PORCUPINE MARINE NATURAL HISTORY SOCIETY

NEWSLETTER

Autumn 2012 Number 32

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Porcupine Marine Natural History Society

Newsletter

No. 32 Autumn 2012

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

Individual £18 Student £10
(new rates in effect from 1st January 2013)

www.pmnhs.co.uk

COUNCIL MEMBERS

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

@PorcupineMNHS

Cover Image: Seasearch diver collecting seaweeds (Seastacks, sponges & seaweeds survey, North Cornwall, 2011) – Kat Brown

Editorial

Recently I have been reflecting on what makes Porcupine what it is - a society made up of individuals from diverse and varied backgrounds, occupations and interests who are drawn together by a common interest in the natural marine environment. Sounds a mouthful! Ok, so perhaps it comes down to a set of people having a passion for a subject and wanting to both share and increase knowledge.

Individually and collectively we seem to do this in many interesting, creative and exciting ways. I recently went into my son's school and talked to year 2 children about being a marine biologist. I took in my dive kit and a rather large and beautiful giant triton *Charonia tritonis* (Linnaeus, 1758) shell which I inherited from my great grandmother. The children were great fun and all clearly had a natural and engaging curiosity for the marine environment which is something that has never left Porcupines. I know of other Porcupine members who have visited schools in their own time; Keith Hiscock posted a great image of his visit on Facebook not so long ago! Kat Sanders has contributed a very interesting article in this newsletter about the unique work Yorkshire Wildlife Trust are doing in schools and I hope this is taken up by other wildlife trusts throughout the country.

Engagement with the general public is also becoming more creative from Bioblitz events open to all (for example, that proposed for Strangford Lough, August 2013; see page 6, details coming soon) to Porcupine sponsored Seasearch surveys focusing on specific locations and groups of organisms (see the article in this issue by Angie Gall on Seastacks, Sponges and Seaweeds, North Cornwall 2011). There really is so much going on and I wonder where Porcupine fits in to extending and sharing knowledge of the marine environment, and how the Society should continue to develop? Certainly we have work to do in connecting to more undergraduates and I know that when I "discovered" Porcupine after graduating it was like finding a hidden gem. The newsletter (past issues of which can be downloaded from our website*) is just one way we can connect with people. Returning to the current Porcupine membership, the diversity of their interests is amply demonstrated by the range of contributions in this the latest Porcupine Newsletter. Happy reading.

*all members can obtain the latest newsletters in pdf format on request

Photo: Peter Barfield

ANNOUNCEMENTS

Marine Science Events Calendar goes live

The Marine Biological Association has been working with the Marine Science Coordination Committee to develop a freely accessible events calendar for national and international events relevant to marine scientists. The driver for this was the recognition that information on marine conferences, workshops and meetings emerges piecemeal and while some schedules collating these events exist, they are fragmented and appear across a number of different organisations. An on-line marine events schedule will therefore capture this information in one place with the following key aims:

- To enable more effective deployment of staff and timings of communication activities so as to make the greatest impact on the target audiences.
- Raise awareness within the wider scientific community of what events are taking place.
- Encourage greater publicity of marine events by the media.
- Aid planning of events (i.e. avoiding timetable clashes)

The calendar can be found at http://marinescienceevents.co.uk/ where you can also sign up and register your event for free.

To keep up to date on the latest events you can subscribe to the RSS feeds or follow the calendar on Twitter.

Request for information

The Marine Biological Association (MBA) is working with ABP Marine Environmental Research Ltd (ABPmer) on a review of ecological evidence for the proposed Marine Conservation Zones. We would like to hear from Porcupine members if they have any specialist knowledge relating to any of the UK MCZ sites. If you have any information that you are willing to share then please get in touch with the Project Manager – Claire Brown – at ABPmer on 023 8071 1864 or by email.

MB0116 - In-depth review of the ecological evidence supporting the recommended Marine Conservation Zones

The Ministerial Statement on Marine Conservation Zones (MCZ) published on 15th November 2011 included a commitment to an in-depth review of the evidence base for all the Regional MCZ Projects' site recommendations.

To address this commitment and support the work already being taken forward by Natural England (NE) and Joint Nature Conservation Committee (JNCC), Defra has appointed ABP Marine Environmental Research Ltd (ABPmer), supported by the Marine Biological Association of the UK (MBA) and Marine Planning Consultants (MPC), through open competition, to undertake a review of the ecological evidence.

The aim of the project is to build on and extend the evidence-base of the Regional Projects, NE and JNCC which will be used to support the designation of MCZs. It will also complement and extend the evidence reviews that have been recently undertaken by the Science Advisory Panel, NE and JNCC, as well as inform the statutory advice being provided by NE and JNCC. The study will deliver a comprehensive review of the evidence collected by the Regional Projects and will seek to identify any additional data/information relevant to the 127 recommended MCZ (rMCZs) and Reference Areas (rRAs), with particular focus on the Ecological Network Guidance (ENG) features; see http://jncc.defra.gov.uk/page-2409 for information on the location of the sites and the

detailed site reports. The study will also advise on how any new evidence would affect the confidence that may be placed in the evidence used for each feature within each site, based on the Evidence Protocols recently developed by NE and JNCC. The work will be undertaken in the period February to June 2012.

The study team is aware that many of you will have already supplied data and information during the data gathering exercises undertaken by the Regional Projects up to Autumn 2010, which has been invaluable in assisting with the recommendations made in August 2011. The Regional Projects, Defra, NE and JNCC are extremely grateful for all your contributions to date. However as part of the work to search for and identify potential additional information sources, particularly any data that have become accessible since Autumn 2010, the study team would like to engage with any organisation or individual that considers that it may have such evidence that would be relevant to any of the 127 rMCZ/ rRA sites.

While the study team will be approaching many organisations and individuals, they are happy to be contacted directly, and to receive information via the e-mail contact below. All submissions will be acknowledged. Prior to submission of data the study team will be available to speak to you to clarify any points, to discuss data agreements (to cover the use, storage and distribution of any information provided to the project) and the format to provide data in. Any material submitted will be documented and used to inform the confidence assessment.

If you would like to get in touch with the study team, please contact the Project Manager – Claire Brown – at ABPmer on 023 8071 1864 or by email cbrown@abpmer.co.uk .

Thank You

Peter Tinsley is standing down from the Porcupine Newsletter editorial team. The Council would like to thank Peter for his dedication and hard work in developing and producing the newsletter over the past few years. Thank you Peter.

Porcupine Marine Natural History Society Annual Conference and Field Meeting 2013: Swansea "Sea-change"

Outline programme

Friday 15 March

Field Meeting Worms Head, Gower.
Low water: 14.08 (GMT)

Saturday 16 March

First day of conference, Swansea University. (including the Annual General Meeting)

Sunday 17 March

Second day of conference, Swansea University.

Booking form and further details (including confirmed speakers and accommodation list) will be on the website http://pmnhs.co.uk/ at the beginning of December.

Fees for the three days:
£50 members
£60 non members (includes 2013 membership)
£40 students (includes 2013 membership)

Includes refreshments and buffet lunch on Saturday and Sunday. The conference dinner on Saturday 16 March is not included.

Although sea-change is about transformation, presentations will not be limited to those about change in the marine environment. Potential speakers should contact Anne Bunker: abunker@marineseen.com

Worms Head (B. Bullimore)

Worms Head: the rocky, jagged causeway joining the Worm to the westerly tip of the Gower Peninsula is exposed for 2.5 hours before and after low tide. Named Wurm, meaning dragon, by Viking invaders, the promontory is shaped like a giant sea serpent. There is a good selection of intertidal habitats including lots of very beautiful rockpools.

Porcupine Marine Natural History Society

Minutes of the 35th Annual General Meeting

Saturday 24 March 2012, 12:30, The Deep, Hull

1**. Apologies for absence** were received from Roger Bamber, Jon Moore, Tammy Horton, Paul Brazier, Peter Tinsley and Peter Barfield

2. **Matters arising from the Minutes of the 34th Annual General Meeting, as published in the PMNHS Newsletter No. 30.**

Acceptance of the minutes of the 34th Annual General Meeting was proposed by Frank Evans, seconded by Julia Nunn, and carried unanimously. There were no matters arising from the Minutes of the 34th Annual General Meeting.

3. **Officers' Reports**

The Hon. Treasurer's Report was presented by the Hon Chairman in the absence of the Hon Treasurer.

A summary of the Porcupine receipts and payments accounts for 2011 was presented with a few explanatory notes.

Subscriptions – the Membership Secretary Sèamus Whyte was very active in 2011 collecting back (and forward) subscriptions from members who had been out of date with their payments.

Bank interest – interest rates from the bank accounts is now very low and options for better accounts are being considered (more below).

Newsletter – costs are for the Autumn 2010 and Spring 2011 newsletters, but postage costs for the latter will be included in the 2012 accounts. Printing costs are increasing as we move to more colour in each issue.

Web site – costs are for the recent design and development work on the site (described elsewhere in this issue), plus the biannual webhosting fee.

Council meeting expenses - primarily for out-of-pocket expenses for Council members to travel to the November meeting.

Conferences – The School of Geography and Geosciences at St Andrews University, who organised the 2010 St Andrews conference, made a profit of £1060. It was agreed by Council to split this profit between Porcupine (£500), the Bell Pettigrew Museum at St Andrews (£280) and the School (administrative support) (£280). Booking of laboratory space for the Guernsey field meeting (April 2012) required a £200 deposit.

Grants – Three projects were approved for small grants in 2011, but only one of those (the Underwater Survey of North Cornwall 2011, organised by Emily Priestley) has so far been invoiced and paid for the work carried out.

Porcupine support for an earlier grant to Roger Herbert for a project on *Padina pavonica* has had an unexpected additional benefit. The Porcupine grant of £438 was to act as seed money for a much larger grant application: this was successfully obtained and, since the overall project ended with a small underspend, Porcupine is to receive a refund of £218.91 !

The increase in annual Membership Fee from 2013, to £18 for full Members and £10 for concessions, was announced.

Acceptance of the Report was proposed by Steve Jarvis and seconded by Roni Robbins and carried unanimously.

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

There are about 300 members which is an increase of 34 from last year. The membership is composed of 291 full members, 18 students, 10 libraries, 5 life members, and 9 free memberships. SW reminded delegates that if they change their address they should remember to let the Porcupine Membership Secretary know, otherwise there may be confusion with Standing Orders.

Acceptance of the Report was proposed by Vicki Howe and seconded by Mike Elliot and carried unanimously.

The Hon. Editor's Report was presented by Vicki Howe

There have been two Newsletters since the last AGM, both in full colour. There are also two new sections, Fieldwork Forays and Porcupine Snippets. The dates for deadlines are still to be confirmed. VH thanked those who had edited and proof-read the various contents.

Acceptance of the Report was proposed by Séamus Whyte Proposer and seconded by Frances Dipper and carried unanimously.

The Hon. Web-site Officer's Report was submitted by Tammy Horton and presented by the Hon. Chairman in her absence.

"We now have a new website powered by Wordpress which has made the editing and publishing of webpages far easier than before. I hope it is also visually improved and easy to navigate.

On the front page we now have the recent news items, which scroll through the first six items and you can click through to read more. All older news items are automatically archived and can be searched (there is a search box and dropdown menu on each page). There is an option to search by category or by month. Some content from the old site has not yet been moved across but this will happen bit by bit. It was not thought necessary to add old links to maps for old meetings etc so these links have been disabled.

If you notice anything missing that was on the old site and you want on the new one please let the website officer know. Indeed, for any suggestions for improvement, contact Tammy Horton.

On each page we also have links to our Facebook, which is used for posting pictures, general discussions and enquiries, and to our Twitter account, so please like us and follow us if you can!

Since December 2011, when the new site went live, we have had 4500 views which is an increase since the previous version of the website. We had ~1000 visits in January and February 2012 and over 600 visits by the 13th March. This clearly indicates that the website is being well-used. "

Acceptance of the Report was proposed by Anne Bunker and seconded by Fraser Ballie and carried unanimously.

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

The data from the last field trip to Kent is now on National Biodiversity Network. One additional record was received from Dawn Watson.

Acceptance of the Report was proposed by Angie Gall, seconded by Ann Leighton and carried unanimously.

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

The Southampton NOC 2011 conference organisers, Tammy Horton, Roger Bamber & Roni Robbins, were thanked for all their hard work. There was a good response to the conference presentations and many have been included in the Newsletters - see the last newsletter for 2012 (no. 30) and latest (No 31) – Out Now!

With regard to the Newsletter: many thanks to Vicki Howe and Peter Tinsley for the two newsletters produced in 2011, the latter having been a bumper edition. Thanks also to all who helped with reviewing, and proofreading the newsletter

Student Prize: the winner was Kathryn Ross, who produced an excellent article entitled Invertebrate life of Brownsea Island lagoon and its importance to the birds of Poole Harbour" for the Autumn Newsletter (No. 30; published in December). Kathryn receives a prize of £50 plus 1 year's membership.

The Autumn Fieldtrip was to Kent, organized by KWT and Fiona Crouch. The event was very successful and enjoyed by all; some people even took part in bird ringing. Twelve attendees would like to go back to the Sandwich Bay Bird Observatory.

This year's conference has been organized by Ann Leighton, Karen Nicholson and Mike Elliott: there is a good turnout of 67 attendees. Thanks are due to them, and in advance for

the fieldwork, etc tomorrow; 33 is a fantastic attendance for the field-trip.

Acceptance of the Report was proposed by Julia Nunn, seconded by Fiona Crouch and carried unanimously.

4. **Porcupine Grants Scheme** (AM)

Emily Priestly & Angie Gall successfully completed their project and gave a presentation to the Hull meeting.

Rayner Piper project, on scale microchemistry as a tool to investigate the authenticity of the vagrant fish *Pampus argenteus* from North Sea, is still ongoing

There have been three applications this year but more information is required before a decision can be concluded. The closing date will be early this year.

5. **Constitution**: proposed amendment to Rule of Procedure 2

The current Constitution states:

"The maximum and minimum numbers of members on the Council shall be left open, but shall not normally exceed twenty."

It is proposed by Council, to change this to read

"The maximum and minimum numbers of members on the Council **shall not normally exceed sixteen**."

The vote of those present for approving this change was unanimous.

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

Three members of Council, Frances Dipper, Sue Chambers and Paul Brazier, retired at the AGM, and the last two were available for immediate re-election. Dawn Powell was also proposed for election to Council. The election of Dawn Powell, the re-election of Sue Chambers and Paul Brazier, and of the Office Bearers en-bloc, was proposed by Frank Evans, seconded by Ann Leighton, and carried with no votes against.

The Council for 2012-2013 is as follows.

Office Bearers:
Ordinary Members of Council:

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

Julia Nunn
Peter Barfield
Paul Brazier
Sue Chambers
Dawn Powell
Anne Bunker
Fiona Crouch
Angie Gall
Peter Tinsley

7. **Future meetings**

A Fieldtrip to Cornwall, to continue the Sea Search recording project, is planned for September 2012, organized by Emily Priestly and Angie Gall

Ann Bunker is investigating the possibility of Swansea for the next Annual Conference in 2013.

Julia Nunn presented information about the BioBlitz to be held in Autumn 2013 with field work in Strangford Lough and the laboratory work at Portaferry. The diving will be organised by local Seasearch but there will be opportunities for shore work. One of the aims of BioBlitz is to have a session for public engagement for one day.

A Bryozoa and Hydroid workshop will be held on 18-22 August 2012 in N Ireland.

8. **A.O.B.**

There being no other business, the meeting closed at 13:10

PORCUPINE MNHS

RECEIPTS AND PAYMENTS ACCOUNT

Year to 31 December 2011

Year to 31.12.10 £	£			Year to 31.12.11 £	£
		RECEIPTS			
0			2008 to 2009	69	
1382			2010	117	
65			2010	1634	
0			2012 onwards	40	
	1447				1860
	0	Sales (Sweatshirts & books)			0
	11	Bank Interest (gross, both accounts)			7
	(1)	Tax deducted			(1)
	1467	Total Receipts			1867
		PAYMENTS			
(458)		Newsletter-	Printing	(1387)	
(173)			Postage	(241)	
(631)		Total Newsletter Costs		(1628)	
(6)		Web site expenses		(300)	
(292)		Council meeting expenses (travel/catering)		(255)	
	(929)				(2183)
	538	**SURPLUS BEFORE MEETINGS & GRANTS**			(316)
0		**Annual Conference** – St Andrews (2010)		500	
0			– Southampton (2011)	240	
(95)			– Guernsey (field) (2012)	(200)	
(23)		**Deep Sea Conservation UK** Project expenses		0	
(617)		**Porcupine grants**		(1200)	
	(735)				(660)
	(197)	**SURPLUS/DEFICIT FOR THE YEAR (before tax)**			(975)
	0	Corporation Tax			0
	(197)	**SURPLUS/DEFICIT FOR THE YEAR (after tax)**			(975)
	10,230	**BALANCE BROUGHT FORWARD**			10,033
		BALANCE CARRIED FORWARD			
4543			Current Account	3562	
5490			Deposit Account	5495	
	10,033				**9,057**

Jon Moore, Hon Treasurer
23 February 2012

J. J. Moore

Nick Light, Hon Examiner
7 March 2012

N Light

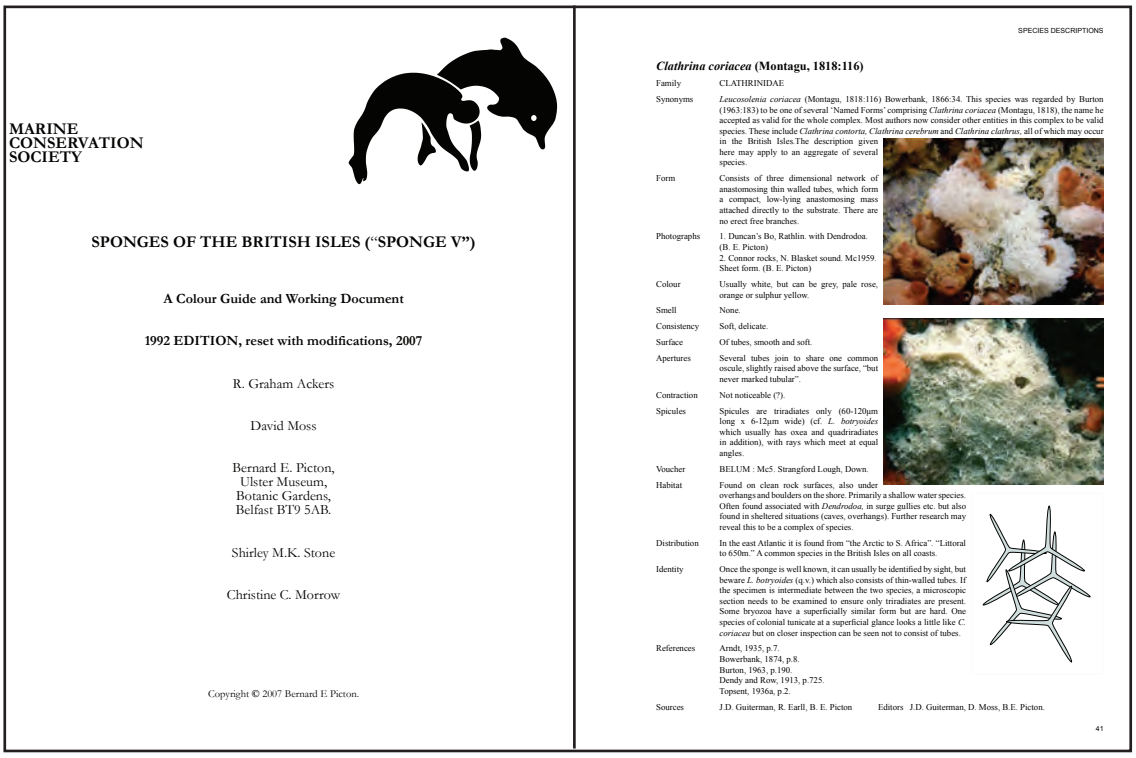
OBITUARY
Graham Ackers 1941-2012

Graham Ackers was an outstanding, self-taught marine naturalist whose interest in marine life started to blossom through the Underwater Conservation Year (UCY, 1977) projects. In those early days, diving opened up a whole new world for many of us and this was certainly true for Graham, a key player in many of the early marine survey expeditions that followed in the 1980s. Graham was a long time supporter of Porcupine and embodied one of the key strands of Porcupine membership – a keen enthusiast for marine recording and natural history. Whilst he had no formal biological training he brought to bear his professionalism to his interests and he was never an amateur....

His pioneering and patient work on British sponges, along with David Moss (a mathematician) and marine biologist Bernard Picton, dragged that most difficult of groups from cautious obscurity to accessible interest. "Sponges of the British Isles" started life in 1979 as 'Sponge I' led by David Guiterman with 22 species entities. Graham joined the fray in 1981 at a time when the World Wide Web didn't exist and no academic or scientific efforts looked like they would ever break the embarrassing absence of sponge information. He saw the project through from 'Sponge II' to 'Sponge V' (1992) which covers 103 species. With the difficult bit done Graham turned landwards and in recent years, moved onto an altogether different group, ferns, much to the benefit of the fern world and the British Pteridological Society.

Graham continued to support the Marine Conservation Society and Porcupine, and attended the Porcupine conference in 2011, hosted by the Southampton Oceanography Centre in Southampton. His final contribution to Porcupine was an excellent review in the newsletter, of Eve Southward's long awaited Echinoderm guide. Perhaps he was planning to move onto the prickly subject of Echinoderms next. Whatever group he chose there is no doubt his would have been a rich and useful contribution.

Bob Earll and Frances Dipper



MARINE CONSERVATION SOCIETY

SPONGES OF THE BRITISH ISLES ("SPONGE V")

A Colour Guide and Working Document

1992 EDITION, reset with modifications, 2007

R. Graham Ackers

David Moss

Bernard E. Picton,
Ulster Museum,
Botanic Gardens,
Belfast BT9 5AB.

