 2010).

Of course, we do not know what other 'annelids' were present in the Early to Mid Cambrian or Precambrian. Budd (2008) reviewed the fossil record of animals and the 'Cambrian Explosion' of life forms. He concluded that, while the oldest animal fossils appeared around 630 Mya (see also Xiao & Laflamme 2008), evidence for mobile bilaterians date from the Late Ediacaran (ca. 550 Mya) near the end of the Precambrian. Further, "by the time of the first major exceptionally preserved faunas at ca. 516 Myr ago, complex ecologies and many body plans recognizable as, if not identical to, those of the modern phyla have largely been established." Others (e.g., Wang *et al.* 1999; Levinton *et al.* 2004; Levinton 2008) estimate that bilaterians

appeared earlier in the Precambrian (e.g., ca. 650 Mya: Nielsen & Parker 2010: fig. 1). Butterfield (2011) contends that these early animals were environmental engineers, and did not simply respond to changing conditions: "In less than 100 million years, the marine biosphere shifted from an exclusively microbial world to an alternate, more or less, stable state based on the pervasive influence of animals."

The information available regarding early annelids is sparse and does not provide definite evidence that simple chaetae arose first, but there is currently no fossil support for compound chaetae doing so. Note also that compound chaetae are not present in the Aphroditidae; Gibson's Table 1 reference is to a figure of a sigalionid in Fauvel (1923). Merz & Woodin (2006) provided detailed tabulations of the distribution of capillary chaetae and the different forms of uncini, hooks, and compound and pseudocompound chaetae across the polychaete families. Their tabulations also included mobility and, where applicable, 'anchored lifestyle' categorizations.

Compound chaetae are additionally present in the polychaete family Acrocirridae (e.g., small benthic species of *Macrochaeta*), however, in an exciting new discovery, Osborn *et al.* (2009) described a large holopelagic acrocirrid (*Swima bombiviridis*) with only long simple capillaries. Most other holopelagic polychaetes are believed to have affinities with the Phyllodocidae, and some of the currently recognized 'families' could be derived phyllodocids (see Struck & Halanych 2010; Nygren & Pleijel 2011). The chaetae of these pelagic species can be simple, compound or absent (Dales 1955; Rouse & Pleijel 2001). Osborn & Rouse (2008) studied the Flabelligeridae, which have a sister relationship with the Acrocirridae (e.g., see Rousset *et al.* 2007; Zrzavý *et al.* 2009), and concluded that the pelagic members represented multiple invasions from benthic ancestors. Many benthic flabelligerids have 'pseudocompound' chaetae and, since the Acrocirridae-Flabelligeridae clade have not been considered closely related to other taxa with compound chaetae, the compound chaetae of acrocirrids are perhaps more likely convergent, than homologous, structures?

Hopefully, advances in molecular techniques will result in better supported relationships toward the root of the annelid tree, and help answer this and other questions, including whether compound chaetae have been gained or lost (see Rouse & Pleijel 2001: 17; Struck *et al.*, 2011).

Representatives of some other polychaete families are temporary members of the pelagic realm. In some, reproductive individuals will metamorphose (epigamy) and the epitokes can swarm releasing their gametes in the water column. Well-known examples with compound chaetae include some nereidids, syllids and the eunicid Palolo-worm (*Palola viridis*), and various morphological changes accompany the production of gametes. For example, in epitokous nereidids, foliaceous parapodial lobes can develop and the compound chaetae change to forms with 'oar-like' blades. There are a number of different strategies in the syllidae (Garwood 1991; Nygren 1999), including epigamy (e.g., exogonins such as *Sphaerosyllis*) and different forms of schizogamy where reproductive individuals bud off (e.g., the stolons of *Autolytus*). In both cases long capillary 'swimming-chaetae' develop. Another swarming epitokous polychaete is the scalibregmatid *Scalibregma* (Fage & Legendre 1927). In addition, the larvae of *Poecilochaetus* are known to have an extended planktonic life, and can acquire many chaetigers and attain a large size prior to benthic settlement (Hannerz 1956). Both *Scalibregma* and *Poecilochaetus* lack compound chaetae, though some 14 different chaetal types have been identified from the latter (Mackie 1990).

Concerning the function of compound chaetae, Gibson says these "appear to be largely adapted for swimming" – and, in the next sentence, he describes how the joint "can aid crawling over soft substances and gripping the sides of tubes." The examples provided in the preceding paragraphs suggest the first statement is too simplistic.

Several recent studies have been made of how compound chaetae function in polychaetes. Merz & Edwards (1998) examined the hesionid *Ophiodomus pugettensis*. After trimming

the compound chaetae either just above or just below the articulated joint, they found that swimming performance was reduced in those lacking the joints, but not in animals with trimmed blades. However, Hesselberg & Vincent (2006b) cut the chaetal shafts of the nereidid *Hediste diversicolor* close to their emergence from the neuropodia and this more radical trimming had no effect on swimming performance. Hence, the articulated joint may not be important for swimming in all species. Further studies are needed on the effect of also trimming *Hediste* notochaetae, and of the relative influences that parapodia and body undulation might have on swimming. Hesselberg (2007) reports that swimming ragworms “utilize a novel form of continuous jet-like propulsion where the action of the parapodia can be likened to a conveyor belt moving water backward”.

Hesselberg & Vincent (2006a, b) found that nereidid chaetae were multifunctional, and not adapted to movement on the surfaces of specific substrates. Nevertheless, animals with trimmed neurochaetae were found to move more slowly. Merz & Edwards (1998) found similar results for *Ophiodromus* with chaetal joints removed, though no speed reduction occurred in animals with trimmed blades only. They concluded that compound chaetae might be important for enabling better contact and traction with the seabed, the chaetal tips bending and increasing contact with the substrate. In addition, serrations on the chaetal blade might be expected to increase friction (Gustus & Cloney 1973; Hesselberg 2007), but Merz & Edwards found no evidence for this on hesionids moving across sand. Gustus & Cloney (1973), Merz & Woodin (1987) and Hesselberg (2007) point out that the shaft socket and boss, and ligament between shaft and blade, restrict the degree of movement in the compound chaetal joint. The extreme flexing envisaged by Gibson (2002: fig. 1c) seems unlikely. The ‘compound’ chaetae in Eunicida are rigid (Merz & Woodin 2006).

Gibson’s (2010) postulation that “Possibly, compound chaetae result from one chaetoblast lying immediately below the other so the innermost chaeta grows into the one above” is somewhat reminiscent of a theory put forward

by Mesnil & Caullery (1898: 143, footnote) to explain the presence of forked chaetae in orbinid notopodia. They proposed that two adjacent cells could each secrete the distal portion of a chaeta and then, should their secretions merge, together produce a single bifurcate chaeta. Furthermore, though a rare occurrence, this was imagined more likely to occur within dense chaetal bundles. However, there is no evidence whatsoever for this form of chaetogenesis. All forms of chaetae are associated with a single chaetoblast at the base of a chaetal follicle (Bouligand 1967; Specht 1988; Bartolomaeus 1995; Hausam & Bartolomaeus 2001; Hausen & Bartolomaeus 1998; Schweigkofler *et al.* 1998; Hausen 2005). The chaetoblast and adjoining lateral follicle cells secrete chaetal material, and chaetal formation is guided by the microvilli on the surface of the chaetoblast. The chaeta produced has a series of internal longitudinal channels that correspond to the number and orientation of these microvilli. Gustus & Cloney (1973) and O’Clair & Cloney (1974) respectively provided a detailed account of ultrastructure and described three stages in the morphogenesis of compound chaetae in *Nereis vexillosa* larvae.

Hooded hooks

Hood-like structures can occur on simple and compound chaetae – variously referred to as hooded hooks or crotchets. This is acknowledged in Gibson’s Table 1, though lumbrinerids, eunicids, and onuphids have both. These hoods appear transparent and smooth under light microscopy, but opaque or semi-transparent and sometimes ‘hairy’ (very much so in the spionid *Atherospio disticha* Mackie & Duff, 1986) using a scanning electron microscope (e.g., see Hilbig 1982; Schweigkofler *et al.* 1998). Spionid, magelonid and capitellid hooks have hoods with delicate inner and outer lamellae and, while these chaetae are regarded as homologous (Hausen & Bartolomaeus 1998), lumbrinerid hooded hooks are not (Hausen 2005). Gibson speculates that the hood in species with such hooks, which he erroneously believes occur only in soft muddy sediments, “probably scoops up mud during burrowing much like a dredger.” This seems very fanciful and Gibson himself admits he

has never found hoods filled with mud. I too have not observed this, either in preserved specimens or living animals. Quite apart from the delicate nature of the hoods, there would remain the problem of how the animal could expel the mud from the hoods and clean the inside. One could easily propose an opposing hypothesis that the hood protected the hook rostrum and apical teeth from contamination with debris!

Such speculations, without even any observational insight, are easy to make – though difficult to evaluate. Hartman (1957: 221), for example while studying orbinid furcate chaetae, wrote that the “dimensions and positions in the fascicle suggest that these setae function to keep clean the long pointed setae.” No explanation was made as to how this operation would be carried out and, to my knowledge, no study has ever been made to test this.

Chaetae and the anchor hypothesis

Woodin & Merz (1987) examined the orientation of hooks in a large variety of tube-dwelling polychaete species and found this predictable according to the form (shape) of the tube. They set up an experimental system using a head-up sabellid with anteriorly orientated hooks and a head-down maldanid with predominantly posteriorly directed hooks. In both cases it was at least three times harder to move the worms toward the surface openings of their tubes (and toward potential predators). This was shown to be an active process; anesthetized maldanids offered no resistance to either anterior or posterior forces. Hence the experiment supported the hypothesis of hooks functioning as anchors.

In a subsequent study, Merz & Woodin (2000) further tested the anchor hypothesis in two species of sabellid and an oweniid. The same chaetal and resistance to removal patterns as before were found. In addition, the maximum number and largest size of hook heads corresponded with the regions of greatest animal width; anterior in the sabellids and mid-body in *Owenia*. The differences between the families were likely to have been due to the proportions of body exposed during feeding. The sabellids only expose their crowns,

whilst *Owenia* has been reported to extend a large proportion of its anterior region when feeding (Dales 1957). The number of hooks and/or their size in the regions of maximum width increased as a squared function; that is, proportional to tube cross-section and not linearly with worm circumference. This relationship enabled small and large worms to have the same resistance to extraction from their tubes. Finally, areas of greatest hook wear or physical damage coincided with these same body regions in both experimental and naturally living animals, again indicating the role of the hooks as anchors.

Capillary chaetae

Woodin *et al.* (2003) investigated the functionality of capillaries in the maldanid *Clymenella torquata*. Tube irrigation efficiency was reduced in worms with trimmed capillaries, though the peristaltic pumping rate remaining the same as in control worms. The data were interpreted as reflecting alterations to the body musculature – capillary chaetae relationship in holding the worm in position for peristaltic pumping. Hence, in worms with trimmed capillaries, the body width had to be increased to gain traction with the tube wall and this reduced irrigation; about 33% less water was moved through the tube. Direct observation of control worms in artificial tubes showed that the distal region of the capillaries flexed on contact with the tube wall and this would help brace the worm in position. Flexural stiffness in capillary chaetae has been found to be very variable between polychaete families, species, and even within the same individual (Kryvi & Sørvig 1990; Merz & Woodin 1991). No directional effects or taxonomic patterns were found.

An unexpected finding of Woodin *et al.* (2003) was that worms with trimmed capillaries constructed new tubes that were wider than those they built when they had normal full-length chaetae. This would seem to be counter to what might be anticipated. The postulated, but untested, explanation was that capillary chaetae in such tube-dwelling worms also acted in a sensory way, providing the worm with feedback information on its position relative to the tube (see also Merz & Woodin

2006). Shortening the chaetae interfered with this process and the tube was erroneously widened.

Quite apart from a possible sensory function of chaetae, polychaetes are very well-endowed with sensory organs (including statocysts in some) and the function of some such organs is still not determined (e.g., see Purschke 2005). Therefore, Gibson's postulation that "polychaetes are probably unable to determine their positions within burrows" is highly doubtful.

Determining chaetal function

So, it is often difficult to demonstrate the function of chaetae – even in seemingly 'obvious' cases. How *Polydora* bores into hard substrata is a good example. One of the characteristics of this spionid genus is the possession of large spines in chaetiger 5. These spines exhibit wear (e.g., see Michaelis 1978) and are generally assumed to be involved in excavating their burrows (though some live in tubes). Some species burrow into calcareous substrates and Lankester (1868) stated "We cannot suppose that these [heavy spines] have any effect in perforating limestone, since they are merely chitine." Instead, he reported that specimens "placed on litmus-paper, give a strong acid reaction". McIntosh (1868) was not impressed and strongly opposed the "chemical (or acid) theory". Subsequent investigations supported the role of secretions (Söderström 1923; Haigler 1969; Zottoli & Carricker 1974), chaetae (Hempel 1957) or both chaetae and secretions (Söderström 1920). The observations of Hannerz (1956) led him to believe that the initial penetration of shells by *Polydora ciliata* larvae was due to secretions and mechanical action. The secretory glands identified in the larvae disappeared in adults and he thought it likely that the latter bored using their chaetae alone. Haigler (1969), however, found that removal of the large chaetae from larvae and adults of *Polydora websteri* did not impair boring. Attempts at using detached chaetae to abrade limestone (Dorsett 1961) and "various natural substances" (Haigler 1969) were unsuccessful. The mechanism (or mechanisms) of boring by species of *Polydora* is still not fully resolved (Sato-Okoshi & Okoshi 1993; Lui &

Hsieh 2000; Beesley *et al.* 2000).

As another example, an anatomical study of the musculature in *Trochochaeta multisetosum* revealed that the posterior notopodial spine clusters could be everted from their capsules, but not retracted (Weitbrecht 1984). This suggests these structures are not used for routine activities. Whether they are used to anchor the worm in its tube while under attack from a predator, help ensure survival through regeneration, secure the posterior reproductive segments in position for fertilisation, or for other reasons entirely is not known.

To conclude: polychaetes have an extensive variety of chaetal forms and our meagre understanding regarding their functionality is surprising. There is a great need for more detailed observational and experimental study. Anyone interested in the challenge?

Acknowledgements

I thank Fred Pleijel, Roger Bamber, Kate Mortimer and Peter Garwood for some helpful comments on an earlier draft.

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Information Requests and Observations



Porcupine Small Grant Awards 2011

We were pleased to receive four applications for the 4th round of the *Porcupine Marine Natural History Society Small Grants Scheme*. The Grants sub-committee evaluated these prior to the conference at the *National Oceanography Centre, Southampton*, and all were considered to be of a high standard. However, the total financial support requested exceeded this year's allocation (£2000) and choices had to be made. After much discussion, two projects were selected for support and these were announced at the Society's AGM on March 12:

- Underwater Survey of North Cornwall 2011 (Emily Priestley)
- Scale microchemistry as a tool to investigate the authenticity of vagrant *Pampus argenteus* from the North Sea (Rayner Piper)

Congratulations to the successful applicants.

The PMNHS Council has decided that the Grants Scheme will continue in 2012. Details will be posted on the PMNHS website and in a forthcoming Newsletter.

Porcupine MNHS Recording Scheme

Found something unusual?

The PMNHS has run a recording scheme for its members and any other interested parties, since its inception in 1976. The main rationale behind the scheme comes from:

the interest of society members in marine biogeography and species ecology;

the recognition that knowledge of species distributions is often very poor; and

that many important records are lost because most existing recording schemes do not cater for the collation of informal records.

Although there are many initiatives that involve the gathering of information on marine wildlife the PMNHS scheme is useful for collecting unstructured records i.e. observations that are unlikely to be submitted to other schemes.

Our recording scheme not only includes informal records, but we are also collating all our data from Porcupine field trips and incorporating these into Marine Recorder. Once they are in Marine Recorder they can be exported onto the NBN Gateway without danger of repetition or loss of data as the source remains labelled as Porcupine. Voucher specimens from field trips will be deposited in one of the four national museums as appropriate. The existence of the voucher specimens will be included in Marine Recorder.

Information from records will be published in the society's journal by way of short notes and articles making the information widely available. Experts in particular taxonomic groups are encouraged to use these records in, for example, atlases and synopses.

Finally, we take this opportunity to remind and encourage our members to continue to submit their records to the scheme: the success of the scheme depends on as much input from the membership as possible. There are two ways to submit records. Firstly, email the Hon. Records Convenor: Roni Robbins - roni.robbins@artoo.co.uk ; secondly, print out the records form and post it to Roni.

Instructions for completing the form

Species - the name of the species in Latin (genus and specific names), with authority and date or reference to identification guide if possible. If you do not have a full Latin name, give the best name that you can. e.g. *Goneplax rhomboides* (Linnaeus, 1758)

Location - the name of the site and the region, e.g. N. side of West Angle Bay, Pembrokeshire,

Wales, UK.

Grid Ref. or Lat./Long. - the Ordnance Survey grid reference (Easting and Northing) or the Latitude and Longitude of the record location. As accurately and precisely as you can. e.g. SX 4671 5346 or 53° 55.34' N 3° 5.26' W.

Date - date that the species was collected or recorded (day/month/year), e.g. 12th August 1999

Recorded by - the name of the person who observed and recorded the species, e.g. James Mason.

Phone number - the recorder's phone number, with area code (incl. country code if appropriate (non-UK)), e.g. 01752-345876

Identified by - the name of the person who identified the species. Will often be the same as the recorder.

Phone number - the identifier's phone number, with STD code (incl. country code if appropriate (non-UK)).

Other material available - circle if any of the listed items are available - a specimen or photograph of the species, a list of other species recorded from the site, a detailed description of the habitat (e.g. on an MNCR habitat form). You would be contacted on the given telephone number if there was interest in the material.

Habitat details - include as much relevant information as you can on the habitat in which the species was found, e.g. in tideswept well sorted medium fine sand. Include the MNCR biotope code if you know it.

Depth - the depth in meters or the approximate shore zone, e.g. lower eulittoral.

Other information - any other details of potential interest - e.g. unusually high abundance, interesting behaviour, presence of eggs or juveniles, other species in the community, your reasons for recording on the site etc. etc.

More information on the recording scheme

Validity of records

The Scheme incorporates a process for

checking the validity of records. A panel of taxonomic experts assist in this process. It would obviously be useful if specimens or photographs are available, BUT, please avoid collecting specimens of species that you believe to be rare. There is no point in collecting species to extinction!

Record storage

Records are stored on an electronic database held by the Scheme co-ordinators and forwarded to the NB Gateway

Feedback and publication of records

Feedback to recorders and other marine biologists is by publication of short notes and articles in the society's journal, by the recorders, the co-ordinators and others. Experts in particular taxonomic groups are encouraged to use the records in atlases and synopses.

Co-ordinators and contact details

Records may be sent to any of the following:

Roni Robbins roni.robbs@artoo.co.uk

Jenny Mallinson, Dept. of Oceanography, University of Southampton, Southampton Oceanography Centre, Southampton, SO14 3ZH.

Dr Lin Baldock, 24 Martel Close, Broadmayne, Dorchester, Dorset, DT2 8PL.

Jan Light, 88 Peperharrow Road, Godalming, Surrey, GU7 2PN. jan@aquamar.demon.co.uk

We look forward to receiving your records. Keep them coming!

