



BULLETIN of the PORCUPINE MARINE NATURAL HISTORY SOCIETY

Autumn 2017 — Number 8



Bulletin of the

Porcupine Marine Natural History Society

No. 8 Autumn 2017

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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 Bulletins per year which include proceedings from scientific meetings, field visits, observations and news.

Membership fees: Individual £18 Student £10



www.pmnhs.co.uk



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



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



Cover Image: Kathryn Birch & Paul Brazier investigating one of the rock pools at Wembury during the Porcupine Conference fieldtrip, March 2017 (see report p.13). (Photo: Fiona Crouch)

Editorial

What are you noticing?

I have just arrived home after an adventurous few weeks exploring southern Africa. Although not much opportunity for marine natural history, every day left me feeling energised and excited by new finds and observations, both great and small. One particular highlight was kayaking amongst Cape Fur seals, *Arctocephalus pusillus* (Schreber, 1775). The 50,000-strong colony consists of very large males with harems of 5–25 females and numerous inquisitive, lively juveniles. Two things sparked my curiosity: the beach was littered with many small, partly decomposed seal pup carcasses - at the time the females were about 2 months off giving birth, so what has happened to cause so many infants to be lost? Sadly, not much

time to find out more, but the local guides thought that a change in the local weather conditions caused some first-time mothers to give birth too early and the pups were too premature to survive. The second was related to the playful nature of the juveniles. The seals would swim, spin and jump around the kayaks and then suddenly stop and hang vertically, upside down in the water with their flippers 'flopping' around the surface of the water. They would hang like this for a few minutes and then start playing again. Again, on talking to the guides their thoughts were around the seals having a sleep - I am not so sure but not being able to observe from below it is difficult to work out what they were up to.

So how does this relate to noticing? I feel that as someone interested in the natural environment my noticing starts with a 'what is that?' It quickly moves on from identification to wanting to know more, so much more. The *Porcupine Bulletin* is always filled with a variety of articles which build on curiosity and this autumn edition is one to be enjoyed by all. From the 'curious' air breathing sea slug *Onchidella celtica* (Cuvier, 1817) and its use as a climate change indicator, to collecting and collating behavioural observations of undulate rays and the black bream and the

invitation for us to be more curious and help add to the information gathered. Nick Owen's report combines a Porcupine marine natural history curiosity with the experimental curiosity of "how to gather information". The knowledge gained from his endeavours in limited visibility are fascinating and certainly provide a catalyst for me wanting to know more about the elusive mud-dwelling echiuran *Maxmuelleria lankesteri* (Herdman, 1898).

I hope also that these articles will inspire you to be curious and to notice more. We look forward to hearing from you - either by way of an article, snippet or report to Editor@pmnhs.co.uk. Perhaps you will be motivated to present a paper or poster at the next Porcupine conference in Edinburgh in March next year.

Vicki Howe, Hon. Editor

Image: Cape fur seal pup (Photo: V. Howe)



Marine Climate Change Impacts



An assessment of climate change impacts over the last decade (2006–2016) was released in August 2017 by the Marine Climate Change Impact Partnership. The organisation, which was created in 2005 to coordinate the provision of marine climate change impacts evidence to decision makers, has been releasing regular updates on current understanding of the issues since then. The 10 year assessment conclusions included:

- global ocean pH continues to decrease and will have an overall negative effect on marine ecosystems although some environments such as algae and seagrasses may benefit from increased CO₂ availability;
- productivity of many seabirds has decreased as temperature rises with short-term weather events such as severe summer storms having negative impacts on breeding;
- some established non-native species have expanded their range in the UK although there is no direct evidence that introduction has been a consequence of climate change;

- there have been no changes in distribution ranges of intertidal fauna and flora since 2000, consistent with the lack of increase in sea surface temperature;
- fisheries continue to change with cod stocks remaining low, thought to be a result of climate change, and increases in occurrences of warm water species and cephalopod populations.

The full report card can be accessed at:

<http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2017-10-year-report-card/>

Young Marine Biologists (YMB) Summit 2017



Marine Biological Association, Plymouth
28 October 2017

A new initiative run by the MBA to inspire and nurture 12-18 year olds with a passion for marine biology. The day will consist of talks and workshops provided by experts and YMB members themselves.

Visit <https://www.eventbrite.co.uk/e/ymb-summit-2017-tickets-36100399266?ref=ecal> for more details.

Porcupine Annual Conference 2018

National Museums Scotland, Edinburgh
March 16th–18th 2018

Porcupine last visited National Museums Scotland in Edinburgh 15 years ago in 2002 (group photo right) where the theme was 'Marine Natural History of the North Atlantic'. So we are delighted to announce that the museum has agreed to host our conference again in 2018. The Conference itself will take place on Saturday 16th–Sunday 17th March 2018 with a field trip planned for Monday 18th March.

The theme and details are still under discussion so now is your chance to tell us what YOU would like to see included. The programme will include a visit to the seashore as per our usual format. So **SAVE THE DATE** and keep an



Left: Group photo from 2002 Porcupine Marine Natural History Society Conference in National Museums Scotland, Edinburgh. Top right: part of the natural history collections of National Museums Scotland and bottom right, some of the polychaetes from the collection.

eye on our website for further information in the near future as details become available.

Porcupine Bulletin Prize 2016

The winner of the 2016 Porcupine Student Prize is Aidan Hunter. His article *The impact of fishing the Firth of Clyde: background information for the basis of an ecosystem enhancement plan* was published in Porcupine Autumn Bulletin, No 6. Well done to Aidan who also presented at the conference in Millport 2016. The prize was £50 and one year membership of the Society.

Porcupine Bulletin Prize 2017

We are pleased to announce that there will again be a prize awarded to the best article published in the Bulletin by a student or amateur enthusiast (i.e., not professionally employed in the marine field), as judged by a subcommittee of the Council. The prize will consist of £100, plus 1 year's membership.

There are no exclusive themes. An article could be on a project or thesis you are working on, a visit or field trip you have made to a shore or dive site or a particular marine organism you are interested in and have been researching (in the field or desktop) etc. There are many examples you can draw on for inspiration in

past Newsletters and Bulletins. We ask only that there be no multiple authors.

To be considered for the prize, please make your status clear on submission of your article to the Honorary Editor – Vicki Howe, editor@pmnhs.co.uk. The PMNHS looks forward to your contributions.



Anne Bunker

Porcupine Marine Natural History Society

**Minutes of the 40th Annual General Meeting
Saturday 12th March 2017**

Plymouth University, Plymouth

1. Apologies for absence:

Frances Dipper, Roni Robbins.

2. Matters arising from the Minutes of the 39th AGM, as published in the PMNHS Bulletin, Autumn 2016. Number 6:

3. Officers' reports:

The Hon. Treasurer's Report (Jon Moore) –

Overall situation – The Society's finances have assuredly turned a corner and the bank balance is a lot healthier. Income from the Millport conference provided the biggest boost to the 2016 accounts, but membership subscriptions also increased and are continuing to increase in 2017. Membership subscriptions were substantially higher than the costs of the newsletter (which were lower than 2015) and other core maintenance costs. The raffle, held at Millport, also provided notable additional income.