Shirley M.K. Stone

Christine C. Morrow

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SPECIES DESCRIPTIONS

***Clathrina coriacea* (Montagu, 1818:116)**

Family	CLATHRINIDAE
Synonyms	*Leucosolenia coriacea* (Montagu, 1818:116) Bowerbank, 1866:34. This species was regarded by Burton (1963:183) to be one of several 'Named Forms' comprising *Clathrina coriacea* (Montagu, 1818), the name he accepted as valid for the whole complex. Most authors now consider other entities in this complex to be valid species. These include *Clathrina contorta*, *Clathrina cerebrum* and *Clathrina clathrus*, all of which may occur in the British Isles.The description given here may apply to an aggregate of several species.
Form	Consists of three dimensional network of anastomosing thin walled tubes, which form a compact, low-lying anastomosing mass attached directly to the substrate. There are no erect free branches.
Photographs	1. Duncan's Bo, Rathlin. with Dendrodoa. (B. E. Picton) 2. Connor rocks, N. Blasket sound. Mc1959. Sheet form. (B. E. Picton)
Colour	Usually white, but can be grey, pale rose, orange or sulphur yellow.
Smell	None.
Consistency	Soft, delicate.
Surface	Of tubes, smooth and soft.
Apertures	Several tubes join to share one common oscule, slightly raised above the surface, "but never marked tubular".
Contraction	Not noticeable (?).
Spicules	Spicules are triradiates only (60-120µm long x 6-12µm wide) (cf. *L. botryoides* which usually has oxea and quadriradiates in addition), with rays which meet at equal angles.
Voucher	BELUM : Mc5. Strangford Lough, Down.
Habitat	Found on clean rock surfaces, also under overhangs and boulders on the shore. Primarily a shallow water species. Often found associated with *Dendrodoa*, in surge gullies etc. but also found in sheltered situations (caves, overhangs). Further research may reveal this to be a complex of species.
Distribution	In the east Atlantic it is found from "the Arctic to S. Africa". "Littoral to 650m." A common species in the British Isles on all coasts.
Identity	Once the sponge is well known, it can usually be identified by sight, but beware *L. botryoides* (q.v.) which also consists of thin-walled tubes. If the specimen is intermediate between the two species, a microscopic section needs to be examined to ensure only triradiates are present. Some bryozoa have a superficially similar form but are hard. One species of colonial tunicate at a superficial glance looks a little like *C. coriacea* but on closer inspection can be seen not to consist of tubes.
References	Arndt, 1935, p.7. Bowerbank, 1874, p.8. Burton, 1963, p.190. Dendy and Row, 1913, p.725. Topsent, 1936a, p.2.
Sources	J.D. Guiterman, R. Earll, B. E. Picton Editors J.D. Guiterman, D. Moss, B.E. Picton.

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Front cover and page extract from Sponge V

PORCUPINE 2012

Conference Report

The Deep, Hull
Friday 23rd – Sunday 25th March 2012.

This year's meeting was held at The Deep (Hull), one of the country's most spectacular aquariums. It is home to over 3500 fish and contains a beautiful assemblage of marine life including some truly awe-inspiring sharks and rays. Porcupines were allowed free access around The Deep during breaks and between talks to enjoy the surroundings. An excellent array of speakers covered a wide variety of topics from local and national conservation initiatives and perspectives to taxonomic challenges and developments. In addition, I am sure no one at the conference will forget the captivating film kindly provided by Frank Evans, showing his transatlantic voyage from Dakar in West Africa to Barbados in the West Indies in 1953. Inspiring and exciting footage, with a refreshing insight into H&S at sea in the 1950s! The Friday evening meal was held at the Two Rivers Restaurant (The Deep's restaurant) and members enjoyed their evening meal surrounded by sharks, fish and rays.

On the Sunday Porcupines went on a field trip to Thornwick Bay, on the Yorkshire coast, 1.4 miles out of the coastal village of Flamborough, to collect samples. The coastline along Flamborough Head is designated as a Special Area of Conservation (SAC) with sea caves and an extensive chalk reef. The chalk headland of Flamborough is also a Special Protection Area (SPA) for breeding seabirds including kittiwakes, guillemots, razorbills

and gannets. The Porcupines were treated to unusually good weather for the time of year and spent the morning searching for fauna in the intertidal area. Despite searching for polydorid species boring in the chalk platforms, only a variety of typical east coast rocky-shore fauna was found. However, *Sabellaria alveolata* was recorded, which is not a common species along the east coast. The beautiful weather coupled with the picturesque location made for an enjoyable fieldtrip.

After a traditional seaside lunch of fish and chips Porcupines returned to the Institute of Estuarine and Coastal studies to identify their samples in the lab.

Photographs from the 2012 Conference field trip to Thornwick Bay, North Yorkshire, Sunday 25th March

Porcupine field trip: the divers' perspective

Paula & Phil Lightfoot

Shore surveys or diving? It was a tough choice, but we decided to make the most of Guernsey's beautiful gin-clear water (something we see too little of back home in Yorkshire!) by spending our time on the Porcupine field trip carrying out Seasearch dives around the island.

As soon as the ferry docked in St Peter Port, we headed straight to nearby Havelet Bay for our first dive. Seasearch recording has already been carried out at Havelet Bay, as this site was used for training dives following an Observer course in October 2011. Nevertheless, it was a great location for an orientation dive: an easy shore entry from a sandy beach leads to rock outcrops covered in a variety of seaweeds and kelp, providing the perfect opportunity to familiarise ourselves with the Channel Islands flora and fauna. Havelet Bay is also conveniently close to the Dive Guernsey shop (in an old WWII bunker!) for air fills.

The following day we headed to Guernsey's west coast to dive at Torquetil Rock just south of Lihou Island, which was designated as a Ramsar site in 2006. The west coast of Guernsey shelves very gradually, so we snorkelled for a long time over seaweed-covered bedrock before descending into kelp-fringed gullies, their walls encrusted with sea squirts and sponges.

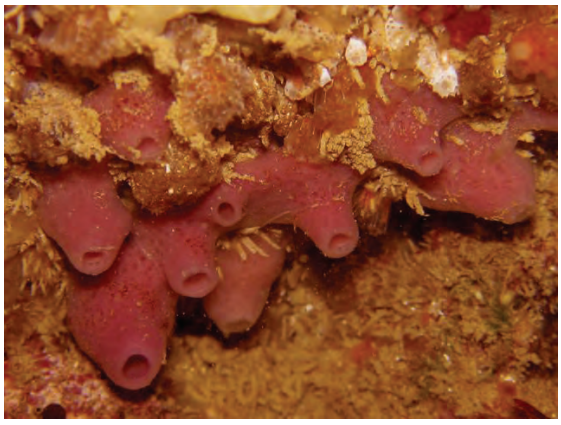

Figure 1. Haliclona viscosa *on a gully wall at Torquetil Rock*

Perhaps it was due to the range of microhabitats offered by the crevices and overhangs in the gully walls, or perhaps simply because we spent over two hours in the water, but we recorded considerably more species here than at the other sites we visited. We recorded 71 species, including that favourite of divers, the charismatic tompot blenny.

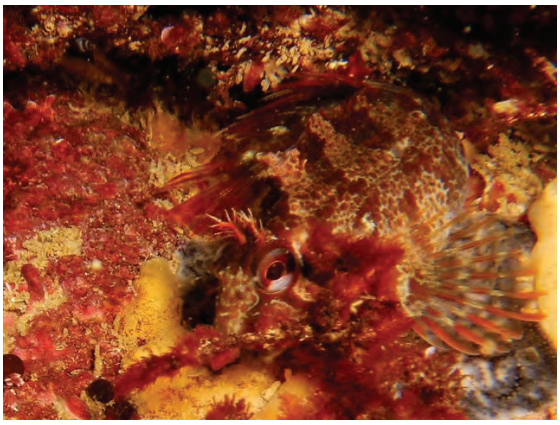

Figure 2. Well camouflaged tompot blenny Parablennius gattorugine *at Torquetil Rock*

In contrast to the gently sloping west coast, Guernsey's south coast is characterised by dramatic granite cliffs plunging straight into the sea, making it less suitable for intertidal surveys but ideal for diving.

The shore dive entry at Saints Bay is not for the faint-hearted; it's a choice between a steep and very slippery cobbled launch slip or steep and very slippery concrete steps!

Figure 3. Saints Bay, showing the car park and shore dive entry point

However, once in the water it is a beautiful dive site, with kelp-covered reef giving way to walls, overhangs and small caves covered in scarlet and gold cup corals, sponges, sea squirts, nudibranchs, cowries and the giant fan worm *Sabella spallanzanii*.

Figure 4. The Mediterranean fan worm Sabella spallanzanii *at Saints Bay*

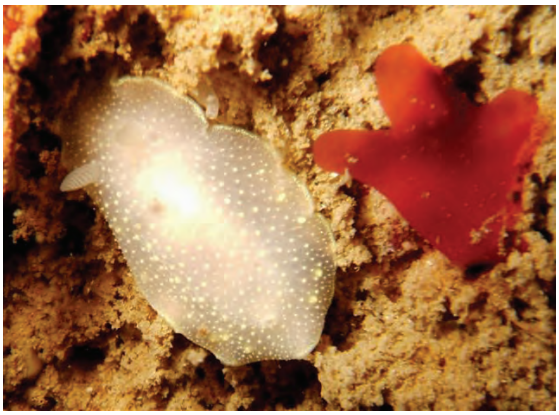

Figure 5. The nudibranch Cadlina laevis *at Saints Bay*

We also recorded some lead weights and fishing line and part of a broken fishing rod at Saints Bay, but overall we found very little litter at any of the sites we visited.

Saline Bay, south of Grande Rocque on Guernsey's west coast, was a site recommended by local dive operators. The underwater landscape is picturesque and very colourful, with boulders covered in a great variety of red and coralline seaweeds.

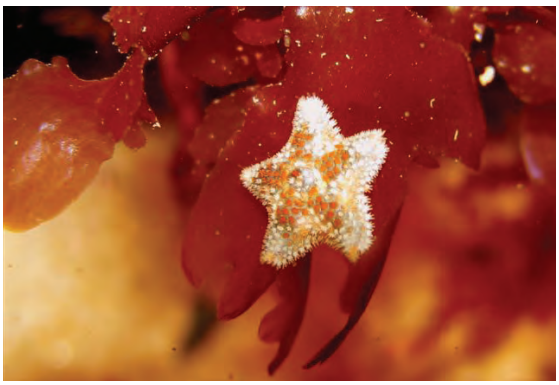

Figure 6. Asterina phylactica *on red seaweed in Saline Bay*

As we headed into deeper water, the habitat changed to sugar kelp forest, which then gave way to forests of sea oak, *Halidrys siliquosa*, supporting a rich epibiota and with brightly coloured two-spot gobies darting around the fronds. Having only ever seen this brown alga in rock pools, it was impressive to swim amongst specimens that were taller than us!

Figure 7. Hydroid, possibly Aglaophenia pluma*, attached to* Halidrys siliquosa *in Saline Bay*

Making our way back to shore we swam over a sea grass meadow, the blades covered in eggs of the netted dog whelk, *Nassarius reticulatus*.

Figure 8. Coralline alga Jania rubens *amongst sea grass in Saline Bay*

L'Ancresse Bay was our fifth and final diving destination and our only trip to the Island's north coast. It was Easter Monday, and in true bank holiday fashion, the weather had changed, bringing pouring rain and a swell which churned up the sand and decreased visibility. Perhaps for this reason, we recorded fewer species here than at the other sites. However, our 'grand' total of 37 species recorded at L'Ancresse Bay included several

species that we had not seen during previous dives on the island, such as the blue-rayed limpet and the orange sponge *Hymeniacidon perlevis*.

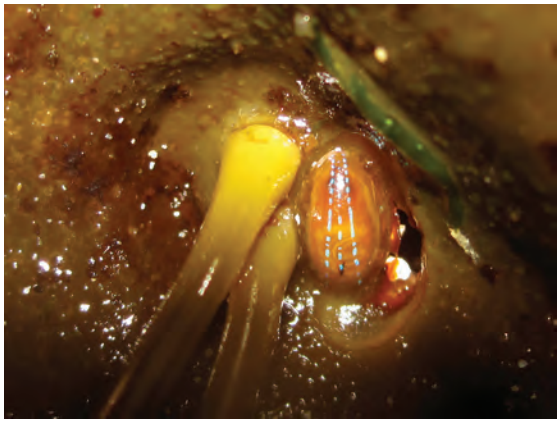

Figure 9. Blue-rayed limpet Helcion pellucidum *on thong weed* Himanthalia elongata *in L'Ancresse Bay*

We filled in Seasearch Survey forms for each dive and recorded a total of over 120 species across the five sites. The data will be entered into Marine Recorder over the winter and will appear on the NBN Gateway next year.

Thank you very much to all the Porcupine members, especially Richard Lord, who helped to identify species from our photos during the field trip and afterwards via the extremely useful PMNHS and Seasearch Facebook groups - how did we manage before Facebook?!

If you are interested in Seasearch diving in the Channel Islands, please contact the regional coordinator Kevin McIlwee on: jerseyseasearch@gmail.com.

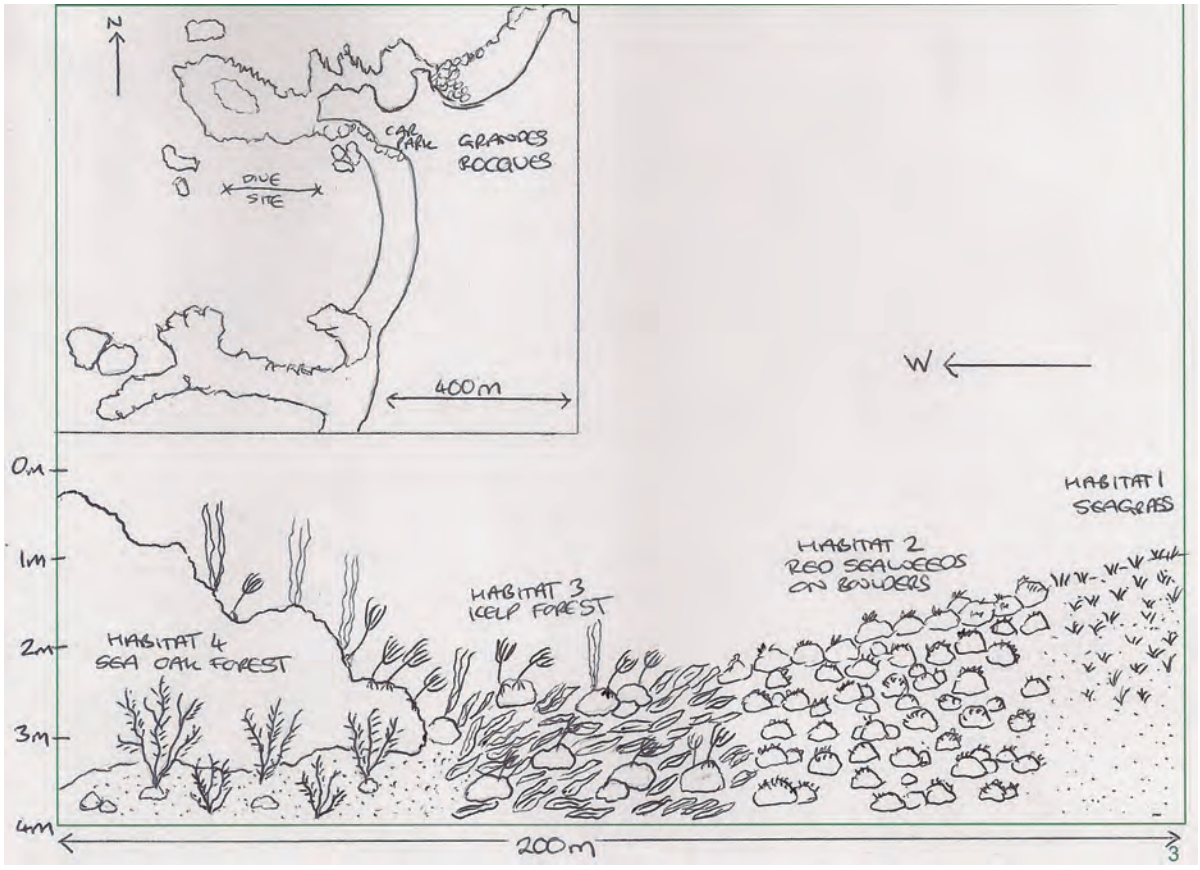

Figure 10. Seasearch sketch showing the habitats present at Saline Bay: sea grass meadow, red and coralline seaweeds on boulders, sugar kelp forest and sea oak forest.

Extreme environmental conditions & intertidal organisms: Lessons from two case studies in the sub-tropics

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Introduction

Global climate change is one of the biggest challenges facing the world today. In addition to rising sea and air temperatures it is predicted that there are going to be more frequent extreme weather events, such as heat waves, cold episodes, storms, flooding and droughts (IPCC 2007; Firth & Hawkins 2011). If this is the case, then with extreme weather events set to become more frequent with global climate change, research carried out in places that already experience extreme climates can yield valuable information about what may happen in the future.

This article discusses two case studies carried out in the sub-tropics assessing the effects of extreme weather events on the persistence of intertidal organisms. The first case study investigated the effects of extreme heat stress and salinity fluctuations on an intertidal limpet in Hong Kong (Firth & Williams 2009) and the second case study investigated the influence of cold temperature stress on an invasive mussel in Florida (Firth *et al*. 2011).

Case study 1 – Monsoon season in Hong Kong

Rocky shores in Hong Kong experience seasonal monsoon patterns with dry, cool winters and hot, wet summers. Although tidepools can offer refuge from the harsh physical conditions encountered on emergent rock they may also become stressful environments, with great fluctuations in temperature, salinity and dissolved oxygen (Metaxas & Scheibling, 1994). Tide pools in Hong Kong can experience temperatures >40°C (Williams & Morritt 1995) and salinities >40‰ (Firth unpubl. data).

During the summer the intertidal limpet (Figure 1) is more abundant in tidepools than on emergent rock (Williams 1993) and summer mortality events are common (Harper & Williams 2001). Laboratory experiments were designed to test the effect of high temperatures and fluctuating salinities associated with monsoonal rains on the persistence of during the summer in Hong Kong.

Figure 1. Cellana toreuma *at the bottom of a tidepool.*

One experiment was designed to test the effect of increased temperature and salinity on mortality of the limpet *Cellana toreuma*. Each of three temperatures (28°C, 34°C, 40°C) and salinities (25‰, 32.5‰, 40‰) were selected based on ambient, intermediate and maximum values observed in the field respectively. This design enabled the testing of both the individual and combined effects of temperature and salinity on mortality.

Another experiment was designed to test extreme conditions experienced as a result of heavy rainfall on mortality of *C. toreuma*. Twenty individuals were placed in plastic mesocosms filled with seawater in the laboratory. Rainfall was simulated for 1 hour which reduced the salinity of the water to 0‰ - completely fresh water. Five individuals were randomly selected prior to simulated rainfall and every hour for 3 hours following rainfall.

In the first experiment mortality was significantly higher at 40°C than at the lower two temperatures and this was similar across all three salinities. In the second experiment no mortality was recorded prior to rainfall or after 1 hour of exposure to freshwater conditions. After 2 hours, 12% had died but this increased to 40% after 3 hours.

Increased temperature had a significant effect on mortality but increased salinity did not. Rainfall has the potential to cause mortality of *C. toreuma* in tide pools, but this is a function of the duration of exposure to freshwater conditions.

Case study 2 – Cold wave in Florida

Florida experiences a subtropical climate, with hot summers and relatively warm winters. In general

water temperatures remain in the high teens and air temperatures range from 11-22°C. Despite this, Florida is prone to some very cold winter weather when air temperatures can drop below 5°C.

The Asian green mussel (Figure 2) is native to the tropical Indo-Pacific region (Rajagopal *et al*. 2006). It was first recorded in North America in 1999 in Tampa Bay, Florida but has since spread to other parts of Florida and northwards as far as Georgia (Power *et al*. 2004). It fouls artificial substrates such as piers, pontoons and bridge pilings and occasionally experiences winter mortality in Florida (Baker *et al.* 2007).

Figure 2. Perna viridis *fouling pontoons on Courtney Campbell Causeway, Tampa Bay, Florida.*

Nine survey locations were selected across a wide area of Tampa Bay: Safety Harbor Pier; McKay Bay Bridge; Ballast Point Pier; Gandy Bridge; Davis Islands Slipway; Fantasy Island Pier; Picnic Island Pier; Sunshine Skyway Bridge and Fort De Soto Slipway. At each location, 12 quadrats (20 × 20 cm) were placed 1 m below the mean high water mark or just below the water mark on pontoons. All live mussels within quadrats were destructively sampled and enumerated. Surveys were carried out in December 2007, February 2008 and May 2008. Data on air and water temperature during the sampling period was obtained from a meteorological station near St Petersburg, Florida and supplied by TB- PORTS (Tampa Bay Physical Oceanographic Real-Time System).

A bay-wide mortality event was observed between December 2007 and February 2008 (i.e. during the study time). During this period water temperature was relatively constant, remaining above 20°C for the majority of the period. Air temperature was generally a few degrees cooler than water temperature, but a major drop in air temperature occurred between 2 and 4 January 2008 when temperatures remained below 15 °C for 64 h. During this 3-day period, the temperature dropped again and mussels were exposed to severely cold air temperatures (<2 °C) for 6 h.

Although this was not tested experimentally, the cold air temperatures and not cold water temperatures during this period were the likely driver causing winter mortality events in Florida. This species occurs as far north as Georgia and some isolated individuals have been recorded in South Carolina. It is thought that the colder weather north of Georgia is preventing this species from advancing further at this point. In the short-term, the cold weather and frequent cold snaps may prevent the further spread of *P. viridis* in the US. In the long term, however, if climate change continues it is likely that this will facilitate the spread of and other non-natives which are constrained by cold temperature stress.