A recent subtidal invasion by a red alga

Comment by Paul Brazier

Lucy Kay and Lin Baldock were the first to mention the *Heterosiphonia japonica* (guess its country of origin!) that had been found in Holyhead harbour in 2010. An occasional specimen that was unfamiliar to those living anywhere other than the south English coast.

It had also subsequently been seen around Holyhead marina during a mission to eradicate another non-native species, carpet sea squirt *Didemnum vexillum*. The next visit was in March 2011, during some shake down Seasearch dives off Newry beach in Holyhead harbour. The bright red carpet that met the divers was quite outstanding, growing to a depth of around 4 metres below chart datum, beyond any other seaweeds in this location, and completely covering areas of mud and gravel that would normally be left to the polychaetes and bivalves to inhabit. A walk along the full length of the beach along the sublittoral fringe revealed that this seaweed had dominated the whole of this sheltered, slightly silty rock, boulder and cobble area.

Another sighting in the Menai Strait in February this year has demonstrated how rapidly this seaweed is translocating, either by natural spread along the coast or through an unknown vector. Records of non-native species, particularly invasive ones are always sought after by the Invasive Non-Natives Secretariat and MarLIN (www.marlin.ac.uk) if they are marine species.

Expect the Unexpected!

Fiona Crouch (Shore Thing Project Officer)



When organising a Shore Thing survey, timing is everything! You know what time low water is and you want to be down surveying the lower shore, just when the tide is reaching its lowest point. So imagine our surprise and horror when myself and a group of students from Ridgeway school arrived at Wembury Point on a beautiful sunny day to find our path down to the shore blocked by a double decker bus!

The driver, who I'm ashamed to say was a woman (blokes stop laughing) had, in an attempt to turn the bus around managed to get it completely wedged across the road. I never found out why it was down such a narrow lane as all I could think about was the tide. We all stood around whilst the now male driver tried to move it by revving the engine to the max and burning out the clutch. Thankfully, seeing my frustration our minibus driver explained the situation to the driver who said we could climb through the bus. As the tide was dropping we decided to go for it, in through the emergency exit at the back and out the front door. Easy if you're 6ft tall! Thankfully we all made it through unharmed (except I had to go back as I forgot the ID cards), completed our survey and luckily the bus was gone by the time we returned.

Never a dull moment with the Shore Thing Project!

Shopping Trolleys to Sea Monsters

Vicki Howe

I was one of the lucky ones on March 13th and went out on the NOC vessel "*The Bill Conway*" as part of the Porcupine fieldtrip/excursion. I love spending time on boats and sending the grab over the side to collect some great dollops of gloopy mud for sieving, and then sending the trawl over always gives me a huge sense of excitement – you just never really know quite what you might find!

Certainly sending a beam trawl over the back of any vessel has some risk and there is always the possibility of snagging the trawl on the seafloor, though it is hoped that with good background research the risk is minimized. Perhaps the most memorable non-biological capture I remember is a shopping trolley which managed to wedge its self quite neatly in the mouth of the trawl somewhere between Cardiff and Newport and the mind boggles as to how it managed to get so far from its land-based home. There was really no predicting that particular find and the time wasted trying to extract it was frustrating and not easy with cold hands and against the clock. Trawling along this stretch of the Severn estuary (the edge of the Wentlooge levels) has its own specific set of challenges; the average tidal range is 10 m and so keeping an eye on depth and time is crucial to ensure a safe and rewarding trawling excursion. The considerable current (when the tide is in full flood or even more so on an ebbing tide after much rain) can mean that even if the vessel is on "go very slow" you may still be covering the ground at quite a pace and going too fast means that the trawl lifts off from the seabed and your catch is not the bottom fauna you were planning on collecting. Going too slow can also be problematical and you are highly likely then to fill your trawl full of anoxic mud or even get the trawl stuck which means time needs to be spent dragging the trawl mid water to flush away the mud before you can set it again. Trawling the river Severn when there is considerable water flow and after much heavy rain may also mean a sharp eye needs to be kept out for debris – mainly huge tree trunks. These may not only cause damage to

your vessel but if they do get caught in the trawl, may damage the net beyond repair. These large logs can be extremely heavy and much care is then needed to try and make a recovery of the trawl as the weight of the log can also have a significant effect on the handling of the vessel. This combined with the strong currents and shallow water has given me some interesting moments!



The satisfaction of recovering the trawl with what looks to be a reasonable catch and releasing it into a crate for a rummage before systematic recording is always a good feeling. A crate with flatfish such as dab and flounder and tiny thornback rays hiding in the bottom along side multi-coloured shore crabs with whiting, bib and even the odd sprat swimming above makes a good catch. Occasionally we have been lucky to record an Allis shad, *Alosa alosa* closer to Newport and we even caught a "sea monster" according to one student I had aboard! On this particular occasion as we hauled the net over the back of the vessel and put the net down the whole cod end started writhing on the deck. This particular student leapt up onto the rail (luckily not overboard) screaming "it's a monster!" It turned out (after much jumping and slipping about on deck undoing the cod end) we managed to grab hold of the sea monster – a rather sizeable conger eel which was, I have to say, quite a handful!

I have been fortunate to trawl in other parts of the country and find all sorts of interesting beasts but the satisfaction of going out on small vessel through the Cardiff Barrage into the mud laden Severn estuary to do some trawling with all the challenges that this holds,

still gives me a wonderful sense of adventure and anticipation. You can't beat finding a little pogge, *Agonus cataphractus*, with its curious armour plating along side a huge sole, *Solea solea*, bigger than anything you have seen in a fishmonger's!

OBITUARY – Dr Richard Hamond

By Séamus Whyte

It was with deep sadness that we learned of the death of Dr Richard Hamond on 22nd July 2010. Those of you who met him would know Dick, his preferred moniker, as an eccentric but highly knowledgeable individual on all things copepod, crustacean and Norfolk marine, in that preferred order.

Dick was born on 26th January 1930 and educated at St George's Windsor and Radley College. After National Service, he went to Cambridge University and then to Queen Mary College, London University, where he read Marine Biology.

After short spells of teaching and working on copepods at Plymouth Marine Biological Station, he set off for Australia. According to legend, following a somewhat eventful departure from Heathrow, when the wing next to which he was seated, and then the tail, caught fire, the aeroplane returned to Heathrow, losing a blazing engine en route, which fell into a gravel pit at Staines - miraculously, there were only two fatalities. Eventually arriving in Australia, he carried out research at Cronulla and Macquarie Island, later becoming Professor of Marine Biology at Melbourne University.

His earliest scientific papers were on the copepods of Norfolk, where he returned in retirement. Having seven new copepods named after him, he also discovered a new copepod family in Australia. He was an expert on these small crustaceans and wrote many articles on them.

Dick became a member of Porcupine in its earlier years and contributed articles and letters to the newsletter, mainly on copepods of the parasitic kind. He is remembered for his attendance at Porcupine meetings and field trips over the years, and those of you attending those

events would remember him. The last meeting that he managed to attend was in 2001 but he did make a spirited appearance at the 2005 field trip in Norfolk, just the dinner mind you, but he was spirited.

Dick was also a past President of the Norfolk and Norwich Naturalists' Society, and was the marine recorder for Norfolk. He studied and had a love for the marine fauna of the North Norfolk Coast throughout his life, during which time he produced 13 scientific papers and added at least 664 species of marine invertebrates to the Norfolk list. He also helped a local diving group with identifications, thereby passing his knowledge on to others to the benefit of local marine conservation.

He was a gifted pianist and also maintained a lifelong interest in Heraldry and Astronomy. Although diabetic and increasingly troubled by old age and the onset of illness, he remained controversial and eccentric to the last, living and dying in his family home and place that he loved, Scaldbeck House in north Norfolk, which was his dearest wish.

Esmée Fairbairn Collections Fund

The Esmée Fairbairn Collections Fund, run by the Museums Association, focuses on time-limited collections work outside the scope of an organisation's core resources. The fund will be open for applications from mid-February, please go to The Museums Association website for further information and application guidance; please follow the link at the bottom of this page.

Through this fund the MA will award approximately £800,000 per year to museums, galleries and heritage organisations with two grant rounds per year. In 2011 the application deadlines will be **31 May** and **31 October**. Organisations can apply for sums between £20,000 and £100,000.

This new fund has been developed from the Esmée Fairbairn Museum and Heritage Collections strand and the MA's Effective Collections programme. Like the Museum and Heritage Collections strand we are keen to fund projects at an early stage of development where it may be difficult to guarantee tangible outcomes, but like Effective Collections we want organisations that are funded to become part of a network to develop ideas, share knowledge and build a legacy.

Projects that are eligible to apply to the Esmée Fairbairn Collections Fund include research into collections, conservation, collections review and initiatives to develop the use of collections.

Our intention is that successful projects will include work that:

- is developmental
- builds a legacy that has an impact after the duration of the project, even if this is hard to define at the start of the project
- is in some cases innovative
- is in some cases sector-changing in scale.

Our aim is that projects result in:

- better understanding of collections
- better appreciation of the potential of collections
- better use of collections.

Please visit the [Museums Association website](http://www.esmeefairbairn.org.uk/funding/collections-fund.html) for full details and application guidance.

<http://www.esmeefairbairn.org.uk/funding/collections-fund.html>

PORCUPINE MARINE NATURAL HISTORY SOCIETY ANNUAL CONFERENCE 2011

NATIONAL OCEANOGRAPHIC CENTRE, SOUTHAMPTON

11/12 MARCH 2011

By Tammy Horton, Roni Robbins & Roger Bamber

Porcupine recently held its annual conference at the National Oceanography Centre, Southampton. There were two days of talks (Friday 11th and Saturday 12th March, 2011) followed by an excursion/field trip on the Sunday. The theme of the conference was "*A Celebration of Marine Life*" which reflected the passion of all of our membership, and linked conveniently with the recent culmination of the ***decade of discovery*** by the Census of Marine Life.

The conference was very well-attended with 108 delegates, some of whom had come from as far a field as Spain, and there was a full schedule of 26 talks. Speakers came from a wide variety of disciplines and gave excellent talks on so many different subjects. It was a privilege to hear about the many and varied projects being carried out around our coasts (and beyond). We had three presentations covering aspects of the Census of Marine Life including Seamounts, the Mid-Atlantic Ridge and a general overview of the Census from Professor Paul Tyler. We were also lucky to have presentations from participants on the 2010 Porcupine Isles of Scilly Field trip, covering fish, polychaetes and more fish! There were presentations with a local focus too, with seals, seagrass and surfing all being tackled. There were too many great presentations to mention them all here, but if you missed the conference

then the abstract booklet is available to download from the porcupine website (www.pmnhs.co.uk/previousmeetings.php) and you will also have the chance to see a couple of the presentations (downloadable as PDF files).

The Conference Dinner at the Royal Southampton Yacht Club was well-attended, and all there thoroughly enjoyed the food, the company and the ambience, and not least the annual monologues from Frank Evans.

On the last day, 25 intrepid porcupines remained for the traditional Sunday field excursions. Some managed to get a place on the NOC vessel "*The Bill Conway*" which was out in the morning grabbing and collecting beam-trawl samples. Some attendees remained at the laboratory to look at deep-sea specimens from the Discovery Collections and a further two groups of people set off to sample the local harbour pontoons looking for alien species, and to Calshot shore. This was a very successful and enjoyable day and species records have now been sent to Hon. Records Convenor, Roni Robbins.



2011 Conference Field Trip - Species List

Table showing participants in field work during the Southampton conference, 13th March 2011.

NW Netley' to 'Hound' buoys	Ocean Village Marina	Calshot Activity Centre	Calshot salt marsh	NOC pontoon
Sue Chambers (SC)	Lin Baldock (LB)	Matt Green (MG)	Matt Green	Sue Chambers (SC)
Fiona Crouch	Paul Brazier	Jackie Hill (JH)	Jackie Hill (JH)	Andy Mackie
Frances Dipper	Ann Bunker (AB)	Bryone Pearce (BP)	Bryone Pearce	
Louise Firth	Jenny Mallinson (JMa)			
Carolyn Francis	Jon Moore (JMo)			
Doug Herdson (DH)				
Vicki Howe				
Andy Mackie (AM)				
Chris Moody				
Nick Owen (NO)				
Kathryn Ross				
Sheila Wyers				

The data tables uses a semi-quantitative scale as follows:

R = rare, **O** = occasional, **F** = frequent, several, **C** = common, **A** = abundant. **P** = present, abundance not given.

Table of species recorded at the 5 field locations during the Southampton conference

Phylum	Species	English name	NW Netley' to 'Hound' buoys	Ocean Village Marina	Calshot Activity Centre	Calshot salt marsh	NOC pontoon
Porifera	Halichondria sp			O			
	Haliclona cf viscosa			R			
	Hymeniacidon perleve			O			
	Scypha ciliata			O			
	?Suberites massa			O			
Cnidaria	Gonothyrea loveni	(on mussels)		P			
	Halecium sp.			P			
	Actiniaria				P		
	Sagartia ornata				R		
	Nemertea				P		
Nemertea	Anaitides mucosa				P		
Annelida	Aphelocheata marioni		F				
	Caulleriella bioculata		R				
	Caulleriella zetlandica		F				
	Chaetozone gibber		C				
	Cossura pygodactylata		R				
	Euclymene sp.				P		
	Eupolymnia nebulosa	strawberry worm	P				
	Lanice conchilega	sandmason worm			P		
	Hydroides sp.			F			
	Hydroides ezoensis				P		P
	Nephtys hombergii		C				
	Nephtys caeca				P		
	Notomastus sp.		F				
	Melinna palmata		F				
	Parougia eliasoni		F				
	Pectinaria belgica		P				
	Pholoe synophthalmica		P				

Phylum	Species	English name	NW Netley' to 'Hound' buoys	Ocean Village Marina	Calshot Activity Centre P	Calshot salt marsh	NOC pontoon
Pycnogonida Crustacea	Phyllodoce maculata				P		
	Platynereis dumerilli		P				
	Pomatoceros sp.	keel worm		O	P		
	Protodorvillea kefersteini		F				
	Sabella pavonina	peacock worm	F				
	Sthenelais boa	scale worm	R				
	Ammothea hilgendorfi		F	F	P		
	Elminius modestus	Darwin's barnacle		C	P		
	Semibalanus balanoides			O	P		
	Caprella acanthifera			R			
	Apherusa jurinel				P		
	Caprella mutica			R			
	Eulimnogammarus						
	obtusatus				P		
	Gammaridae				P		
	Gammaridae sp. (female)				P		
	Gammarus insensibilis				P		
	Gammarus locusta				P		
	Melita palmata				P		
	Orchestia aestuarensis				P		
	Orchestia gammarellus				P		
	Eudorella emarginata				P		
	Eudorella truncatula		F				
	Crangon crangon				P		
	Hippolyte varians			O			
	Palaemon elegans				P		
	Palaemon longirostris			R			
	Carcinus maenas	green shore crab			P		
	Inachus phalangium		R				
	Macropodia rostrata	long legged spider crab	O	R			
	Necora puber	velvet swimming crab	R				
	Pagurus sp.	hermit crab	P				
	Pilumnus hirtellus	hairy crab	R				
	Pisidia longicornis	long clawed porcelain crab	P				
Mollusca	Aeolidiidae	grey seaslug			R		
	Archidoris pseudoargus	sea lemon	R				
	Elysia viridis				P		
	Acanthochitona crinita		R		P		
	Lepidochitona cinerea		R		P		
	Buccinum undatum	common whelk	O + eggs				
	Crepidula fornicata	slipper limpet	P	O	P		
	Gibbula cineraria	grey topshell			P		
	Gibbula umbilicalis	purple topshell			P		
	Hinia reticulata	netted dog whelk			P		
	Hydrobia ulvae					P	
	Littorina littorea	common winkle			P		
	Littorina saxatilis	rough winkle			P		
	Ocenebra erinacea	tingle		O			
	Patella vulgata				P		
	Rissoa membranacea		P				
	Abra sp		P				
	Acanthocardia echinata	prickly cockle	P				
	Cerastoderma edule	cockle	P		P		
	Corbula gibba	basket shell	P				
	Nucula sp.	nut shell	P				
	Ostrea edulis	native oyster		O			
	Mytilus edulis	mussel	P	C	P		
	Tapes decussatus				P		

Phylum	Species	English name	NW Netley/ to 'Hound' buoys	Ocean Village Marina	Calshot Activity Centre	Calshot salt marsh	NOC pontoon
Bryozoa	Venerupis senegalensis	pullet carpet shell	P				
	Alcyonidium diaphanum	jelly fingers	P				
	?Scrupocellaria sp.			P			
Echiodermata Tunicata	Tricellaria inopinata			F			
	Amphipholis squamata		P		P		
	Ascidella aspersa		F				
	Ciona intestinalis			O			
	Dendrodoa grossularia		O	O			
	Styela clava			O			
	Botrylloides leachii			O			
	Botrylloides violacea			O			
	Botryllus schlosseri	star ascidian		O			
	Diplosoma sp.			R			
Pisces	Crenilabrus melops	corkwing wrasse	R	R			
	Lipophrys pholis	shanny			R		
	Pleuronectes platessa	plaice	O				
	Taurulus bubalis	long spined sea scorpion	R				
Algae	Bryopsis hypnoides			P			
	Cladophora sericea			P			
	Petalonia fascia			P			
	Undaria pinatifida	Japanese kelp		P			
	Ceramium cimbricum			P			
	Ceramium diaphanum			F			
	Ceramium nodulosum			O			
	Chondrus crispus	Irish moss		O			
	Grateloupia turuturu			R			
	Lomentaria clavellosa			R			
	Polysiphonia brodiei			R			
	Polysiphonia elongata			F			
	Polysiphonia fucoïdes			R			
	Polysiphonia stricta			O			
	Porphyra ?dioica			O			
	Pterothamnion plumula			F			

BioScribe – a biotope matching decision support tool (Emu Ltd)

Dr Garnet J. Hooper, Peter Barfield, Dr Nigel Thomas and Evelina Capasso

As anybody involved in this sort of work can testify, assigning biotopes to field data can be a time consuming and subjective process. To the uninitiated it can appear an arcane art and unfortunately for them BioScribe will do little to dispel this sense as it was designed for those with a modicum of knowledge, in the hope of reducing those hair-tugging moments of frustration usually inherent in the process (alas far too late for Dr Hooper and Mr Barfield).

Prior to BioScribe (now freely available to all via the JNCC website, www.jncc.gov.uk/bioscribe) one of the primary tools available to aid the process of 'biotoping' data were the JNCC webpages (Connor *et al.* 2004) on the Marine Habitat Classification for Britain and Ireland (not to mention the paper copies with thumb-darkened edges quietly gathering dust in the corner of some forgotten shelf). At the website you could, and can, access the classification either by jumping to a selected habitat type, searching for a habitat code/name or inputting a descriptive word or phrase. This last was most likely the first port of call for anyone approaching the database with their potentially biotope-defying bag of seemingly mixed species, gathered in an un-reassuring neat list, before them. Thus the laborious process began of placing one species name at a time into the search box and hitting return.

Many people have surely scratched their heads at this point and thought, 'there must be another way!' In fact at least one serious attempt has been made in the past to address this need, the full details of which were supplied to us by the JNCC. Suffice to say the attempt did not work. However, it did provide a useful guide on what directions not to take during the developmental stages of our project. The main conceptual message here was that seeking to automate the process to any degree, or pursuing a 'black-box' solution (input-species-here, output-biotope-there) was unlikely to prove productive. Biological systems are highly complex and the original classification scheme was fundamentally reliant on expert opinion, two forces which when coupled together would confound the most able mathematicians!