Membership subscriptions – income from 2016 subscriptions was substantially higher than from 2015 subscriptions. The efforts of the membership secretary have continued to improve the situation for 2017, which are already showing a further increase. Increasing numbers of new and renewing members are using the new PayPal method for paying subscriptions – this is beneficial to the Society, even though we pay approximately 4.5% to PayPal for each transaction. A few members are still paying at the old rates. We will continue efforts to encourage automatic renewal by members and generally to increase membership.

Bank interest – the Society's bank account now pays no interest. As interest rates are currently low we are still waiting before we move the account.

Bulletin– costs are for the Spring and Autumn 2016 bulletins. The 2015 costs are not directly comparable as they included some postage costs from the previous year.

Website – regular annual maintenance costs from the internet service provider. The domain costs are biennial (i.e. 2015 & 2017).

Council meeting expenses – some small claims for travel expenses from Council members for the October Council meeting in London.

Annual conference – the Millport conference made a substantial profit. Taking account of the deposit paid in 2015, this totalled £2089.

Field meeting – there was no income or expenditure for the Society for the Staffa field trip.

Grants – the Grants Scheme has been put on hold until the Society's financial situation improves.

Contribution – Paul Naylor, who sold some of his books at the Millport conference, made a further contribution of £30 to the Society.

Acceptance of the report was proposed by Séamus Whyte and seconded by Tammy Horton.

The Hon. Membership Secretary's Report (Roni Robbins):

Membership numbers are on the increase with a current total of 204 members. There is currently a small number of members (6) who are students and so I would encourage those students who are attending this conference, who are not members, to join the society. As you are probably aware, the society is very friendly and gives you a fabulous opportunity to meet fellow marine biology enthusiasts as well as a great platform to present your work to an encouraging audience. For those members of the audience who work with students, please encourage them to join.

Thank you to all those members who ensure that their subscriptions are paid on time – it does make this role a lot easier. If anyone here is not a member or is unsure when their subscriptions are due, please do not hesitate to email me. Further details about joining the

society and the membership email address is available on the Porcupine website.

Lastly, please may I remind all members to ensure that we have their correct contact details.

Acceptance of the report was proposed by Fiona Ware and seconded by Sarah Bowen.

The Hon. Editor's report (Vicki Howe):

VH gave a verbal report with powerpoint presentation.

The first *Porcupine Newsletter* was published in 1976 and the Autumn 2016 *Bulletin* celebrated 40 years of Porcupine publications with a time line of 40 Porcupine firsts. The *Newsletter* is now called the *Bulletin* and two editions are published each year, one in the spring and one in the autumn. Deadlines for copy are the first week in June and the first week in December each year and guidelines for authors are available on request and are also on the website.

The Spring 2016 Bulletin had 17 + contributors and 16 articles ranging from species specific (*Velella velella* to *Sabellaria alveolata*) descriptions to papers on Seasearch and beach combing. The Autumn 2016 Bulletin had 24 + contributors, 19 articles and featured articles reporting on Porcupine fieldtrips to Staffa, Aberystwyth and Millport and papers from the Spring conference in Millport.

Thank you to all contributors and all the Porcupine Council who proof read and help with printing and distribution. Special thanks to Teresa Darbyshire who spends a considerable amount of time putting the Bulletin together,

We are always on the lookout for copy and are open to publishing anything which we feel would be of interest to Porcupines including observations, notes, research papers, field reports, book and website reviews and so much more! Please contact Vicki if you would like to know more.

Acceptance of the report was proposed by Dawn Powell and seconded by Peter Barfield.

The Hon. Website Officer's report (Tammy Horton):

Organisation and updates:

There have been some minor changes to the way the news posts are presented and we now keep the site up to date by removing to archive older posts about field trips and meetings that have passed. The conference and field trip pages were re-organised in 2016. The website hosted online payments for the conference at Millport in 2016 (via Paypal) and this worked well and was relatively easy to set up. However, for 2017 we moved to Eventbrite which has been simple to set up and is useful for tickets and downloading of the registration details.

We have continued hosting the 'donate' button, and membership can be paid using Paypal via the website.

We need to update the recording scheme webpages, and this is currently being discussed with Julia Nunn.

Newsletter hosting & downloading:

Issues of the *Bulletin* from the last two years are only available to paid members of the Society. This is updated prior to the March conference each year. Therefore all back issues of the *Newsletter* (and now the *Bulletin*) are available on the website up to *Bulletin* number 3 (Spring 2015). Table of contents are available for download for later issues.

We are now making use of the website to enable downloads of the *Bulletin* (password protected) for students and others choosing to receive the *Bulletin* in this format in the future. This has been carried out for the last three *Bulletins* (4-6).

Council member details/positions & Constitution.

The current constitution has been added to the website here: <http://pmnhs.co.uk/contact-us>

It will now be available for all to view and any updates can be made and a new version uploaded as necessary.

Social Media:

The Facebook group remains very active with 509 current members. Facebook is well-used for PMNHS interactions; for posting pictures,

general discussions and enquiries. Our Twitter account is now steaming ahead with 728 followers and almost 1600 tweets posted so far (thanks to resident tweeters Angie Gall and Kate Mortimer) attracting retweets. Please join our Facebook group, like our Facebook page and follow us on Twitter if you can.

A reminder that we are encouraging tweeting during the 2017 conference which was very successful for the 2016 conference at Millport. Please use the hashtag #PMNHS17.

Speakers who do not wish contents of their presentations to be tweeted should state this at the beginning of their slot.

Acceptance of the report was proposed by Teresa Darbyshire and seconded by Andy Mackie.

**The Hon. Records Convenor report:
(Julia Nunn):**

(see p.8–9 for article)

Acceptance of the report was proposed by Andy Mackie and seconded by Frank Evans.

4. Porcupine Grants Scheme and Bulletin student prize.

Winner of the 2016 Porcupine Student Prize is Aidan Hunter with his article 'The impact of fishing the Firth of Clyde: background information for the basis of an ecosystem enhancement plan.' Published in *Porcupine Bulletin* 6 (Autumn 2016).

Thanks to all students who submitted articles.

5. Constitution:

No proposed changes.

6. Election of Officers and Council:

Angie Gall resigned her role on Council. Therefore only 1 ordinary member was required to stand down and it was Peter Barfield.

The Council for 2017 is therefore as follows:

Office bearers:

Hon. Chairman Susan Chambers

Hon. Secretary Frances Dipper

Hon. Treasurer Jon Moore

Hon. Editor Vicki Howe

Hon. Membership Secretary Roni Robbins

Hon. Records Convenor Julia Nunn

Hon. Website Officer Tammy Horton

Ordinary members of Council:

Peter Barfield

Anne Bunker

Sarah Bowen

Fiona Crouch

Teresa Darbyshire

Dawn Powell

Fiona Ware

Seamus Whyte

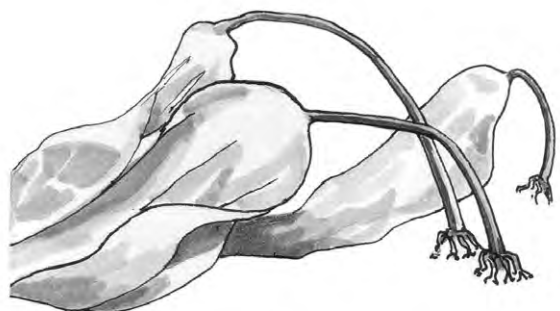
All members of council were re-elected on mass unanimously. After the meeting Becky Hitchin volunteered to be a member of council.