Conclusions

Taking both studies into account, it can be concluded that extreme weather events can have a strong impact on ecosystem structure and functioning.

Research carried out in regions where extreme weather is a regular occurrence can yield valuable information about the potential impacts of climate change at higher latitudes. Intertidal organisms are vulnerable to fluctuations in environmental conditions as they are exposed to both marine and aerial conditions. As a result, they represent sentinels of climate change and can often serve as proxies for changes occurring offshore.

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Why does taxonomy take so long?

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The aim here is to outline the taxonomic task when applied to the large numbers of living organisms and to describe some of the background steps required to identify and describe new taxa. Also, to explain why taxonomy takes so long but is not dull and only pursued by the old working in museums (Guerra-Garcia *et al*. 2008).

What is taxonomy?

Taxonomy is an artificial mechanism to identify, name and classify the living world in order to help us understand the complexity a little better. These are three separate processes and all require a different skill. The edges of these processes are fuzzy and overlap with phylogeny which is a classification based on evolution and molecular data. Both taxonomy and phylogeny are embraced by systematics which brings together the knowledge of the organisms and their relationships over time.

The scale of the problem? Or how many taxa?

Another way to make sense of the world is to record, assign a number and analyse the data. The numerical diversity of the biological world is still unknown. The Convention on Biodiversity, Rio Summit 1992, could not answer questions about the number of species and which ecosystems needed to be conserved. Politicians and policy makers need numbers to make decisions and informed choices about sustainable development. This task is particularly daunting for marine biologists as so much funding and research is concentrated on the terrestrial world. The Census of Marine Life took place between 2000-2010 to answer the question of the number of marine species and abundance of marine life. The Census was world wide and looked at all groups of animals and plants (Costello *et al*. 2010: www.plosone.org/article/info%3Adoi/10.1371/journal.pone.0012110).

The global estimate for eukaryotes is between 3 and 100 million taxa (May 2010). A recent application of statistics narrowed the number to approximately 8.7 million, of which 2.2 million are marine. Since Linnaeus' classification system was published 250 years ago, 1.2 million species have been catalogued, which breaks down as 14% terrestrial species and 9% of marine species. This means that 91% of marine species are still waiting to be described. At the current rate of 15,000 newly discovered species per year it will take 480 years to complete the task of identifying and naming all known taxa (Mora, *et al*. 2011).

Identification

Before you can name something you need to separate the specimen from the many others you see. Over the years many identification guides have been published but there are very few for marine life compared to guides for example, garden birds, or flowering plants. There are two main obstacles to the publication of marine guides:

- Knowledge of the fauna or flora
- How to write descriptions.

British Polychaetes are a good illustrative example and will be used here. Polychaetes are one of the most abundant groups in the benthic environment and there were 1,397 recorded in the Marine Directory of the British shallow water fauna (Howson & Picton 1997). My current estimate is nearer 2,000.

Knowledge of the British polychaete fauna: How do you start?

Literature: The first obstacle is that there is no single comprehensive polychaete publication for the British marine fauna. The standard texts for the last 100 years have included the British Annelid Monographs (McIntosh 1900, 1908, 1910, 1911, 1915 & 1923), Clare Island Survey (Southern 1914), Polychètes Errantes and Polychètes Sedentaires (Fauvel 1923, 1927) and Polychaeta, Tierwelt

Deutschlands (Hartmann-Schröder 1971, 1996) which are useful for some geographic areas of the British fauna. The drawback of these publications is that they are difficult to access for a variety of reasons including price, rarity and language. They are often poorly illustrated and difficult to interpret, so they demand a lot of time and skill. The recent series of the Linnaean Society Synopses of the British Fauna includes some polychaete families, but less than 10% of the total. (George & Hartmann-Schröder 1985; Pleijel & Dales 1991; Chambers & Muir 1997). The Marine Fauna of the British Isles and North West Europe (Hayward & Ryland 1990) has a polychaete chapter which only includes common species.

Electronic keys: The National Marine Biological Analytical Quality Control (NMBAQC) scheme has published some keys electronically e.g. http://www.nmbaqcs.org/scheme-components/invertebrates/literature-and-taxonomic-keys.aspx. The Natural History Museum also publishes an electronic guide to polychaetes www.nhm.ac.uk/research-curation/research; the Marine Life Information Network www.marlin.ac.uk/phylumdetails.php?phylum=2448 describes some more common species and the environmental consultancy Thomson Unicomarine produces identification guides to some polychaete families.

These electronic guides are useful and interesting but again they are not always comprehensive or easy to use. To identify hundreds of samples you have to acquire a vast variety of reprints from various journals, monographs and the web which takes time to accumulate, requires knowledge of and access to the literature and becomes a major task in itself.

Specimens: To understand the range of characters, where one ends and another begins, you need to examine hundreds of specimens in good condition. Obtaining specimens in good condition is a challenge as collections of soft-bodied animals are usually obtained under pressure of the incoming tide or on research vessels where time is precious and cost is the main driver rather than the quality of the samples. Living material is the best way to see the characters in perfect condition but this is not always practical. Skill is required to prepare animals for narcotisation and preservation to ensure that essential characters are retained (Smaldon & Lee 1979; Mackie 1994; Pleijel & Rouse 2001).

A specimen without data is of no value to taxonomic research. Museum specimens are acquired from a range of sources, e.g. government agencies, commercial consultancies, government-funded environmental monitoring programmes such as the Strategic Environmental Assessment programme, Marine Laboratories such as Scottish Association for Marine Science and personal field-work. Specimens donated to museums are organised by the donor's research objective, e.g. monitoring sites, geographic location or chronological sequences such as yearly time series. The physical data needs to be matched to individual specimens before they are incorporated into the collection in systematic order. This is a time consuming task and is fundamental to the role of a curator (Chambers 2001; Mackie 2001).

As well as museums, many environmental consultancies, e.g. Unicomarine, Fugro and individual consultants, have established reference collections which are essential for their geographic area of work. A good example of why it is important to keep a reference collection is the cirratulid polychaete *Chaetozone setosa,* which was considered a common species for about 100 years with a world-wide distribution from the intertidal to the deep sea. In the 1980s a survey was completed that used multivariate analysis to examine the population dynamics of *C. setosa* in relation to changing organic enrichment (Hily 1987). It is unlikely that the species for this interpretation was *C. setosa* as we now know it does not occur in the area where the samples were collected. *'Chaetozone setosa'* is a complex of species and includes 2 intertidal species and 3 subtidal shallow water species around the UK (Chambers 2000). It is not known how many taxa were analysed for the population dynamics of the Bay of Brest as no samples were retained for future taxonomic work. If the samples had been deposited in a museum or university collection they could have been re-examined and checked to confirm their identification.

Good quality, data-rich specimens are invaluable for producing text and illustrations which become the foundations of taxonomy. All British National Museums have a statutory requirement to lend material to researchers all around the world to assist in systematic research. Once you have acquired good quality specimens and associated data, the next step is to begin the description.

How to write a new species description or re-description.

1. A group of animals is separated as distinct from known specimens. Ideally specimens should be from more than one locality and collected at different times of year.
2. A thorough search of the literature is made to check whether or not the entity has been described before. If it has been inadequately described then a re-description may be necessary.
3. Specimens from other surveys or type material from other museums are borrowed for comparison.

4. Most specimens need to be dissected and prepared for optical microscope slides or SEM so more than one specimen is required.
5. The morphological characters are described, and illustrated with line drawings, and photographs; internal structures and any morphological measurements are presented as a graphic, e.g. body length to segment ratio.
6. Other information where appropriate is also valuable to add to the data set, e.g. habitat, tubes/burrows, colour, smell, associated parasites/hosts, reproductive stages.
7. If the description is for a new species one specimen is selected as the Holotype (the first described specimen of that species) and assigned a name within a genus, e.g. *Chaetozone christiei*. The Holotype will always be associated with that name and cannot change. The specimen is only considered valid if it has the associated data attached, e.g. Northumberland coast, low shore, Low Newton-by-the Sea, 55^0 32'N 0.1^0 36'W, clean sand. It is good practice if this specimen is given a unique number from a museum, e.g. NMSZ.1988.122.
8. Once accepted for publication the new species is then known as, *Chaetozone christiei* Chambers, 2000. The name, which includes the generic name, specific name, author and date are forever associated with the Holotype specimen.
9. Only after publication in a peer-reviewed journal and available in multiple copies is the name **valid** and **available** to the scientific community.
10. The name, description, figures, etc are the basis for comparison of future identifications.

It is good practice to donate type and non-type material to a museum and cite the location in the publication to avoid future confusion. If molecular data is available this can be included with the type material information. Publications often include new records or samples from locations which are expensive to re-visit, e.g. deep water sites, and these specimens are of great interest for zoogeographic information when trying to compose a guide. A large amount of valuable time is lost during taxonomic work by looking for type and non- type material that has not been donated to an institution with a good record of maintenance. It is not uncommon for a long time-series of research samples to be left under the marine biologist's desk and thrown away when they retire or leave this world. This leads to all kinds of problems including lost type specimens, which may then require a lectotype or neotype to be selected and assigned to the name. The change in status of the type material needs to be published and often requires the application of the International Code of Zoological Nomenclature rules (ICZN 1997). This is a separate process and leads to unnecessary delay of the original publication. There are a few ICZN guidance notes for publication of a new species.

- the description is published in a work that is obtainable in numerous identical copies, as a permanent scientific record.
- the scientific name must be spelt using the 26 letters of the Latin alphabet; binominal nomenclature must be consistently used; and new names must be used as valid when proposed.
- that names are consistently formed following certain rules; that original spellings can be established.
- that names are based on name-bearing types, the objective standard of reference for the application of zoological names.
- that general recommendations are followed for ethical behaviour.
- and that best practice should be used to give taxa names which are unique, unambiguous and universal.

Molecular data

More and more phylogenies are based on DNA sequence data; these are especially enticing for their potential to be automated and speed up the identification process. Eventually, this may change our understanding of evolutionary biology. Meanwhile a lack of taxonomic progress will not be solved by DNA systems alone, largely owing to costs and difficulty of practical applications, especially is less-developed regions of the world. We need both morphological and molecular techniques to construct phylogenies as DNA cannot be extracted from palaeontological material or rare specimens. There are too many mis-identifications in the invertebrate literature to produce clear results from sequencing. The vast majority of taxa has not been sequenced so adding another requirement to descriptions will slow the process down even more (Mallet & Wilmott 2003). Molecular techniques provide another set of information alongside the ecology, behaviour and reproductive strategies (Misof *et al*. 2005). At the moment the two systems are running in parallel; hopefully they will merge in the future.

Classification

One of the defining features of humans over millennia has been to find order and name it! This phenomenon

has been found in many scientific disciplines, e.g. Physics: Newton's law of mechanics, Chemistry: Dalton's theory that matter is made of atoms and Mendeleyev arranged elements by atomic weight. Nature can be ordered as well, but the basic unit is harder to find. Aristotle began a classification of the living world approximately 300 BC, and later 18th and 19th century biologists such as Jussieu, Cuvier, Lamark, Haeckel (1866, introducing phylogeny), Banks and Darwin all looked for an underlying order. Most of these systems work on the principal of moving from the general to the specific and have been developed over centuries. The biological world uses a hierarchical system, e.g. *Chaetozone gibber* is classified as follows:

Domain: Eukaryota

Kingdom: Animalia

Phylum: Annelida

Class: Polychaeta

Order: Canalipalpata

Family: Cirratulidae

Genus: *Chaetozone*

Species: *gibber*

Biological classification itself has evolved and can be usefully divided into four phases (Tudge 2000).

Ancient: Aristotle (384 – 300 BC) demonstrated the need to choose characters carefully as some features gave unsatisfactory results. For example animals with two legs grouped birds and humans together whereas characters such as oviparous and viviparous were more helpful.

Classical: The 16th, 17th and 18th centuries were dominated by the practical needs of commercial policies, e.g. timber trade, plants for pharmacy. In 1758, Linnaeus combined a hierarchy from a kingdom to species with a bi-nomial method of naming. This was very easy to use and reduced the need to re-state the characters.

Immediate post Darwin: Darwin proposed a dynamic process of natural selection leading to the theory of evolution. It is a mechanism to describe evolution but it has fundamentally changed the way the world thought about biology. This had immense consequences for classification.

Cladistics: Hennig (1966) introduced rules to distinguish between primitive and derived characters. This led to an entire new philosophy of classification based on natural relationships which reflected an evolutionary history.

Nomenclature

Linnaeus, in 1758, published the 10th edition of his hierarchical classification system of plants and animals and gave them all two names, a binomial system (Linnaeus 1758). This is considered as the starting point for current biological classification. It led to the need for objective rules and in 1895 a committee was formed to produce guidance on the rules for zoological names. This is known as the International Code of Zoological Nomenclature. The aim of ICZN is to regulate the application of zoological names to ensure each name is unique and universally available. The code is international and has evolved over more than 100 years. An electronic version of the 4th edition of the code is available: www.iczn.org. One of the main issues for the committee is the need to revise the plans for the 5th edition of the code to include electronic publication and registration of names. Consequently an interactive discussion forum has been established to enable a wide involvement of all concerned www.iczn.ansp.org/wiki.

Hennig's development of phylogeny and the application of cladistics has led to the proposal for a new system of classification. It is based on clades which do not recognise the standard naming of ranks. This new system would require a new set of rules or code, to be known as a Phylocode, The adoption of this proposal has not yet received universal acceptance. (www.ohiou.edu/phylocode).

Catalogues

As the classification of zoological specimens increased in size and complexity after 1758, cataloguing this information became the obvious next step. Over the next 250 years there have been numerous catalogues published to suit particular commercial and aesthetic needs, e.g. types of timber, agricultural pests, toxic organisims. In response to the Convention of Biodiversity held in Rio, 1992, the Global Taxonomic Initiative was launched to improve data capture for conservation policies and planning. There were specific European initiatives such as Fauna Europea, and European Register of Marine Species which have been subsequently linked to the Species 2000 framework. At about the same time computers became widely available and software to produce bigger catalogues was developed eg. (www.sp2000.org; www.gbif.org; www.eol.org). There are numerous ways to catalogue by species in systematic order, alphabetical, geographical area etc. There are also combinations of some of these factors, e.g. the Marine Directory of British fauna and flora (Howson & Picton 1997), Fish catalogue (www.fishbase.org),

Checklist of European Marine Mollusca (http://www.somali.asso.fr/clemam/index.clemam.html).

Recent developments include catalogues of DNA sequences commonly known as bar-codes. DNA bar-coding uses a specific mitochondrial genome (CO1) to provide a single fingerprint tag (Marshall 2005).

The sequences are registered in a gene bank and there are three main International GenBanks, the European Molecular Biology Laboratory, the Data bank of Japan and the USA International Nucleotide Sequence Database which all have publically available DNA sequences. Each GenBank includes concise descriptions of the sequence, scientific name and taxonomy and other sites of biological significance. The Barcode of Life Database (BOLD) manages the use of DNA barcodes and best practice includes vouchered specimens. DNA barcodes have a standardised method for non-experts to identify species using a DNA sequence.

Electronic developments

Web-based applications have allowed the taxonomic community to share and access data in imaginative and various ways; this is known as Biodiversity Informatics. A new name proposed by Quentin Wheeler is Cybertaxonomy (www.v.smith.info/cybertaxonomy.) which he defined as a fusion of taxonomy, computer science and engineering. Electronic tools have helped to create, store and share large amounts of data to produce electronic descriptions and guides, e.g. the National Museum of Wales produced a British Bivalve web-based guide; http://naturalhistory.museumwales.ac.uk/britishbivalves. There is also the development of *Scratchpads* which had been funded by ViBRANT, an EU project. The aim was to increase collaboration in an electronic framework and accelerate the pace of biodiversity research. http://scratchpads.eu/.

Zookeys (www.pensoft.net/journals/zookeys) is a peer-reviewed, open-access, rapidly disseminated journal launched to accelerate research and free information exchange in taxonomy, phylogeny, biogeography and evolution of animals. Zookeys will publish and give priority to manuscripts with large keys, new descriptions and identifications which many standard journals find a challenge (Smith & Penev 2011).

The future for taxonomy?

Acquiring identification skills takes time and patience and is often a lonely occupation as there are fewer and fewer people to pass on their knowledge. Most people start their identification career from a very low knowledge level and can only proceed slowly due to lack of basic literature and skill transfer. Also, informatics is not a substitute for science and this includes taxonomy (Knapp *et al*. 2002). The Census of Marine Life summary (Costello *et al*. 2010) found that there was a positive relationship between availability of taxonomic guides and knowledge of biodiversity. More than 80% of phyla are found in the sea which is a good reason for taxonomists to turn their attention from the land (May 1992). Species are complex but taxonomy is a mature and stimulating science. It is a dynamic process and by no means static, dull or only for the elderly.

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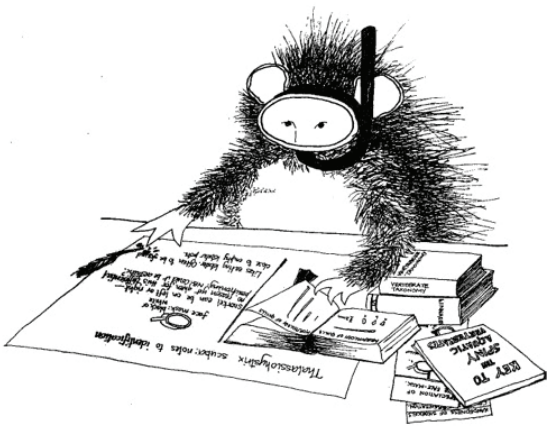

Seastacks, Sponges and Seaweeds

A week long survey on the north coast of Cornwall

Angie Gall

Emily Priestley has lived near St Agnes on the North Coast of Cornwall since 1983 when she first took up diving. She used to collect and dry seaweeds to eat and was curious to find out more about them, so she contacted Stella Turk of the Cornwall Biological Records Unit (later to become the Environmental Records Centre for Cornwall and the Isles of Scilly). Over lunch Stella said that the area had been little visited by marine surveyors – mainly a few inter-tidal visits, but nothing underwater. Stella enthused about focusing on un-surveyed sea stacks as an opportunity for divers.

Guided by the local British Sub-Aqua Club, Emily quickly realised that North Cornwall was not really considered suitable for diving because of huge swells, rough seas and windy weather. But she started exploring the local area during windows of calm weather and discovered that there were some hidden gems to be found – not least off St Agnes.

Over the years Emily and a group of local divers developed experience of launching tiny boats through the surf from the cove at St Agnes, to dive the Bawden rock (a seastack two miles from the coast) and the base of the sea cliffs. Fifteen years ago the local diving and fishing community, now thriving as the St Agnes Marine Conservation Group, established the area as a new Voluntary Marine Conservation Area.

Some of the divers trained with Seasearch and started contributing to pink sea fan surveys; finding and recording local populations. As they gained confidence, they started to join forces with marine biologists and worked with Cornwall Wildlife Trust to record the marine life in the St Agnes area. Some 28 years on, in 2011, Emily decided to plan and host a survey to try to fill in some of the data gaps that still existed for this, often neglected, part of the Cornish coast.

I first met Emily when she taught me to dive at the age of 14 in the Isles of Scilly. We have often dived together since. Through Seasearch and The Wildlife Trusts we were able to bring together a multi-talented team to survey the local shores and sub-tidal sites, some of which had been recommended as Marine Conservation Zones but still needed more data to support them. Thanks to a small grant from the Porcupine Marine Natural History Society and funding assistance from Emily's employer, GE Money, her 28 year vision looked possible.

Enthusiastic volunteers, many of them Porcupine members, travelled from across the country to converge on St Agnes for a week. A local dive boat was chartered, whose knowledgeable skipper, Chris Lowe, took us to a variety of 'blips on the echosounder' and promising looking points on the charts, to explore sites that hadn't been dived before, let alone surveyed. The generosity of the 20 strong team of talented ecologists, taxonomists, photographers and local enthusiasts made the week a great success.

Figure 1. Leaving the shelter of Newquay Harbour (Credit: Annabelle Lowe)

Day one of the expedition saw us facing ten foot swell, water green with plankton and ground swell that washed us around even at 25 metres depth; the north coast was living up to its reputation. Subsequent days saw some improvement in conditions but we struggled to get to some of the more distant sites and several on the boat turned as green as the plankton soup that surrounded us. Fortunately, we also had a plan B, which meant that each day a small team was able to head off to the sheltered south coast estuaries and dive some sites there to add new records and to create a reference collection of seaweeds for these important areas.

Seaweed collecting and recording was led by Professor Juliet Brodie from the Natural History Museum and involved both shore and diving collection. The shore team visited sites along a large stretch of the north coast including the Voluntary Marine Conservation Areas at St Agnes and Polzeath. In the packed 'lab' back at Emily's house the seaweeds were sorted, identified and pressed by the team of volunteers – in all, over 560 samples were pressed, filling a significant geographic gap in the Natural History Museum's seaweed collection.

In total we recorded 189 seaweed species (116 red, 50 brown and 23 green) - 30% of the UK seaweed flora. Of the 189, 42% red, 20% brown and 39% green species were new records for the area. This included

the nationally rare species *Osmundea truncata*, *Cystoseira humilis* var. *myriophylloides* and, if the identification is correct, *Ceramium cimbricum*, which is being checked through DNA sequencing. Each of these species has been recorded from 10 sites or fewer in Britain.

Figure 2. Seaweed pressing in the lab at Emily's house. (Credit: Emily Priestley)

Non-native seaweeds were a feature of the flora, with *Sargassum muticum* and *Asparagopsis armata* (including *Falkenbergia* phase) being very prominent as well as *Bonnemaisonia hamifera* (including *Trailliella* phase), *Caulacanthus okamurae*, *Grateloupia subpectinata* and *Codium fragile* subsp. *fragile*. This represents about 16% of the non-native seaweed species for Britain.