Added to this mix was the knowledge that should your sample data have come from sites in offshore coarse sediments there was a greater than even chance that you'd spend an age shoe-horning your data into this or that ill-fitting biotope 'shoe' before heading back up the classification to the

broader havens of Infralittoral or Circalittoral Coarse Sediment (ICS/CCS) or beyond. This is because when the classification was developed originally there was a lack of data from these offshore habitats, so few biotopes were defined for this more expensive-to-reach area of the sublittoral seabed. The alternative for some brave souls was to define new biotopes or suggest variants of those existing ones, but this is a long-road, with only a small chance of success when coming from limited datasets. The greater part of the work which also produced BioScribe has, among other things, sought to address this lack and 23 new biotopes (identified from the analysis of 907 samples spanning two regional seas) have been sent to the JNCC for their consideration.

The name 'BioScribe' was chosen for the tool because it uses biological information to help the user assign or ascribe biotopes to sample data. It was developed in collaboration with the JNCC and the GeoData Institute (Southampton University). In an initial meeting to discuss the project and ways in which it might be delivered, GeoData suggested the possibility of developing a decision support system (DSS). Crucially in a DSS approach the users are a key component of the architecture. A DSS can be complex in structure but this was not thought to be the best option, given past experiences, and therefore the design principles were based on pragmatism and simplicity. The delivery platform selected reflected these principles.

Having some in-house skills in manipulating MS Access databases, Emu built a basic querying routine to illustrate the desired direction for GeoData to develop. Other, more novel, delivery platforms were considered but within the constraints of the project these could not match the availability, familiarity and stability of MS Access. This platform clearly offered the best chance for producing a practical working tool and was therefore selected as the one to take forward. Furthermore, using this well-known database as the basis of the tool fulfilled an important requirement, namely that the JNCC would be able to manipulate, and update it in-house, after the end of the project.

So what can BioScribe do? The first thing to highlight is that gone are the days of inputting one species at a time either at the website or through the pdf. Now you can paste your entire species list, irrespective of length, into the input pane (top left, Figure 1). To do this you simply copy the list to the clipboard with CTRL C, click on 'Species Name' to highlight the column and paste it in with CTRL V. When you then click on 'Display Biotope List' BioScribe takes each species in your list and searches through a modified version of the JNCC's

MNCR database (housing the sample data used to construct the Classification system) to find which biotopes contain your species. The output pane (bottom half, Figure 1) shows in the first column the number of species from your list which occur in the biotope (column 2). This is an entirely new approach. Previously you could search through only those species mentioned in the biotope description or listed as characterising species. Now you match your list against the entire community. This enables a better chance of fit, even if characteristic taxa may be missing from a sample (e.g. due to low density random sampling or other limitations of the sampling method) as it matches with defined communities with which characteristic taxa may be associated. The user has the choice of whether or not to weight the importance of taxa (based on whether they are characteristic or not, relative abundance, etc) as *part of their interpretation* of the outputs.

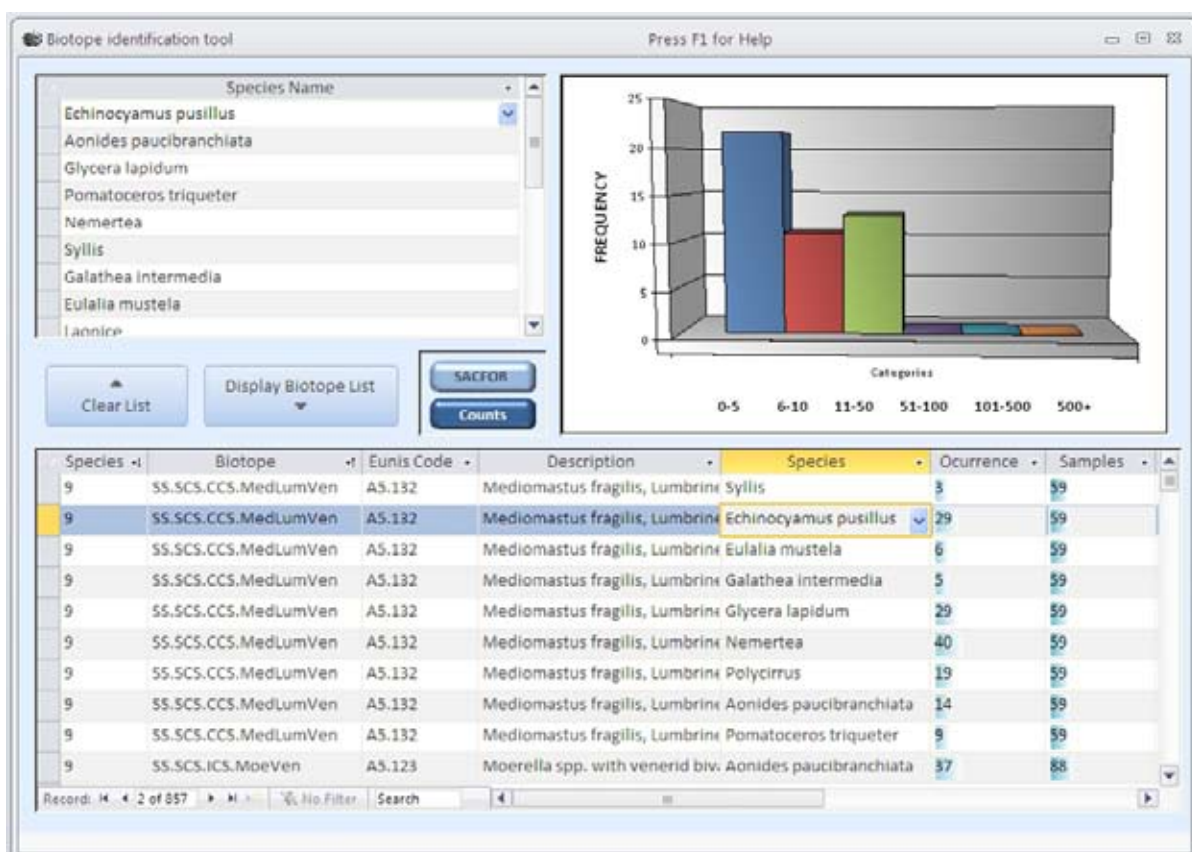
I mentioned the MNCR database in BioScribe had been modified. Modifications to the database involved removing redundant data in order to reduce the file size and removing inconsistent data or biotope mosaics. A full list of the biotopes within BioScribe can be viewed in the help menu (F1, Appendix 2). In total BioScribe searches biotic community data from 645,185 samples.

Confidence indicators have been built into the tool, in the form of values for “occurrence”, “samples”

and “prevalence”. “Occurrence” is the number of samples from the specified biotope within which a certain taxon was previously recorded. “Samples” denotes the total number of samples from which that biotope had been derived in the JNCC database. This value can vary widely. To illustrate this out of a total of 446 biotopes in the tool there are 54 with less than 10 samples used to describe them, others may have in excess of 500. “Prevalence” is a simple statistic showing the proportion of “occurrences” relative to “samples”, as a percentage. For appropriate interpretation, this *must* be used in conjunction with the “samples” in order to provide a meaningful confidence indicator. The number of samples per biotope varies widely in the database and this, therefore, needs to be allowed for in the analytical process.

It is important to note that the species names used by the tool are those which appear in the MNCR database and as such may not match those currently in use. For instance the small bivalve *Mysella bidentata* is now recorded as *Kurtiella bidentata*.

BioScribe clearly approaches the process of biotoping from a bottom-up direction with the fauna as the key to the process. There is also clear support for this methodological direction in the scientific literature, most recently in Shumchenia & King (2010) who suggest that using a bottom-up methodology creates, ‘ecologically relevant habitat units that best



represent the relationships between macrofauna and their benthic environment'.

But it should be stressed that this is in no way meant to suggest that the user should disregard physical parameters associated with the biological sample data. Biotopes are an abbreviation of the biological and physical nature of a site and as such both aspects are important. So generating a list of possible biotopes from the species data and then reducing this by, in part, comparing physical data makes biological sense and keeps the *biology* in *biotope* paramount. To this end additional information and access to online resources have been built into the tool. It had been hoped that physical data could be input to the tool but GeoData found that currently the database did not support the construction of such an interrogative route.

Although this article cannot give a detailed account of everything about BioScribe we hope it has given some useful background information and piqued your interest. If you haven't downloaded it yet then please do. Happy biotoping!

BioScribe was developed as part of a wider project funded by the Aggregate Levy Sustainability Fund (ALSF). The Marine ALSF is administered by The Centre for Environment, Fisheries and Aquaculture Science (Cefas) under the Marine Environmental Protection Fund (MEPF). The project title was, 'Redefining Biotopes at a Regional Scale and Development of a New MNCR Habitat Classification Support Interface' (ALSF project number: MEPF 09/P93; <http://www.alsf-mepf.org.uk/>)

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Scott, scientific baselines and detecting biological change in Antarctica

Barnes, D.K.A.^{1*} & Kuklinksi, P.^{2,3}

¹ British Antarctic survey, NERC, High Cross, Madingley Road, Cambridge CB3 0ET, UK.

² Institute of Oceanology, Polish Academy of Sciences, Powstancow Warszawy 55, Sopot, Poland

³ Natural History Museum, Cromwell Road, London, U.K.

* Corresponding author. Email: dkab@bas.ac.uk. Tel: +44 1223 221613, Fax: +44 1223 221259

Robert Falcon Scott lead two expeditions to the Ross Sea, Antarctica, both of which made substantial collections of scientific information and samples. These now represent some of the earliest and most important reference sources against which the biology of modern specimens can be compared. This is especially crucial in parts of the polar regions where there are multiple and complex physical changes with global ramifications, and there are very few baselines spanning more than three decades. For this reason marine biological change has been hard to detect and even harder to interpret causally.

When Scott was given command of the British Antarctic Expedition rather than a scientist it was feared that science could be subordinated to adventure in terms of geographic exploration. However the effort, ingenuity and care that was put into the scientific collections is obvious from the extensiveness and quality of samples present in the Natural History Museum, London. During the later National Antarctic Expedition of 1911 it became apparent that Scott's team was not the only party trying to reach the geographic South Pole. A Norwegian team lead by Roald Amundsen beat Scott's expedition to the pole and the five British explorers died on the return journey, just 11 miles short of a food depot. These events lead Scott to become an icon, initially of heroism but later more divisively for whether the attempt to be first to the pole was carried out inappropriately and the deaths were preventable. Scott is now widely remembered for arriving at the South Pole second to Amundsen, and for dying with his team. What has received much less attention is the science they achieved, which was the stated main purpose of the expedition and which was outstanding compared with other



Figure 1 Robert Falcon Scott, pioneer Antarctic explorer and the bryozoan *Cellarinella nutti* that his expeditions collected many of between 1901 and 1913 from the Ross Sea continental shelf.

voyages of the time and even much later. It is likely that Scott's refusal to sacrifice scientific effort was a major distraction from the attempt to be first to the pole and may have even directly contributed to their deaths (it was not possible to man-haul enough food to maintain their weight but they still collected 16 kg of geological samples and tried to bring them back). For our study, published in *Current Biology* (24: R147-8), their samples extended the time-span of our data by 23 years, without which we would have had little confidence in the reliability of any baseline.

One of the most common bryozoans in Scott's expedition collections was the erect, heavily calcified bryozoan *Cellarinella nutti* (Fig. 1). The cheilostome bryozoans of this genus grow with a very strong seasonal signal in their skeletons that is visible to the naked eye. Work in the 1990s established that these tree-ring-like growth lines were, as suggested in the 1980s, annual in periodicity. This meant that any specimen could easily be aged and a year ascribed to each band of growth as long as the collection date was known. Furthermore, research showed that the amount of growth (area, dry mass or organic mass) was proportional to the duration of the phytoplankton bloom (the bryozoans' food). However no relation was found between growth of

the bryozoans and the amount of phytoplankton. This makes sense because enzyme rates in cold water mean that polar ectotherms process meals very slowly (actually they do everything in the slow land), so once the stomach is full additional food is irrelevant until this can be digested. So once a collection of the same species from the same region of known collection dates can be amassed, growth can be measured and assigned by year and age.

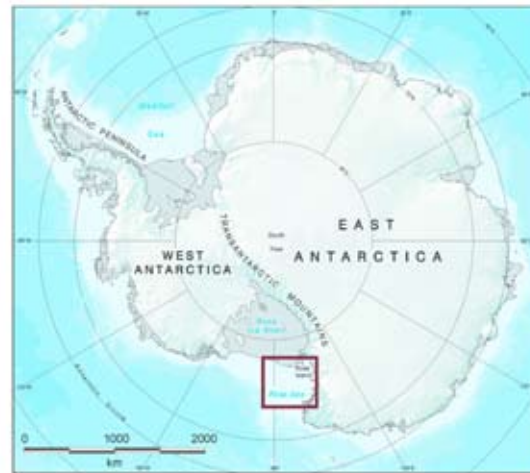


Figure 2 Antarctica and the Ross Sea study area (red box) from where specimens were collected from 1901-2008.

Our study area was the western Ross Sea, East Antarctica (Fig. 2) though for 90% of the specimens examined the 'realised study sites' were the curated historic collections in museums, institutes and universities. Specimens of *C. nutti* were collected in 2008 by SCUBA divers from McMurdo station (US) under the direction of one of the *Current Biology* paper authors, who was at the nearby Scott station (NZ). The same year was also a major time of collection and pooling of information due to initiatives such as the Census of Antarctic Marine Life (part of the Census of Marine Life). A global search of museum collections revealed *C. nutti* in; 1) the RV Tangaroa cruises of the National Water and Atmospheric Institute (NIWA) of New Zealand, 2) a private collection of a researcher at the University of Otago (NZ), 3) from the 1950s to the 1970s in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. and the Virginia Museum of Natural History (US). The oldest specimens (from 1901-1913) and the Discovery expeditions (1936) were held in the Natural History Museum London. These yielded 887 single year sections with growth data from 1890 to 2008 with some gaps. These data can be directly compared by age-standardising them then plotted as deviations from the mean over time (i.e. as an anomaly). This revealed that there had been little change in growth

between 1890 and 1972. The data from 1950-1970 was quite noisy and we hope to find more specimens in museum collections to probe this period, although priority will go to periods for which we had no data. From about 1990 to 2008 growth of *C. nutti* increased considerably and significantly (Fig. 3). On average across the last two decades growth doubled the previous rate but the last year is quadruple the level for the rest of the century. This suggests that the bloom of the phytoplankton that bryozoans eat is now considerably longer and there is some evidence showing recent positive anomalies in remote sensed chlorophyll in the Ross Sea (Arrigo et al 2008).

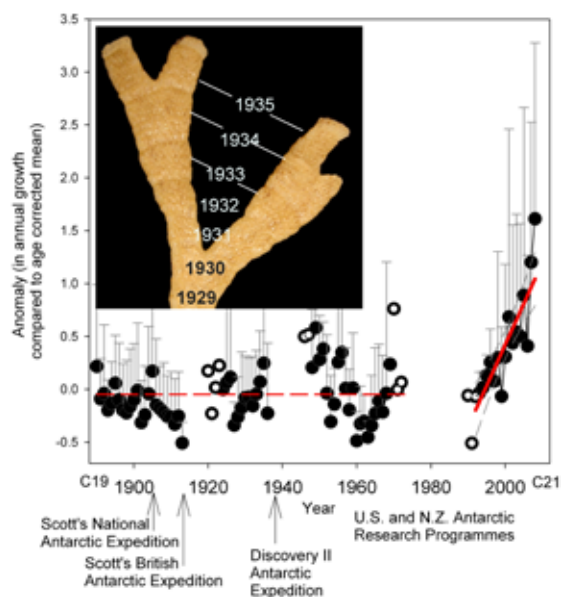


Figure 3. Growth of *Cellarinella nutti* in the Ross Sea, Antarctica by year. Significant regression line is fitted to post 1990 data. Insert is a colony collected by Discovery II in 1936 showing growth by year.

This is a rare example of distinct change in aspect of the biology of a polar species away from a long-term norm. The bryozoan *C. nutti* has previously been found to show increased growth in the Weddell Sea (Barnes et al 2006), and in the same region declines in krill populations and increases in salp populations have been found (Atkinson et al 2004) – but without any longer term reference baseline and thus making it hard to rule out natural cyclicity. In some ways the typically long life spans of polar species and the strong seasonality of polar environments (making annual growth signals more obvious) should make detecting change easier than elsewhere. In the subarctic a bivalve, with the charismatic name of ‘the ocean quahog’ (*Arctica islandica*), may live hundreds of years enabling growth to be examined over longer time courses (Scourse et al 2006). However the ocean quahog occurs at lower latitudes

and the arctic is influenced by very many complex factors compared with the Southern Ocean. Aside from the *C. nutti* data providing the highest latitude record of a century of growth, there were specimens of widely varying age across decades for which there was data - reducing confounding age effects which typically limit contemporary collections. So again the value of Scott’s early collections across 1901-3 and 1911-13 comes to the fore. There has been distinct change in Antarctic megafauna, particularly in penguins (see summary in Trivelpiece et al 2011) much of which has been linked to changes in sea ice and their food (krill) caused by climate change, but we found no evidence for similar causality of changing growth in the Ross Sea.

The study area within the Ross Sea is not a hotspot of demonstrable ‘climate change’ to date. Physical change varies considerably in magnitude and type around Antarctica and the Southern Ocean. Warming in the region is mainly restricted to the Antarctic Peninsula and nearby seas, as are ice shelf loss, glaciers retreat change, sea ice losses and biological responses (see Trivelpiece et al 2011). Parts of the Ross Sea show seasonal sea ice gains and increased wind speeds. Wind speed increases are generated by an increased thermal gradient between pole and tropics due to stratospheric ozone losses. In addition, parts of the Southern Ocean are projected to be amongst the first and most severely impacted by ocean acidification, but thus far evidence for significant change in pH is weak. When the potential for these diverse impacts to interact is also considered, as well as rates of species description still being high for the benthos and our embryonic knowledge about most of the biota, the difficult of detecting biological responses to climate change is clear. Whilst drivers of the *C. nutti* growth change are unclear, the growth changes are likely to influence carbon cycling (and thus ‘climate change’) through increased burial of carbon.

Our observations using SCUBA diving and previous research (Winston 1983) have shown that *Cellarinella* bryozoans are easily broken by currents, and that these fragments can then be quickly buried. Iceberg scour could crush specimens (buried or otherwise) and resuspend material probably leading to carbon recirculating and not being genuinely sequestered. However most specimens, and indeed other benthos, live deeper than the depths regularly ice scoured. We think that most of this new carbon accumulated is likely to be genuinely sequestered. Whilst we can estimate how much carbon this involves per specimen per year, what is really needed is quantification by carbon draw-down per unit area of the seabed. This could be calculated using high resolution imagery by camera systems (e.g. in remote operated vehicles) but

first we need to know how reflective increased growth of *C. nutti* is of other species in the region. Thus museum collections and baseline strengths are again the limiting factor. Demonstrating the first evidence that new carbon is being sequestered to the seabed in polar regions is a good first step to investigating change in polar carbon sinks but there is clearly much work to do before this can be quantified even to within an order of magnitude. We think it is likely that the influence of life in Antarctica on climate is being underestimated through lack of knowledge and understanding of carbon flow through it. Even if this is true, measuring it is non-trivial and separating noise from signal in shorter data sets will be difficult but the collections made by Scott's and other early expeditions give a strong start point.