7. Future meetings:

The conference venue for 2018 has not been decided. Field trips this year will be to Northumberland (September).

8. Any other Business:

There was no other business.



Anne Bunker

PORCUPINE MNHS
RECEIPTS AND PAYMENTS ACCOUNT

Year to 31 December 2016

Year to 31.12.15			Year to 31.12.16
£	£		£
		RECEIPTS	
349		Subscriptions	36
2630		2014 & earlier	40
0		2015	2810
0		2016	101
		2017 onwards	
2979			2987
0		Sales (Sweatshirts & books)	0
0		Bank Interest (gross, both accounts)	0
(0)		Tax deducted	(0)
50		Raffle	318
50		Contribution	30
3029		Total Receipts	3335
		PAYMENTS	
(2212)		Bulletin-	(1528)
(559)		Printing	(404)
		Postage & other expenses	
(2771)		Total Newsletter Costs	(1932)
(144)		Web site expenses	(13)
(53)		Council meeting expenses (travel/catering)	(74)
(2968)			(2019)
(61)		SURPLUS BEFORE MEETINGS & GRANTS	1317
0		Annual Conferences – Portsmouth (2015)	0
(333)		– Millport (2016)	2422
0		Field meetings –	0
0		Porcupine grants	0
0		Newsletter prize	(50)
(333)			2372
(272)		DEFICIT FOR THE YEAR (before tax)	3689
0		Corporation Tax	0
(272)		DEFICIT FOR THE YEAR (after tax)	3689
2009		BALANCE BROUGHT FORWARD	1737
		BALANCE CARRIED FORWARD	
1737		Current Account	5282
0		PayPal Account	144
<u>1737</u>			<u>5426</u>

Jon Moore, Hon Treasurer

9 March 2016

J. J. Moore

Report of the Hon. Records Convenor March 2017

Julia Nunn

This winter, I tackled the backlog and updating of the Marine Recorder database.

- Issues with locations for 2 original surveys have been clarified.
- Technical errors, duplications and typos have been corrected.
- The whereabouts of some Porcupine survey data has been clarified e.g. 2010 Isles of Scilly (diving).
- A number of Porcupine members were pestered for survey data!! My thanks go to everyone who responded to my pleas for assistance.
- No records other than for Porcupine fieldwork were received during the past year.

All PMNHS Bulletins have been checked for records and the backlog entered. Traditionally the database contains records from Porcupine fieldwork. When going through the back issues of the *Bulletin/Newsletter*, I also included any

other records published there and clearly in the public domain, but unlikely to have been digitised through another route. This generally meant records prior to the last 10 years. Issues with site locations were dealt with by use of online support such as Grid Reference Finder.

NOTE: when publishing a record in the *Bulletin* please include the 'who/what/when/where/how'!

The dataset now holds 63 surveys from 1961 to 2016 inclusive. This is an increase from 24 previously.

- 530 events (52)
- 599 samples (87)
- 20 biotopes (1)
- 19,819 species records (3,087) – an increase of 16,732

The PMNHS dataset has been sent to NBN Gateway and all appropriate paperwork completed. These records will be transferred to new NBN Atlas in due course. All Porcupine records are freely available under the licence Creative Commons with Attribution.

Reporting module

JNCC
Joint Nature Conservation Committee

Cyfoeth Naturiol Cymru
Natural Resources Wales

Scottish Natural Heritage
All of nature for all of Scotland

Filter: ☐ Filter Snapshot data from: C:\MarineSnapshot\SnapshotDatav51.mdb

Reports:

- ☐ Report Wizard
- ☐ Summary of events (containing samples)
- ☐ *Plot samples (based on number of samples)
- ☐ *Plot species (based on number of species)
- ☐ Summary of samples (based on number of samples & replicates)
- ☐ Output data to matrix
- ☐ Output data for biotope matching
- ☐ Output data to PRIMER file

*View: ☒ On map ☐ As table

Records currently selected:

Surveys:	63
Locations:	399
Events:	530
Samples:	599
Biotopes:	20
Physical:	599
Species:	19819

Fig. 1: Marine Recorder Reporting Module for full PMNHS dataset

Year	Month	Location	Comments
1977	Jun	South Shields	molluscs only
1977	Aug	Orkney	molluscs + limited list for other groups
1978	Jun	Portaferry	
1979	Mar	Redheugh	molluscs only
1980	Sep	Channel Islands	molluscs only
1981	Sep	Rhossili, Gower	molluscs only
1982	Aug	Sherkin Island	molluscs entered + limited list for other groups
1983	Aug	Eyemouth	molluscs only
1983	Oct	Cullercoats	limited species list published
1984	Sep	Cornwall	molluscs only
1985	Jun	Skye	
1990	Oct	Anglesey	
1992	Apr	Dunstaffnage	molluscs only
1993	Oct	Isle of Man	molluscs only
1994	Sep	Channel Islands	mainly molluscs
1995	Mar	Millport	molluscs only
1999	Mar	Dunstaffnage	molluscs only
1999	Oct	Pembrokeshire	molluscs only
2000	July	The Trink, Northumberland	molluscs only
2001	May	Isle of Purbeck, Dorset	
2003	Aug	Northumberland & The Trink	molluscs only
2009	Mar	Plymouth Marina & Wembury	limited species list published
2009	Aug	Poole	
2012	Mar	Thornwick Bay, Yorkshire	

Table 1: Porcupine Surveys with missing records.....

An article about Marine Recording/Marine Recorder was published in the PMNHS Bulletin.

Future

1. Update the web site page on Marine Recording to encourage submission of records.
2. All field leaders should send me the records from PMNHS field trips as soon as the full and final lists are available for data entry.
3. Clarify status of records generated during PMNHS fieldwork, especially diving.
4. There are still some casual records that have not been entered onto the database, principally those collated for the Recording Scheme by Jon Moore during his tenure as the Recorder for Porcupine.

5. A few older Porcupine surveys still have no records. Many have only mollusc records supplied by Shelagh Smith and/or myself. I would ask anyone who can help with additional records to please do so. Any medium for the records including paper records, notebooks etc. is fine!



Anne Bunker

Obituary

Stella Maris Turk MBE MSc

27 March 1925 – 3 April 2017



As a long-standing member of the Porcupine MNHS Stella was delighted when Porcupine members travelled west to the Cornish Biological Records Unit (CBRU), Redruth, for their 1992 Autumn meeting surveying shores at Marazion and Falmouth and adding significantly to the list of recorded species. It was a chance for several members to meet face to face with the legendary figure dedicated to biological recording and known to a huge network of contacts through her prodigious correspondence and who regarded herself as an amateur conservationist in the traditional sense who worked just for the love of studying wildlife.

The early years

“Star of the Sea” Stella Maris Turk MBE née Treharne Phillips was born on 27 March 1925 in St Mary’s on the Isles of Scilly where her father was a clergyman. In 1927 the family, including 3 sisters and 2 brothers, moved to the parish of Otorohanga, in New Zealand where they stayed for 5 years before returning to Cornwall to live first at Trevone, then Treleigh and later Feock in 1940.