Figure 3. Teresa Darbyshire identifying polychaetes. (Credit: Emily Priestley)

Unlike most Seasearch surveys we were able to study groups that are very hard to identify in the field. Ali Bessell spent long evenings at the microscope adding new species to our lists of bryozoans and hydroids. Teresa Darbyshire from National Museum Cardiff focused on the polychaete worms that she searched for on the shores and underwater. It was frustratingly difficult to collect soft, slippery polychaetes underwater and place them in a plastic bag whilst being washed from side to side by the swell.

Teresa found the north coast shores to have a low diversity of polychaetes because of the exposed nature of the rocky coastline, but subtidally there was much more to keep her busy. The highlight was an offshore reef near Newquay where the conditions were the best of the week and she brought back the biggest species list. Most polychaetes were found in turf samples and on pebbles brought back to the lab. Teresa feels there is still more to find on the deeper reefs if only the weather would let us get out there.

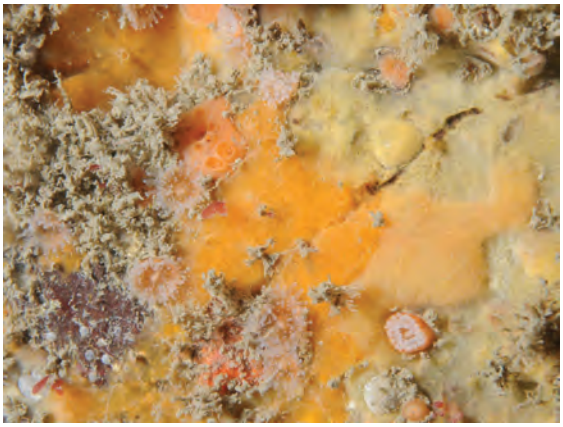

Figure 4. Encrusting sponges on the north coast including the new Phorbas *species. (Credit: Claire Goodwin)*

Another focus of the week was sponges, guided by Dr Claire Goodwin from National Museums Northern Ireland. Despite the tricky conditions for collecting sponge scrapings we found 44 sponge species in 128 samples. Had we been able to get to deeper sites further offshore it is likely that we would have found more, as the tantalising few deeper sites that we did visit promised greater diversity. There were lots of common, shallow water species such as that encrusted the rocks, as well as several interesting records. We found *Hymedesmia peachii,* a nationally rare species, and *Phorbas dives* and *Mycale minima* which have restricted southwestern distributions in the UK.

We also collected two specimens of a new species of *Phorbas* from Bawden Rock in St Agnes Voluntary Marine Conservation Area. This species was first recorded in the Isles of Scilly and Claire is in the process of scientifically describing it. The south coast dives turned up a specimen which is of a new genus to the UK, first found in Plymouth by Emily Priestley on a sponge course in 2010. Species are extremely hard to identify because they lack spicules, which are key to identifying many sponge species. Claire suggests that, since the genus is common in the Mediterranean, we may be seeing the arrival of a non-native species on our reefs.

Overall, during the incredible and exhausting week, we surveyed twenty sites on the north and south

coasts, making new discoveries and filling in some data gaps that had been identified years ago. But the experience only served to whet our appetites for more information on our north coast, and is the reason that we decided to host a Porcupine field meeting in St Agnes this September, open to everyone. We hope that you will join us!

Thanks to all the team!

(Juliet Brodie, Claire Goodwin, Teresa Darbyshire, Steve Adams, Kat Brown, Dave Goodwin, Ali Bessell, Chris Lowe, Dawn Watson, Rob Spray, George Gall, Sue Pybus, Jax Metcalf, Rob Seebold, Sarah Bowen, David Kipling, Keith Hiscock, Jane Morgan, Chris Whitworth)


Sarah Bowen


Teresa Darbyshire


Rob Spray


Sarah Bowen


Rob Spray


Rob Spray


Emily Priestley


Rob Spray

Further photos from the survey

The transatlantic voyage of the yacht "Petula".

Frank Evans

At the Porcupine meeting in March of this year I showed a film of my transatlantic oceanographic voyage in 1953, together with two companions, aboard a twelve ton yacht. Leaving Plymouth we sailed to West Africa, then with a raft in tow undertook a drift of twelve weeks from Dakar to Barbados. From the raft we took graded sea and air temperature measurements to two metres above and below the surface, in an investigation of air-sea heat exchange, and also did underwater filming. We collected fish specimens and extensive plankton samples and kept weather and sea current reports over the course of the voyage. We had a contract with a small film company and carefully attended to filming when underway. Later I helped in the editing of this material for a short commercial production which on completion was launched at the Odeon, Leicester Square. With the experience I had gained in editing and with the help of Newcastle University Photographic Department I put together the longer film which was recently shown to Porcupine.

Figure 1. The yacht 'Petula' drifting

Our film has aroused some interest, which may warrant a short additional description. First, we were recent graduates, lacking much scientific authority. Nevertheless our initial requirement was to raise cash and equipment. For equipment, we were generously supported by many sources including the Admiralty, the Met Office, the Marine Biological Association and many private firms. In particular, several hundred Kilner jars for specimen storage were specially made for us with copper sealing rings to prevent rust. Semi-officially we occupied a room in the Natural History Museum basement which just happened to have a telephone.

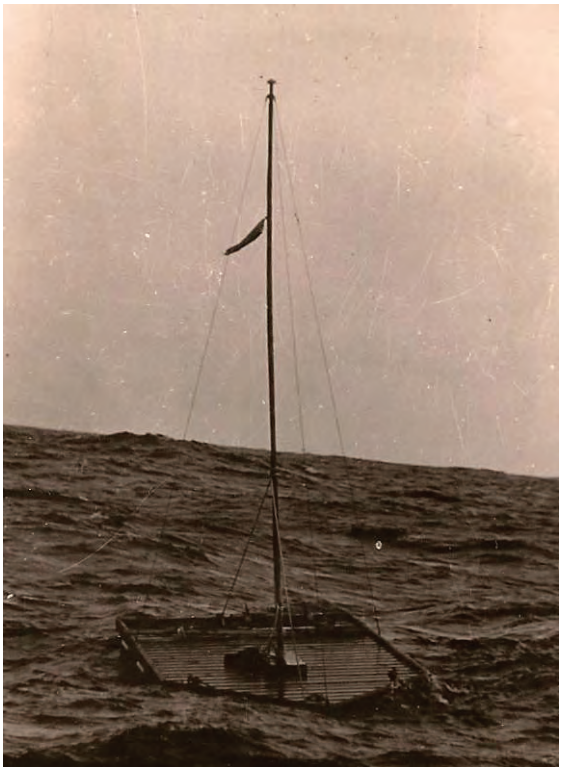

Figure 2. The raft towed by 'Petula'

Money was a different matter and we were fortunate to approach the Belgian Natural History Museum at a time when they had wrongly abandoned support for Jacques Pickard's diving bathyscaphe (with US help, Pickard subsequently dived to a world record eleven thousand metres). The museum thus had cash in hand and some came our way. Now with funds we looked for a suitable, moderately priced ship, eventually purchasing the yacht "Petula", built in 1899, from Col. "Blondie" Hasler of Cockleshell Heroes fame. He subsequently built the junk-rigged "Jester" with which he joint-founded the single-handed transatlantic yacht race. Meanwhile, at a Hamble yacht yard we brought the "Petula" up to A1 at Lloyd's standard.

Our whole enterprise took over a year to prepare and seven months to complete. During our time at sea and subsequently, we remained on excellent terms (a FAQ). We ate well, mostly on dehydrated food, and drinking water was unrationed although forbidden for any other purpose. Water was carried in a large bilge tank and in the numerous Kilner jars, later to hold plankton. Additionally we had a still and jellied petrol (napalm) fuel for distillation of sea water in emergency, although it was never called upon. Further war-like material included an illicit pistol and a substantial quantity of submarine blasting gelignite supplied by the Nobel Division of ICI. The purpose of this explosive was to kill fish,

which it signally failed to do, even when the blasts lifted the raft under us.

Without a radio we relied on the Admiralty chronometer for our longitude and at the end of twelve weeks our landfall at Barbados was precise. Without radio signals my heroic wife waited at home for news but apart from an early message, her first indication of our progress was after nine weeks of silence when we managed to call up a ship on the signal lamp in the middle of the night and she reported our position.

Apart from the investigations noted we also measured such factors as Aitken nuclei in a cloud chamber, the pH of the sea (almost constantly 8.2 until approaching the West Indies, when it fell to 7.9) and attempted to capture Sahara dust on exposed greased microscope slides but all we got were dinoflagellates from spray.

When in Dakar, a colony of sessile barnacles grew along our waterline, but offshore these were very rapidly replaced by the stalked barnacle *Lepas* spp. Oddly, the plankton nets, which fished continuously, supported only *Conchoderma* spp. Some of the *Lepas* reached maturity in only thirty days from settlement. Barnacles supplied a ready diet for the triggerfish that surrounded us.

On calm days it was sometimes possible to watch the only truly marine insect, *Halobates*, flitting over the sea surface. Like its pond skater relatives it lives on and not in the water and lays its cleidoic eggs on floating material.

Often big dorado would hurtle through the air in hot pursuit of flying fish. I sometimes wondered what they could see when airborne.

Leaving Plymouth, we were seasick but later hardly noticed the ship's motion and would cheerfully sit in the heaving galley at the bow when cooking. We became well used to rolling and in later years aboard research vessels, when the engine is switched off for sampling and the ship lies at the mercy of the waves, people start to feel unwell and I start to feel better.

We had one or two frights, once when I tried to retrieve the anemometer which had become slack-bolted at the mainmast head and more seriously when the raft towing chain, which was the ship's anchor chain, pulled out one of the stout cleats to which it was secured. This happened during a strong gale. I should say that it can sometimes blow quite hard in the tropics and we sometimes experienced force nine winds.

Once in Barbados we put up at a small hotel and spent a month packing our equipment and collections before returning to Heathrow by air where we were met by reporters offering us our fifteen minutes of fame. Among the newspaper reports is one I treasure. What happened was that, as the voyage neared its end, we cast off the raft and made full sail for port. To do this one of us had to board the raft from our rubber dinghy to unshackle the cable. While returning to the ship he received unwelcome attention from a large white-tipped shark which rubbed against his frail craft. The newspaper reported this story with a headline reading: "Shark feels man through bottom of rubber boat".

We sold the "Petula" in Barbados and I have no news of her subsequent fate. Although old she was a fine ship, built of first-class materials at Fife's of Fairlie, a leading Scottish yacht yard of the time, and despite her age she served us extremely well in all circumstances. I cannot think she survives today.

Plastic pollution and marine microbes:

Identifying plastic colonisers in the ocean

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Plastic in the ocean

The production of plastic started over 100 years ago, reaching extensively high production levels within the last 60 years. Yearly, about 245 million tons of plastic are produced on a global scale (Andrady & Neal 2009). Two of the features making plastic so popular are its durability and longevity. Common plastic goods have a degradation time of hundreds to thousands of years. For the environment on the other hand, durable plastic represents a major threat. Since the first piece was produced, plastic has been accumulating in the world's oceans. Only recently has the alarming scale of the plastic pollution in the marine environment been recognized. In particular, the discovery of the Great Pacific Garbage Patch raised awareness of our need to improve management of plastic goods. The Great Pacific Garbage Patch represents an area of high concentration of plastic debris in the North Pacific Gyre (Marks & Howden 2008; Moore & Phillips 2011). Its discoverer, Captain Charles Moore, refers to the Garbage Patch as "plastic soup". There are no exact data about the size of the Great Pacific Garbage Patch, since most plastic in the oceans is broken down to small pieces that are impossible to detect via satellite (Carpenter & Smith 1972; Browne *et al*. 2007). Rough estimations describe the Garbage Patch as covering an area from twice the size of Hawaii up to twice the size of Texas. Current research indicates that such litter accumulations can be found in all five gyres of the world's oceans (Law *et al*. 2010; www.5gyres.org).

Plastic particles floating in the oceans or being washed up at beaches (Fig. 1) mainly belong to packaging, manifold household items or fishing-related goods. During a recent beach clean in Devon, UK, crisp packs and drink cans from the 1960s were collected, which "have been on UK beaches for almost as long as the Queen's reign" (Surfers Against Sewage 2012). Plastic particles in the environment are roughly classified as macroplastic (>5mm) and microplastic (<5mm). The most common macroplastic polymers found in the ocean are polyethylene, polypropylene and polystyrene. Detected microplastic particles consist mainly of polyester, acrylic, polyamide and polyvinylchloride (Browne *et al*. 2010).

Figure 1. Plastic collected from a UK beach

In this context, the following question needs to be raised: how is all the plastic transported from the consumer into the ocean? About 80% of marine litter originates from land-based sources (www.algalita.org). Improper disposal of plastic litter represents one of the main causes of the marine plastic pollution. The routes of transport of plastic into the ocean are diverse and mainly preventable. To name a few: Direct dropping and dumping, blowing from landfills and losses in transport or accidents. Also the overflow of sewage treatment plants after heavy rain is partially responsible for the marine plastic pollution, since many hygiene and medical items from the wastewater system are flushed into the ocean.

Plastic particles enter the marine food web and represent a threat to organisms at all levels (Pierce *et al*. 2004; Browne *et al*. 2008; Barnes *et al*. 2009). Animals are injured by bigger plastic pieces or even starve, since they mistake plastic particles for food. Furthermore, intoxication represents a threat arising from plastic pollution. Plastics attract and attach persistent organic pollutants, which bioaccumulate in plastic-ingesting organisms, with unknown consequences on the food chain or human health (Mato *et al*. 2001).

A study in the area of the Great Pacific Garbage Patch on plastic ingestion by fish revealed that 35% of all investigated fish stomachs contained plastic particles (Boerger *et al*. 2010). In the Midway Atoll, researchers found ingested plastic pieces in over 97% of investigated dead and injured albatross chicks. The amount of ingested plastic was significantly higher in the stomachs of albatross chicks which had died of dehydration and starvation, compared to albatross chicks which had died for other reasons (Auman *et al*. 1997). Even though plastic pollution might not be the direct cause of the mortality, it most likely contributes to the death of the birds by causing additional stress.

The most abundant organisms in the ocean are microorganisms such as bacteria, archaea and

microbial eukaryotes. Those organisms represent a fundamental part of the marine food web. However, the role of microbes in the fate of marine plastics and associated toxins, and the consequences of plastic pollution on the marine microbial community structure and function, has received scant attention (Harrison *et al.* 2011). It is very likely that microorganisms are able to use plastic as habitat, since this group of organisms adapts very quickly to emerging niches. But there are many open questions regarding microbial plastic colonisation in the ocean: Which bacteria, archaea or microbial eukaryote species use plastic as habitat? Are those microorganisms able to degrade plastic and metabolise the associated toxins? Can pathogenic microorganisms use plastics as distribution vectors? Our study aims to fill these knowledge gaps, investigating microbial plastic colonisation at sampling stations around the UK.

Our research focus: Plastic and microorganisms

In order to examine the microbial colonisation, drinking water bottles (PET) were attached for a six week period onto jetties and buoys in the North Sea, UK, under estuarine and marine conditions. Besides this controlled approach, we collected plastic from beaches at the UK East Coast (Fig. 1). Furthermore, plastic sampling of the surface of several UK waters (North Sea, English Channel, Celtic Sea, Bristol Channel) was performed using a Manta trawl net. Manta trawl sampling yielded many broken down plastic pieces per sampling station (Fig. 2).

Initially, samples from all approaches were checked for microbial colonisation using fluorescence microscopy. Subsequently, we were able to extract DNA from the plastic and to then amplify bacterial as well as archaeal 16S and eukaryotic 18S rRNA gene fragments, to enable characterisation of the structure and taxonomic composition of microbial assemblages attached onto plastics. To learn about the diversity and spatial features of microbial plastic colonisers, community fingerprinting was carried out. We performed denaturing gradient gel electrophoresis (DGGE), a method to display the diversity and structure of microbial communities. It is based on the specific melting properties of the DNA due to its base pair composition. DNA fragments, commonly of the 16S or 18S rRNA gene, migrate through a polyacrylamide gel along a urea/formamide gradient. The DNA of each species in the investigated community melts at a specific position in the gel and is displayed by a specific band, resulting in a specific fingerprint for each microbial community. Currently, DNA fragments from prominent DGGE bands are being sequenced, in order to identify the colonisers.

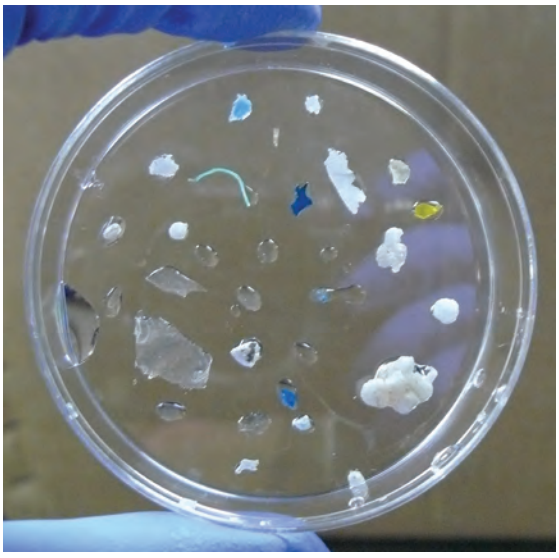

Figure 2. Small pieces of plastic collected by a mantra trawl

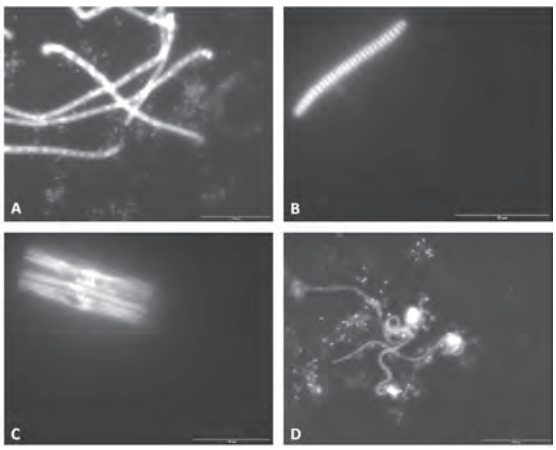

Figure 3. Prokaryote biofilm on plastic samples

Fluorescence microscopy (Fig. 3) revealed a biofilm of colonising prokaryotes on all plastic samples: Deployed PET bottles, plastic from beaches and from the surface of marine UK waters. Colonising eukaryotes were detected on all investigated plastic samples as well, but at lower densities. Also using DGGE we discovered a diverse community of prokaryotic and eukaryotic microorganisms colonising plastic. The colonising communities displayed differences in composition, diversity and variance regarding sampling station. In particular, the plastic-colonising microbial community at the estuarine sampling station showed a high diversity and differed distinctly in its structure from the communities at the marine sampling stations. However, some microbial colonisers were found in all samples, whereas some were specific for individual sampling stations or even individual samples.

At this point, we are able to confirm that bacteria as well as archaea and microbial eukaryotes are capable of using plastic as a habitat in the ocean. We also know that the plastic-colonising community differs from the typical microbial community in the ocean (Communication with Dr. M. B. Duhaime, University of Michigan). Sequencing of DNA fragments eluted from DGGE bands will identify the microbial colonisers being present at all sampling stations as well as the ones specific for each location. 454 pyro-sequencing and metagenomics will reveal more detailed information on the community composition and function of this colonisation. Ongoing sampling of more locations and seasons is crucial to identify spatial and temporal dynamics of the plastic colonising community. Our work represents a step towards the understanding of microbial plastic colonisation and will help to identify its possible positive and negative consequences.

Acknowledgements

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Living in an alien environment: the post-harvest live crustacean

Roger Uglow

Crustacean shellfish are internationally appreciated as expensive delicacies. Here, in the British Isles, they are landed at ports large and small all around our coast including the Western and Northern Isles. Many of these are rather remote areas where alternative employment is scarce so these fisheries have often acquired a socioeconomic importance disproportionate to their actual value. Nevertheless, the fiscal value of these landings has increased greatly in recent years. Fishing for brown crab (*Cancer pagurus*) and lobster (*Homarus gammarus*) has a long history and, traditionally, these species supported our modest domestic demand – often with the catches being sent by overnight train to Billingsgate to supply the large, cosmopolitan, London population.

Recent decades have seen large changes even though the variety and volume of our domestic consumption has changed comparatively little. The changes have been brought about by very large increases in both the volumes and variety of crustacean shellfish landed which now support a valuable export market. Some of these animals are processed and others are traded alive – the proportions of these vary according to species but this article addresses the live trade only. This live trade has grown in other parts of the world also and now comprises a £multibillion trade which is global in extent. The British animals are consigned, in bulk, mainly to the near continent where the tradition of eating seafood has always been strong and where the per capita consumption of it is much higher than here in the UK (Fig. 1). Some, however, are air-freighted to the Middle and Far East and this trend to export beyond Europe is increasing as techniques develop and improve.

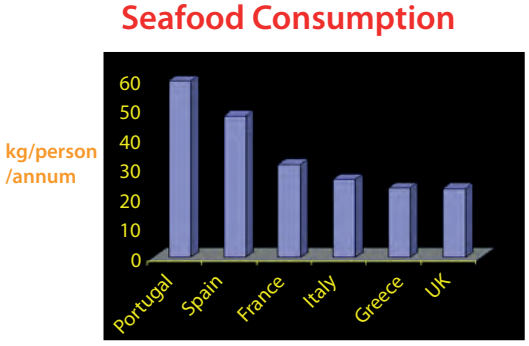


Figure 1. per capita consumption of shellfish in Europe.

In the UK, we are most familiar with brown crab and lobster and, more recently, with *Nephrops* or scampi (*Nephrops norvegicus*) as food items. This wasn't always the case though, when the author was young, there was no market for *Nephrops* and those landed were mainly as crews' perks. The marketing ploy of making *Nephrops* pub food and re-naming it scampi changed all that, and our *Nephrops* landings have now become the most valuable of all fish and shellfish landed in the UK. Many of these *Nephrops* are processed but there is also a strong demand for live *Nephrops* on the continent and in high-end restaurants in the UK (where it is often referred to as langoustine). Spider crabs (*Maja squinado*) are fished principally in southwest England and Wales, and traditionally were consumed mainly in these areas. Velvet crabs (*Necora puber*) have never been a common food item in the UK although there have been stocks of them along the western seaboard of the UK – and, since the '90s, a large expansion of the populations in the North Sea.