There is little doubt that reaching the South Pole was very important to Scott but there is truth to Amundsen's claim that in terms of effort and preparation the *"..British expedition was designed entirely for scientific research. The Pole was only a side-issue..."*. The erection of Scott to hero only for later critical treatment focussed almost entirely on performance in the polar 'race' and on fatalities both miss the point, that those two expeditions were outstanding in terms of scientific achievements; their very stated purpose from the outset. Antarctica is key to global thermo-haline (and as a result deep sea oxygen) circulation in the sea, weather and sea level, and is the best archive of planetary change through ice cores. Recent rapid regional change around the southern polar region has intensified the imperative of understanding biological responses and impacts on change there – because it is important to everywhere-else on Earth. The collections and data collected by Scott and other pioneers are likely to become more valuable and more widely used to understand polar physical and biological change.

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Artificial coastal defences: Enhancing biodiversity using sensitive design

Louise B. Firth

*School of Ocean Sciences, Bangor University,
Menai Bridge, Anglesey, LL59 5AB*

Background

Global climate change is one of the greatest challenges facing modern society. Coupled with increasing sea surface temperatures, sea levels are also rising, with estimates of rises between 0.18-0.59 m within the next century (IPCC 2007). The combination of sea level rise and the increasing frequency of storms will lead to more severe coastal flooding and erosion over the next few decades (Hulme et al. 2002, Thompson et al. 2002). In response to these threats, our coastlines will become increasingly 'hardened' as more artificial sea defences are constructed (Figure 1). These defence structures prevent or reduce coastal erosion and flooding of adjacent land, in addition to stabilising and retaining beaches and reclaimed land.



Figure 1. Artificial coastal defence structure at West Shore, near Llandudno, north Wales.

Until recently, relatively little attention has been paid to the potential effect of these structures on colonising epibiota. These new structures are made of a variety of materials and differ from natural

habitats in terms of composition, orientation, surface topography and provision of microhabitats (Chapman & Underwood 2011, Moschella *et al.* 2005). Artificial structures have been shown to have distinct differences in community structure and functioning compared to natural rocky substrates. Artificial structures are generally constructed of relatively smooth, uniform materials and lack the suitable habitats for settlement of marine organisms such as rock pools, crevices and depressions.

The projects

I am involved in two large projects assessing the ecology and design of artificial coastal defences. THESEUS (www.theseusproject.eu) is a large EU-FP7 funded project comprising 31 partners from all across Europe and beyond, whilst URBANE (www.urbaneproject.org) is funded by Esmée Fairbairn and comprises 6 British partners. There are three key aims of these projects: (1) to evaluate how the biodiversity associated with coastal defence structures varies with design features; (2) to assess the impact of these artificial structures on soft sediment communities; and (3) to design a BIOBLOCK – a habitat-enhancement unit that can be incorporated into coastal defence structures. In this article I am going to discuss the various features of habitat that can be incorporated into artificial structures that will provide habitat enhancement and promote biodiversity.

Design features

There is now considerable pressure to identify alternative solutions to the construction of hard artificial coastal defence structures and mitigate for their effects on the local environment. Bulleri & Chapman (2010) describe how natural habitats alone may provide a buffer against erosion in sheltered areas, but in locations of higher wave energy, a combination of natural habitats with hard structures (e.g. “hybrid” designs) may provide an alternative effective approach.

The incorporation of crevices and depressions into artificial structures is simple, cost-effective way to provide novel habitat for colonizing epibiota (Figure 2). Research carried out in the Azores demonstrated that by adding small pits and crevices into an existing seawall resulted in increased abundance of the exploited limpet *Patella candei*, due to both recruitment and immigration (Martins *et al.* 2010).

Similarly the incorporation of rock pools into artificial structures can significantly increase biodiversity. Figure 3 shows a shallow rock pool that has formed naturally on Plymouth Breakwater following the faster erosion of the limestone block which is surrounded by harder granite blocks. It is clear to see that different



Figure 2. (a) Mussels inhabiting longitudinal crevices on boulders of Tywyn Breakwater, Wales and (b) littorinid snails inhabiting small depressions in natural rock on Port St. Mary Ledges, Isle of Man.

assemblages that have colonised the pool habitat (coralline algae, *Lithothamnium*, *Himantalia elongata*, anemones) compared to the surrounding emergent rock (furoids, *Ulva* spp., barnacles and limpets). Recent research in Australia (Chapman & Blockley 2009) has focused on adding rock pools into flat, featureless façades of seawalls in a cost-effective manner that neither compromises safety nor other engineering requirements, but increases diversity of species living on the wall itself. The communities that developed in these artificial pools were more diverse than those in nearby natural pools, likely due to the fact that the artificial structures provided more shading than natural pools.

Chapman & Underwood (2011) also describe a method of incorporating rock pool habitats into any seawall, irrespective of state of construction or repair. By attaching modified concrete plant pots to seawalls in the same manner as plant pots are attached to walls of houses, it is possible to create an intertidal rock pool which can provide habitat for diverse assemblages of flora and fauna (M.G. Chapman and M.A. Browne; unpubl. data, <http://iconiclandscapes.wordpress.com/2010/02/16/planting-sea-life-into-flowerpots/>).



Figure 3. Eroded limestone blocks on horizontal surfaces of Plymouth Breakwater form rock pools supporting a diverse assemblage compared to surrounding granite blocks.

BIOBLOCKS

A range of artificial features are being designed to experimentally compare modifications that could be incorporated into artificial structures (e.g. crevices, depressions and rock pools). The results will be used to design various types of BIOBLOCKS which could be cheaply prefabricated and incorporated into structures. BIOBLOCKS can be constructed for incorporation into structures in two different situations: (1) a large-scale BIOBLOCK that can be integrated into a structure as it is being built or during maintenance work; and (2) a smaller-scale BIOBLOCK that can be integrated into an artificial structure at any time.

The challenge now is to design a BIOBLOCK that can successfully be incorporated into an artificial coastal defence structure that will stand up to wave action while providing suitable habitat for colonisation by a diverse marine assemblage without jeopardising the integrity of the structure. Watch this space!

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Seagrass in the Solent

Amy Dale. *Hampshire & Isle of Wight Wildlife Trust.*

Seagrass : Importance and threats

If only casting a passing glance, seagrasses could be seen simply as another type of seaweed lining some coastlines. However, seagrasses are not algae, but higher plants and very special ones at that. Representing just 0.02 % of angiosperm species, seagrasses are the only true marine flowering plant and so conduct their entire life cycle, including flowering, in saline conditions. Far from being confined to the tropics, where they're often the backdrop of photographs depicting grazing turtles or manatees, they have a broad global distribution and occur in shallow waters of all continents except Antarctica. The genus *Zostera*, or 'eelgrass' has the largest latitudinal range of any of the seagrass genera, extending from the Equator to the sub-Antarctic and to the Arctic. *Zostera marina* (common

eelgrass) is probably the best known (most widely researched) of all seagrass species.

Seagrass habitats used to be far more prevalent than they are today and the plants have been utilized by humans as a resource for thousands of years. Well documented uses of seagrass include salt production (Jutland), as a straw substitute and thatch (Europe, Mexico, North America), and in dike construction (Denmark). Other, less widely recorded uses include its use in housing insulation and as a fire retardant (USA), as fertiliser (Europe and USA), being ground down for flour and as a dressing to reduce bleeding (Seri Indians, Mexico), in production of "Zosterin" gelling agent (USSR) and as an ingredient in cleaning milk (UK, spotted on the shelves of John Lewis just a few months ago!).

Despite Linnaeus first describing common eelgrass (*Zostera marina*) in 1753, neither naturalists nor scientists paid it much attention, and so its importance as a habitat and its vulnerable nature wasn't immediately realised. However, this all changed when widespread decline of seagrass beds in the 1930s was linked to a decline in fishery stocks, prompting a boom of research to establish the role of seagrass habitat in marine ecosystem functioning. The 1930s decline is now thought to be the result of "wasting disease" caused by the slime mould *Labyrinthula zosterae*. The outbreak of the "disease" in the 1930s wiped out an estimated 90% of common eelgrass across North Atlantic coasts, including the UK, and put an end to many of the historic seagrass processing industries such as salt production.

The fundamental ecological importance of seagrass habitats is now well documented. Seagrasses provide a structurally complex habitat with rich food supply. This enhances biodiversity by creating niches for numerous species, as well as protection from



Figure 1. Common eelgrass (*Zostera marina*). Photo: Paul Naylor.

predators that is required for effective nursery and spawning grounds. Seahorses and elasmobranchs are included in the long list of fauna which utilise

seagrass beds, and cuttlefish regularly use them as anchor points for their eggs. The complex structure of seagrass plants also provides coastal protection by stabilising sediment with their roots and providing a buffer to waves with their canopy. Another very important role seagrasses play, especially with our current problem of high carbon emissions, is that of a carbon sink; although they account for less than 1% of total ocean production, they can provide ~ 12% carbon storage by locking it in their detritus.

Although some eelgrass beds damaged by "wasting disease" had recovered by the 1950s, anthropogenic pressures we are applying to coastal areas have resulted in many areas only recovering partly, if at all. As seagrasses are rooted, photosynthesising plants, they require good water quality and a stable, soft sediment environment in which to grow. Human pressures of land reclamation, coastal development, boat traffic, anchor damage, dredging, salinity changes from irrigation, toxin and/or nutrient loading from pollution, agricultural run-off and sewage discharge can all play a role in hindering or preventing seagrass bed establishment and growth.

Solent Seagrass Project

There are three types of seagrass in the UK, common eelgrass (*Zostera marina*), dwarf eelgrass (*Zostera noltii*), and tasselweeds (*Ruppia* sp.) and they are all nationally scarce. Many British and Irish reports also refer to narrow-leaved eelgrass (*Zostera angustifolia*) which was traditionally regarded as a separate species by these authorities as its morphology, reproductive strategy and habitat differs from *Z. marina*. However, it is now generally considered to be a variant of common eelgrass, a hypothesis supported by DNA sequencing.

We're lucky in Hampshire and the Isle of Wight as the Solent supports several beds due to its sheltered conditions and sandy/muddy substrate. The Hampshire and Isle of Wight Wildlife Trust (HIWWT) recognised that anthropogenic pressures on local seagrass beds are likely to be very high, especially with the Solent being such a busy stretch of water. Yet very little was known about the seagrass that grow in the region, and without more information, conserving and protecting these vulnerable habitats would be impossible. Therefore, in 2006, HIWWT launched the Solent Seagrass Project. Its aims are to survey existing beds to map their extent and quality, produce a Seagrass Inventory for Hampshire and the Isle of Wight, raise public awareness about seagrass, and feed data into current conservation measures to aid its protection.

The first stage of the Project was to establish exactly

what information was out there, and compile it so that the Seagrass Inventory could be a one stop shop for seagrass in the two counties. It contains background information on the ecology of seagrass, methods, and maps of where the seagrass is, not just from HIWWT surveys but from other organisations work too, whether they were academic research projects, monitoring surveys, or historic records. The Seagrass Inventory is updated annually with new HIWWT survey data and any other new data that have been produced.

The Project has been running for four seasons now, with planning well underway for season five. The seagrass survey season runs from May to October every year, during which seagrass beds already documented are revisited, and any new beds found are properly recorded. Time is also spent throughout the year raising public awareness of seagrass. We use the media, educational institutions, information display panels and leaflets, and public events such as talks and shows to engage with the public.



Figure 2. Seasearch divers stumbled across dozens of mating pairs of sea hares (*Aplysia punctata*) on a recent

During the surveying season, a variety of methods are used to survey seagrass areas, depending on how accessible the beds are. Some, such as those growing along the sandy beaches of the Isle of Wight, are easy to access directly by foot while others, such as those growing on the mudflats of the Hampshire harbours, require us to use a boat or kayak. One of the main methods used to document the seagrass

uses digital photography and GPS. The photos provide a visual record of the species of seagrass present and its density. They are also linked to the GPS tracks, stamped with exact location (latitude and longitude), and uploaded into Google Earth or GIS to draw distribution maps of exactly where the seagrass is growing. Due to the low water clarity in the Solent, much of the seagrass in the area is exposed on good low spring tides, and so it can be surveyed on foot. Unexposed areas can be reached by boat using a camera on a drop-down pole, or using a towed video camera on a sledge. Occasionally, local Seasearch divers are asked to scuba dive on specific areas to collect extra information.

Seagrass Conservation in the Solent

Data collected through the Solent Seagrass Project has played an important roll in conservation of seagrass in the Solent. As part of the Marine and Coastal Access Act 2009, a suite of new marine protected areas, called Marine Conservation Zones (MCZs), will be established. Their aim is to provide a coherent network of protected areas that represent not just the vulnerable and rare species and habitats occurring round our coast, but the whole range of marine wildlife occurring in UK waters, both inshore and offshore. Seagrass is listed as a Feature of Conservation Importance (FOCI), meaning it has been acknowledged as rare and threatened and so must be represented adequately in the MCZ network. The distribution data collected through the Solent Seagrass Project, as the most comprehensive seagrass data set available, is being utilised in the designation of draft MCZs to ensure seagrass is included. One draft MCZ off the coast of the Isle of Wight includes a substantial seagrass bed. At ~4 km long and at least 136 ha, it's one of the best seagrass beds in the area. However, as the area has heavy recreational pressure from yachters and anglers it has been the focus of lots of discussion in local stakeholder group meetings.

The establishment of a network of MCZs around the UK is undoubtedly a very positive step towards better conservation of our marine environment. However, one aspect of the designation procedure is that MCZs cannot protect habitats or species that are deemed to already benefit from protection through another legislation. For this reason, many areas which are known to contain substantial areas of seagrass have not been considered for inclusion in MCZs. Although the importance and vulnerability of seagrass is recognised within current legislation (e.g. BAP habitat, OSPAR Priority Habitat, important features in SPAs and SACs in the EU Habitat Directive) this does not guarantee them any protection from damage. In the Solent, damage to seagrass beds

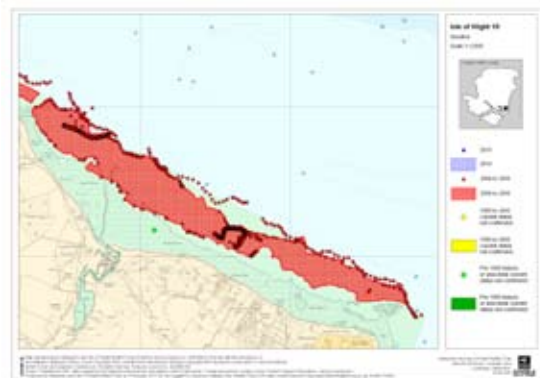


Figure 3. A Seagrass Inventory map of seagrass at Wootton, Isle of Wight. At ~4 km long and at least 136 ha, it's one of the largest seagrass beds in the Solent. Map reproduced with permission from British Crown and Seazone Solutions Ltd (Licence No. 032009.008) and Ordnance Survey (Licence No. 100015632).

by clam dredgers is particularly prevalent with beds in Portsmouth Harbour (SPA, SSSI, Ramsar site), Brownwich Beach (SPA, SSSI, Ramsar site), and Langstone Harbour (SPA, SAC, SSSI, Ramsar site) all impacted by this fishing method. Damage may not be limited to physical removal of the seagrass, but can include reduced water clarity through mobilisation of the sediment, smothering of plants (both seagrass and salt marsh), and reduced sediment stability. Activities usually deemed as very low impact, such as yachting, also have the potential to have adverse effect on seagrass habitats through damage caused by anchors and keels.

Seagrass beds in Cams Bay, Portsmouth Harbour, have been heavily damaged by dredging and data collected by the Solent Seagrass Project has been fundamental in its protection. Maps produced by the project showed the Cams Bay bed to reduce from 3.1 ha in August 2009, to 2.5 ha in October 2009, with extensive dredge scars in the area suggesting this activity was the probable cause. This prompted Natural England to meet with local fishermen and put a voluntary agreement in place to prevent dredging in the area. Without maps to pin-point exactly where the seagrass is growing, this would not have been possible. Disappointingly, despite the efforts of all involved, dredging continued to take place in the area, and the seagrass bed remained vulnerable to degradation or complete loss. Therefore, following more discussions with Natural England and with support from Solent Seagrass Project data and evidence gathered from local members of the public, an Emergency Byelaw was imposed by the Marine Management Organisation in January 2011 to protect seagrass from all mobile demersal fishing gear. This was the first byelaw to be passed under the new Marine and Coastal Access Act and we hope will be made permanent to ensure the survival of seagrass in the Harbour.



Figure 4. Dredger tracks through seagrass at Cams Bay, Portsmouth Harbour show plants are completely



Figure 5. Damage caused by clam dredgers to the soft mud of Cams Bay, Portsmouth Harbour.

In the last five years, our knowledge of seagrass in the Solent area has expanded dramatically. This has allowed us not only to appreciate how fortunate we are to have such a scarce, beautiful and biodiverse habitat on our doorstep, but also to be actively involved in its protection. Seagrass habitats are both beautiful and fundamentally important to a healthy marine ecosystem. Through continued engagement in the MCZ designation process, and championing the habitat to all who can impact it, we hope they'll stay rooted firmly to the sands and muds of our Solent shores for many years to come.

Acknowledgements

The Solent Seagrass Project is funded by the Esmée Fairbairn Foundation, Natural England, Solent Forum, Hampshire County Council, Environment Agency, Sita Trust and Hampshire and Isle of Wight Wildlife Trust. We would also like to thank all who have assisted in surveys and supplied data as part of the Project.

Postmarsupial development and intraspecific morphological variation in *Apseudopsis latreillii* (Milne-Edwards, 1828) (Crustacea, Tanaidacea)

Esquete P.¹ and Bamber R.N.²

Departamento de Ecología y Biología Animal,
Facultad de Ciencias del Mar, Universidad de Vigo,
E-36310 Vigo, Pontevedra, Spain.

ARTOO Marine Biology Consultants, Ocean Quay
Marina, Belvidere Road, Southampton SO14 5QY,
UK.

Intraspecific variations in morphology during postmarsupial development are common among tanaidaceans in general and apseudomorphans in particular. Knowledge of intraspecific variation between developmental stages is needed owing to the difficulty of identification of the significant number of juvenile specimens within a sample, particularly when occurring sympatrically with other apseudid species. Furthermore, knowledge of the morphotypes of a species is a necessary basis for other studies, such as of life history, or of the role of a species in the ecosystem. However, descriptions of such variations are scarce in the literature.

Apseudopsis latreillii can be one of the most common invertebrates in the coastal, shallow sedimentary bottoms of the north west Atlantic; it can be found on a variety of habitats, including estuaries, seagrass meadows, seaweeds and sandy beaches, locally reaching densities of more than 25,000 individuals/m² (Moreira 2003). Morphological characters have been investigated throughout the postmarsupial development of *A. latreillii* in order to identify and describe all the morphotypes.

A total of 5003 individuals found in mud samples from O Grove Inlet (NW Iberian Peninsula), collected in 1996, were studied; 31 individuals collected in 2010 in the Isles of Scilly (SW England) were also examined, this area being considered close to the type locality (Bate & Westwood 1868); additionally, two specimens were kindly lent by the invertebrate collection of the Muséum National d'Histoire naturelle (Paris).