A lover of wildlife from an early age, in her teens she became more seriously interested

in natural history studies and met zoologist Dr Frank Turk, an extra-mural tutor for the University of Exeter. After their marriage in 1946 Stella came to live at Shangri-La Reskadinnick, Camborne, where she remained after his death in 1996 until her own death on the 3 April 2017. Stella first assisted Frank and then led Workers’ Educational Association adult education classes herself throughout Cornwall and the Isles of Scilly. Her first scientific paper was published when she was just 16 and was followed by many others in the following years.

Frank and Stella were founder members of Camborne-Redruth Natural History Society in 1956 and founder members of the Cornwall Naturalists’ Trust now Cornwall Wildlife Trust in 1962.

Stella developed a life-long interest in conchology, the study of molluscs, and later served as the British Isles National Recorder for marine molluscs 1967-1974, and President 1981-1983 of the Conchological Society of Great Britain & Ireland. At an early stage Stella also volunteered as the Strandings Recorder for marine mammals.

Cornish Biological Records Unit (CBRU)

In 1971, the Institute of Cornish Studies was formed and in 1972 Dr Frank Turk became one of its Research Fellows, the Fellowship being



Stella at work, late 1960s

envisaged as being entirely concerned with Biological Recording. Stella joined Frank as a joint tutor of a small but devoted group of recorders, generating a databank of 4,000 species indexing some 21,000 records and this project became the Cornish Biological Records Unit.

Stella continued her natural history studies, in particular her love of the marine environment, and with a small voluntary group, carried out numerous voluntary marine surveys around the Cornish coast and also many general flora and fauna surveys which added to the card data collection. In 1980, Frank retired as CBRU director, Stella took over and when the University decided to computerize the records, Dr Colin French joined the CBRU to manage the project, launched formally in 1987 (Environmental Recording In Cornwall Automated) whilst Stella continued her organisational role.

Together with 'her team' Stella played an active role in the early years of the national biological recording scene, venturing out of Cornwall on rare occasions. She inspired innumerable people to become involved with the natural history of Cornwall and maintained a prodigious correspondence all through her long life.

Helford Marine Conservation Area

In the late 1980s, Stella and fellow marine recorder Dr Norman Holme, joined forces to halt the perceived deterioration of the marine wildlife of the Helford River area and, in 1986, the Helford Marine Conservation Area was created. Stella handed over the organisational role to Dr Pamela Tompsett in 1989 but she maintained an enthusiastic input for the rest of her active life.

Library & collections

In the days before the internet it was even more important to maintain an up-to-date library together with well-documented specimens. These were of great help in answering the endless stream of requests for assistance in identification with which Stella patiently coped.

As well as wildlife and studying molluscs Stella liked entertaining people and her lunch-time

gatherings at the Institute with her home-made cakes were legendary and enjoyed by all, especially the large number of visitors.

She was also a very practical person with hammer and nails ever at the ready to erect shelves or fix leaks when needed. The garden with its oriental theme was her particular delight.

In earlier years Stella bred Siamese and boarded cats, including one belonging to the then Prime Minister Harold Wilson, during his Scillonian trips. The cage door was labelled No.10!

Stella wrote numerous articles and papers and was the author of a popular book *Seashore Life in Cornwall and the Isles of Scilly* published in 1971. For a few years she wrote a weekly column on wildlife in the West Briton. She also wrote poetry and made her own greetings cards.

Awards

- 1972: Bard of the Cornish Gorsedd with the bardic name Covathor Morrep (Recorder of the Seashore)
- 1979: Zoological Society of London (ZSL) Stamford Raffles Award. '*For distinguished contributions to zoology by amateur zoologists or professional zoologists in recognition of contributions which are outside the scope of their professional activities.*' Awarded to Stella for '*contributions to the study of seashore life and marine molluscs.*'
- 1980: Honorary MSc, University of Exeter
- 2003: MBE for her services to the recording of the natural environment in Cornwall, presented by Lady Mary Holborow on 21st August 2003

Many people will have fond memories of Stella, either on the sea shore, in all weathers, peering into rock pools or sat at her desk surrounded by her vast collection of shells, mounted fish, other marine memorabilia and library of books.

Pamela E. Tompsett

Report on the Annual Conference Plymouth, March 11th-13th 2017 *Marine Species Biology & Ecology*

Teresa Darbyshire

Eighty-two people registered for the Annual Conference in March at Plymouth University and there was a buzz in the entrance hall of the Roland Levinsky building on Saturday morning as the delegates started arriving to register. It was lovely to catch up with so many people that I see once a year and a chance to speak to others whose names I might have seen on reports, giving talks or otherwise heard of but not met. The lecture hall was full with an impressive projection screen that dwarfed the speakers and made viewing the presentations easy. The little Porcupine mascot sat quietly and inconspicuously beneath the screen (look carefully in the photographs following the species list!).

Our new Chairwoman, Sue Chambers, opened proceedings and welcomed everyone to Plymouth and the conference. Charlotte Bolton and Paul Kay then started the morning session with an overview of how Seasearch divers have contributed to our knowledge of UK marine fauna and flora and its distribution. Three talks in the afternoon on fish behaviour by Paul Naylor, Matt Doggett and Martin Openshaw delivered some stunning photography, captivating video and showcased the use of such techniques in capturing rarely seen fish behaviour and then Mike Kent reminded us how important voucher specimens are for field observations, particularly when

validation is called for at a later date. Emily Priestley provided an overview of the excellent Porcupine fieldtrip to the Staffa archipelago in September 2016, organised by Rayner Piper (I certainly wished I'd been able to go!).

After a full first day, 55 delegates then



descended on Citadel Hill for the conference dinner at the Marine Biological Association. The food, service and company were all fantastic, not to mention the Porcupine wine (see photos)! Vicki Howe and Jon Moore had devised a fiendish quiz to tax our brains with and I am ashamed to say that, despite being on the winning team, I'm not sure how much I really contributed! The evening was topped off with a birthday celebration and special cake - Happy 40th Birthday Porcupine!

Day two started with jellyfish and parasites and then moved on to a particularly wormy session (I was very pleased!) with elusive echinurans, worms sharing shells and reproducing lugworms. In the afternoon, Peter Barfield led an observations-based discussion session before we wrapped up with seaweeds and sea fans. The fieldtrip to Wembury Field Centre was well attended on Monday, but I'll leave that review for someone else...

Finally, many thanks to Plymouth University for hosting the conference, Fiona Crouch for all her hard work in co-ordinating much of the organisation including the dinner and fieldtrip and the other committee members for pitching in and helping with registration, raffle prizes and tickets.

Roll on March 2018 and the next conference in Edinburgh, I can't wait!



Wembury spring field trip - March 13th 2017

Paul Brazier

After 2 days of great talks at the Porcupine conference, Plymouth, on 13th March, it was time to step out. What better place than the well-known Wembury Beach (Figure 1), hosted by the Marine Centre, manned by the Devon Wildlife Trust (<http://www.wemburymarinecentre.org/>). The shore lies within the 'Plymouth Sound and Estuaries' Special Area of Conservation and the Wembury Voluntary Marine Conservation Area and as such, all shore surveyors were requested not to remove any items from the beach (other than litter!). Understandably, such a honey pot location can rapidly decline, unless visitors act responsibly and leave it as they found it. A number of animals were collected, to confirm identity, before being returned to the site. Some algae were collected, where it was possible to split the frond, to leave the bulk of the plant intact.