In the '80s, continental dealers came to the UK looking for our fished, under-fished and non-fished species to satisfy the strong demand for them on the continent. This resulted in a large expansion of our fisheries, both in terms of the volumes and variety of species landed. Of course, in many instances this involved completely new fisheries, unfamiliar species and novel systems to apply. Not surprisingly, mistakes were common and some are proving slow to be rectified.

It is sensible to consider the requirements and principal constraints associated with this trade. Live crustaceans comprise an expensive, niche market in which the customer demand is for a live, quality animal. This is an expensive requirement because a processed product would be a much easier and far less expensive commodity to supply. The high price they command is a consequence of them passing through the hands of several owners, each of whom has to protect the vulnerable quality of these animals, even though they will be in, what is to them, an alien environment. It should be pointed out that, in the early stages of the supply chain, these animals are traded in large quantities (tonnes) which have to be selected in order to remove animals that may be sub-standard commercially from those that are acceptable for processing and those that are suitable for the live trade. All of these grades may be perfectly normal biologically – biological and commercial quality are often, but not always, synonymous. The closer to the point of capture that selection can occur, the greater the chance that biologically-sound discards can be returned to the sea and thus help maintain the stocks. Thus selection is important as a valuable conservation and fisheries management tool as well as a means

of ensuring that the standards expected by the customers are met.

Some of the supply chains are impressive in terms of distance and duration. The quality lobster being eaten in a Beijing restaurant may have been caught in Canadian waters six months earlier. Such commercial achievements do not occur by accident but have to be made consistently — a challenging requirement especially as, on top of everything, all the procedures have to be cost-effective. Meeting these challenges successfully implies that the conditions provided for the animals are conducive to them maintaining their commercial quality in spite of it being impractical to supply exactly their natural conditions. As is the case with many animals, crustaceans can be 'conditioned' to altered conditions – in other words their tolerances to prevailing conditions can be shifted. They are invertebrates that have a metabolic rate that is directly related to the prevailing temperature – their core temperature is usually slightly higher than the ambient temperature. The lower the temperature to which they can be conditioned, the lower their metabolic rate and the lower their oxygen demands, carbon dioxide and ammonia production and excretion. Their natural response to low temperatures is to become progressively more immobile and sit out the period. A commercial advantage of this behaviour can be seen with the low temperature conditions that are supplied in the large, on-land lobster holding facilities in North America (Fig. 2).

Figure 2. Large scale lobster storage

This is not a cheap option but lobsters, of course, are expensive and thus warrant the considerable financial investment involved. Normally, crabs are much less expensive commodities and such large-scale storage would not be so cost-effective. A number of other advantages accrue from bulk, low temperature storage, including it being unnecessary to feed the animals (they would not eat, even if presented with food) and the lack of physical damage caused by mutual aggression of the animals.

All of the commonly landed British species are ones that typically live on the sea bed where, by and large, the environment is very constant compared with that of the immediate sublittoral and intertidal regions. Salinity and temperature there are slow to change and an abrupt change of any environmental variable is an extremely rare event. Emersion does not occur and they utilise dissolved, not gaseous oxygen. This inability to utilise atmospheric oxygen results in them rapidly becoming anaerobic when emersed. If the species is also incapable of switching temporarily to some form of anaerobic respiration they will die. Some species are much more adaptable than others in this respect. Before capture, the animals will have spent their adult lives in this constant environment where temperature and salinity changes are slow seasonal ones but, at capture, they are rapidly catapulted into an alien environment, experience handling, temperature change, lack of oxygen, increased noise, vibration and a probable huge increase in light intensity. This is not an auspicious beginning of a post-harvest phase within which the objective is to maintain the animal in excellent condition. Many of the fishing vessels are small and have few facilities for optimising the husbandry of the catch. Contrastingly, some of the most modern fishing vessels are equipped to supply their catches with a flow through of seawater, chilled to below ambient temperature (Fig. 3). The considerable costs of these refinements are considered to be a sound investment because of the perceived quality of the landed catches. Subsequently, the animals have to be consigned to purchasers – often over considerable distances.

Figure 3. Modern large lobster catching vessel

In Europe, the principal transportation mode is the vivier lorry for most of the species exported (Fig. 4). These are expensive, dedicated vehicles especially equipped to carry approximately equal volumes of chilled seawater and crustaceans. By and large, only the more valuable species are profitably sent (dry) by air freight.

Figure 4. Vivier lorry designed for long haulage of live shellfish

In a simple way, an animal can be considered as an impermeable container that maintains an internal environment with a different composition from that in their surrounding environment. All living creatures, however, have to exchange materials with their environment, take up essential raw materials and get rid of wastes, so no animal is completely impermeable. Essential exchanges are restricted to specialised sites and, in the case of crustaceans these are mainly the gills and the lining of the gut. By implication, exchange sites are very delicate structures, hidden away from direct, physical contact with the physical, surrounding environment. Thus you do not see the gills of a crab or lobster as these are covered and protected by the carapace. However, they are ventilated by seawater by the beating of the scaphognathites – specialised structures on a pair of limbs that acts very like the impellor of a pump. Their activity can provide very fine tuning of flow rate, with beat frequencies ranging from tens to hundreds of beats per minute resulting in a consequent change in ventilation volume.

The normal, immersed crustacean will take up oxygen and various ions from the incoming ventilatory stream, and excrete carbon dioxide, ammonia and various ions in to the outgoing stream which jets its away from the animal (Fig. 5a). When the animal becomes emersed its ventilatory stream ceases and the rate of its exchanges reduce markedly or cease altogether (Fig. 5b). The animal now becomes deficient in oxygen and cannot get rid of toxic wastes that will compromise the internal environment. It has been mentioned that tolerance to these conditions varies according to the species but it also varies according to the animal's metabolic rate which, as has also been mentioned, varies with the prevailing temperature. Consequently, the survival and quality maintenance of cooled animals is better than that of non-cooled ones – a valuable thing to know in the trade and one that is used extensively in the supply chain systems.

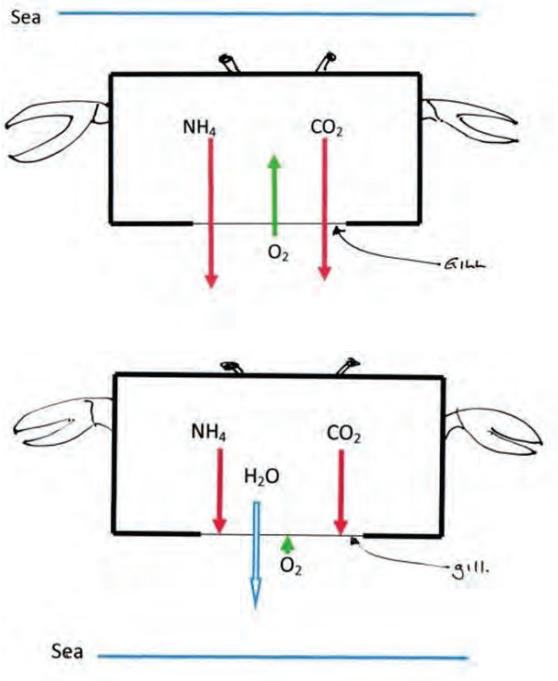


Figure 5. a) the immersed crustacean, b) the emersed crustacean

A sudden temperature change does not occur in the crustacean's natural environment but is a frequent occurrence in its post-harvest environment. Such changes can be traumatic and, if possible, are best avoided because of their negative impact on commercial quality and are an avoidable inhumane treatment. In this context, there is the implication that it is the internal, core, temperature that is affected. For the internal temperature to change there has to be an efficient heat exchange mechanism available. The engineering requirements for a heat exchanger are for a very thin wall and a large surface area – requirements met perfectly by the crustacean gill.

In the commercial environment, it is a frequent occurrence for crustaceans to be taken from one tank and placed in another – often those of a new owner and the water temperature in these tanks may differ by one or a few degrees. When the crustacean experiences such a water temperature change they will have a shock reaction in which their ventilatory pumping ceases for a period that may extend into several minutes. When pumping resumes it will flush their gills with water at the new temperature. The blood that is pumped through the gills by the heart will be at the old temperature but it leaves the gills at the new, external one. Within a matter of a few minutes, all the blood will be at the new

temperature – physiologically, a very rapid change and, if the change is a degree or more will be a traumatic event. The severity of this trauma will depend on the size of the temperature change and whether the change is a temperature increase or decrease. An increase will accelerate the metabolic rate whereas a decrease will retard it – the former often causing the most problems.

When the animal becomes emersed, gill ventilation ceases so the heat exchange mechanism ceases to operate. Internal temperature adjustment now depends on the latent heat of the blood and tissues – very similar to that of water – hence become very slow. This also can be turned to commercial advantage by chilling the animal in water and then removing from the water to pack and consign 'dry' - during which time the animal warms up very slowly.

It is clear that a suite of appropriate physiological conditions for the post-harvest animals should be in place at each of the component links of the supply chain. This fulfils two important functions – an enhanced proportion of the animals retaining their original commercial quality – hence a higher profit and secondly, providing humane systems for the benefit of the animals. For this to be successful it is necessary to ensure that catchers, exporting and importing dealers are made aware of the advantages of investing in such systems and that such feedback information is kept up to date. So a humane system is actually a profitable one.

This application will lead to some major changes to operations in the near future. As it becomes more widely recognised that properly-conditioned animals are emersion tolerant there will be a swing away from costly vivier transport and a switch to alternative, more humane and more cost-effective transportation modes. This will lower transportation costs and will probably increase the likelihood of consistently delivering a quality, living crustacean, despite the complexity of the supply chain involved.

Why Quality and ISO 17025 for Commercial Marine Taxonomy?

Carol Milner

Marine BioLabs manager, APEM Ltd

Quality can be defined as something which conforms to a client's requirements and ensures that work is fit for purpose. A quality system ensures that errors are prevented or at least minimised and a good quality system should enhance and improve processes over time. But it is more than just a good finished product.

There are various options available to a commercial marine laboratory to ensure high quality outputs. Recommendations in the industry literature suggest that all stages of analysis should be subject to internal AQC (NMBAQCS '*Guidelines for processing marine macrobenthic samples: a Processing Requirements Protocol*') and at least one in ten samples should be subject to re-analysis by a second analyst. Additionally, there are various methods of external quality assurance, for example, sending individual specimens to experts for verification, having a percentage of samples re-analysed by a second benthic laboratory, and membership of a quality scheme such as NMBAQCS. For a real belt and braces approach to quality, accreditation can be sought from the United Kingdom Accreditation Service (UKAS) to ISO 17025, an International Standard which underlines the general requirements of a quality management system for laboratories. The goal of accreditation is to ensure reproducibility and traceability of results and conformance of the quality system to the international standard (ISO 17025).

But it is unusual to see accreditation under ISO 17025 for biological analyses. A recent check of the UKAS website showed only 15 labs were accredited for biological analysis compared to more than 200 for chemical analyses. Accreditation is achieved after a vigorous audit by UKAS and is formal third party recognition of competence of a laboratory to perform a specific task while meeting the requirements of international accreditation standards (ISO 17025).

As part of accreditation to ISO 17025 there is a requirement for the standardisation of company procedures (from ordering supplies to ensuring feedback of the quality system to directors and registering customer complaints and compliments) as well as lab procedures and in-house procedures. These procedures should refer to and conform to industry standards (for example the NMBAQC processing requirements protocol and CSEMP

Green Book), must be detailed enough so all staff understand what to do, and all procedures when updated must be read and signed by all analysts. Up-to-date copies remain in the labs so they can be referred to easily.

Staff training must be documented and consistent, with justification for considering staff suitably trained. For existing staff internal and external Analytical Quality Control (AQC) is training as all differences in identification are re-examined and the AQC records are used to show continuing competency. All new staff, regardless of experience, must undergo some degree of training. For new staff with no experience it may be beneficial to start them on sorting until they are used to recognising the various phyla and they can soon become signed off; a further period of training can then be added in future for identification. In all cases, at least the first batch of 10 samples is reanalysed.

In addition, auditing is important and consists of regular internal audits by trained staff of both the company systems and the lab procedures and annual external audits by UKAS as an impartial third party. These aim to check the systems, ensure staff are following procedures, and checking that the system is doing what it is supposed to do. It should pick up on issues and lead to, most importantly, corrective action and improvements.

During audits, and at any time where non-compliance with the system is encountered, a non-conformance is raised. This results in an investigation into the cause and actions to ensure the non-conformance does not happen again. The system ensures tracking of problems and highlights whether these problems are recurring. This ensures that corrective action is undertaken so that the system is constantly improving and being updated. Only by testing a system can you measure its effectiveness.

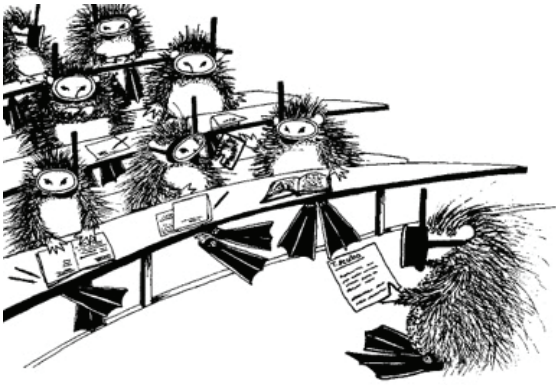
So what does UKAS accreditation mean for a commercial laboratory? Once a year we are audited by UKAS auditors. Our records for the whole year are examined, our procedures are demonstrated and questions are answered to prove we are doing what we say we are doing in our procedures, and we prove our competency to carry out the work through our internal and external AQC results. The whole process can take a few days.

Why do we put ourselves through it? As a relatively new commercial marine benthic laboratory our reputation is hugely important within the field of benthic invertebrate identification and with our clients. We often need to prove our competence, prove that we undergo internal and external AQC, and are robustly consistent in our work, in particular in tenders for public bodies. We also need to show that new staff undergo rigorous training in all aspects of marine taxonomy. This is because, at the most fundamental level, we deal in data and we must ensure that both our clients and we have complete confidence in those data.

The benefits of quality systems and in particular ISO 17025 are comprehensive. The system ensures that all staff use the same procedure, and that they are rigorously audited, confirming compliance with these procedures. Furthermore it guarantees that training is structured and monitored, while ensuring that the system is constantly updated and improved. It also promotes open dialogue and makes teamwork and interaction with the wider benthic community part of everyday working processes. Through AQC, mistakes are corrected and analysts learn from these mistakes. And through external QA and membership of the NMBAQC Scheme we receive input from other labs and this can lead to learning about new literature and species.

The most valuable benefit is that the system is continually updating and improving so any issues or non-conformances that do occur are unlikely to happen again and that way we can ensure that our data are always of the highest quality and that our reputation is maintained.

A quality system, therefore, is of the utmost importance for a commercial marine taxonomic laboratory like APEM. It aims to ensure that our staff produce work of a guaranteed high standard of output to our clients and, ultimately and most importantly, enables robust, confident and scientifically accurate interpretation of our results.



North Sea

Marine Conservation Zones – a North Sea Perspective

Kirsten Smith

North Sea Living Seas Manager for the North Sea Wildlife Trust partnership

There are 47 Wildlife Trusts across the UK, Isle of Man and Alderney, each an individual charity but all working together as part of a national partnership that is 'The Wildlife Trusts'. Collectively we have over 800,000 members and provide a national voice through 'real world' on the ground experience. Collectively we work towards a vision for Living Landscapes and Living Seas. Within our Living Seas vision we set out our recipe for rebuilding and restoring our marine environment so that:

- Wildlife and habitats are recovering from past decline
- The natural environment is adapting well to climate change
- People are inspired by marine wildlife and value the sea for the many ways in which it supports our quality of life.

Central to achieving this vision – which will benefit everyone – is the goal of creating an effective network of Marine Protected Areas (MPAs) in UK waters. As a result The Wildlife Trusts have engaged in all four of the regional Marine Conservation Zone (MCZ) stakeholder projects as well as influencing wider MPA designation. Engaging at national, regional and local levels we have been working to ensure that the recommendations put forward to government represent the best possible gains for marine biodiversity.

The North Sea Wildlife Trusts

In 2009 the North Sea Wildlife Trust partnership was formed to begin addressing gaps in Living Seas activity along the length of the East Coast, through the North Sea MPA project. This initially focussed on working towards the development of MPAs within the North Sea, advancing now to local marine awareness and strategic survey programmes across the project area. The partnership consists of 12 local Wildlife Trusts (Northumberland, Durham, Tees Valley, Yorkshire, Sheffield, Lincolnshire, Derbyshire, Nottinghamshire, Leicestershire & Rutland, Bedfordshire, Cambridgeshire & Northamptonshire,

Figure 1. North Sea MPA project area and location of local Wildlife Trusts engaged in the project

Norfolk and Suffolk) and spans from Berwick to Felixstowe reaching as far inland as Derbyshire and offshore to 200 nautical miles.

The key aims of the project are to raise awareness of North Sea marine wildlife, advocate for and gather evidence to support designation of MPAs and develop partnerships with those using the sea in order to develop a better understanding of the demands placed on the sea's resources. Since 2010, the project has focussed on establishing Marine Conservation Zones (MCZs) by working within the Net Gain, North Sea MCZ project. This saw representatives from Northumberland, Yorkshire, Lincolnshire and Norfolk Wildlife Trust advocate for the protection of North Sea wildlife.

Following two years of discussions with stakeholders under the guidance of the Environmental Network Guidance (established by the statutory agencies) 26 North Sea MCZs were recommended to government in August 2011 by the Net Gain project.

These sites, alongside the recommendations from the other three regional projects (Balanced Seas, Finding Sanctuary, Irish Sea Conservation Zone Project) contribute towards a network of 127 recommended MCZs in English and offshore Welsh waters. Collectively these recommendations have resulted from over 2,500 meetings, costing £8 million with the engagement of 1 million stakeholders. This is a network resulting from considerable hard work from many people. Although there are many compromises contained within this network, and areas where it could be improved, The Wildlife Trusts believe that

these recommendations, if well managed, could be capable of not only protecting our marine wildlife but of allowing our seabed time to recover from previous unsustainable exploitation.

Progressing MCZs - *an NGO perspective*

Until recently there appeared to be strong political commitment to the designation of a network of MPAs by the end of this year and so we remained cautiously optimistic.

Richard Benyon MP, Minister for Natural Environment and Fisheries, Defra, January 2011:

'I am committed to substantially completing an ecologically coherent network of MPAs by the end of 2012'

However, since a Ministerial announcement in November the timetables have changed and with it doubt has been cast regarding the future of this network. The revised timetable for progression of the network is;

- Advice from the statutory agencies to Defra due on July 17th 2012. This advice will detail how the recommended MCZs meet the Ecological Network Guidance.
- Public consultation expected late 2012, likely starting in December lasting 12 weeks. Government have committed to take all 127 recommendations to consultation, however no commitment has been made to take all through to designation.
- Designation of **first tranche** of MCZs expected in 2013 – only 20-30 sites have been identified as having 'sufficient' evidence for designation at the current time.
- MPA network designated and well managed by 2016? Deadline outlined within the Marine Strategy Framework Directive.

Changes in timetables saw delays introduced and the possibility of only a handful of sites reaching designation – far short of a full network. As of yet the lack of timetable for progressing the rest of the network raises concern.

The Wildlife Trusts welcome the investment that Government is making in the collection of new information as part of the data review that is underway. However, the reasons given for delaying designation in order to gather additional data result in uncertainty regarding the evidence base underlying the MCZ recommendations. It is argued:

- First that extra time is needed to learn lessons from the review of the evidence base supporting the designation of the most recent tranche of candidate Special Areas of Conservation – the cSAC review.
- And second that a review of the evidence base is called for according to the comments of the Science Advisory Panel (SAP)

The Wildlife Trusts do not believe that either of these arguments support the levels of delay that we are now faced with or the reining back of the number of sites to be designated in 2013. Regarding the interpretation of the SAP comments, it is difficult to determine whether it is the quality of evidence used to identify MCZs that requires review or whether it is the quality of the way the evidence has been

North East	Yorkshire	Lincolnshire	East of England
1 Fulmar	8 Runswick Bay	15 Silver Pit	19 Seahenge Peat and Clay
2 Berwick Coast	9 Compass Rose	16 Lincs Belt	20 Blakeney Seagrass
3 Farnes East	10 Castle Ground	17 Wash Approach	21 Blakeney Marsh
4 Rock Unique	11 Flamborough No Take Zone	18 Dogs Head Sandbanks	22 Glaven Reedbed
5 Swallow Sands	12 Holderness Inshore		23 Seahorse Lagoon and Arnold's Marsh
6 Aln Estuary	13 Holderness Offshore		24 Cromer Shoal Chalk Beds
7 Coquet to St Marys	14 Markham's Triangle		25 Alde Ore Estuary
			26 Orford Inshore

Table 1. The 26 recommended North Sea Marine Conservation Zones

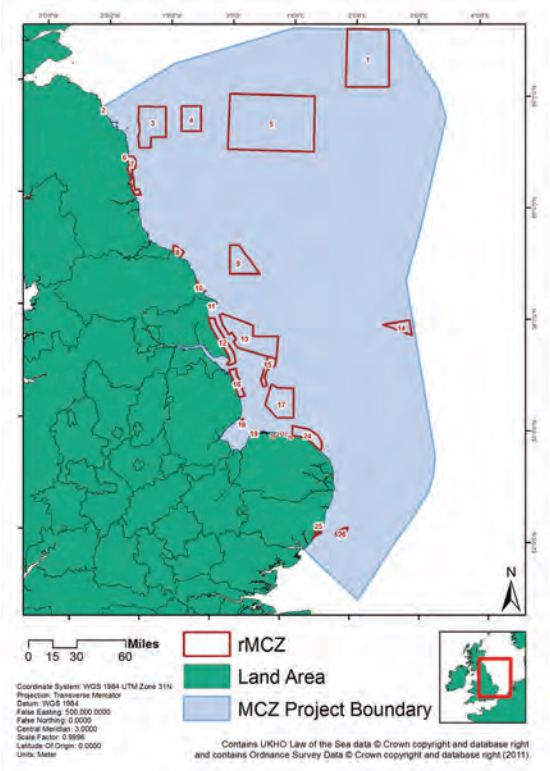


Figure 2. Map detailing the recommended North Sea Marine Conservation Zones

reported in the final submission documents from the four regional projects. Perhaps it is both. As a result of the engagement of Wildlife Trust staff within each of the four regional projects, we are aware of cases where datasets were used by stakeholders to identify sites but were simply not cited in the final reports; we are keen to see this issue addressed. This suggests that much of the problem may be with the reporting of the process rather than the process itself.