The results show that the manca II offspring is followed by two juvenile stages before reaching maturity. Males present two possible morphologies that can be differentiated by the robustness of the cheliped. Early mature females bear oostegites on pereopods 1 to 6; after this preparatory stage,

females pass through a sequence of copulatory instars followed by intermediate stages during which the female loses the ovisac after release of the manca.

A careful examination of these instars leads to the conclusion that there are characters that remain stable through the development, and thus can be used for the identification of the species regardless of the developmental stage. In *Apseudopsis latreillii* these characters are the rostrum features, the pereonite shape and, more importantly, the spination of the first pereopod.

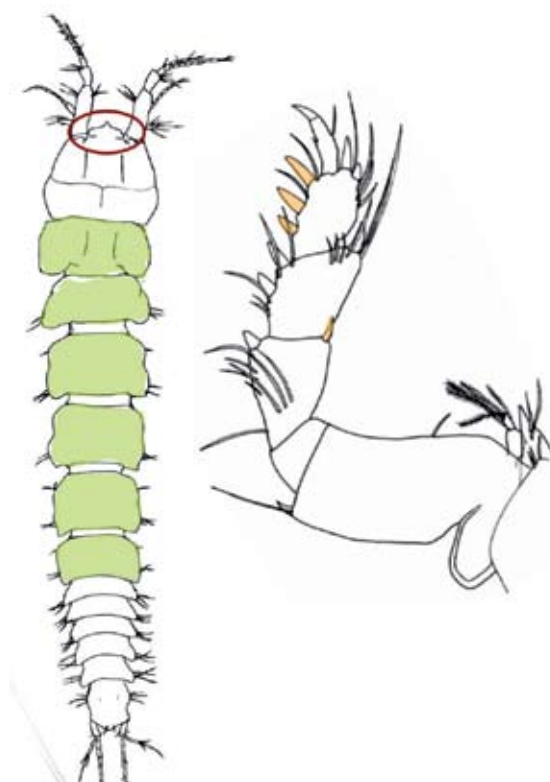


Figure 1

Other characters that can be used to recognise the developmental stage of an individual are the number of articles of the inner flagellum of the antennule, and the increase in the complexity of the mandibular palp through the life history. Differentiation of the copulatory structure on pereonite 7 is characteristic of the adults. The two types of males and females can be differentiated by the robustness and ornamentation of the cheliped. In general, an increase in the number of setae and spines on the pereopods, as well as in the number of articles on the uropodal endopod occurs during the development of *A. latreillii*.

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Parasite biomarkers of amphipod health (Short Note)

R. Mansergh, S. M. Cragg, and A. T. Ford

Institute of Marine Sciences, School of Biological Sciences, University of Portsmouth, Ferry Road, Portsmouth PO4 9LY.

Contact: robert.mansergh@port.ac.uk

The utility of parasites as indicators of environmental contamination has been substantially improved by a better understanding of parasite taxonomy (Williams & Mackenzie 2003). Recent studies of the marine amphipod *Echinogammarus marinus* (Gammaridae: Gammaridea), an abundant and widespread species distributed across the coastline of north-west Europe, have shown increases in feminising microsporidia resulting in intersexuality within industrially-impacted habitats (Ford *et al* 2006). In this ongoing study, the effect of industrial contaminants on ectoparasitic ciliates is being explored.

The principle aims of this study are to identify and describe each ciliate species found in association with *E. marinus*, and to evaluate the variations in ciliate diversity, abundance and the utilisation of the host micro-niche at industrially-impacted and 'clean' reference sites. Currently, subsamples (15-30 animals/site) from two impacted sites and two reference sites have been examined using conventional bright-field and scanning electron microscopy. Representatives of each ciliate type found in close association with these amphipods will be compared to described examples in the primary literature (for example, Foissner & Berger 1996).

Preliminary observations have indicated that a number of loricated peritrich and chonotrich ciliates attach to distinct micro-niches on the exoskeleton of *E. marinus*. Efforts to identify these ciliates are facilitated by the morphology of the lorica (Foissner & Berger 1996), the protective case that the ciliate contracts into (Figure). These data also suggest a lower diversity of ciliate species at the industrial-impacted sites known for high levels of hydrocarbons, PCBs and heavy metals compared with the two reference sites. Efforts are also ongoing to replicate the numbers of both clean and polluted sites and to include new geographical locations and additional amphipod species.

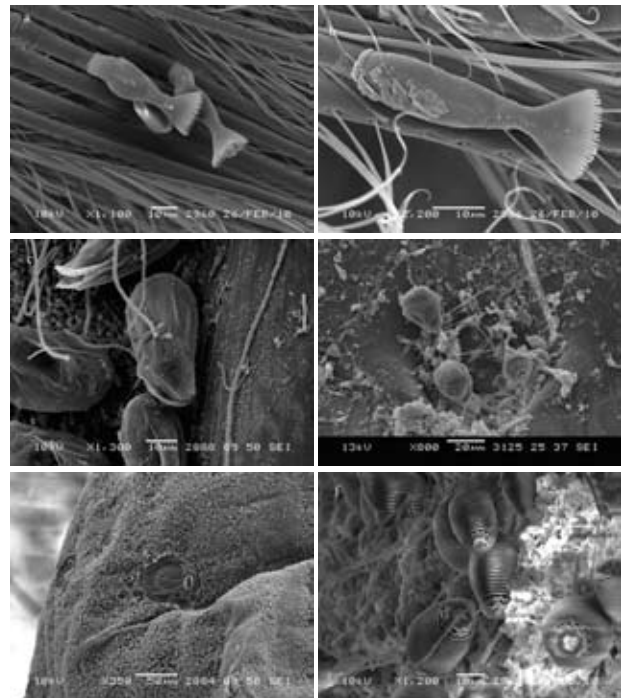


Figure. Scanning electron micrographs of the loricated ectoparasitic ciliates *Heterochona* sp., attached to the host's pleopods (a and b); a stalked chonotrich species, attached to the host's exoskeleton (c); two stalked peritrich species which attach to the host's appendages (d and e); and *Lagenophrys* sp. attached to the host's gills. (f).

Acknowledgements

This study would not be possible without the assistance of Christine Hughes, Stephen Short and Simon Streeter.

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ASSESSING THE IMPACTS OF THE CHRONIC EXPOSURE OF ZINC AND COPPER ON THE POLYCHAETE *NEREIS VIRENS* (SARS) 1835

J. Pini^{1*}, G. J. Watson¹, Alex T. Ford¹

¹Institute of Marine Sciences, School of Biological Sciences, University of Portsmouth, Ferry Road, Portsmouth, PO4 9LY, UK

*Contact: Jennifer.pini@port.ac.uk

Introduction

Zinc and copper are common contaminants of sediment in coastal environments and are known to be toxic to marine invertebrates (Dean 2008). The king ragworm, *Nereis virens*, (Figure 1) is an ecologically and commercially important polychaete species of soft sediment inter-tidal communities, found throughout Europe and the northern hemisphere. It is one of the dominant species in the Solent, UK (Watson *et al.* 2007). It is amenable to long-term studies to investigate chronic effects of these pollutants as it readily acclimatises to captive conditions and growth, maturation and reproduction are well documented especially the endocrine control system. The aim of this EU INTERREG IVa funded project is to investigate the effects of chronic exposure of copper and zinc on the different life stages of *N. virens*.



Figure 1 - *N. virens*, the key species.

Materials and Methods

Sediment cores and associated worms will be collected from a range of sites in the Solent, UK, with different pollution histories, but are also known to be natural habitats of *N. virens* (Figure 2). Bioavailable concentrations of these metals will be assessed using BCR-sequential and aqua regia extraction methods followed by Atomic Absorption Spectroscopy (AAS) analysis. The concentrations within the worms will also be measured using standard extraction techniques and AAS.



Figure 2 - Location of sampling sites and natural habitats of *N. virens*.

(Source : <http://www.nbn.org.uk/>)

These data will be used as a guide for establishing the level of spiking required for long-term sediment exposures so that they are environmentally relevant. To investigate the chronic effects of these metals, adults will be incubated for nine months in control, copper-spiked, zinc-spiked and copper and zinc spiked sediment. Worms and sediment will be sampled at three-monthly intervals and a suite of sub-lethal endpoints will be measured including growth, feeding rates, behaviour, regeneration rates as well as changes in key biochemical, cellular and histological systems (e.g. metallothioneins, antioxidant and oxidative damage, DNA damage, lysozyme, lipid peroxidation and metabolomic changes). In addition, Scanning Electron Microscope (SEM) coupled with Energy-dispersive X-ray spectroscopy (EDX) will be used to understand the sequestration and compartmentalisation of the metals in the tissues of the worms during the exposure.

Assessment of genotoxic damage in polychaetes

Contaminations of marine environments by heavy metals can induce DNA damage or interfere with the processes involved in cell division. The use of the comet assay (Figure 3) combined with the micronucleus assay will allow us to measure repairable DNA damage and permanent DNA damage. Using both assays will permit to consider the proportion of repairable versus permanent damage induced by copper and/or zinc chronic exposure and have a complete approach of the DNA damage in *N. virens*. (Collins 2004; Dixon *et al.* 2002; Lewis & Galloway 2008).

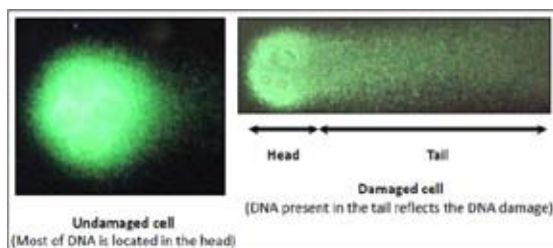


Figure 3 - The comet assay showing the difference between an undamaged cell and a damaged cell.

Outcomes

It is expected that this work will provide the first significant insights into the chronic toxicity of these metals in sediments (alone and in combination) on sediment-dwelling polychaetes. It will provide a better understanding of the consequences and the processes involved in heavy metal contamination in an ecologically important species and how this might affect soft-sediment communities.

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Polychaeta of the Isles of Scilly: A New Annotated Checklist

Teresa Darbyshire
 Amgueddfa Cymru–National Museum Wales
 Cardiff
 CF10 3NP.

The 'Marine Flora and Fauna of the Isles of Scilly' is a long-running series of papers published by the *Journal of Natural History*. Since the first introductory paper by Harvey (1969) describing the ecology of the islands, there have been a further 17 papers reviewing 23 different groups of animals.

A list of the Polychaeta was compiled by Harris (1972) mainly from collections made by the *British Museum (Natural History)* and *University of London Sub-Aqua Expedition* as well as incorporating his own material from University of Exeter student fieldtrips and specimens collected by other zoologists. This meant that the list included both subtidal and intertidal species, and it totalled 184 (benthic) species. Two additional species in the list were pelagic and have not been included in this review.

As part of a larger DEFRA-funded project, Richard Warwick and Paul Somerfield from Plymouth Marine Laboratory (PML) asked Amgueddfa Cymru–National Museum Wales (NMW) to put together an expert team to carry out a new assessment of the polychaete fauna in 2006. The aim was to produce a new updated checklist and, to this end, Andy Mackie invited myself and Kate Mortimer (NMW), Peter Garwood (Identichaet), Fred Pleijel and Erika Norlinder (Tjärnö Marine Laboratory) and Wilfried Westheide (Universität Osnabrück) to participate. Help in the field came from Richard and Paul and Mike Kendall (PML), Neville Barratt (formerly Exeter University), and Jen Pinnion, Anna Langford and Tom Davies (then NMW). Subsequent sampling of the sublittoral by diving (2009 and 2010) involved myself and others courtesy of Angie Gall (Isles of Scilly Wildlife Trust), *Seasearch* and the *Porcupine Marine Natural History Society*, and by grab (2009) using the R.V. *MBA Sepia*, with Roger Bamber and Sue Chambers. The updated checklist incorporates all material from these new collections, species identified from three previous benthic surveys of the area (Rostron 1983, 1988; Munro & Nunny 1998), as well as those species listed in the original Harris (1972) paper.

Comparison of Surveys

Two diving surveys were carried out by Dale Rostron in 1983 and 1988 to assess habitats and communities in the area in relation to proposals at the time to establish a voluntary Marine Nature Reserve. The

surveys were small with only 9 and 15 stations respectively. Samples were taken by divers using suction samplers and sieved through a 1 mm mesh sieve. The resulting species list for the polychaetes was small with only 64 (1983) and 77 (1988) species identified from each survey.

A larger benthic survey was carried out by Colin Munro and Rob Nunny in 1998 as part of a habitat mapping project. A total of 57 stations were sampled quantitatively for fauna using a 0.1 m² Day grab. Two samples were taken at each station and sieved through a 0.5 mm mesh sieve. This survey recorded 123 species of polychaete.

National Museum Wales staff carried out five separate surveys of both intertidal and subtidal habitats between 2006 and 2010. Subtidal samples were acquired using both diver and ship survey methods. The species list from these surveys totals 287 species.

Table 1 lists the different surveys/sources used for the checklist, whether they sampled subtidal, intertidal or both habitats and how many species they recorded. It is apparent that sampling both the intertidal and subtidal regions, rather than one or the other leads to a longer list of species – as does a greater level of sampling effort. Additionally, sieving samples with a 0.5 mm sieve rather than a 1 mm mesh will naturally retain many more species of polychaete.

Survey / Source	Sampling Region	No. of Species
Harris 1972	Intertidal & Subtidal	184
Rostron 1983	Subtidal	64
Rostron 1988	Subtidal	77
Munro & Nunny 1998	Subtidal	123
NMW	Intertidal & Subtidal	287

Table 1: Comparison of the sampling area and number of species recorded by the different sources used to compile the species list.

National Museum Wales Surveys



Figure 1: Sampling different intertidal habitats

The first and main intertidal survey took place in September 2006. Six Museum staff and five other polychaete experts spent six days on the islands collecting polychaetes from 75 sites across 7 shores on 5 islands. As large a variety of habitats as could be found were sampled (Figure 1). Wilfried Westheide, an interstitial polychaete expert, added an extra element to the survey as interstitial polychaetes are smaller even than those we usually look for.

In 2009, some more money became available for further survey work and we were able to make use of the Marine Biological Association's Research Vessel *Sepia* to do some subtidal sampling (Figure 2).



Figure 2: R.V. *Sepia* (top) & retrieving a grab sample (bottom)

The seabed around the Isles of Scilly is not greatly diverse in terms of sediment types, but using Admiralty Charts for the area as well as local knowledge, we aimed to sample as many different sediment types as we could while also trying to distribute the stations around the islands. Despite this, there were, of course, large gaps in our coverage, although stations from the other included surveys helped fill these. Twenty-five stations were sampled over 5 days using a 0.1 m² Van Veen grab where possible or, where the ground was too hard for the grab, either a Tjärnö or scallop dredge. Up to four samples were taken at each station but as this was not a quantitative survey, samples were elutriated several times to wash off as many of the polychaetes as possible with the material retained on the 0.5 mm sieve being combined per station for later analysis. The residues of the samples were

picked through, with any further polychaetes found being removed and added to the elutriated station sample. Additionally, any encrusted stones or shells and any seaweed holdfasts were retained for inspection. The washed and picked-through sample was then discarded.

Later that year, an opportunity arose to join in with a *Seasearch* survey taking place in the area and get some more samples by diving. Sampling by diving enabled us to reach those habitats inaccessible by either shore sampling or shipwork. Rock crevices, bryozoan & hydroid turf scrapings, kelp and other seaweed holdfasts were all sampled. In addition, encrusted stones/shells were hand-picked, sediment samples taken (Figure 3) and individual animals collected from the undersides of rocks small enough to turn over. During 10 dives, samples were collected from 25 locations.



Figure 3: Examples of samples collected by diver (top: stones encrusted with tubeworms; bottom: sediment sample)

In 2010, as part of the *Porcupine Marine Natural History Society* fieldtrip, further intertidal and diving sampling was undertaken (Figure 4). Fifteen shore sites were collected from and 19 samples from 8 dive sites obtained. By this time, we were trying to focus on specific habitats and species that we believed were likely to be present. Even at this stage, we added another seven species to the list, from both

intertidal and subtidal habitats, that had not been recorded by either ourselves or other surveys.



Figure 4: Teamwork at the shore (top); divers (bottom)

Table 2 compares the results from the different Museum surveys. Each different method of sampling resulted in a large list of species simply on its own merit. Both the intertidal and ship sampling each had species lists of comparable size to the Harris list of 1972 that incorporated both intertidal and subtidal collections, and both were larger than the other three subtidal-only surveys. The diving samples alone yielded more species than the Rostron surveys and nearly as many as the Munro & Nunny survey.

Sampling Method	Total No. Species	Exclusive Species
Intertidal	163	62
Subtidal	222	129
Subtidal: ship	186	83
Subtidal: diver	96	17

Table 2: Comparison of number of species recorded by different National Museum Wales surveys, including number of species exclusive to that method.

Each survey method also had a number of species that were only recorded by that method. Although

some of these figures may not be precise, no quantitative samples were taken, and sometimes species were not recorded if they had already been collected by another method, there were still some species that could obviously have only been collected using a particular method.

Exclusive Species

Chaetopterus spp.

Identifications of these animals are currently under review as we consider there is more than one species present in the area. They were collected intertidally, generally from sediment, and were also found to be common during dives living in tubes attached to rocks and in rock crevices (Figure 5). Due to the tough, papery nature of the tubes they could sometimes be peeled off the rocks and collected. No *Chaetopterus* specimens were collected during the ship sampling as the ship could neither get into the shallower waters to sample the sediment there nor get samples from the crevice habitats accessible to divers.



Figure 5: Subtidal *Chaetopterus*: tubes emerging from crevice (top); animal removed from tube (bottom)

Eupolymnia nebulosa / nesidensis

Eupolymnia nebulosa (Figure 6) was collected quite commonly from tubes attached to the underside of subtidal rocks, often embedded in coarse sand. This type of habitat could only be sampled by diver and without the diving aspect to the collecting methodology, this species would not have been recorded at all. The scaleworm *Polynoe scolopendrina* was only collected living commensally in the tubes of *E. nebulosa*. Another species, *E. nesidensis*, was only collected intertidally.



Figure 6: *Eupolymnia nebulosa* (Strawberry worm)

Sabella discifera

A small sabellid in distinctive narrow mud tubes (Figure 7) around 5-10 cm in length, this species was recorded by divers and was living attached to the sea fan, *Eunicella verrucosa*, and also as part of the hydroid/bryozoan turf that encrusted rock walls and ledges. It was not recorded either intertidally or during the ship sampling.