The 20 or so Porcupine members quickly dispersed across the rocky headland, seeking

the overhangs, gullies and pools that add to the diversity of animals and plants to be found. Numerous individuals made separate recordings in different locations. I headed as far as I could to the sublittoral fringe (Grid Ref 251772 048304), across the middle of the day, whilst the tide was at its lowest. The rockpools in the lower shore (Grid Ref 251750 048234) also provided plenty of scope. The species table here includes species found whilst travelling across the bedrock shore, as well as those found in the two specific habitats.

The rockpools (Figure 2A), along with the boulders within them threw plenty of records, ranging from brown and red seaweeds, to many molluscs, both on upper surfaces and under boulders, with cryptic crabs and brittlestars.

One notable overhang contained the less frequently recorded bearded mussel, *Modiolus barbatus* (confirmed with photographs later), the blue sponge *Terpios gelatinosa* (Figure 2E) and an unidentified (probably *Haliclona* – Bernard Picton) sponge (Figure 2B). This would have required a check of the spicules in a sample to confirm the identity.



Fig. 1: View across the extensive Wembury beach (half tide) with the Great Mew Stone in the distance.





Species Name	Authority	Low shore rockpool	Sub-littoral fringe	Rest of shore
PORIFERA				
<i>Grantia compressa</i>	(Fabricius, 1780)		O	P*
<i>Ophlitaspongia papilla</i>	Bowerbank, 1866			P*
<i>Terpios gelatinosa</i>	(Bowerbank, 1866)		O	
<i>Halichondria (Halichondria) panicea</i>	(Pallas, 1766)	O	F	P*
<i>Hymeniacidon perlevis</i>	(Montagu, 1814)	R	C	P*
<i>Haliclona</i> sp.?	Grant, 1841		R	
<i>Halisarca dujardinii</i>	Johnston, 1842	R		
CNIDARIA				
<i>Craterolophus convolvulus</i>	(Johnston, 1835)			P*
<i>Dynamena pumila</i>	(Linnaeus, 1758)			P*
<i>Actinia equina</i>	(Linnaeus, 1758)	O	O	P*
<i>Actinia fragracea</i>	Tugwell, 1856			P*
<i>Anemonia sulcata</i>	(Pennant, 1777)		R	
<i>Anemonia viridis</i>	(Forsskål, 1775)			P*
<i>Urticina felina</i>	(Linnaeus, 1761)			P*
<i>Aulactinia verrucosa</i>	(Pennant, 1777)			P*
<i>Sagartia elegans</i>	(Dalyell, 1848)			P*
PLATYHELMINTHES				
<i>Platyhelminthes</i> sp.	Minot, 1876	R		
NEMERTEA				
<i>Lineus bilineatus</i>	(Renier, 1804)			P*
<i>Lineus longissimus</i>	(Gunnerus, 1770)		R	
ANNELIDA				
<i>Polynoidae</i> sp.	Kinberg, 1856	R		
<i>Sthenelais boa</i>	(Johnston, 1833)			P*
<i>Eulalia viridis</i>	(Linnaeus, 1767)	R		
<i>Malacoceros</i> sp.				P*
<i>Flabelligera affinis</i>	M Sars, 1829			P*
<i>Sabellaria alveolata</i>	(Linnaeus, 1767)		R	
<i>Lanice conchilega</i>	(Pallas, 1766)			P*
<i>Spirobranchus</i> sp.	Blainville, 1818	F		P*
<i>Spirobranchus lamarcki</i>	(Quatrefages, 1866)			P*
<i>Spirobranchus triqueter</i>	(Linnaeus, 1758)			P*
<i>Spirorbinae</i> sp.	Chamberlin, 1919	C		
<i>Spirorbis</i> sp.				P*
ARTHROPODA (CHELICERATA)				
<i>Halacaridae</i>	Murray, 1877	O		
ARTHROPODA (CRUSTACEA)				
<i>Verruca stroemia</i>	(O.F. Müller, 1776)	F	O	
<i>Chthamalus montagui</i>	Southward, 1976	F		
<i>Chthamalus stellatus</i>	(Poli, 1791)	A	A	
<i>Semibalanus balanoides</i>	(Linnaeus, 1767)	R		
<i>Balanus crenatus</i>	Bruguière, 1789			P*
<i>Perforatus perforatus</i>	(Bruguière, 1789)	R	O	
<i>Austrominius modestus</i>	(Darwin, 1854)	F		
<i>Gammaridae</i> sp.	Leach, 1814	A		
<i>Idotea granulosa</i>	Rathke, 1843			P*
<i>Pagurus</i> sp.				P*
<i>Galathea</i> sp.				P*
<i>Galathea squamifera</i>	Leach, 1814		R	
<i>Pisidia longicornis</i>	(Linnaeus, 1767)	O	O	
<i>Porcellana platycheles</i>	(Pennant, 1777)	O	F	P*
<i>Cancer pagurus</i>	Linnaeus, 1758	O	O	P*
<i>Necora puber</i>	(Linnaeus, 1767)			P
<i>Carcinus maenas</i>	(Linnaeus, 1758)			P*
<i>Lophozozymus incisus</i>	(H. Milne Edwards, 1834)	O		

Table 1: Table of species recorded from Wembury. Species list based on that by Paul Brazier with records from other participants marked by *. (R=rare, O=occasional, F=frequent, A=abundant; P=present).