While this is an issue that requires further consideration, to suggest that the whole timetable for delivery of MCZs is delayed by up to four years just because of some problems with writing up, seems a risky approach to take.

What are the implications of this approach?

Other conclusions of the SAP report are less often quoted, but present an interesting quandary when looking at the data review. The SAP concludes that all 127 MCZs will provide us with 'ecological coherence' in our marine environment. This leads to two possible outcomes of the data review, each giving rise to important questions about the process.

- If the data review leads to sites being removed, then what is the process for identification of new MCZs to maintain the ecological coherence of the network?
- If the data review does not lead to sites being removed then why delay the process?

There is considerable uncertainty still surrounding this process. However, what we do know is that urgent help is needed for our marine environment and that delay is risky. Studies such as the National Ecosystem Assessment show that our current use of the marine environment is not sustainable……while others stress the urgent need for action.

'…the delivery of many of these provisioning and regulating services in the Marine environment are declining because of heavy exploitation…'

UK National Ecosystem Assessment, June 2011

Unless action is taken now, the consequences of our activities are at a high risk of causing …the next globally significant extinction event in the ocean.' International Earth system expert workshop on ocean stresses and impacts.

Summary report. IPSO, Oxford, June 2011

Delay leaves ecosystems vulnerable to continued pressure and reduces the opportunities and chances for recovery.

What is The Wildlife Trusts' role now?

Since the MCZs were recommended to government The Wildlife Trusts have invested effort in developing and reviewing evidence to support recommendations. We are developing a benefits package as part of the impact assessment review accompanying the site recommendations, highlighting not only the benefits that individual MCZs may have, but the benefits of designating the network in its entirety. We are continuing to gather new evidence through intertidal and subtidal survey to support MCZ designation and engendering public and political support for marine wildlife and its protection.

North Sea survey

This summer we embark on an exciting array of survey work, hoping to strengthen the evidence basis for the recommended MCZs. Northumberland, Yorkshire, Lincolnshire and Suffolk Wildlife Trusts are all now undertaking intertidal survey with volunteers through our Shoresearch programme.

Yorkshire and Lincolnshire also propose to take this further through the development of marine invasive survey work, following a training course with the Marine Biological Association earlier this year.

Figure 3. A John Dory was found in a shallow rockpool last summer during Shoresearch surveys at Creswell with Northumberland Wildlife Trust. Needless to say this magnificent creature was immediately rescued and returned to open water.

We continue to support Seasearch North East and Seasearch East Anglia this summer in their subtidal data collection. Seasearch dives along the Holderness Coast are being organised through Yorkshire Wildlife Trust and undertaking dive survey with the University of Hull throughout recommended MCZs across the North Sea area.

Figure 4. In 2011 we coordinated the first Seasearch surveys undertaken along the Lincolnshire coast. The survey resulted in astonishing photographs of faunal turf. Look closely at this photo of a Montagu's sea snail, hidden in the background are 30 different species, including several bryozoans.

Alongside the University of Hull and volunteers from MARINELife and RSPB we depart on an expedition for the Dogger Bank to undertake cetacean, seabird and subtidal survey. Through our recently formed partnership with MARINELife we will begin training volunteers to undertake marine mammal survey in order to develop both land and sea based surveys on commercial ferries in the North Sea.

Figure 5. Northumberland Wildlife Trust are currently undertaking surveys alongside MARINELife in the Farnes East rMCZ for white beaked dolphins.
(Credit: Martin Kitching, North Eastern Wildlife Tours.)

To find out more about our survey work and how to get involved visit www.northseawildlife.org.uk or follow our facebookpage www.facebook.com/northseawildlifetrusts.

How can you help to secure a network of MPAs?

You can help us secure a network of MPAs in UK waters by playing an active role in our current campaigns, 'petition fish' and 'friends of MCZs'.

Petition fish

Is The Wildlife Trusts' campaign to put pressure on the UK, Scottish and Welsh Governments to create MPAs. We are calling on the Government to deliver sites that are:

- In the right place – where nature conservation is required;
- Support recovery from past decline - not just maintenance of their current, sometimes damaged condition, and
- Managed well - with adequate regulation and controls.

Visit www.wildlifetrusts.org/petitionfish to add your name today.

Figure 6. From left Rob Stoneman (CEO Yorkshire Wildlife Trust), Hugh Bayley (MP for York Central) and Kirsten Smith (North Sea Living Seas Manager) show support for Petition Fish by adding their names to the campaign.

Friends of Marine Conservation Zones

On June 8th, World Oceans Day, The Wildlife Trusts' launched their 'friends of MCZs' campaign. We are looking for eager volunteers to befriend and support all 127 recommended MCZs, providing a voice for the wildlife within them. Each site needs groups of friends who will encourage others to take notice of them in order to ensure they are designated. To find out more visit http://www.wildlifetrusts.org/MCZfriends.

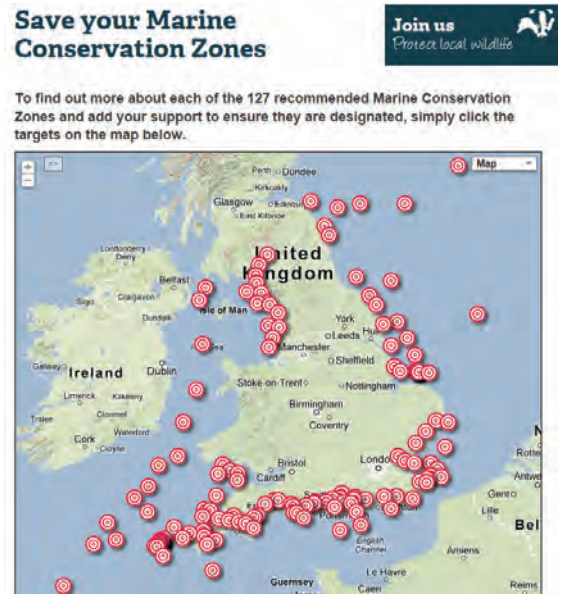


Figure 7. Why not use our interactive map and downloadable factsheets to find out why each MCZ site is so important http://www.wildlifetrusts.org/MCZmap.

In summary.....

We are cautious regarding the future for our marine environment. We recognise the risks that significant delays can bring to designation, and as such we encourage a more precautionary approach carrying out the data review in parallel with the timely designation of the complete network as originally planned, addressing any major issues through the ongoing review process. It is not too late for the Government to reconsider.....if we act now.

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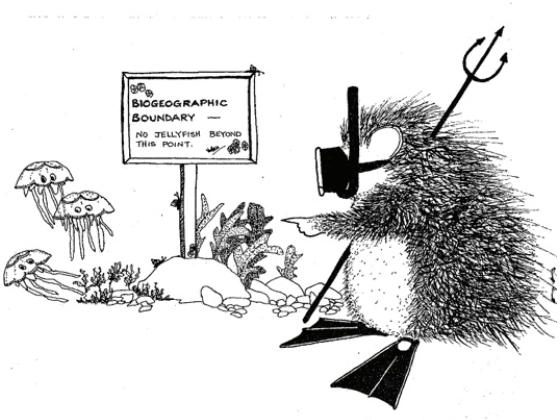

Copper: from molecules to model organisms.

When do copper-induced changes detected at the molecular level manifest in the behaviour of the polychaete worm *Hediste diversicolor*?

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This study was aimed at observing the effects of copper toxicity at different levels of biological organisation, specifically at the molecular and behavioural level. It aimed to draw a connection between impacts of copper at the molecular level and subsequent changes in behaviour in the ragworm *Hediste diversicolor*.

Background: introducing copper as a pollutant at different levels of biological organisation, and the test species *Hediste diversicolor*.

Copper is an essential metal for all living organisms. However it can be extremely harmful in aquatic, marine and estuarine environments (Grant *et al*. 2010). Copper may enter the estuarine systems via a number of pathways including run off from mineral deposits and mining operations, corrosion of copper plumbing, leaching from wood preservatives, fertilizers, fungicides, algaecides, molluscicides, antifouling agents, urban runoff and sewage (Bonnard *et al*. 2009; Galletly *et al*. 2007). The damaging effects of copper contamination have been observed at a number of levels of biological organisation and in many different organisms as follows. At the molecular level copper has been shown to interact directly with both proteins and DNA. For instance in the polychaete worm *Laeonereis culveri* copper induced DNA strand breaks (Geracitano *et al*. 2002). The effects of copper have also been observed at the whole organism level; this may include changes to physiology, morphology and behaviour. Some of these recorded physiological effects from copper include stunting to growth and reproduction (Poirier *et al*. 2006; Durou *et al*. 2007). Alongside these, behavioural changes have also been observed in a number of organisms. For example in *H. diversicolor* feeding depression and changes to burrowing speed have been recorded in the literature (Kalman *et al*. 2009; Bonnard *et al*. 2009). Copper contamination in estuarine environments is also known to have impacts further up levels of biological organisation at the population, community and ecosystem levels, via bioaccumulation and biomagnification (Berthet *et al*. 2003).

The test species used in the present study was *Hediste diversicolor*. This is a sediment-dwelling marine polychaete worm found mostly in brackish waters and present in all European estuaries (Gillet *et al*., 2008). It is considered a keystone species owing to its ecological importance as a food source, predator, filter feeder and its role in bioturbation (Durou & Mounyrac 2007; Lawrence & Soame 2009; Kalman *et al*. 2009). This species is often used as a bio-indicator, owing to its close relationship with sediment and its relative abundance. It is also easy to collect in large numbers and is quite resilient when kept in laboratory conditions (Scaps *et al*. 2002).

Methodologies: describing the specific molecular and behavioural biomarkers selected and procedures adapted for measuring them.

In order to examine the effects of copper at different levels of organisation a testable biomarker was selected at both the molecular and behavioural levels. The selected marker at the molecular level was based on the enzyme acetylcholinesterase, and at the behavioural level burrowing speed was measured. Acetylcholinesterase enzyme has a role in synaptic transmission which will be briefly outlined here. Neurones run throughout animal bodies; they are long cellular structures that carry electrical messages to and from the brain. However there are gaps between neuronal cells, known as synapses, over which the electrical message cannot cross and so must be converted to a chemical message. To do this the pre-synaptic neuron releases the neurotransmitter acetylcholine into the synaptic cleft, and this then diffuses across to the post-synaptic neuron. Once at the post-synaptic neuron it binds to receptors and triggers an action potential, which allows the electrical message to continue down the post-synaptic neuron. The role of acetylchonlinesterase is to break acetylcholine down into acetic acid and choline, which may be reabsorbed by the pre-synaptic neurone. This means that the post-synaptic neuron is not constantly being switched on and the system for relaying chemical messages across the synaptic cleft is reset (Silverthorn 2007).

Burrowing, on the other hand, is an essential behavioural mechanism for *H. diversicolor*; it provides protection against predation and wave damage and plays a vital role in bioturbation in estuarine environments. It has also been hypothetically linked with acetylcholinesterase because it is controlled by a series of coordinated reflexive actions (Bonnard *et al*. 2009; Kalman *et al*. 2009).

Two different methods were adapted to measure burrowing and acetylcholinesterase (AChE) gene expression. Two burrowing trials were performed with *H. diversicolor*, these included a pre- and post-acclimatization trial. Animals were collected from Paull (Humber Estuary U.K.) and kept in a mesocosm environment which matched their natural environment as closely as possible. For the pre-acclimatization trial worms were split into four conditions of varying copper exposures (0, 300, 600 and 1200 µg/l) and the time it took to burrow measured; this experimental trial was repeated with the same individuals in the same conditions for the post-acclimatization trial one week later.

To measure changes in AChE, polymerase chain reactions (PCRs) were first used to isolate and sequence the messenger RNA (mRNA) coding for acetylcholinesterase (AChE) in *H. diversicolor*. Levels of mRNA expression of AChE and a positive control reference gene (18S rRNA) were then examined in *H. diversicolor* exposed to different concentrations of copper using semi quantitative PCR. Because mRNA is a precursor for the production of proteins/enzymes it was thought that this process would give an indication of the quantity of AChE protein being produced in *H. diversicolor*.

Results: examining changes at the molecular and behavioural levels in *H. diversicolor*.

The burrowing experiments indicated significant differences between pre- and post- acclimatization trials. The pre-acclimatization trial (Fig. 1) showed no significant differences in the time taken for worms to burrow between different copper exposures. Although control worms were slightly faster to burrow. Error bars are wide which indicates a high degree of variation between repeat conditions.

The post-acclimatization trial (Fig. 2) showed that worms exposed to higher concentrations of copper contamination were faster to burrow then worms in other conditions. However all worms in all conditions including the control were significantly slower to burrow than they had been in the pre-acclimatization trials. Error bars were again wide indicating a high degree of variation between repeat conditions.

The results from the semi-quantitative PCR showed that there was less AChE mRNA in worms exposed to higher concentrations of copper contamination (Fig. 3). Such results may suggest that there is less net AChE enzyme in worms exposed to higher concentrations of copper. There was also a slight reduction in the reference gene 18S rRNA at higher copper exposures. However figure 3 shows that AChE was reduced to a greater extent than 18S at

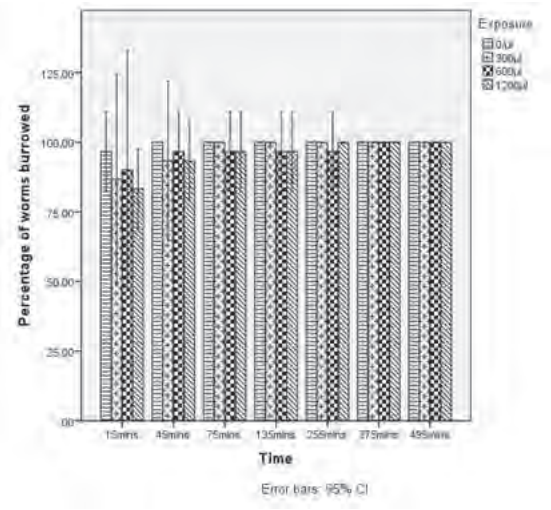

Figure 1. Burrowing rates in groups of pre-acclimatized H. diversicolor *from different copper exposure conditions at various time points. Error bars demonstrate a 95% confidence limit.*

higher copper levels suggesting a that copper had a direct impact on AChE mRNA despite the changes to 18S. There is also evidence of contamination in the negative control lane in figure 3; however, because this contamination does not occur in all lanes and owing to time restrictions the PCR was not repeated.

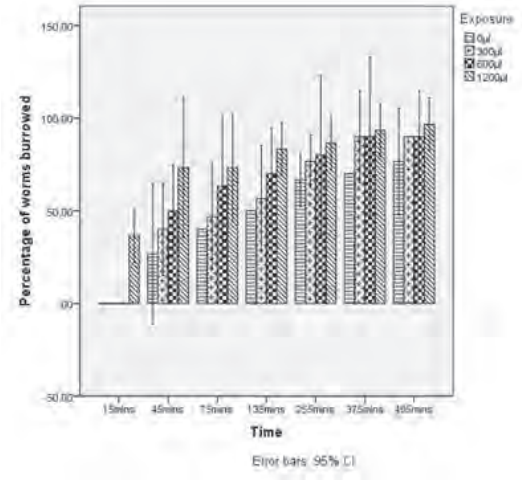

Figure 2. Burrowing rates in groups of post-acclimatized H. diversicolor *from different copper exposure conditions at various time points. Error bars demonstrate a 95% confidence limit.*

Discussion and conclusions

The results appear to indicate that there is a correlation between concentrations of copper, burrowing speed and levels of AChE mRNA. Worms at higher copper concentrations were faster to burrow then worms exposed to lower concentrations of copper. This correlated with a reduced level of AChE mRNA which would indicate less AChE enzyme in worms exposed to higher levels of copper. The pathway behind this

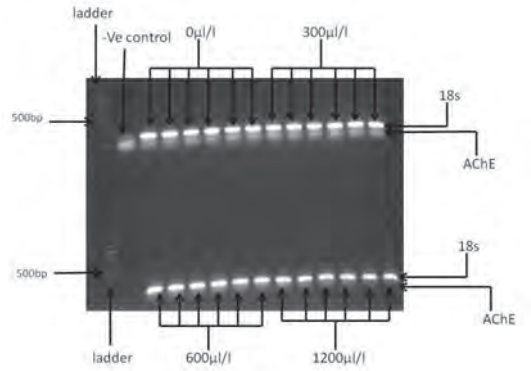

Figure 3: An image of a 0.8% agarose gel taken under UV light showing changes in 18S and AChE regulation at different copper exposures. The far left lane shows a molecular ladder which shows known molecular weights. Using this, the molecular weight of H. diversicolor *gene product can be ascertained. The larger of the two bands shown is 18S and the smaller is AChE.*

correlation can be theorized if the function of AChE is examined. If there is less AChE in the synaptic cleft then there will be more active acetyl choline which will be initiating an action potential in the post-synaptic neurone leading to the neurone being constantly stimulated. This may then manifest as increased movement and burrowing in *H. diversicolor* (Silverthorn 2007; Lehtonen *et al.* 2003).

However, a number of issues with this research should be addressed. Firstly, worms in the post-acclimatization burrowing trials (including control worms) were slower to burrow than in the pre-acclimatization trials. This would indicate a confounding variable and, in the case of this study, has been attributed to stress caused by over-handling between trials. Despite this confounding variable, however, the results from the post-acclimatized burrowing trial are partially linked with exposure to copper as can be seen in figure 2. If copper exposure was having no effect, then burrowing speeds across all conditions would not be statistically significantly different, as they were in the pre-acclimatization trial. The second main issue with this study is that the specific activity of the AChE enzyme itself was not examined. Some authors have previously found that AChE increases in activity in copper-exposed worms, while others have found that AChE activity decreases in copper conditions (Bonnard *et al.* 2009; Kalman *et al.* 2009; Frasco *et al.* 2005). This could have been measured to ascertain a complete profile of AChE in copper-exposed *H. diversicolor*.

To conclude, this study has ascertained that there is a correlation between AChE mRNA expression at the molecular level and burrowing at the behavioural level. However further work should be done to confirm causation between the two variables.

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The application of taxonomy to a marine consultancy and its outputs

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Background

Marine consultancy as an industry is multifaceted and the client base can range from private companies to governmental organisations. Projects can be summarised into three broad categories: conservation designation, national monitoring programs and direct impact assessment. The most recent focus for conservation designation is the establishment of 127 networked MCZ's around the United Kingdom under the Marine and Coastal Access Act (2009), which includes the collection of baseline habitat data (Derous *et al*. 2007). National monitoring programmes, such as being carried out under CSEMP are aimed to detect long-term trends in the quality of the marine environment by collecting detailed and standardised data. Direct impact assessment involves the measurement of anthropogenic influences and their affects and effects on the marine environment. A major component is concerned with ensuring the compliance of developers to environmental regulations. Developments range from offshore construction of oil/ gas platforms and wind turbines to aggregate extraction, foreshore development, water abstraction and sewage treatment.

The focus of this article is on marine consultancies that specialise in benthic ecology that are contracted to undertake surveys, laboratory analysis and/ or reports to provide data on the diversity and abundance of benthic biota. Surveying and sampling can be implemented by various means such as remote video observation, trawls, cores, sweep nets or grab samples. The methodologies used are generally adapted from published guidelines (e.g. Ware & Kenny 2011).

Laboratory methods may also follow published guidelines (e.g. Worsfold *et al*. 2010). Samples are usually sieved into varying size fractions to allow the floatation and separation of biological material; the mesh size being a specified requirement and fundamentally affecting the data produced (Schlacher & Wooldridge 1996). Biota are then picked from the retained sediment and separated into taxonomic groups for identification (Fig. 1). From this process, a data matrix is generated, showing samples and the abundance of constituent taxa.

Figure 1. In lab processing of samples and extraction of taxa.

These data can then be subjected to multivariate analysis which can also integrate PSA (Particle Size Analysis) to elucidate animal sediment relationships (Fig. 2).

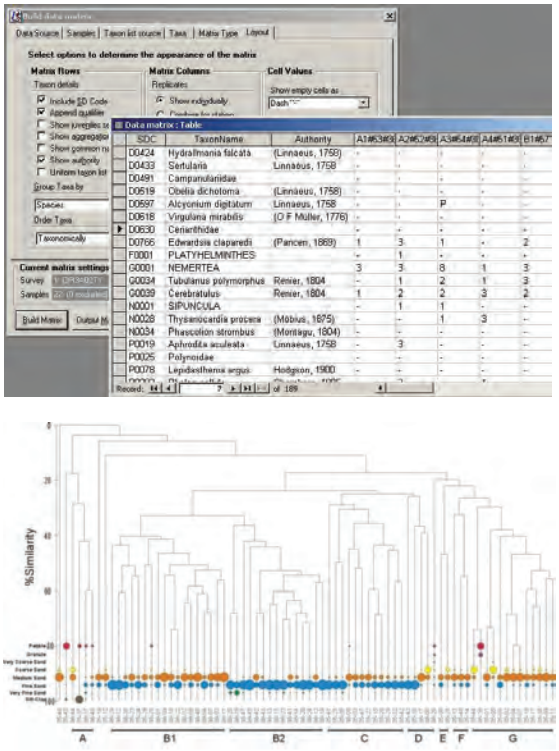

Figure 2. Data matrix of taxon abundance within samples (top) and multivariate analysis graphic output of such data (bottom).