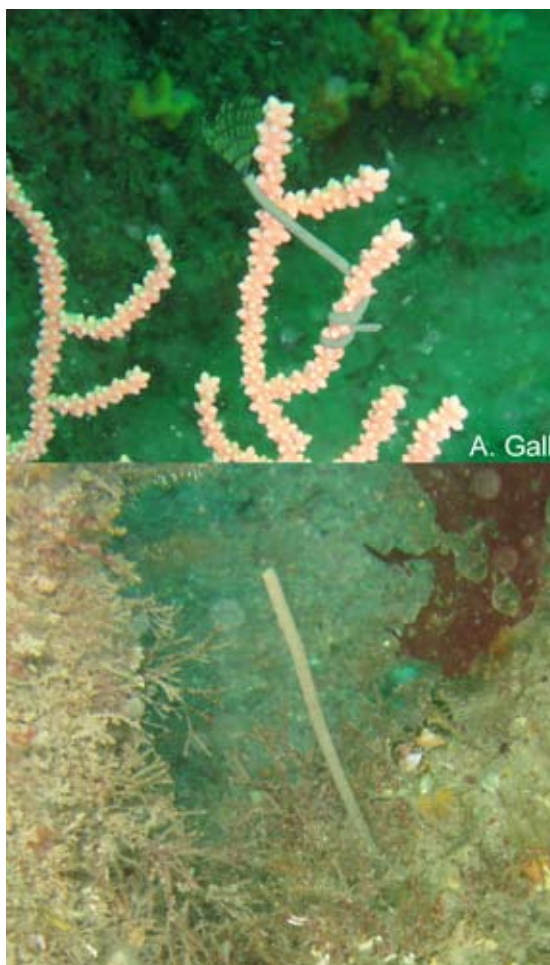


Figure 7: mud tube of *Sabella discifera* coiled around a Pink Sea Fan (top) and embedded in hydroid/bryozoan turf on rock (bottom)

Bispira sp.

Probably *Bispira volutacornis*, no actual specimens of this animal were collected. It lives in thin-walled wide mud tubes that extend deep into narrow rock crevices (Figure 8). Any attempt to collect the tubes merely tore off a short section of the end (unlike the tough *Chaetopterus* tubes). Therefore, all records of this species are photographic only, the ends of the tube having a distinctive 'crimped' appearance. Again, without the diving aspect to the surveying this species would not have been recorded.



Figure 8: Two tubes of *Bispira* sp. emerging from rock crevice with distinctive 'crimped' ends (animals visible within the tube)

The Compiled List

Figure 9 shows the spread of stations used to compile the full polychaete list. It does not include the locations of the sites used in the Harris's 1972 paper as these are more difficult to locate with precision. In general, a very comprehensive coverage has been achieved of both intertidal and subtidal areas.

A total of 52 families and 388 species of polychaete are included on the list (at present). The UK as a whole has just over 900 species of polychaete, hence the Isles of Scilly region alone has nearly half of the entire British species list.

Of the above, eight families and 120 species were recorded exclusively by the NMW survey work. Within this, eight species were contributed by Wilfried Westheide from the interstitial polychaetes. There are also two potentially new species, further work on which will be done in the near future.

However, two families and 101 species were recorded

by the other surveys used in the list but not by NMW. Some doubt is attached to this number though, due to problems encountered in ensuring consistency of identification between surveys.

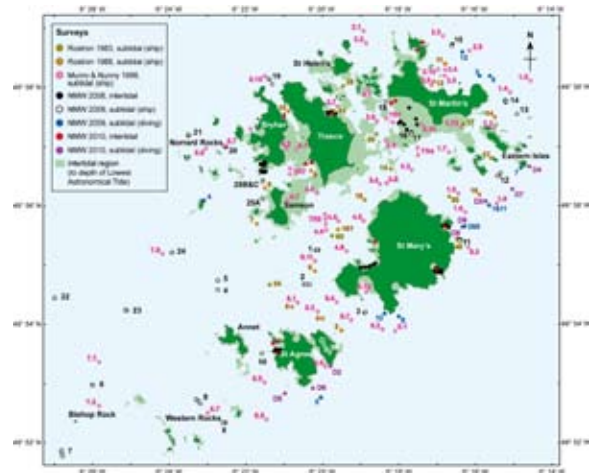


Figure 9: Map showing all the survey stations, except for Harris 1972, used to compile the species list.

In order to be confident that species have been identified consistently across surveys, the specimens need to be obtained and inspected, particularly where doubt is already expressed over the identification or species are recorded as 'indet'. Additionally, some of the species we have recorded were not yet described at the time of the earlier surveys. They were undoubtedly present at these times but were probably recorded under other names and it would be useful to identify these and correct the records.

Unfortunately, we have not been able to obtain any of the specimens from earlier surveys, although we are still following leads in our bid to track them down!

Summary

To create a comprehensive checklist, it was essential to include other work that had already been undertaken in the area. Many polychaetes are, by nature, 'scarce' in any particular location and therefore difficult to collect without a large amount of sampling effort. Utilising these earlier surveys increases the amount of sampling effort and coverage of an area and therefore the chances of collecting less common animals. However, in order to ensure consistency in the identifications, it is important to be able to re-examine specimens collected previously. Without this, there may be an element of doubt over some of the records. Ideally, a voucher collection of specimens from any survey, particularly a published one, should be deposited in a public access collection such as a museum.

It was also apparent that the use of several different methods of sampling had also greatly benefitted the

range of species collected. Some habitats could only be sampled using specific methods such as diving.

Acknowledgements

Funding for the project was through the DEFRA funded project *Assessment of Marine Biodiversity Linked to Ecosystems*, run jointly by Richard Warwick and Paul Somerfield (Plymouth Marine Laboratory). Many thanks to all those who participated in and aided the fieldwork. Photos taken by Teresa Darbyshire except where stated otherwise.

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Surf's up dudes! – The colonisation of Europe's first artificial surf reef, Boscombe, Dorset

Josie Pegg¹, Roger Herbert¹, Kathryn Dawson² & Ken Collins³

1. Bournemouth University, Talbot Campus, Fern Barrow, Poole, Dorset, BH12 5BB
2. Dorset Wildlife Trust, Brooklands Farm, Forston, Dorchester, DT2 7AA
3. NOCS, University of Southampton, Waterfront Campus, European Way, Southampton, SO14 3ZH

Introduction

Completed in autumn 2009, Boscombe Surf Reef is the first artificial surf reef in Europe. Located 260 m offshore to the east of Boscombe Pier near Bournemouth, the reef is designed to act as a ramp, pushing waves upwards, increasing their size and improving their quality for surfers. The reef is constructed of sand-filled geo-textile bags with a basal area the size of a football pitch and held in place by 5 tonne anchor blocks.

The construction of the Boscombe surf reef, as part of a large scale regeneration package supported by Bournemouth Borough Council, has raised concern among some stakeholders over its potential ecological impact. This study, undertaken by Bournemouth University School of Applied Sciences and partners is investigating the colonisation of the reef, in conjunction with a parallel project examining the impact of the reef on the locality's macro benthos and fishery. Collectively these projects will establish and evaluate the ecological impact of the reef structure on the inshore marine ecosystem; its biodiversity and local fisheries resources.

The particular objectives of this project are:

1. To record and quantify the colonisation and succession of marine organisms on and over the reef structure, measuring the changes in species diversity and biomass over a three year period.
2. To compare the developing species assemblages with those on other nearby artificial structures (including Boscombe and Bournemouth Pier and Poole Bay artificial reef) and nearby natural reefs at Durley Rocks.

Public Involvement

Boscombe Surf reef has received a considerable amount of press attention, not all favourable. Yet the high-profile location of the surf reef will help

promote and increase an awareness of the marine wildlife on the offshore reef and on other nearby structures and habitats to residents and visitors of Bournemouth and Boscombe.

The data collected will be largely photographic and video media that can be displayed using conventional interpretive boards and magazines, but also web-based and electronic tools. The promotion of marine wildlife on the reef will also help to increase awareness of the local marine wildlife beyond the reef structure, for example in Poole Harbour, Studland Bay and on the Jurassic Coast World Heritage Site.

Methods

The reef will be studied over a three year period. SCUBA survey and Remotely Operated Vehicle (ROV) survey will be used for *in situ* evaluation of the degree of colonisation by sessile organisms and mobile fauna (including fish and larger crustacea), with photography and video used to quantify and identify colonising species.

In 2010 three dive surveys were conducted, one in April by staff from the National Oceanography Centre and two by Dorset Seasearch in June and September. The ROV was deployed in November.

At the time of writing, Boscombe surf reef is closed to the public pending repair work. This work is expected to impact on the colonisation of the reef adding a further layer of interest to this study. It is hoped that these new works will make it possible to incorporate an ability to periodically remove samples of geotextile for microscopic examination and measurement of species diversity, abundance and biomass.

Results



Fig. 1 Landscape view of the surf reef taken in June 2010, showing mixed red and green algae growing on the geo-textile surface. Photograph by Ray Drabble

By the time of the initial survey in early 2010 the surfaces of the reef were already colonised with a variety of life, with approaching 100 species of

plants and animals observed.

The horizontal upper surface of the artificial reef was covered in mixed red and green algae, which bathymetric surveys, supported by diver ground-truthing, revealed grew in the region of 30-60cm during the summer months. The vertical walls were encrusted in short animal turf, primarily ascidians which were both abundant and diverse with a total of 13 species recorded. In the sheltered crevices towards the base of the reef, larger mobile animals including greater pipefish (*Syngnathus acus*) and spiny spider crabs (*Maja squinado*) were recorded.



Fig. 2 Velvet swimming crabs (*Necora puber*) pre reproduction. Photographed in September 2010 at the base of the surf reef. Photograph by Matt Doggett

There was some evidence of Boscombe surf reef acting as a spawning area with eggs of a number of invertebrates including paddleworms (Phyllodoctidae), nudibranchs and whelks (*Buccinum undatum*) observed. Juvenile pollack were observed in high numbers, as were additional unspecified juvenile members of the Gadidae family.



Fig. 3 Eggs of the common whelk (*Buccinum undatum*) at the base of the surf reef. Photographed in June 2010. Photograph by Ray Drabble

Amongst the many species recorded were a number of non-natives, including the sea squirts *Corella eumyota* and *Styela clava*, and the algae *Grateloupia turuturu* and *Sargassum muticum*.



Fig. 4 A heavily encrusted leathery sea squirt (*Styela clava*). Photographed in September 2010. Photograph by Kathryn Dawson

Discussion

Artificial structures are increasingly being established in the marine environment for a wide range of applications; for industry, coastal defence and for recreational purposes (Jenson *et al*, 2000). The works often court controversy and there is a need to establish the wider impact and benefit, and to learn from existing structures how future construction might be designed to benefit the conservation of biodiversity and fisheries resources and contribute to an understanding of ecosystem functioning (Airoidi *et al* 2005). This structure, unique in form and function, creates an opportunity to make a valuable contribution to this body of research; the study is a partner of the URBANE project that seeks to enhance the biodiversity of new structures through sensitive design (<http://urbaneproject.org/>).

Although only preliminary results have been gathered, some observed signals of the ecological impacts of the reef are consistent with other recent work; artificial structures can act as fish attractors or producers (Cenci *et al* 2011) and high numbers of juvenile Gadidae observed on the Surf Reef, would suggest it is playing a role in fish production and distribution. The presence of a number of non-native species is of interest as research suggests non-indigenous epifauna are able to exploit artificial structures more effectively than native species (Bulleri and Chapman 2010). In addition, previous studies have shown that even when native species are present, artificial reef communities may differ

from those on adjacent natural structures (Hiscock *et al* 2010).

The reef is still biologically very young and its inhabitant fauna and flora is likely to change considerably in the coming years. Over time, this research will allow us to build a more complete picture of life on the reef, compare it to existing structures in the locality and assess its impact on the ecology of Boscombe seafront and Poole Bay.

Acknowledgements

The authors would like to thank Mike Markey, skipper of Peveril Myth and the Seasearch divers who contributed to this study: Amy Dale, Matt Doggett, Ray Drabble, Julie Hatcher, Sally Keith, Jenny Mallinson and Steve Trehwella.

The study is funded by the Esmée Fairbairn Foundation.

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A celebration of life on seamounts

Jason Hall-Spencer¹, Malcolm Clark², Mireille Consalvey², Ashley Rowden¹, Karen Stocks³, Thomas Schlacher⁴

1. Marine Biology and Ecology Research Centre, Marine Institute, University of Plymouth
2. National Institute of Water & Atmospheric Research, Wellington, New Zealand
3. University of California, San Diego, SDSC, USA
4. University of the Sunshine Coast, Queensland, Australia

Seamounts are underwater mountains, usually of volcanic origin, and it is estimated that worldwide there are more than 30,000 seamounts over 1 km high (Yesson *et al.*, 2011). Seamounts are found in all ocean basins, but very few have been sampled, with less than 300 (<0.1%) surveyed in any great detail. The Census of Marine Life field programme on Seamounts (CenSeam) started in 2005 and brought together more than 500 seamount researchers, policy makers, environmental managers and conservationists from every continent (Consalvey *et al.*, 2010). The project addressed two main themes:

- 1) what factors drive community composition and diversity on seamounts, including any differences between seamounts and other habitat types?, and
- 2) what are the impacts of human activities on seamount community structure and function?

At the outset of CenSeam, understanding of seamount ecosystems was hampered by significant gaps in global sampling, by heterogeneous approaches and sampling methods, and by a lack of large-scale synthesis. CenSeam helped connect, focus and collate the efforts of many international researchers and has facilitated a variety of seamount research initiatives, encompassing direct sampling, data mining and subsequent data analysis. When CenSeam commenced, several widely-accepted assumptions about seamount ecology existed. It was widely thought that seamounts usually had high levels of endemism, that they supported isolated, island-like populations, and that their elevated biomass was supported by upwelled nutrients enhancing local primary productivity. In the intervening five years, through a combination of new field-sampling and analyses of existing data, the CenSeam scientific community has challenged and revised many of these paradigms (Rowden *et al.*, 2010). For example, researchers at the University of Plymouth showed that seamounts do not have high levels of endemism and that, where seamounts occur close to continental shelves and banks, they can support

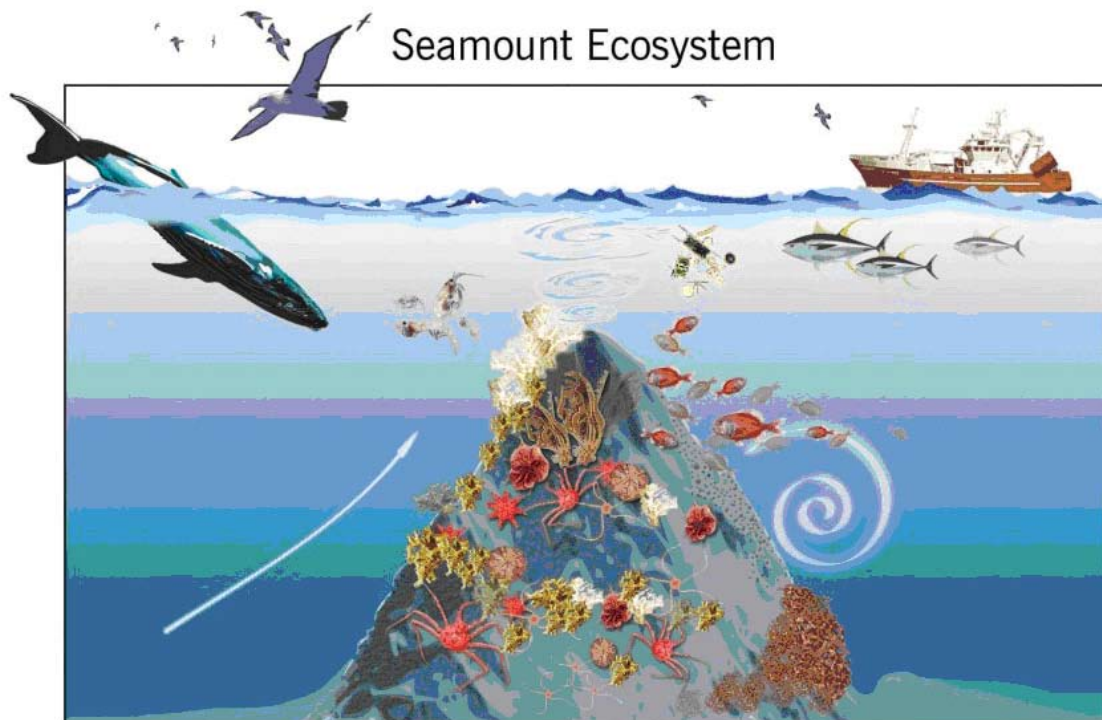


Figure 1 The CenSeam field program investigated what factors drive community composition and diversity of seamounts, and was designed to understand better the impacts of human activities such as fishing on seamounts (Erika Mackay, National Institute of Water and Atmospheric research)

similar communities (Hall-Spencer *et al.*, 2007; Howell *et al.*, 2010).

At the inception of CenSeam, the first global map of seamount sampling highlighted that the Indian Ocean, South Atlantic, and the Western and Southern Central Pacific were major under-sampled regions. Since 2009 seamount researchers have secured funding to support expeditions to the Indian Ocean, South Atlantic and South-West Pacific, and research is ongoing in these regions. Each voyage has revealed species and discoveries new to science. More than 150 species have been formally described through CenSeam and many more await description by taxonomists.

Anthropogenic impacts on seamount communities are of global concern. CenSeam has undertaken research critical to improving seamount management, including demonstrating that seamount benthic communities are vulnerable to human impacts and slow to recover from disturbance, but can be protected using satellite-based vessel monitoring (Hall-Spencer *et al.*, 2009). Recognising that we cannot study all of the world's seamounts, CenSeam researchers used the latest modelling methodologies to create maps of predicted coral habitat suitability, and identify regions most vulnerable and most at risk from fishing and climate change (Clark & Tittensor 2010, Tittensor *et al.* 2010). Furthermore, CenSeam researchers were involved in the creation of the first global seamount classification, which will help environmental managers include representative seamounts in networks of marine protected areas (Clark *et al.* 2011).

Where next?

CenSeam finished in 2010, and, recognizing that deep-sea habitats should no longer be studied in isolation, the deep-sea Census of Marine Life field programmes have been succeeded by the International Network for Scientific Investigations of Deep-Sea Ecosystems (INDEEP). The long-term overarching aim of INDEEP is to create a global network of committed scientists (including a substantial proportion of younger-generation scientists) with a wide variety of skills to maintain and develop further the international collaborations first fostered during the Census of Marine Life. INDEEP will address key gaps in knowledge relating to deep-sea ecosystem science across habitats and, crucially, will also provide a framework to bridge the gap between scientists and policy makers.

The initial three year element of the INDEEP programme will focus on the need to identify and address gaps in knowledge around five scientific topics:

1. to address gaps in taxonomic knowledge for key groups;
2. to determine global biodiversity and biogeography patterns for all habitats;
3. to establish connectivity patterns amongst habitats and ecosystems;
4. to understand ecosystem function and community resilience;
5. to address the effects of anthropogenic impacts, providing the necessary information for science policy.

An open INDEEP meeting is planned on the 26 September 2011 at the World Conference of Marine Biodiversity in Aberdeen. For information or to register please contact Mireille Consalvey (m.consalvey@niwa.co.nz) and Maria Baker (mb11@noc.soton.ac.uk).

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Observations of intertidal life beneath Mumbles Pier, south Wales

Judith Oakley, Oakley Intertidal

info@oakleyintertidal.co.uk



Mumbles pier is located three miles from Swansea (OS Grid Ref: SS614879). The pier extends approximately 250 m seawards, west of Mumbles Head, in a north-easterly direction across Swansea Bay. It was opened on 10th May 1898 and is a tribute to Victorian architecture. It was constructed of lattice steelwork on cast iron piles, with a pitch pine deck and was once the way to travel to Swansea, north Devon and Somerset (National Piers Society, no date). The White Funnel Steamers would dock on the end unloading hundreds of tourists, to Mumbles via the first passenger railway. On one day in the 1930s, over 20,000 people visited the pier by land and another 3,000 by sea (Strawbridge 2007). The pier is used presently mainly as a fishing location or for taking a view across Swansea Bay.