Species Name	Authority	Low shore rockpool	Sub-littoral fringe	Rest of shore
MOLLUSCA				
<i>Lepidochitona cinerea</i>	(Linnaeus, 1767)	O		
<i>Gibbula cineraria</i>	(Linnaeus, 1758)	C	C	P*
<i>Gibbula umbilicalis</i>	(da Costa, 1778)	F		P*
<i>Phorcus lineatus</i>	(da Costa, 1778)	F		P*
<i>Calliostoma zizyphinum</i>	(Linnaeus, 1758)	O	O	P*
<i>Patella depressa</i>	Pennant, 1777		F	P*
<i>Patella ulyssiponensis</i>	Gmelin, 1791	O		
<i>Patella vulgata</i>	Linnaeus, 1758	C	C	P*
<i>Patella pellucida</i>	Linnaeus, 1758		F	
<i>Lacuna vineta</i>	(Montagu, 1803)	P		
<i>Littorina</i> sp.				P*
<i>Littorina fabalis</i>	(Turton, 1825)			P*
<i>Littorina littorea</i>	(Linnaeus, 1758)	C		
<i>Littorina obtusata</i>	(Linnaeus, 1758)			P*
<i>Littorina saxatilis</i>	(Olivi, 1792)	O	O	
<i>Melarhaphe neritoides</i>	(Linnaeus, 1758)			P*
<i>Rissoa parva</i>	(da Costa, 1778)			P*
<i>Onoba</i> sp.				P*
<i>Crepidula fornicata</i>	(Linnaeus, 1758)			P*
<i>Trivia monacha</i>	(da Costa, 1778)	O	O	P*
<i>Lamellaria perspicua</i>	(Linnaeus, 1758)	R		
<i>Ocenebra erinaceus</i>	(Linnaeus, 1758)	R	R	P*
<i>Nucella lapillus</i>	(Linnaeus, 1758)	O	O	P*
<i>Tritia reticulata</i>	(Linnaeus, 1758)			P*
<i>Tritia incrassata</i>	(Strøm, 1768)	R	O	
<i>Raphitoma purpurea</i>	(Montagu, 1803)			P*
<i>Aplysia punctata</i>	Cuvier, 1803			P*
<i>Goniodoris nodosa</i>	(Montagu, 1808)	O		
<i>Limacia clavigera</i>	(O F Müller, 1776)			P*
<i>Rostanga rubra</i>	(Risso, 1818)			P*
<i>Doris pseudoargus</i>	Rapp, 1827			P*
<i>Mytilus edulis</i>	Linnaeus, 1758			P*
<i>Modiolus barbatus</i>	(Linnaeus, 1758)		R	
<i>Anomiidae</i> sp.				P*
<i>Anomia ephippium</i>	Linnaeus, 1758		F	
<i>Heteranomia squamula</i>	(Linnaeus, 1758)			P*
<i>Lasaea adansoni</i>	(Gmelin, 1791)			P*
BRYOZOA				
<i>Bryozoa</i> sp.		F	C	P*
<i>Flustrellidra hispida</i>	(Fabricius, 1780)			P*
<i>Membranipora membranacea</i>	(Linnaeus, 1767)			P*
<i>Electra pilosa</i>	(Linnaeus, 1767)		O	P*
ECHINODERMATA				
<i>Asterina gibbosa</i>	(Pennant, 1777)	O	O	P*
<i>Marthasterias glacialis</i>	(Linnaeus, 1758)		R	P*
<i>Ophiothrix fragilis</i>	(Abildgaard in O.F. Müller, 1789)		P	P*
<i>Ophiocoma nigrum</i>	(Abildgaard, 1789)			P*
<i>Amphipholis squamata</i>	(Delle Chiaje, 1828)	O		P*
TUNICATA				
<i>Morchellium argus</i>	(Milne Edwards, 1841)		R	
<i>Aplidium pallidum</i>	(Verrill, 1871)			P*
<i>Didemnidae</i> sp.	Giard, 1872	O	O	
<i>Botryllus schlosseri</i>	(Pallas, 1766)	O	O	P*
<i>Botrylloides</i> sp.				P*
PISCES				
<i>Lepadogaster lepadogaster</i>	(Bonnaterre, 1788)			P*
<i>Ciliata mustela</i>	(Linnaeus, 1758)			P*

Table 1: (cont.)

Species Name	Authority	Low shore rockpool	Sub-littoral fringe	Rest of shore
<i>Nerophis lumbriciformis</i>	(Jenyns, 1835)			P
<i>Lipophrys pholis</i>	(Linnaeus, 1758)	R		
RHODOPHYTA				
<i>Rivularia</i> sp.	C.Agardh ex Bornet & Flahault, 1886	R		
<i>Porphyra purpurea</i>	(Roth) C.Agardh, 1824			R
<i>Rhodothamniella floridula</i>	(Dillwyn) Feldmann, 1978		C	
<i>Asparagopsis armata</i>	Harvey, 1855	R	O	P*
<i>Gelidium pulchellum</i>	(Turner) Kützting, 1868	C	F	
<i>Gelidium pusillum</i>	(Stackhouse) Le Jolis, 1863	O		
<i>Gelidium spinosum</i>	(S.G.Gmelin) P.C.Silva, 1996			P*
<i>Pterocladia capillacea</i>	(S.G.Gmelin) Santelices & Hommersand, 1997	O		
<i>Palmaria palmata</i>	(Linnaeus) Weber & Mohr, 1805	F	C	P*
<i>Ahnfeltia plicata</i>	(Hudson) E.M.Fries, 1836	O	O	
<i>Hildenbrandia rubra</i>	(Sommerfelt) Meneghini, 1841			P*
Corallinaceae	Lamouroux, 1812	S	F	P*
<i>Corallina caespitosa</i>	R.H.Walker, J.Brodie & L.M.Irvine, 2009	A	O	
<i>Corallina officinalis</i>	Linnaeus, 1758	O	F	P*
<i>Jania rubens</i>	(Linnaeus) J.V.Lamouroux, 1816	O	F	
<i>Lithothamnion</i> sp.				P*
<i>Melobesia membranacea</i>	(Esper) J.V.Lamouroux, 1812	F	F	
<i>Mesophyllum lichenoides</i>	(J.Ellis) Me.Lemoine, 1928		C	P*
<i>Grateloupia doryphora</i>	(Montagne) M.A.Howe, 1914	F		
<i>Calliblepharis jubata</i>	(Goodenough & Woodward) Kützting, 1843		O	P*
<i>Chondracanthus acicularis</i>	(Roth) Fredericq, 1993	O	F	
<i>Chondrus crispus</i>	Stackhouse, 1797	A	O	P*
<i>Gigartina</i> sp.?	Stackhouse, 1809	O		
<i>Callophyllis laciniata</i>	(Hudson) Kützting, 1843		R	
<i>Mastocarpus stellatus</i>	(Stackhouse) Guiry, 1984	O	F	P*
<i>Phyllophora pseudoceranoides</i>	(S.G.Gmelin) Newroth & A.R.A.Taylor, 1971	F		
<i>Gracilaria gracilis</i>	(Stackhouse) M.Steentoft, L.M.Irvine & W.F.Farnham, 1995	O		
<i>Gastroclonium ovatum</i>	(Hudson) Papenfuss, 1944	F	F	P*
<i>Lomentaria articulata</i>	(Hudson) Lyngbye, 1819	O	F	P*
<i>Ceramium shuttleworthianum</i>	(Kützting) Rabenhorst, 1847		O	
<i>Plumaria plumosa</i>	(Hudson) Kuntze, 1891		O	
<i>Cryptopleura ramosa</i>	(Hudson) L.Newton, 1931	R	O	
<i>Hypoglossum hypoglossoides</i>	(Stackhouse) F.S.Collins & Hervey, 1917	R		
<i>Osmundea oederi</i>	(Gunnerus) G.Furnari, 2008	R	O	
<i>Osmundea hybrida</i>	(A.P.de Candolle) K.W.Nam, 1994	F		P*
<i>Osmundea osmunda</i>	S Gmelin) Maggs et Hommersand			P*
<i>Osmundea pinnatifida</i>	(Hudson) Stackhouse, 1809	F	F	P*
<i>Vertebrata lanosa</i>	(Linnaeus) T.A.Christensen, 1967		R	P*
<i>Vertebrata fucoides</i>	(Hudson) Kuntze, 1891	O		
OCHROPHYTA				P*
<i>Ralfsia verrucosa</i>	(Areschoug) Areschoug, 1845	F	F	
<i>Halopteris scoparia</i>	(Linnaeus) Sauvageau, 1904	R		
<i>Colpomenia peregrina</i>	Sauvageau, 1927	R		
<i>Cladostephus spongiosus</i>	(Hudson) C.Agardh, 1817		F	
<i>Desmarestia</i> sp.				P*
<i>Laminaria digitata</i>	(Hudson) J.V.Lamouroux, 1813	R	C	P*
<i>Laminaria hyperborea</i>	(Gunnerus) Foslie, 1884		A	P*
<i>Saccharina latissima</i>	(Linnaeus) C.E.Lane, C.Mayes, Druehl & G.W.Saunders, 2006	R	O	
<i>Saccorhiza polyschides</i>	(Lightfoot) Batters, 1902		F	P*
<i>Ascophyllum nodosum</i>	(Linnaeus) Le Jolis, 1863			R P*
<i>Holidrys siliquosa</i>	(Linnaeus) Lyngbye			P*
<i>Fucus serratus</i>	Linnaeus, 1753	F	O	P*
<i>Fucus spiralis</i>	Linnaeus			P*
<i>Fucus vesiculosus</i>	Linnaeus			P*
<i>Pelvetia canaliculata</i>	(Linnaeus) Decaisne & Thuret, 1845		P	
<i>Himanthalia elongata</i>	(Linnaeus) S.F.Gray, 1821	O	A	P*

Table 1: (cont.)