Application

How data are used depends upon which of the three fields of the industry (summarised above) they have been collected for. For example, data may be passed to a client for the purposes of impact assessment and require to be examined by a regulatory body to allow consent for a license for a marine development, such as wind turbine construction.

Some form of taxonomic data are essential to such processes and can be applied in several ways dependent on the outcome of the study. The data can be applied to GIS in order to characterise and classify marine habitats by taking a snapshot in time of the community assemblage with outputs of conservation assessment. Generally, broad community analyses are applied to condition assessments, such as cluster analysis (Diaza *et al.* 2004).

Another important application of the data is the identification of critical species (Fig. 3). These include British Red Data Book (Bratton 1991), protected (Betts 2001), nationally rare/scarce (Sanderson 1996) or BAP species (Table 1). As well as threatened species, the data may also highlight ecologically important species in an assemblage (Fig. 4), such as biogenic reef builders (Hendrick & Foster 2006), and also the presence of alien/ invasive species (Eno *et al.* 1997; Gollasch & Nehring 2006) (Fig. 5).

Defined indicator species may also be applied to impact assessments where the comparative abundances of different species can act as indicators of impacts. For example, a high abundance of *Capitella* spp. is indicative of organic enrichment, *Alitta virens* (=*Nereis*, *Neanthes*) has shown to be tolerant of high concentrations of copper and

Red List Species	JNCC nationally rare/ scarce species	Biodiversity Action Plan
Alkmaria romijni	*Sternaspis scutata*	*Mercuria similis*
Nematostella vectensis	*Hydrobia acuta*	*Mitella pollicipes*
Apocorophium lacustre	*Eunicella verrucosa*	*Lophelia pertusa*
Tenellia adspersa	*Asteronyx loveni*	*Ostrea edulis*

Table 1. Examples of officially rare or threatened species listed under different systems.

Figure 3. Examples of species from left, starlet anemone Nematostella vectensis, *polychaete* Sternaspis scutata *and the goose barnacle* Mitella pollicipes.

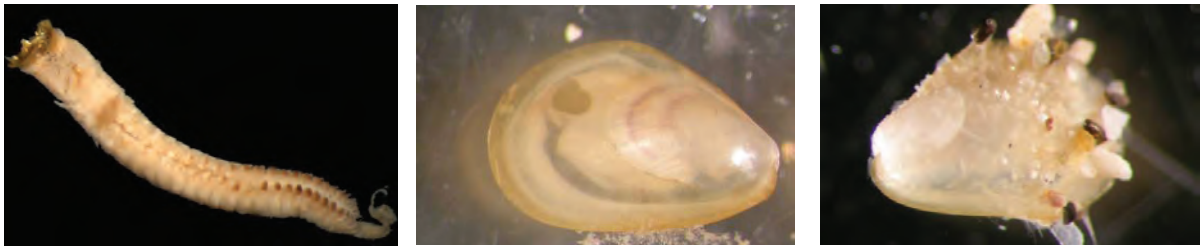

Figure 4. Biogenic reef builders from left polychaete Sabellaria spinulosa, Mytilus edulis *and* Modiolus modiolus.

Figure 5. Examples of non-native species in UK waters from left Crepidula fornicata, Eriocheir sinensis & Palaemon macrodactylus.

Cirriformia tentaculata to be resistant to organic petroleum contaminants. There can however be problems with pinpointing which species are affected by which specific pollution, and there are also issues with temporal and geographical variations of species (Dean 2008).

Data on a wider range of species can be used by the application of trait information. Trophic levels can be applied to biotic indices, such as the infaunal trophic index or AZTI AMBI. As a general rule, in an organically enriched environment there will be a decline in filter feeders and an increase in deposit feeders (Maurer *et al.* 1999; Muxika *et al.* 2004).

Traits analysis is currently under further development with the potential for greater value in impact assessment through the incorporation of additional attributes, such as species distributions, habitat preference, life cycle, body type and other characteristics that may serve as means of describing the ecological functioning of a marine benthic assemblage. MarLIN (the Marine Life Information Network) has contributed to the field through the development of the BIOTIC (biological traits information) database which allows data not only to be analysed at a taxonomic level but at a functional one (Bremner *et al.* 2006; Jackson *et al.* 2010).

Multivariate tools are extremely valuable in some areas of taxonomic data application. One possible future development may be found in biological network theory. A comprehensive integrative analytical technique based on nodes and linkages incorporating various data sets with the potential to show as yet unidentified relationships in noisy data sets between biota and other environmental or anthropogenic factors (Fath *et al.* 2007).

Taxonomy and Consultancy

One aspect of taxonomy that is particularly relevant to marine consultancy is the set of morphological characteristics inherent to a species. This is intrinsically linked with the description of taxa or alpha-taxonomy that is utilised in identification. Phylogeny and systematics are of less direct relevance, although the taxonomic hierarchy is used in measures of taxonomic distinctness (Clarke & Warwick 1998).

One consideration sometimes discussed in the optimal application of community data sets is the taxonomic level of identification or resolution. The majority of UK benthic laboratories identify most benthic invertebrates to species level, or as far as practically achievable, which requires a high level of expertise. In order to address a supposed cost implication, the field of taxonomic sufficiency was developed, with the suggestion that the same information about a benthic assemblage can be derived from higher taxonomic levels. Although data at higher taxonomic levels may be applicable to the detection of stress in assemblages using certain basic statistical tests, finer scale information is lost, which could affect the interpretation of ecological function in a biological community (Trigal-Domínguez *et al.* 2008). For example, the three *Gibbula* species summarised below exhibit differing habitat preferences (Graham 1998), vertical zonation and biogeographic distributions (Table 2).

Gibbula umbilicalis
Mid shore
Western in UK; UK-SW Europe; expanding eastwards and northwards
Gibbula cineraria
Lower shore – shallow subtidal
Throughout UK; Norway – SW Europe
Gibbula tumida
Shallow subtidal
Throughout UK; Arctic-W Europe

Table 2. Vertical and geographic distributions of three Gibbula *species.*

The value of data produced by consultancy is affected by, among other things, the accuracy of identification. Commonly utilised methods to build accuracy and quality include the development of a reference collection for comparison of specimens and also the use of data management tools, such as UNICORN for compiling taxonomic information. Quality control schemes, such as provided by the NMBAQC, aim to promote best practice in sampling and analysis and assist training through species identification tests between laboratories and audits of processed samples, as well as provision of training workshops and literature lists and guides. Despite this scheme, difficulties remain for consultancies in the identification of species.

Although many descriptive identification guides exist for commonly occurring species, many sources are dated, limited to shallow water coverage and lacking descriptions of juvenile morphology. New species are continually being recorded in samples, whether geographically new to the region or completely new to science. Other complications arise through ambiguity in taxonomic placement and frequent revisions. There is considerable research into molecular analysis (Paul *et al.* 2010) but a comparative lack of funding toward alpha-taxonomy.

A possible solution towards minimising these issues could be achieved by legislative incentives for industry to fund research into alpha-taxonomy. The JNCC's and EA's data are made available in the public domain but, in the latter case, for an administrative charge. As it stands, there is little incentive for ecological consultancies to release their data which are also retained at the request of the client. Further legislative measures for this information to be made freely available could open a vast resource from which to make advances in taxonomy, biogeography and climate change and ultimately benefit the industry and other stakeholders.

Taxonomy is an essential tool and offers a basic framework of biological data that can be applied in different ways to achieve goals and outcomes through consultancy that are relevant to marine environmental management.

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Undersea Explorers

Kat Sanders

With the financial support of Centrica Storage Limited and other supporters, the Yorkshire Wildlife Trust has been able to set up and deliver its concept for the '*Undersea Explorers'* programme. *Undersea Explorers* is an innovative and exciting new project that recreates North Sea undersea landscapes in swimming pools across the county. It is aimed at groups of young people (aged 7-11) and is run through both schools sessions and open events for families. The first session was trialled in April 2010 and since that time the scheme has gone from strength to strength.

Figure 1. Undersea explorers

Children swim through kelp forests, above lobsters and crabs, and imagine themselves as a marine creature, specially adapted to live in the sea. Within this watery world, activities and games deliver set learning outcomes: identification of species, food webs, adaptation of marine life, protected areas and stewardship of the seas, all linking to the national curriculum. But above all the sessions are great fun!

Key Successes

- Excellent feedback from children, parents and schools
- Interest from at least 10 other wildlife trusts (including Manx, Cumbria, Lincolnshire & Ulster) to pilot the scheme in their areas
- Local, regional and national media coverage
- Strengthening and enhancement of YWT's existing marine awareness activities with Undersea Explorers becoming one of the programme's flagship events
- 55 sessions delivered to over 1200 children and parents
- Good links with the region's schools
- Secured funding until March 2013
- Engendering of support for Wildlife Trust's vision for Living Seas and promotion of good stewardship of the marine environment.

One of the great things about the Undersea Explorers concept is that in a time when many families are facing financial hardship, we can offer a Living Seas event that does not involve travel to the coast. Many of Yorkshire's most economically deprived areas are more than 2 hours dive from the coast. In this huge county, there are thousands of people who we would never ordinarily reach with the average rockpool ramble. The other major benefit is that unlike boat trips and snorkelling, this event can be run all year round in all weathers.

The structure of an Undersea Explorers session depends on the group and their requirements but usually involves an introduction to the North Sea, a predator versus prey game and an explanation of marine adaptation using snorkel gear to demonstrate each sense. We also introduce the concepts of stewardship by talking about marine litter and its affects on wildlife.

Figure 2. Croxby School Yr 3 & Yr 4 Undersea Explorers (Credit: Croxby School)

We have had a fantastic response to Undersea Explorers since it began and we hope to continue and improve it over time. We want it to become

an established part of YWT's marine awareness and research programme and hope to support other Wildlife Trusts to run the scheme in their area.

A number of the participating schools have now begun to re-book annual sessions with a particular year group and we are working with specialist groups and schools to expand the activity to cater for learning and physical disabilities.

Yorkshire Wildlife Trust is keen to build on the success of Undersea Explorers. The completed sessions have allowed us to formulate a forward plan for the activity by asking for feedback, evaluating what worked well, and looking for areas that could be improved.

Yorkshire Wildlife Trust have recently acquired some exciting new additions to Undersea Explorers including a full size habitat mat with magnetic creatures, chalk arch, glow in the dark jellyfish and a life-size grey seal!

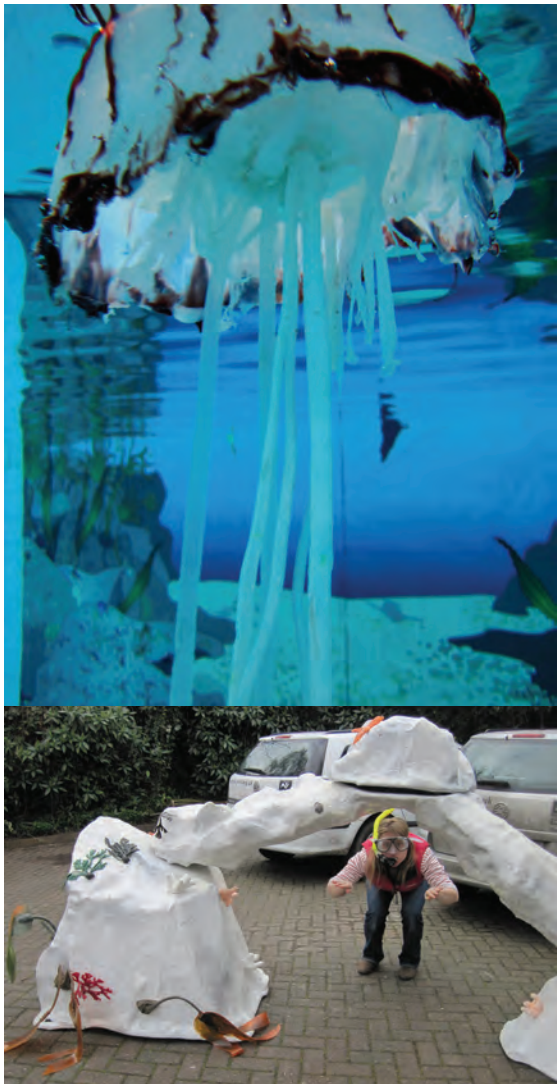

Figure 3. Glow-in-the-dark jellyfish (top) & chalk arch (bottom) models

Undersea Explorers has proved itself as a useful tool for promoting our work in specific areas and for gaining support for our current campaigns. We have introduced a game based on Marine Protected Areas to talk to children about the Marine Conservation Zone network and have also introduced a genuine lobster pot to link the activity to our fisheries work.

Figure 4. The Mount School Undersea Explorers

The future of Undersea Explorers looks bright. Providing we can secure continued funding we hope to recruit a full time Undersea Explorers officer to allow us to meet the ever increasing demand for sessions and realise the many opportunities and ideas for development of this activity.

Seahorses and their conservation in the UK

Beccy MacDonald

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Seahorses have been endeared for thousands of years due to their unusual majestic morphology that allows them to glide through the water effortlessly. Their shy and elusive nature has protected them but with us now encroaching carelessly into their habitats their future is questionable.

Taxonomy and morphology

Their small tubular mouth with fused jaw has placed seahorses into the Order Gasterosteiformes and specifically into the family of slow moving fish, Syngnathidae. The horses of the sea have been placed into the aptly named genus of *Hippocampus** and can be found across the world.

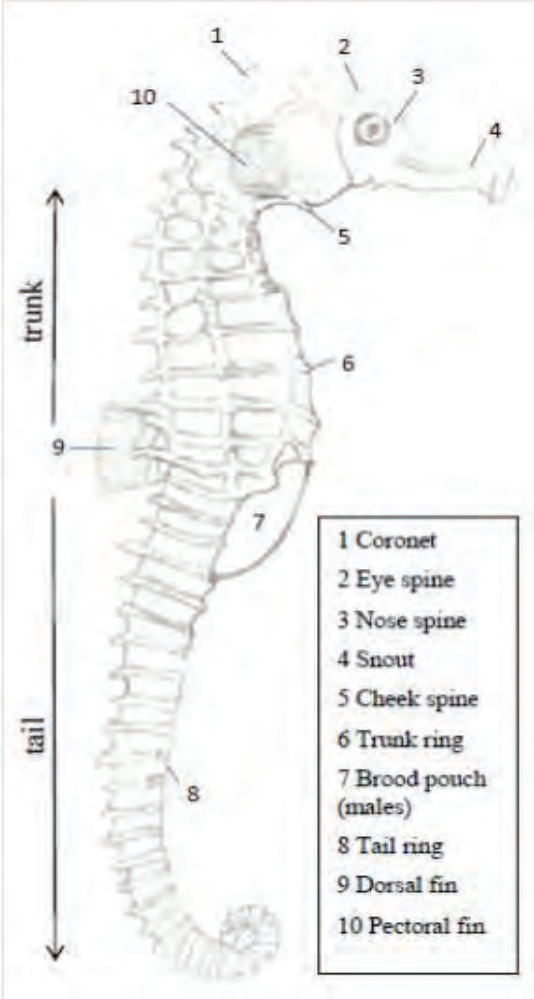

Figure 1. General morphology of seahorse.

Specimens and living individuals can be incredibly difficult to identify to species level, as many of the species do not have morphologically distinct features.

The general external morphology (see Fig. 1) is made up of a head at a right angle to the curved trunk and a prehensile tail. The trunk and tail have bony plates that are segmented by rings. The numbers of rings on the trunk and tail can assist with identification along with the number of rays found on the dorsal and pectoral fins (on the trunk). The head coronet, and the occurrence and form of cheek spines are features that can confirm identification as these are distinctive in some species.

Two species of seahorse, *Hippocampus hippocampus* and *H.guttulatus* currently inhabit the waters surrounding the British Isles (Fig. 2).

Figure 2. Seahorses of the UK: H. guttulatus *(juvenile male) and* H. hippocampus *(adult male).*

The species can be distinguished most easily by the presence of a large mane of thick filaments which give rise to the common name of spiny seahorse for *H. guttulatus*; however individuals of *H. hippocampus* can also have a mane. The latter species is commonly known as the short-snouted seahorse which gives another morphological difference between the two. If there is still a question regarding the species, the short-snouted is a stockier but smaller seahorse and the coronets differ greatly. The coronet on *H.guttulatus* is not attached to the nape of the neck and has five small distinct round points whereas the coronet for *H. hippocampus* is smoothly connected to the nape with no points, and also has a prominent eye spine (see Fig. 3).

** from the Greek hippokampus (hippos, meaning "horse," and kampos, meaning "sea monster")*

Figure 3. Comparison of head features of H. guttulatus *and* H. hippocampus.

Differentiating the sex of mature seahorses is relatively simple as the males have a brood pouch (see Fig. 1) in which fertilisation occurs and the hundreds of embryos grow into fry. After a period of time they are released from the pouch via a series of contractions.

Conservation

The enigmatic nature of seahorses has meant that they have frequently been used as a spearhead to motivate marine conservation across the world. However this has not secured their future, particularly in the waters surrounding the UK, where many people are unaware of their existence or the special conservation status they hold.

One of the greatest threats to seahorses across the world is their use, dried, in traditional medicine or as curios. A more recent threat is the demand for live specimens for aquaria. *Hippocampus guttulatus* and *H. hippocampus* face other threats despite having the protection of the Wildlife and Countryside Act (1981). The protection offered by Schedule 5, Section 9 of the Act prohibits the killing, selling and trading of these species as well as stating that their habitat cannot be damaged and that they themselves cannot be disturbed. This means that you are not permitted to seek these fish without a licence. Due to a lack of awareness the protection of this Act is ineffective for many marine species. The Act prohibits you from disturbing or destroying the habitat of the seahorse but does not prohibit you from dropping your anchor within their seagrass habitat and pulling clumps of seagrass out without any consequences. This is a major issue as it means that whilst the legislation is in place, its enforcement is not and without enforcement conservation cannot be successful.

Flash photography can cause death in many fish species and recently an addition regarding its use was made to the Act. It is believed, in the case of seahorses, that the stress caused by the flash allows the immune system to become weakened allowing diseases that they carry naturally to emerge. It is also possible, like in many other fish species, that flash could blind individuals thereby reducing their ability to feed and eventually causing them to starve to death.

The Seahorse Trust is a charity that runs the British Seahorse Survey. It allows anyone to report sightings of seahorses in order to develop a database of where they can be found around the British Isles. The collection of this form of data is extremely important as both UK species are listed as "Data Deficient". This category is concerning as it means that we do not know the state of the populations and therefore cannot put any truly effective conservation management strategies in place.

The Trust has been surveying one site in particular, Studland Bay in Dorset, for a number of years. The aim is to determine more about the ecology of seahorses in the UK and gain more information on the life histories of the population there. Through this work, they have found that the bay is an active breeding site and that it also acts as a nursery to young seahorses. Adult individuals are tagged, using external tags (see Fig. 4), that allow the movements of individuals to be monitored, providing data to allow the development of a management plan for the site.

Figure 4. H.guttulatus *male with floy tag.*

The future for seahorses in the UK is questionable, but with more public awareness and greater research into their ecology it is possible that we can conserve them for future generations to enjoy.

For further information please see:

www.theseahorsetrust.org where there are a number of research papers and other information available or find us on Facebook: The Seahorse Trust

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Images courtesy of The Seahorse Trust and Beccy MacDonald.

Problematic Recording Underwater

Francis Bunker

I was recently diving off Rathlin Island, situated between Northern Ireland and the Mull of Kintyre. I was on one of my favourite habitats, a maerl bed, and was making a list of the associated seaweed species on my underwater slate. Conditions were ideal, a gentle current, no swell and 15 m horizontal visibility at our working depth of 16 m. I came across some plants of a *Porphyra* species and put down my pencil in order to collect a specimen for later identification in the lab. I was just putting the seaweed in the bag when I got a mouthful of water from my demand valve. When something like this happens to a diver, a series of thoughts go through one's head very rapidly. First, I exhaled forcibly to try and clear the valve but when I breathed in again, I got another mouthful. The second thought was 'don't panic' because panic is after all a natural reaction when one is deprived of air and is a reaction which is bound to result in tragedy. My third thought was a decision, do I go and get air from my buddy or head for the surface? Fortunately a fourth thought came to me, that in fact I did have a spare valve, so I put this in my mouth and breathing (without water) was restored. It's funny how the obvious can escape one in such situations.

Once I'd calmed down, I looked at my normally trusty demand valve to find my slate pencil had become lodged in the exhalent port. Once I pulled the pencil out, I tried the valve and all was fine. I looked across to my trusty buddy who was blissfully unaware of my drama and pleased to have found a specimen of *Cruoria cruoriaeformis* (a red seaweed endemic to maerl). This is the first time in thirty years of underwater recording that I've had a problem like this. Nevertheless, I guess the danger of pencils underwater will have to go in the risk assessments from now on.

Shore Dive

Angie Gall

Emily and I went out for a Seasearch dive off the beach at St Agnes this evening. It was a drizzly, calm evening, no one was about when we went in. We swam around the cove, unmarked on the surface and finally made our way back to the shore. The visibility had been fantastic for most of the dive but there were some bits in the water as we got back towards the beach, just seaweed breaking down, I thought. We finished the dive, surfacing in the shallows right beside the beach. As we looked up we saw a crowd of people looking at us from the slipway, some dressed quite smartly. Confused, we started to walk up the beach and a little boy ran up to us and said 'Our granddad died and we just put him in the sea, you might have seen bits of him floating around'. I have rinsed my kit particularly well this evening!