A lifeboat station and walkway was added at a right-angle to the main pier neck c1920, and is still used by the RNLI today. On 1st October 1937 the running of Mumbles Pier was taken over by AMECO Ltd. The pier, lifeboat station and slipway were notified as Grade: II Listed on 31 July 1991. Mumbles Pier was listed principally for its special interest as one of only 6 iron piers to survive in Wales, of which it is the third longest (Anon 2009). There are currently extensive plans for redevelopment, with a new £39 million scheme to refurbish the pier and build a 150 bed hotel and spa, a conference and exhibition centre, all weather attractions, amusement arcade, boardwalk and restaurants nearby.

Mumbles is one of the few piers where intertidal life can be investigated, due to the high tidal range of the Bristol Channel. The tidal range at Swansea is 10.4 m with a spring range of 8.5 m. The annual mean wave height is 1-1.2 m. A low tide of 0.5 m or below is essential to allow access to the pier piles and stanchions and around 0.1 m to venture under the lifeboat station. Around Mumbles Pier, the intertidal zone is more sheltered than other parts of Swansea Bay. The headland at Mumbles Head provides some protection from prevailing south-westerly winds. Tidal current speeds vary from 0.1 to 0.5 m/s. Salinity varies from 25 to 33 ‰ and the amounts of suspended solids range from 10 to 600 mg/l (Callaway 2010).

My observations since 2004 have revealed an incredible assortment of animal life living below the pier. My main observation period has been from 2007 to the present, after an interesting and inspiring meeting with Prof. Peter Hayward at Swansea University. Due to the redevelopment plans, and the lack of survey information available, I initially wanted to extensively investigate the intertidal life below the pier before any of this work began, and potentially disturbed or destroyed the habitats. I have returned to continue my observations at every suitable low tide since and have recorded around 86 species.



There are a range of habitats below the pier and on the nearby foreshore. These include under and on boulders, on the legs and stanchions of the pier and lifeboat station, in shallow pools, in sediment and on and under two parallel disused sewage pipes. These outfall pipes date from around 1800 and were the original outfall of sewers. They have been disused since 1925/6 and luckily never removed. They provide a refuge for an array of mobile animals under the pipes and sessile animals attached to the pipes.

A diverse assemblage of fauna is present on the pier pilings, including encrusting sponges, bryozoans, cnidarians and ascidians. The marine fauna comprises mainly filter feeders typical of tide-swept

environments. The lower shore in the immediate vicinity of the pier consists of mixed sediments with boulders and cobbles, overlaying fine muddy sand. It is moderately exposed to wave action. Every rock around the pier is covered in bright orange growths of the sponge *Hymeniacidon perleve*. There are extensive common mussel *Mytilus edulis* beds below the pier, and they grow on the legs and on discarded fishing nets hanging down. The largest and fattest common starfish *Asterias rubens*, I have ever seen on any shore, live here, patrolling the mussel beds. Many measure 34 cm across. This is the only location where I have witnessed common whelks *Buccinum undatum* laying egg capsules.



Pier stanchion - ©Judith Oakley

The sewage pipe is covered in encrusting sponges such as *Dysidia fragilis*, hydroids and ascidians. Hanging underneath the pipe are many growths of the soft coral deadman's fingers *Alcyonium digitatum*, the non-native leathery sea squirt *Styela clava* and good sized rosy featherstars *Antedon bifida*. The community here consists mainly of 'overhang' species. In shallow pools below the pipe are abundant common prawns with occasional long-spined sea scorpions *Taurulus bubalis*, corksling wrasse *Crenilabrus melops*, dragonet *Calionymus lyra* and snake pipefish *Entelurus aequoreus*. One of my highlights was finding a species I have never found on any shore before – a greater pipefish *Syngnathus acus* with a distinctive banded body, long snout and shape of tail fin.



Greater pipefish - ©Judith Oakley

The Crustacea are well-represented, with 18 species mainly occurring under stones. These include squat lobsters *Galathea squamifera* and plentiful long *Pisidia longicornis* and broad-clawed porcelain crabs *Porcellana platycheles* with increasing numbers of Risso's crab, *Xantho pilipes* (a western species).



Risso's crab - ©Judith Oakley

The Mollusca are also well-represented by at least 18 species of sea slugs, sea snails and gastropods. In the spring months, sea slugs congregate in large numbers to spawn on the foreshore and outfall pipes. In February and March, thousands of barnacle-eating *Onchidoris bilamellata* gather and piles of their spawn cover the foreshore and rocks. Scattered along the outfall pipes, tiny white sea slugs *Goniodoris nodosa* with egg masses can be found. The sea lemon *Archidoris pseudoargus* has a plentiful supply of large growths of breadcrumb sponge *Halichondria panacea* on the stanchions. This large sea slug has brilliant colouration, with specimens mainly in shades of purple under the pier.

The abundance of various species of sea squirt attracts frequent spotted cowries *Trivia monacha*. On the farthest stanchion that it is possible to reach on foot, the girders are covered in plumose anemones *Metridium senile*, interspersed with large volcano barnacles *Balanus perforatus* and massive sponge growths including the red *Ophlitaspongia seriata* and yellow *Suberites ficus*.



Spawning mass of *Onchidoris bilamellata* ©Judith Oakley

Large dahlia anemones *Urticina felina* are found occasionally, burrowed into the sand and covered in pieces of stone and shell or hanging off the pipe. Snakelocks anemones *Anemonia viridis* are rare, living in the muddy sand on the shore.

Rarely, large flat oysters *Ostrea edulis* grow on the rocks and sewage pipes. Even though this species is identified for priority conservation action, it is still collected as a delicacy by a few locals and once formed extensive beds in Swansea Bay, hence the local area of Mumbles called Oystermouth. At its peak in the 1880s, the oyster industry had nearly 200 ketches operating out of Oystermouth. When the boats put to sea, the main destination was the oyster beds located beyond Mumbles Head (Strawbridge 2007). The oysters were still being sold in oyster bars along the Southend seafront up to the mid-1930s. It was claimed the local oysters had 'a refined and delicate taste'. There are still local aspirations to re-start the oyster industry and to open champagne and oyster bars along the seafront.



Rosy featherstar - ©Judith Oakley

The pier and surrounding shore seems to provide a never ending supply of free produce. Soft or peeler crabs are highly sought after for bait by local fishermen, many of whom fail to replace any of the hundreds of rocks they overturn. In doing so, they crush many unwanted species and leave others to die as they are exposed to the elements. Common lobster *Hommarus gammarus* are also collected, together with fish and other species for home aquaria. Razorshells *Ensis* sp. are taken from the foreshore either for bait or for eating and lugworm are also dug up for use as bait. Common mussels are collected from the pier legs for eating, together with common periwinkles *Littorina littorea* from the foreshore and shrimps and prawns netted from under the pipes and surrounding the pier. All of this is of great concern as the sustainability is questionable and the impacts on local ecology largely unknown.

At very low spring tides, the intertidal life below the lifeboat station can be surveyed. During the March springs this year, there were two suitable

tides of 0.1m. An assortment of fallen metal grills lie below this section of the pier. Clinging to them are hundreds of rosy feather stars *A. bifida*. Large flat rocks shelter large specimens of five bearded rockling *Ciliata mustela* and occasional shore rockling *Gaidropsarus mediterraneus*. The stanchions provide a suitable habitat for extensive colonies of dead man's fingers and the bryozoan *Flustra foliacea*. Plumose anemones are also abundant here.



Growths of deadmans fingers and F.foliacea - ©Judith Oakley

Non-native species are dominated by the leathery sea squirt *Styela clava*. This species has made full use of the man-made structures and is abundant on the outfall pipes as well as on the lower pier legs. I counted 45 individuals in 10 minutes along 2.5 m of pipe. This is nearly a two-fold increase since 2008. The non-native American slipper limpet *Crepidula fornicata* is abundant on the shore, forming long chains and stacks on the mud and sand, and growing on shells, rocks and on pieces of discarded glass and pottery.

Because of my findings and the abundant life thriving under Mumbles Pier, I attended a Public Meeting regarding the Mumbles Pier redevelopment and was able to question the developers directly. They assured me that not only would environmental impact assessments and seabed surveys be undertaken, but that the lower piles of the pier would remain *in situ* and the pier is to be rebuilt from these upwards. Only the parts above these i.e. the steel lattice work and timber joints are to be replaced as they are 'beyond maintenance'. I am hopeful that the intertidal life exposed only at the lowest tides will continue to flourish, despite any disturbances from the pending developments. I will continue to survey and monitor this fascinating site and report my findings.

FOOTNOTE: In June 2011, City and County of Swansea councillors supported the proposal and Mumbles Pier officially closed on 20th July until the end of 2013 for the start of the £9.5 million restoration project. Several sections of the superstructure will be removed to allow loading tests to be undertaken. These will

confirm whether earlier assessments that the cast iron stanchions are able to support the new steel framework and decking are correct. For updates see <http://www.mumblespierdevelopment.com/>

Mumbles Pier Intertidal Species List

Porifera

Dysidia fragilis
Suberites ficus
Myxilla incrustans
Halichondria panacea
Ophlitaspongia seriata
Grantia compressa

Hydroids

Obelia sp.
Nemertesia sp.

Cnidaria

Anemonia viridis
Actinia equina
Metridium senile
Urticina felina
Alcyonium digitatum

Polychaetes

Sabellaria alveolata
Eulalia viridis
Nereis sp.
Spirobis spirobis
Pomatoceros lamarcki
Lanice conchilega
Arenicola marina

Crustacea

Pagurus bernhardus
Porcellana platycheles
Porcellana longicornis
Carcinus maenas
Cancer pagurus
Necora puber
Maja squinado
Liocarcinus depurator
Xantho pilipes
Pilumnus hirtellus
Hommarus gammarus
Palaemon serratus
Macropodia rostrata
Inachus phalangium
Galathea squamifera
Balanus perforatus
Austrominius modestus
Chthamalus montagui
Semibalanus balanoides

Mollusca

Buccinum undatum
Ensis sp.
Trivia monacha
Chlamys varia
Mytilus edulis
Ostrea edulis
Anomia ephippium
Hinia reticulata
Nucella lapillus
Ocenebra erinacea
Lamellaria latens
Archidoris pseudoargus
Flabellina pedata
Onchidoris bilamellata
Coryphella lineata
Facelina auriculata

Aeolidia papillosa
Goniadoris nodosa

Bryozoa

Bugula sp.
Flustra foliacea
Membranipora membranacea
Flustrellidra hispida

Echinoderms

Antedon bifida
Asterias rubens
Ophiothrix fragilis
Amphipholis squamata

Ascidians

Aplidium proliferum
Ciona intestinalis
Diplosoma listerianum
Asciidiella scabra
Botrylloides leachi
Dendrodoa grossularia
Molgula sp.
Botryllus schlosseri

Fish

Callionymus lyra
Syngnathus acus
Taurulus bubalis
Ciliata mustela
Crenilabrus melops
Pholis gunnellus
Lipophrys pholis
Pomatoschistus minutus
Entelurus aequoreus
Trisopterus luscus
Gaidropsarus mediterraneus

Non native species

Crepidula fornicata
Styela clava

Total: 86 species (March 2008- March 2011)

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Tracking the Solent Seals

Jolyon Chesworth

Hants and Isle of Wight Wildlife Trust
Beechcroft House, Vicarage Lane, Curdridge,
Hampshire SO32 2DP

With fur, whiskers, big eyes and a curious nature, seals are some of the UK's most charismatic creatures and one of the "must see's" for many naturalists and scuba divers. If you wanted to tick these animals off your list you may think you would need to head to quiet isolated locations but encounters can often take place even in busy areas, such as the Solent.

There are two species of seal resident in the UK. Grey seals (*Halichoerus grypus*) tend to prefer rocky, exposed areas and so are more common in the south west and off the coasts of Wales and Scotland. Harbour, or common, seals (*Phoca vitulina*), as their name suggests, prefer sheltered harbours and estuaries. They are harbour seals that are most frequently found in the Solent due to its sheltered nature. Distinguishing between the two species is best done by looking at the head and muzzle shape, grey seals have a 'roman nose' with no distinct forehead, harbour seals have a more dog-like head with a distinct forehead.



Figure 1a. Grey seal head shape. Photographer Chas Spradbery



Figure 1b. Harbour seal head shape. Photographer Chas Spradbery

The UK is home to approximately 35% of the global population of harbour seals, however, in some places these populations have declined by as much as 50% in the last 10 years (Special Committee on Seals 2009). Reasons for these declines may include competition with grey seals where populations overlap, predation, disease or shooting by fishermen. Very little was known about the Solent seal population or if it was experiencing similar declining trends. The Wildlife Trusts and Chichester Harbour Conservancy initiated a project with the Sea Mammal Research Unit (SMRU) to investigate further.

Harbour seals are thought to have been living in the Solent for several decades, however it wasn't until 1994 when people started recording their numbers, back then they were able to count just three! Regular counts continue and the population has increased over time to an estimated 18-25. However, we had no idea as to where their most important sites were for resting, feeding and breeding. This was a focus of the study as in order to conserve a species, you also need to conserve its key sites. We were also interested in migrations, French harbour seal studies have shown seals migrating from northern France, across the Channel to the Solent and along the coast towards harbour seal populations off Kent. We were interested to know if the Solent was a stepping stone between these larger populations.

Studying seals is a tricky business, they can range many kilometres to feed and spend significant amounts of time underwater. We utilised various techniques to assess population size and movements, including public reporting forms, regular visual surveys at haul out sites and photo-identification techniques. The markings on the seal pelage are unique to each individual, by photographing them and looking for distinct marks it is possible to identify individual seals and effectively track them around the area and monitor changes to populations as seals arrive or disappear. In the Solent, this can be complicated by seals getting covered in mud or developing a deep copper colour to their pelage that can disguise these marks.

One of the best ways to gather data on mobile animals such as seals is through the use of telemetry. SMRU have developed tags based on GSM mobile phone technology, these tags contain GPS and sensors that record wet/dry time, dive depth and duration, which can indicate foraging behaviour. In February 2009, after 4 days of heavy work wading in soft mud and hauling in nets, which the seals frequently escaped from, the project team managed to capture 5 seals to attach with tags. Tags are fixed with an epoxy resin and fall off naturally during the annual moult in June / July, giving us approximately 5 months

of data per tag. Of the five seals caught, four were adult males and one was a juvenile female, it is not clear if this reflects the sex ratio of the population, or whether it is just easier to catch the males. We did hope to catch a mature female to potentially aid identification of breeding areas but a seal in the net is worth two on the bank and we couldn't afford to be choosy!



Figure 2. Tagged harbour seal. Photographer Jolyon Chesworth

With no previous knowledge of seal movements, the data received from the tags has been hugely informative. Harbour seals are regarded to be less wide ranging than grey seals, rarely venturing more than 60 km from their haul-out sites. The Solent seals were no more adventurous and stayed almost entirely within the Eastern Solent, from Southampton Water to Selsey Bill, often crossing the Solent to visit the Isle of Wight. The widest ranging seal swam to Worthing, approximately 60 km from the haul-out, on a three day trip, sleeping at sea and diving down to depths of 60 m. They have also been found to hold their breath for up to 25 minutes when feeding, although average dive times are around 4 minutes.

Our photo-identification and sightings data, when combined with historical evidence we have collated, suggests that the Solent seal population, although very small, does not seem to be showing the declines seen elsewhere in the country, and 1-2 pups have been seen each year. The tag data has identified all of their haul-out sites, the most important of which are in Langstone and Chichester Harbours. We have also located 15 foraging grounds that are regularly used. Some seals were extremely faithful to just a handful of feeding areas, whereas others utilised a greater number of sites. Temporal variations were also noted, with seals shifting foraging focus at different times of year, presumably to follow certain prey species that move through the area.

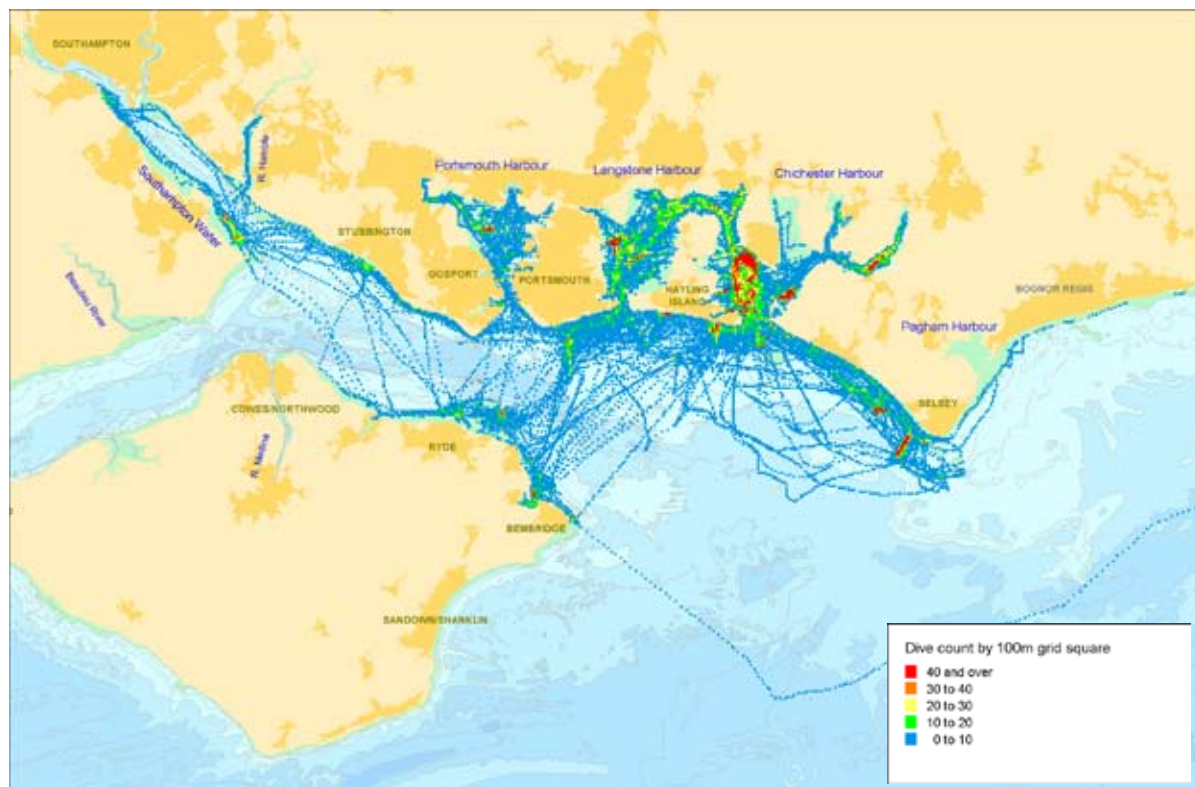


Figure 3. Tagged seal dive behaviour showing frequency of dives to illustrate primary foraging grounds. © British Crown and SeaZone Solutions Limited. All rights reserved. Products Licence 032009.008.

In order to identify any foraging habitat preference, towed video was conducted over foraging grounds. There did not appear to be any clear preference, with seals feeding over a variety of different habitats, from mixed sediments to sandy and muddy channels and rocky reefs. Artificial rock structures, such as anti-submarine walls were also targeted for foraging.

With the Solent seal population being small and coexisting with heavy human activity, it is potentially vulnerable and the loss of even a few individuals or important sites could have significant consequences for the population. To assist our conservation efforts the data has been supplied to the Marine Conservation Zone project to inform possible locations of protected areas, with some key foraging grounds now within draft MCZs.