Species Name	Authority	Low shore rockpool	Sub-littoral fringe	Rest of shore
<i>Sargassum muticum</i>	(Yendo) Fensholt, 1955	A		P*
<i>Bifurcaria bifurcata</i>	R.Ross, 1958	O	F	
CHLOROPHYTA				
<i>Ulva</i> sp.				P*
<i>Ulva lactuca</i>	Linnaeus, 1753	F		
<i>Cladophora rupestris</i>	(Linnaeus) Kützting, 1843	O	O	P*
<i>Bryopsis plumosa</i>	(Hudson) C.Agardh, 1823		R	
<i>Codium</i> sp.				P*
<i>Codium tomentosum</i>	Stackhouse, 1797	R	O	
ASCOMYCOTA				
<i>Lichina pygmaea</i>				P*
<i>Verrucaria mucosa</i>	Wahlenberg, 1803	F	C	P*
<i>Pyrenocollema halodytes</i>	(Nyl.) R.C. Harris, 1987	F	F	

Table 1: (cont.)

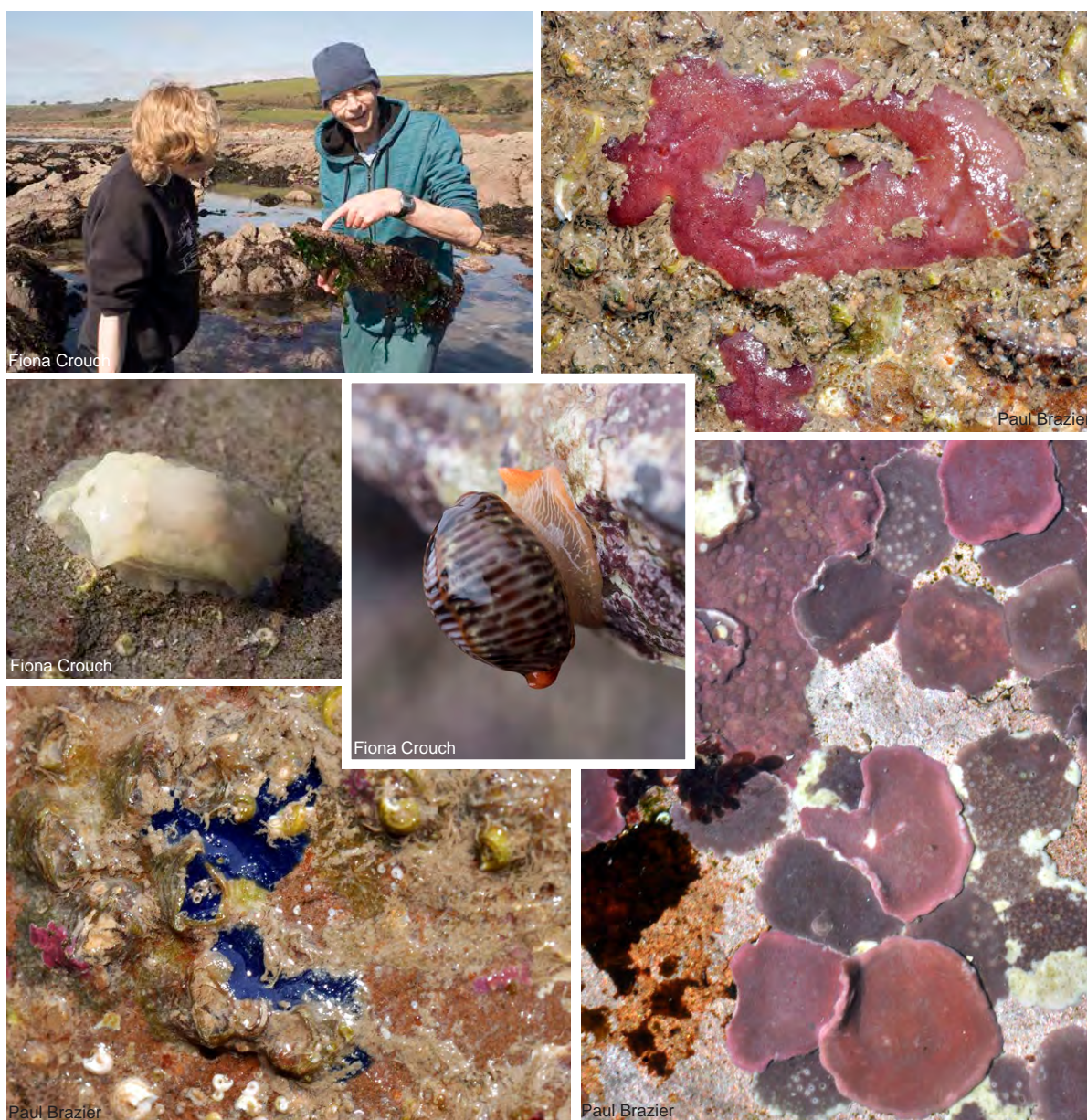


Fig. 2: A. Kathryn Birch & Paul Brazier at Wembury; B. Purply *Haliclona* sp. – unidentified, in a deep overhang; C. unidentified nudibranch; D. *Trivia monacha*; E. *Terpios gelatinosa* in a deep overhang; F. Encrusting pink coralline algae in the rockpool.

Where's Onchi? On the occurrence of *Onchidella celtica* on the shores of Great Britain and Ireland

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Introduction

Yonge (1949) referred to *Onchidella celtica* (Cuvier, 1817) (Figure 1) as "... the very interesting little air-breathing sea slug...which clings like a rounded blob of black rubber on to rocks at and above high water level around the coasts of Cornwall." Why, you might ask, did Yonge regard it as interesting? Clearly, unless your eyes are blinded by love, it's not the most beautiful sea slug on our shores... (Figure 1)... but it is one of the most curious.