Oh, I do like to be beside the seaside

Frank Evans

I do like to be beside the sea and that's where Jim and me found ourselves last summer, on holiday, doin' what we like best, sittin' in the Blue Anchor, drinkin' a drop o' beer and looking out the window watching the birds, o' course I mean the seagulls. But Jim, 'e's a restless sort o' fellow and 'e says 'e fancies a trip across to the Continong. 'E says, "I wouldn't mind a day in Calais." "Well," I says, "you ain't even got the price of the pint of beer you owe me, never mind goin' over to Calais." "Well," 'e says, "You've got a bit o' money in your pocket." "Yes," I says, "but it ain't enough to pay for us both to go over to Calais." Then Jim says 'e has an idea. 'E says: "Down there

is where they hire out them rowin' boats." 'E says: "Why don't we go and hire out a boat for an hour and then we can row across. It's ain't far, you can almost see it."

Well, it seemed not a bad idea, so off we went and we hired this boat and we set off. Jim was rowing. 'E was the one with the nautical knowledge 'cause a long while ago he'd been kicked out o' the Sea Scouts. But I began to see that they should ha' kept 'im a bit longer in the Sea Scouts before throwin' 'im out because 'e wasn't rowing very well.

Anyway, we got a bit offshore, then here comes this speedboat and it goes past us with a big wash and it didn't 'alf give us a wobble. And in the process Jim managed to lose one of the oars. "Never mind," 'e says, "I'll just row over with the other one and pick it up." But we soon saw that the only way we could go with one oar was round in a circle. The tide was carryin' us along and it wasn't long before we was all mixed up with the ironwork under the pier and, would you believe it, in the tangle Jim managed to lose the other oar, too. "Now look what you've done," I says, "now we can't even tie your shirt to the oar and wave it about for a signal of distress so's we could be rescued." I could tell Jim was feeling upset by the thoughtful way 'e was poppin' the bit of seaweed he'd picked off the pier.

We sat there for a bit and we saw we was drifting away from under the pier, it must have been the tide, when suddenly we see this ship. It wasn't very big but it was comin' towards us and then, what do you think, along comes the speedboat again and gets right across 'is path. So the ship in desperation makes a turn to get clear and doing that 'e began to come straight towards us and in the end 'e had to make another turn, a sort zigzag to miss us all. But somehow 'e either made too big a zig or too little a zag and it wasn't a moment later before 'e found 'imself with his nose hard up on the beach. I have to tell you that as 'e was going past us I grabbed a rope that was hangin' over 'is side thinking 'e could take us into port with 'im and we could be rescued.

So there we was, 'im with his nose on the beach and us lyin' beside 'im hangin' on to this rope. And shortly we noticed the tide was beginning to go down and we saw the crew comin' along carrying a rope ladder and lowerin' it over the side and it wasn't long before they was down the rope ladder and splashing ashore and off to the Blue Anchor, which was just up the road. We waited a bit longer, and here comes the captain, along the deck, down the rope ladder and off after them to try and get 'em back.

Well, I thought, they've gone up there for a drink, why shouldn't we 'ave one. I 'adn't told Jim but I 'ad a little bottle of somethin' warming in my coat pocket and I pulled it out and passed it to Jim. 'E pulled the cork out and took a swig but it was just like the oars, 'e went and dropped the cork. I took the bottle off 'im as 'e scrambled to find it in the bottom of the boat. There was a bit of water there but at last 'e got it and passed it to me. But when I came to put it in it wouldn't fit. "This ain't it," I said. " 'Course it must be," said Jim. But it wasn't, it was the bung in the bottom of the boat and he'd pulled it out and the water was comin' in fast. "We're sinking," says 'e. And we were. We had to be quick and we wriggled the boat round to where the rope ladder was and we left the boat just as it sank and climbed aboard the ship.

In no time at all 'ere comes the lifeboat in a shower of spray. The lifeboat skipper steps aboard and comes up to me and asks me: "Are you the captain?"

"No," says I, "I'm not the captain. There's no captain 'ere and no crew neither." "Oh," 'e says, "well in that case, are you going to claim the salvage money?" Well, such a thought 'ad never crossed my mind for a moment, so naturally I replied: "Of course."

And that's how it came about. And I 'ave to say now, that on the strength of that salvage money we 'ave a boat of our own, Jim and me. Our boat's a good deal bigger than the rowing boat that sank but one thing, I'm always very careful to have a spare pair of oars aboard ready in case of emergency. We keep them beside the cocktail cabinet in the saloon.

First record of the marine alien bryozoan *Tricellaria inopinata* in Northern Ireland

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The marine alien bryozoan *Tricellaria inopinata* d'Hondt & Occhipinti Ambrogi, 1985 was introduced into Europe from the Pacific, probably with oysters. The first European record was from the Venice Lagoon in 1982, and later in 1996 from the Atlantic coast (northwest Spain) (DAISIE factsheet). By 2000, it was present in several locations in England, France, the Netherlands and Belgium.

The species has been recorded since 2006 in the Republic of Ireland and is widespread (D. Minchin pers. comm.). It was first recorded in UK waters in 1998 (Dyrynda *et al*. 2000). This species is now widespread around the English and Welsh coasts, and has reached as far north as the west coast of Scotland at Troon (Scotland's Marine Atlas 2011). No records for this species have previously been published from Northern Ireland.

A single large tuft of *Tricellaria inopinata* was hand-collected from a pontoon in the NW of Bangor Marina, Co. Down [54° 39.86' N, 05° 40.19' W] on 22nd August 2011. The specimen was preserved in 95% industrial denatured ethanol. The identification was confirmed by J. Porter, Heriot-Watt University. This species had not previously been found during visits to the Marina in June 2006 (Minchin 2007), and March 2011 (authors). This is the first published record for Northern Ireland.

Tricellaria inopinata is a robust opportunistic bryozoan, capable of enduring temperatures of 2-34.5°C and salinities as low as 20‰. It settles on a variety of man-made and natural hard substrata and may be epiphytic on macrophytes, or epizoic on ascidians and other bryozoans (DAISIE). Larvae are planktonic but have a duration of only a few hours, so introduction is most likely by vessels or dispersal in currents on *Sargassum muticum* (DAISIE factsheet). As Bangor Marina is a major port for both recreational and commercial vessels, shipping is the likely vector for introduction to Northern Ireland.

Where *T. inopinata* invades, it seems to form rapidly-expanding populations; consequently its presence should be expected in other marinas in Northern Ireland. Its presence in the Venice Lagoon, where the population is now considerable, has caused a significant reduction in the frequency and abundance of native bryozoan species (DAISIE factsheet). This species should therefore be regarded as a significant threat to biodiversity.

Several marine alien species have recently been recorded from Bangor Marina: the amphipod *Caprella mutica*, 23rd June 2009 (R. Snijder, pers. comm.); the ascidian *Styela clava*, 11th February 2011 in wash-down from a hoist (R. Snijder, pers. comm.); the ascidians *Corella eumyota* and *Botrylloides violaceus* on macroalgae attached to pontoons, 24th March 2011 (J.D. Nunn). This record of *T. inopinata* confirms Bangor Marina as a 'hot-spot' for marine aliens in Northern Ireland. Additional surveys of Bangor Marina and other marinas in Northern Ireland would be essential to monitor for these alien species and minimise their impact.

Acknowledgements

The authors wish to acknowledge the generosity of R. Snijder in allowing his records to be published here, and thanks to J. Porter for confirming the identification of *T. inopinata*.

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National Tidal and Sea Level Facility

Tidal predictions on the web

Web review by Paul Brazier

As marine scientists, we are all constrained by the actions of the tides (with perhaps the exception of those working in lagoons!). What, then, could be more important and critical than the knowledge of the tidal cycle and its consequences? Gone are the days of working through the harmonic constants, crunching the numbers to find your best work window in the marine environment. A key tool for marine scientists is one which provides an accurate prediction of the tidal heights for selected locations. This provides the intertidal biologists with the best opportunity to utilise extreme low water events, whilst those working from boats or who are diving must find the tides that minimise the tidal flow and avoid the extreme tidal ranges.

The National Oceanographic Centre, as part of the Natural Environment Research Council (and also part funded by the Environment Agency) currently operate the National Tidal and Sea Level Facility. This facility has UK and Irish Predictions, information on the UK Tide Gauge Network, long term data trends (from pre-1930 to current), information on past storm surges (and predictions when you register) and an assortment of data downloads. As might be expected, the times are in GMT and the heights are in metres above Chart Datum.

http://www.pol.ac.uk/ntslf/

UK Tide Gauge Network

This has real and near real time displays of the predicted tide and the actual recorded tide for 46 coastal locations. This is valuable in providing a real time evaluation of the tide and has proven to be useful to the author in confirming a tide that had not fallen as predicted, allowing corrections to the recorded tidal height at low water.

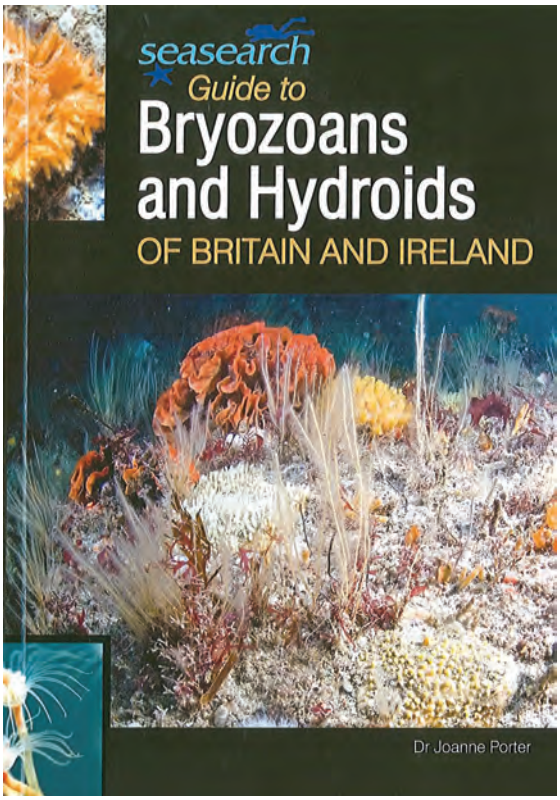
Tidal Predictions

Predictions are available for 51 UK coastal locations and include the high and low water predictions for 28 days, highest and lowest predicted tides for years 2006 to 2028 and the harmonic constants for each port. This web site is the best known for the longer term forecasting of tide times – most only provide predictions for the week ahead.

There is much much more on this website than I could possibly describe here, including additional information across the Atlantic Ocean and reports from past projects. It will prove to be useful for those quick lookups before going out, for recording past data as well as for curious browsing. Take a look and pass it on!

Seasearch Guide to Bryozoans and Hydroids of Britain and Ireland – Joanne Porter

Review by Becky Hitchin



"Bryozoans and Hydroids" is the latest of the Seasearch identification guides (previous volumes in the series being Marine Life, Corals and Anemones and the fabulous Seaweeds guide), and it takes the series to new heights. Whereas previous volumes focus on the more charismatic species seen around our coast, this one is dedicated to the "brown fuzz" that

grows over rock and wreck alike. It demands that we look more closely in our diving, that we don't ignore the background turf of abundant and diverse life and, indeed, get to know and become familiar with some of its components.

This new volume follows the general format of other Seasearch guides. One new feature is that, where applicable, organisms are labelled with an F, N or I – Fouling, Non-native or Invasive – information that is becoming ever more important. Distribution is also handled differently from previous guides. Jo Porter acknowledges at the start that bryozoans and hydroids either seem to have a widespread distribution around our coasts, or are, on the other hand, poorly recorded or known only from certain well-dived localities – mainly those sites we would all list in our UK diving wish list, including Rathlin, Bardsey, St Kilda, Scilly and Sark. As a result, she does not include a map for each species, preferring instead a line of text. This gives us all great scope to go and get new information on the ranges of these species from our local Seasearch sites!

After the introduction, the book is very much divided into two sections, bryozoans and then hydroids.

Bryozoans

Bryozoans are divided up first by order – Ctenostomata, Cheilostomata, Cyclostomatida – then by colony morphology. It's probably worth noting that the page numbers for two of the groups aren't quite right on the main introduction to bryozoans page (Ctenostomata should be p18-27, Cheilostomata p28-78) which seems to be a very rare typographical error in an otherwise incredibly well done book.

The introduction to bryozoans section is cleverly done, showing a photograph of each different morphology next to a line drawing of the essential features needed for identification. As I think we've all discovered with groups like the bryozoans, it is one thing to have a photograph and another entirely to be able to see the details of morphology as illustrated in books like the Linnaean Synopses. Every page of this book helps to close that gap.

The book includes enough anatomical description for people to become familiar with the essential terminology needed in bryozoan identification while managing not to overwhelm with too much science. I love the way that Jo, in this book and in her Seasearch courses, does not apologise for using scientific concepts and language, and always manages to use them in such an accessible way to demonstrate the details needed for her tricky-to-identify subjects.

Figure 1. IIlustration of the layout of the bryozoans section

Within each class of bryozoan, species are grouped together into similar morphologies, for example, encrusting colonies, stoloniferous colonies and nodular colonies. Each species is given a good amount of coverage, about half a page, enough for a good sized photograph or two plus text. The text includes a description of the colony (including morphology, where it grows and which species are maybe under-recorded) followed by "Key Features", "Similar To", "Size" and "Distribution". It may have been a nice added feature to mention previous taxonomic names of certain species when they may still be in common usage. For example, many of us (I suspect) still are more familiar with *Alcyonidioides mytili* as *Alcyonidium mytili*, and mention of the *Alcyonidium* identity may help to stop people tearing their hair out as names they've known for years suddenly evolve or disappear.

Hydroids

The hydroids section is equally well presented, though it works in a slightly different way. The hydroids are divided first into thecate and athecate varieties, but then are further divided by family rather than morphology.

While having different types of subdivision may seem confusing, it does make sense for the two very different groups to be classified in the way that works best for them. As with the bryozoans, the text includes a description of the colony followed by "Key Features", "Similar To", "Size" and "Distribution".

Figure 2. Illustration of the layout of the hydroids section

One thing I think particularly notable in the athecate hydroid section is the quality of the photos, clear throughout the book. Whether an electron microscope photo of a bryozoan zooid or a photo of subtidal hydroids *in situ*, the photos are exceptional, and often provided by Seasearch contributors, making the book feel somewhat more like a collaboration among the Seasearch community rather than just a book written and provided for Seasearch by an academic expert.

Conclusions

The bryozoans and hydroids guide is an excellent continuation of the series of Seasearch guides and will prove invaluable to all subtidal and intertidal enthusiasts who want to delve a little deeper into what's around them. I suspect that it will also stimulate the number of records of these maybe under-recorded groups around Britain and Ireland. Maybe a second edition of this volume will include a lot of ranges extended or narrowed down by enthusiastic Seasearchers who now have the tools to confidently identify a whole new range of animals. Never again will brown fuzz seem unappealing!

How I became a marine biologist

Editors note:

As most members of the Porcupine Council have now contributed to the "How I became a Marine Biologist" section of the newsletter we are keen to hear how other members came to be marine biologists/marine specialists/recorders. Please send your "How I became……." to Vicki Howe viks@sun-fish.co.uk.

Keith Hiscock has very kindly given us permission to use "Recorder insight" which was previously published in NBN eNews - March 2012.

Recorder Insight

Keith Hiscock

Figure 1. Keith Hiscock on Lundy with subtidal survey equipment c/o Neil Hope

When I was growing-up in north Devon, frequent trips to the seashore were aimed greatly at catching prawns and crabs for tea. But Dad also bought me a copy of Collins Pocket Guide to the Seashore and, in my teens, I started putting names to what I saw. I still have that annotated volume, although it bears the scars of being dropped in several rockpools. Meanwhile, in the public library at Ilfracombe, I discovered the writings of Philip Henry Gosse, the foremost Victorian marine naturalist who had made north Devon one of his favourite places. And, he had found CORALS – corals in British waters! Corals

became a special fascination for me but I also re-visited the shores that Gosse had described to see if the same species could be found again 100+ years on – and they could. That activity of re-visiting locations to check if old records persist to the present continues today – although now I also look back at records that I made 40+ years ago.

It was university that gave me so many opportunities to develop my interests in marine natural history. I was at Westfield College where our marine zoology classes included exams requiring 'identify with reasons': what a valuable way to learn. I was also fortunate to go on the tail-end of University of London field trips to the Isles of Scilly where I encountered taxonomists contributing to the Isles of Scilly Marine Fauna lists. And there were also expeditions to Lough Ine – where I learned the importance of careful and accurate identification and the proper record-keeping that Jack Kitching insisted on. I was also fortunate in my choice of PhD supervisor, topic and location (the Menai Bridge Laboratory of the University College of North Wales; now Bangor Univeristy). I was supposed to be researching larval biology of hydrozoans but that wasn't going well and I persuaded Dennis Crisp that I should investigate the effects of water movement (tidal currents and wave action) on the ecology of sublittoral rocky areas. So, on with the diving gear and off to survey Lundy, Anglesey, Lough Ine and Abereiddy Quarry in Pembrokeshire (and to do cruel things to seabed species in a flume).

Now that I was an 'expert' in organizing surveys (!), I set about inviting taxonomic specialists to Lundy where I had started to record the character of the underwater marine life. The resulting fauna lists are available from www.lundy.org.uk.

Identifying what we found in those early days wasn't easy. We did not have most of the identification guides and keys that weigh heavy on our bookshelves now. And, many of the texts that we were using were in French or German. By way of illustration, when I found a bright yellow coral at the Knoll Pins on Lundy in August 1969, it took until May the next year, searching papers and other sources and writing letters to specialists in Europe, before I found that it was *Leptopsammia pruvoti* – a very common species in the Mediterranean; but mine turned out to be the first record for Britain. Now, open any one of many identification guides in English, and there it will be.

Figure 2. Rich cliff communities out of Plymouth, including the sunset coral Leptopsammia pruvoti.

Figure 3. Marine Nature Conservation Review survey team on Rockall in 1988. David Connor, Sue Hiscock, Dan Laffoley, Christine Howson, Ian Dixon and Keith Hiscock.

Marine survey work, for me, 'took-off' in the mid-70s when the Nature Conservancy Council 'discovered' marine conservation and Roger Mitchell started to commission work that would document the marine life of intertidal and subtidal areas around Britain. At the time, I was employed by the Field Studies Council Oil Pollution Research Unit where much of the work involved grab sampling in the North Sea and meticulously identifying the taxa from the grabs. However, I was rocky shores and surveys that involved diving. We were working with check lists of conspicuous species and not getting involved in detail in any

particular group. Our work, and subsequently that which was undertaken by the Marine Nature Conservation Review of Great Britain (MNCR), provides the core of information to characterise locations and identify those that at are special. The MNCR started in 1987 and the Advanced Revelation database that was to store the results of surveys was the starting-point for what eventually was to become a very large part of the Marine Recorder resource. The MNCR was never completed and there remain major gaps in our knowledge of what's where that will only be filled in a way that is relevant to biodiversity conservation if *in situ* surveys of species are carried-out by trained and experienced marine biologist surveyors – yes, I'm trying again to get a message across to those who think acoustic surveys or just identifying biotopes will do the job – they will not.

In 1998, I started work in Plymouth with the Marine Biological Association (MBA) to establish what became the Marine Life Information Network for Britain and Ireland (MarLIN). The following ten years or so were formative for marine recording with the NBN of central importance – although a very different beast today compared with what it was in 1998. We contributed to that development and the MBA now provides the marine node for the NBN and is the Marine Environment Data and Information Network (MEDIN) accredited data archive centre for marine species and habitats. But, I retired in 2008 and, although still involved in research as an Associate Fellow at the MBA, my recording is mainly via hobby rockpooling and recreational diving including participating in Seasearch.

Figure 4. Volunteer divers completing Seasearch forms between dives

My marine life recording has always been driven by curiosity and especially looking for patterns in the distribution and abundance of species. Three passions – marine ecology, photography and diving – have been central to what I have done and am still doing. Highlights occur every-so-often and include finding locations with fabulously rich communities or stashed full of rare and scarce species. A recent highlight was when an ovulid sea snail that seemed 'different' to a species I had been asked to collect by a specialist turned-out to be new to science: *Simnia hiscocki* Lorenz & Melaun.

Figure 5. Simnia hiscocki, *named in 2011 in Molluscan Research, on a sea fan, Hands Deeps, nr Plymouth*

Finally, some confessions. I am no taxonomic specialist – I am a generalist where identifying species is a means to an end: understanding patterns and change in marine ecosystems. I don't submit enough records! I see unusual species and mean to do it (and occasionally do) – but not enough. I don't have the sharp eye that many amateur naturalists have but I am therefore well-placed to make the point that there are rockpoolers and divers out there who do not have a string of degrees but still have the opportunity and skills to point-out species that are unusual or different and, well, you never know where that will take you.

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.

General text: "Normal" style - Times New Roman 12 point, single spacing.

Title: "Heading 1" style - Times New Roman bold 16 point

Subtitles and section headers: "Heading 2" style - Times New Roman bold 14 point.

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.

Spaces between paragraphs, page numbers, headers and footers are not necessary.

Illustrations (Figures and Plates)

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

Line drawings, particularly maps, are best supplied as EPS files. If it is a detailed map which will need the full page width, save it with a width of 15 cm. Maps with complicated colouring schemes will not reproduce well in black and white (although most of the newsletter is now printed in colour) – please consider supplying a greyscale version for the printed Newsletter (we can publish colour maps and diagrams in the pdf version of the Newsletter).

Graphs, histograms, etc. are best supplied as Excel files – save each graph as a separate sheet.

We can scan good quality photographs, transparencies and hard copies of drawings, where necessary.

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

Filename, Caption, Photographer (if appropriate) and please be aware of any copyright issues.

Please do not embed images in the text as this can cause us problems with the next stage of putting the newsletter together. Send as separate files preferably saved with the caption as the file name though this is not essential.

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 follows ….Brown & 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.

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