Figure 4. Harbour seals resting. Photographer Mark Heighes

Acknowledgements

Funding for the project was received from Natural England, Sita Trust, Solent Forum, Hampshire Wildlife Trust, Chichester Harbour Conservancy and Friends of Chichester Harbour. The project would not have happened without the assistance of the Sea Mammal Research Unit, who manufacture the GSM tags and more importantly are able to catch the seals to deploy them.

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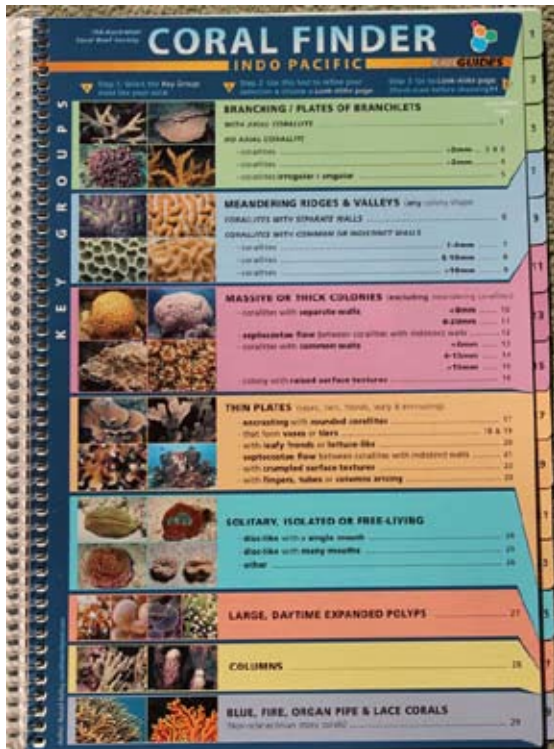
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Indo Pacific Coral Finder by Russell Kelly

2009. Published by BYO Guides, Townsville. Available from www.byoguides.com or coralfinder@gmail.com AUD72.68 (about £47) plus p&p (AUD40, about £25)

Book review by Frances Dipper



In February this year I went out to Sabah as a volunteer with Elizabeth Wood to assist in a Marine Biodiversity Training Course for Sabah Parks staff, organised through the Marine Conservation Society Semporna Islands Project. The two one week long courses were based on training the participants to identify corals to genus level using a new type of underwater guide. The course leader was Russell Kelly himself, ably assisted by his wife Rachel Pears. Having helped on coral surveys in this area for more than 10 years I was reasonably familiar with the corals but had never done any serious identification. Liz is the expert and I was too busy working on sponges, soft corals and sea fans! The Coral Finder was no less than a revelation! With a modicum of common sense, familiarisation with a few technical terms and an interest in learning about corals, any reasonably intelligent diver could soon learn to identify accurately the 83 genera in the guide.

The guide works on a practical level rather than on a systematic level. So using the first page you decide which of 8 categories your coral falls into. For example branching coral or thin plate coral. You then also decide which of just a very few sub-categories it falls into. Again for example whether your branching coral has an axial corallite or not (this is easy), or what size category the corallites fall into (there is a scale on the coral finder!). You are then guided to two or three 'look-alike' pages where, with a little practise you will find your coral amongst three to six coral genera on each page. The identification relies very much on visuals with excellent photographs and cleverly arranged minimal text describing the characters. I can now tell the difference between *Montastrea* and *Favia* underwater by looking for extra- or intra-tentacular budding! Sounds daunting? Well it isn't. If I can do it then so can you!

The physical construction of the guide is excellent. It is A4 size with a clear protective cover on the front and a writing board as the back. The tough, plastic pages turn easily and are held together with a robust plastic ring binder. It has been cleverly weighted so that it will float if being used by a snorkeler but by attaching a suitably sized metal karabiner to it, it becomes just negatively buoyant and so can be put down on the seabed by a diver if need be. Personally, I keep mine clipped to me as I am an expert in dropping things underwater!

Back on dry land it is also excellent for confirming the identification of any photographs you have taken. In fact I find it works best in conjunction with a small digital camera with which to take close up photos. That way you can check your IDs with coral finder in one hand and a beer in the other – not possible underwater!

The Coral Finder is backed up by a comprehensive website complete with training videos so it is entirely possible to teach yourself at your own pace. Access to the large three-volume "Corals of the World" by Jen Veron is also helped by reference in the coral finder to the relevant pages in these large tomes so saving you time.

The participants in the two courses I helped

with, all showed impressive improvements in their coral identification skills as measured by 'before' and 'after' identification tests. As I did too! This in spite of language difficulties (most were Malaysian). Although relatively expensive, especially once postage has been added, this is a really good identification guide. It would be worthwhile trying to combine orders to save on airmail costs and if anyone is interested I would be happy to co-ordinate this if you email me. The guide is currently being updated and improved following our and other users comments and I personally am looking forward to using the new version next time I get to dive in nice warm water. Stopping and reading a book in UK's frigid waters might take a little more doing. Good thing there are no shallow water coral reefs here then!

Exciting new way to access information on benthic sediment dwelling animals.

MarineLife – Genus Trait Handbook iPhone App.

<http://itunes.apple.com/gb/app/marinelife-genus-trait-handbook/id413654051?mt=8>

Review by Anne Bunker



You don't have to have an iPhone to be interested in or to understand this review. Take care though, it might make you want one! The App (application) is just a neat little version of the website that works off line to enable you to play while waiting in a

supermarket queue or on a boring journey (or carry out your last minute work on your way to a meeting?). It might provide a better use for your time than playing Angry Birds.

Background

Marine Ecological Surveys Ltd., in collaboration with MarLIN* and DeepBlueSky, have developed the Marine Macrofauna Genus Trait Handbook as an online evolving resource for use by the marine science community and those scientists involved in the planning and implementation of aggregate licenses. The original handbook was intended to assist in the assessment of the impacts of marine aggregate dredging on benthic resources as well as in the prediction of the potential that individual genera have to recolonise and the time that may be required for restoration of the biomass. An update has been published both as a website www.genustraithandbook.org.uk and as a Gardline Environmental Ltd. match funded iPhone App. The iPhone App is available as a free download and, once downloaded, can be used off line. Reciprocal links exist between the Marine Macrofauna Genus Trait Handbook website and the MarLIN Biological Traits Information Catalogue (BIOTIC) website.

This application covers over 200 genera of marine benthic animals that live on, or in, the seabed and as well as giving the sensitivity of these animals to the impacts of aggregate dredging, it has general information and images.

Content

The Genus Trait Handbook makes it clear that this is a work in progress – the advantage of a web-based application. The genera have been selected as they live in the types of habitats that may be dredged as aggregates from the seabed around the UK. These aggregates provide an important raw material for the construction industry, for beach replenishment and for flood and coastal defense schemes. Any criticism that a certain genus is not represented or that some genera don't have photographs (e.g. *Amaeana*, *Acanthocardia*) or traits (e.g. fecundity for *Ascidella*) should not therefore be justified at this stage – they can be added as and when there is time or

funding. There are some strange inclusions and omissions though. *Caecum*, with the only known occurrence of the genus being *Caecum armoricum*, an interstitial mussel, in the Fleet, Dorset, is included. *Sagartiogeton*, an anemone commonly found in sand and gravel is not included.

The vulnerability of each genus to aggregate dredging is assessed as vulnerable, intermediate or robust. The assessment is based on seven biological traits (size, lifespan, age at maturity, fecundity, substratum preference, larval motility and adult motility) and full details of the assessment are provided. The information is a cut down version of that on the MarLIN website and the same text as used on the BIOTIC website. Some of the text needs a bit of proof reading to correct a few things:

Some Latin names are not in italics,

Some sentences don't read correctly (e.g. for *Sagartia* the text reads "fertilization occurs in the water column and the developmental mechanism is planktotrophic viviparous", which I consider to be rather confusing and not the full picture. It would be better to explain that *S. troglodytes* is habitually viviparous but *S. elegans* habitually and frequently reproduces by basal laceration but longitudinal fission has also been observed (Manual, 1988),

Squashed photographs e.g. *Buccinum*.

It's good to have both a reference section and a fairly comprehensive glossary. Some of the dredge terminology doesn't appear in every glossary related to benthic animals so is a valuable addition. Terms such as Dredge zoning, Anchor dredge and Draghead are clearly defined. Not every term used appears in the glossary though, viviparous being one of them, so room for some additions.

My opinion is that it is a very useful tool and a helpful resource. However, there is still the need for expert interpretation because quoted out of context, without supporting information about area dredged, nature of sediment after dredging, surrounding areas etc. the wrong conclusion about recovery from dredging impacts could be reached. Take the sea squirt *Ascidella* – its vulnerability is stated as intermediate but the detailed text reminds

us that recovery may be fast **if** cobbles and boulders remain for attachment after dredging. Two bivalves in the vulnerable category are *Artica* and *Cerastoderma*. Amongst other things, the life spans of the two genera are very different with *Artica* having a life span of over a hundred years and *Cerastoderma* 6 to 10 years. I feel this one category is hugely broad. I struggle a bit with the idea of looking only at genus level when considering impacts but that is a long running debate that readers may wish to contribute to. It works well for a genus with few species or where species of a genus have similar habitat preferences and biology. For a genus like *Pomatoschistus* (sand gobies) where, for example, *P. pictus* Painted Goby prefers coarser sediment to *P. microps* Common Goby and *P. minutus* Sand Goby, I feel it doesn't work as well.

Operation

Deep Blue Sky Digital Ltd has done an excellent job of making the handbook into an iPhone App. It isn't their fault that the 283 MB file threatened to take 31 hours to download on the first attempt on my slow broadband connection! Once the connection improved it was easy and straightforward to download and install. There are various ways of accessing the information. It is possible to scroll through the entire genus list, or narrow down to 6 different groups (Molluscs, Echinoderms, Annelids, Crustaceans, Fish and "other" – everything that doesn't belong to the first five groups). Vulnerability, sediment or traits can be searched separately. Everything fits and scrolls nicely. It works instantly. It would be good to be able to make the text bigger (altering the 'phone font size doesn't change the font on the App), but good reading glasses compensate! I missed out on Size, Age at maturity and Fecundity when going to traits for the first few genera I looked at because motility and lifespan fill the screen and I didn't realize it was necessary to scroll down. It is obvious after a few times.

The photographs display well and are still good quality when zoomed to fit the screen.

I expect that this App will be followed by other marine biology Apps. Having all this information at your fingertips when away

from books or the internet is great. If you are a Porcupine with an iPhone, download it straight away, you can convince your children that you are working whenever they want to borrow your phone to Facebook their friends. It's free too! I assume that if downloads are popular then additions and corrections are more likely too. I'm not ready to give up books yet though.

To download, search for marine life Genus Trait Handbook on Apple iTunes.

*The Marine Life Information Network

Reference

Manuel, R, L. 1988. British Anthozoa (Coelelerata: Octocorallia and Hexacorallia). (Synopsis of the British Fauna). The Linnean Society of London and the Estuarine and Brackish-Water Sciences Association.

How I became a marine biologist

Tammy Horton



I grew up in Leigh-on-Sea a short stroll away from the muddy waters of the Thames Estuary. From a young age, we spent many days of the summer holidays walking out on the intertidal mud flats following the tides retreat, crossing creeks to get to the 'Ray' for a swim. It was always a very muddy walk and I was in my element, spending ages hunting for cockles and crabs. I think my earliest marine biology experiments would have begun around this time and I can still remember discovering, much to my own dismay that you couldn't take cockles home and keep them in a bucket in the garden. No matter how many changes of fresh water I made....

I later decided I would be a Veterinary Surgeon. I spent school years with this plan in mind. Despite the fact that I was fascinated by the marine world (particularly dolphins of course), I had never considered marine biology as a career but I had at least heard of a Vet and knew what they did and that they worked with animals, so this was the obvious path.

When I didn't get the predicted grades at school to qualify for Veterinary school I decided to follow the family tradition and become a medical doctor instead. Thankfully I was rejected from all the universities I applied to. At this stage I very nearly enrolled on a degree course to study embryology at UCL through the clearing system. My father steered me in the right direction and I went off to Imperial College, London to study a for a Biology degree

with the wise words of my father ringing in my ears – ‘get a good grounding and specialise later’.

I was still fascinated by the world of marine biology, although I had been warned there were no real careers in it. While at Imperial I learned to scuba dive, spending all my spare time and money as a first year undergraduate in the swimming pool, learning my theory in the classroom or helping paint the tanks and look after the dive equipment (which I was promised would get me a guaranteed ticket on the summers’ dive trips). I became more fascinated by all the animals I was seeing on our coasts and positively thrived in any of my degree modules that included marine elements, or indeed any invertebrate zoology/ecology.

At the end of my first summer I signed up with Frontier a conservation organisation, and went away to a small island off the coast of Tanzania called Chole. Here I spent a blissful 10 weeks diving on both pristine and damaged coral reefs assessing the marine life providing data in order to set up Tanzania’s first multi-user marine reserve. It was fantastic. I was sold. THIS is what I wanted to do! Sadly, I still had a degree to finish...

I finished the degree and realised I needed to ‘specialize’ so this I duly did – by doing an MSc in Aquatic Resource Management’ at King’s College London. This introduced me to more Marine work – I spent a total of 6 weeks at Millport Marine Biological Station in Scotland and carried out my MSc thesis project at the MBA in Plymouth studying larval settlement of barnacles and tunicates in response to biofilms. Much to my dismay I seemed to be no more employable once all this was complete. I eventually got a job working in the head office of the Environment Agency. While I was lucky to have a job I was thoroughly bored with the actual job I was doing and felt a long way away from the marine biologist I had aimed to be. Working in the Environment Agency did open up other possibilities though and after 6 months I transferred to Huntingdon for a job working in the fish health laboratories. Here I indulged one of my other passions – parasitology.

I had written to many potential supervisors

during my year with the Environment Agency and told them of my interests. I realised while I was in the world of work that I really wanted to do more research. I eventually landed a PhD that was truly right up my street – it was a study of a possible new species of marine fish parasite. After a further 6 months with the Environment Agency I started my PhD at Reading University. Miles from the sea!

I was now probably what you would call a marine biologist...I spent summers doing fieldwork using my ‘sea plough’ to catch weever fish on low spring tides. I travelled to Lough Hyne and helped out with rocky intertidal surveys for a time series. I worked on fish farms in the Mediterranean; I also spent time at the Natural History Museums in London (under the supervision of Roger Lincoln – Amphipod hero) and Paris, all in pursuit of my PhD.

After my PhD I was lucky enough to get a job at the National Oceanography Centre in Southampton where I have worked ever since. I got the job on the strength of my work in taxonomy and this is the specialism I have continued with ever since. I now describe new species of deep-sea amphipod and am responsible for the management of the deep-sea specimen collections (the Discovery Collections), although I still have a lot of time for the nasty mouth inhabiting isopod parasites (Cymothoids) that I studied for my PhD...

I think the real ‘why’ of becoming a marine biologist and taxonomist (and ‘Porcupine’), stem from a desire to do one thing – a desire to discover and collect – new species names, new species records, new behaviours. The ‘how’ we get here can be by whatever means possible and the route really doesn’t matter.

Instructions to authors

Although we can deal with most methods and styles of presentation, it would make our editorial lives easier if those wishing to contribute to the Newsletter could follow these simple guidelines. Please submit all material in electronic format if at all possible either by e-mail or disc/CD.

Text

Please submit your paper, article, request for information etc. as a Word document. It will be a great help if you use styles to format titles, headings etc. Please use the following style names:

General text: "Normal"

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Author details/address: "Name"

Figure or table captions: "Caption"

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Don't add any spaces after paragraphs.

Insert placeholders to indicate where illustrations, photos, etc should be placed e.g. Insert Fig.1 here, and attach the illustrations, photos, etc separately rather than within the text.

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Illustrations (Figures and Plates)

Photographic images should be supplied as greyscale or colour (RGB) JPGs with a resolution of 300 pixels per inch and width of 7 cm. Save at high quality.

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For each illustration, photo etc. submitted, please provide the following information:

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References

Do not leave a line space between references. Please follow the examples below for format. Journal titles should be cited in full.

Citations are as followsBrown & Lamare (1994)... or.... (Brown & Lamare, 1994)..., Dipper (2001)... or ...(Dipper, 2001).

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.

That said, we will do our best with whatever you send.



Contents

AGM MINUTES	2
ACCOUNTS	5
PORCUPINE PIECES	
Invertebrate life of Brownsea Island Lagoon and its importance to the birds of Poole Harbour <i>Kathryn E. Ross</i>	6
Comments on the "Structure, function and evolution of polychaete crotchets", and annelid phylogeny <i>Andrew S.Y. Mackie</i>	8
PORCUPINE PROBLEMS - Information requests and observations	
Porcupine Small Grant Awards 2011	21
Porcupine MNHS Recording Scheme	21
A recent subtidal invasion by a red alga <i>Paul Brazier</i>	22
FIELDWORK FORAYS	
Expect the Unexpected! <i>Fiona Crouch</i>	24
Shopping Trolleys to Sea Monsters <i>Vicki Howe</i>	24
OBITUARY – Dr Richard Hamond	26
Esmée Fairbairn Collections Fund	27
PORCUPINE MARINE NATURAL HISTORY SOCIETY ANNUAL CONFERENCE 2011	28
CONFERENCE FIELD TRIP 2011	29
PORCUPINE 2011 PAPERS	32
BioScribe – a biotope matching decision support tool (Emu Ltd) <i>Dr Garnet J. Hooper, Peter Barfield, Dr Nigel Thomas and Evelina Capasso</i>	32
Scott, scientific baselines and detecting biological change in Antarctica <i>Barnes, D.K.A. & Kuklinksi, P.</i>	34
Artificial coastal defences: Enhancing biodiversity using sensitive design <i>Louise B. Firth</i>	37
Seagrass in the Solent <i>Amy Dale</i>	39
Postmarsupial development and intraspecific morphological variation in <i>Apseudopsis latreillii</i> (Milne-Edwards, 1828) (Crustacea, Tanaidacea) <i>Esquete P. and Bamber R.N.</i>	43
Parasite biomarkers of amphipod health (Short Note) <i>R. Mansergh, S. M. Cragg, and A. T. Ford</i>	44
Assessing the Impacts of the Chronic Exposure of Zinc and Copper on the Polychaete <i>Nereis Virens</i> (Sars) 1835 <i>J. Pini, G. J. Watson, Alex T. Ford</i>	45
Polychaeta of the Isles of Scilly: A New Annotated Checklist <i>Teresa Darbyshire</i>	46
Surf's up dudes! – The colonisation of Europe's first artificial surf reef, Boscombe, Dorset <i>Josie Pegg, Roger Herbert, Kathryn Dawson & Ken Collins</i>	51
A celebration of life on seamounts <i>Jason Hall-Spencer, Malcolm Clark, Mireille Consalvey, Ashley Rowden, Karen Stocks, Thomas Schlacher</i>	54
Observations of intertidal life beneath Mumbles Pier, south Wales <i>Judith Oakley</i>	56
Tracking the Solent Seals <i>Jolyon Chesworth</i>	60
REVIEWS	
Indo Pacific Coral Finder by Russell Kelly <i>Frances Dipper</i>	63
Exciting new way to access information on benthic sediment dwelling animals. <i>Anne Bunker</i>	64
How I became a marine biologist <i>Tammy Horton</i>	66