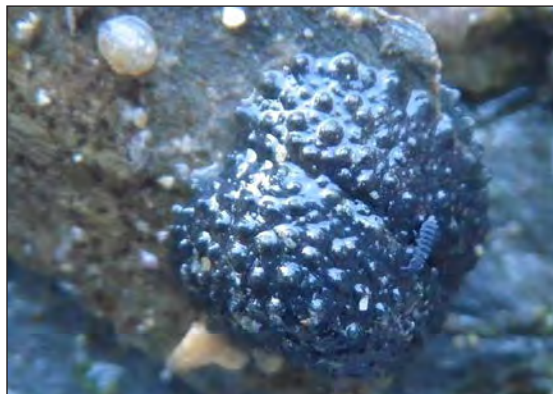


Fig. 1: Two Celtic Sea Slugs, each about 1cm long, immobile and huddling together in a crevice at New Polzeath (Photo: M. Kent, 25/05/2017), with a springtail (*Anurida maritima*) taking a walk over their tuberculated dorsal surfaces.

The Celtic Sea Slug *Onchidella celtica* (Cuvier, 1817) is an air-breathing gastropod belonging to the family Onchidiidae and the Order Systellommatophora (Dayrat, 2011). It is a true slug (it lacks a shell) and the only representative of the family Onchidiidae on the shores of Great Britain where it is an obligate crevice dweller on exposed rocky shores in a mussel and/or barnacle biotope, LR.HLR.MusB (JNCC 2015). Unlike limpets, it can grip onto rocks only weakly. On the surf swept rocky shores of north Cornwall, rather than resist the forces of giant Atlantic rollers, it avoids them by taking refuge in crevices, singly or in groups

of up to twelve or more (Fretter 1943; Tween 1987a). It emerges from its refuge on an ebb tide, soon after the crevice has been exposed to air, primarily to forage for food but also to find a mate. It does not emerge on every ebb tide (Kent in prep.).

Onchidella celtica is a hermaphrodite capable of self-fertilization, but usually reproduces sexually. It feeds mainly on diatoms and small algae, but is capable of ingesting chunks of large seaweeds such as the purple laver, *Porphyra umbilicalis* Kützinger, 1843. One of the most curious features of the slug's biology is that it lacks cellulase to chemically digest cellulose-bound algal cells. It depends instead on mechanically breaking open the cells using sand in the triturating regions of its gut (Fretter 1943; Tween 1987a).



Fig. 2: A Celtic sea slug, about 10 mm long, grazing on the surface organisms of a dogwhelk (*Nucella lapillus* (Linnaeus, 1758)) egg case. (Image taken by the author at Polzeath, north Cornwall).

Geographical range and climate change

Onchidella celtica is a Lusitanian 'southern' species with a geographical range extending from the Azores to the shores of Britain (Rowley 2005; Tween 1987a). It was selected as one of the potential climate change indicator species for the Marine Biodiversity and Climate Change Project (MarClim®) intertidal surveys of shores of Great Britain and Ireland, because this is where it is at its northern limit of distribution and where its precise occurrence is likely to be temperature sensitive (Mieszkowska *et al.* 2005).

One of the major problems of using *O. celtica* as a climate change indicator species is that its occurrence is difficult to quantify. Unless

intertidal surveyors prize open crevices to examine their contents (a sampling method which can be impracticable as well as destructive and unethical), they have to rely on seeing and counting onchidellids foraging on the open rock. Unfortunately, the emergence of Celtic Sea Slugs is not easy to predict. They may come out of their refuges to forage and mate in rain or shine, on hot, sunny days and cool, cloudy and damp nights. Or they may just remain in their crevice when conditions seem to be fine (Tween 1987a; Kent 2017 in prep.). It is therefore possible to conduct a thorough search for the sea slugs on shores where it is known to be abundant and not record any.

Historical records of *O. celtica* in Great Britain and Ireland

Using changes in the distribution and abundance of a species as a climate change indicator depends on having reliable historical records to establish a baseline and to monitor changes in occurrence. For the present study, peer-reviewed journals, books, unpublished theses, and historical data sets were searched for records of the geographical occurrence of *O. celtica* in Great Britain and Ireland. The main sources of information were Tween (1987a), the historical data sets held by the National Biodiversity Network (<https://nbn.org.uk>), and the survey records for MarClim®.

Tween (1987a) made a detailed study of *O. celtica* distribution in Great Britain and Ireland. He concluded that *O. celtica* was confined to the shores of Cornwall and north Devon, occurring discontinuously in Cornwall from Rame Head on the south coast to Bude on the north coast, and at Croyde Bay on the north coast of Devon.

Records of its occurrence on the Isles of Scilly, Ireland and Scotland are not reliable evidence of the occurrence of established populations of *O. celtica* at these locations. According to Tween (1987b), the records of *O. celtica* on the Isles of Scilly (Britton 1984; Seaward 1982) are probably based on a conversation with Stella Turk, a Cornish naturalist, who is reported as stating that this species is found on Tresco and Samson flats. However, Turk (1992) stated that "...it has never been found in Devon nor in the

Land's End peninsula or the Scillies." There are no other records of *O. celtica* in the Isles of Scilly despite detailed searches (personal observations, and Tween, 1987b).

The source of the only Irish record of *O. celtica* is its inclusion in a species list for Lough Ine (Norton, Hiscock & Kitching 1977). However, Kitching (1987) reported that this record for Lough Ine (now called Lough Hyne) was incorrect and that a dorid sea slug (*Onchidoris muricata*) was mistakenly identified as *O. celtica*. No Irish records are in the historic surveys of Southward and Crisp (1954) nor those of Simkanin who searched for *O. celtica* and other intertidal organisms on 63 shores around the Irish coast in 2003 (Simkanin 2004; Simkanin *et al.* 2005). Christina Simkanin kindly went through all of her original field notes for the present study, although she has records of searching for *O. celtica*, she has no records of it being present on any shore she surveyed (Simkanin 2017, pers.comm.).

Scottish records for *O. celtica* are based on a single specimen on the shores of Upper Loch Fyne (Chumley 1918), a single specimen (now a voucher specimen in the National Museum of Scotland) in a sampling bag in 1985 at Craobh Haven, South of Jura (Smith 1987), a diver reporting a specimen floating in intertidal water, and a MarClim® record for Appin. Surveys undertaken by Smith (1987) and Tween (1987b) failed to find *O. celtica* at Loch Fyne, Craobh Haven, or Port a'Mheirlich. The MarClim® record for Appin is the result of a data entry mistake (Nova Mieszkowska, MarClim® data holder, pers. comm., January 2017). Tween (1987b) accepted that the records for single specimens of *O. celtica* may be correct, but concluded that they are not evidence of sustained, overwintering populations of *O. celtica* in Scotland. He suggested that they are "adventitious" specimens displaced from their normal home range. Nevertheless, he was perplexed as to how these individuals reached Scotland because, as a direct-developing species, he assumed *O. celtica* has limited powers of dispersal.

NBN Gateway and MarClim® datasets accessed in January 2017, confirm the presence of *O. celtica* on Cornish shores discontinuously from Rame Head to Bude, and at Croyde Bay in north

LOCATION	GRID REFERENCE	DATE OF OBSERVATION	COMMENTS
Datasets in NBN Gateway archive, accessed January 2017			
Appin Argyll Scotland	NM928491	01/07/2003	Incorrect record due to data entry/transcription error (Nova Mieszkowska, pers.comm)
Rhos on Sea N. Wales	SH844807	18/09/2004	Incorrect record due to data entry error (Nova Mieszkowska, pers.comm)
Rocks west of beach, Farne Island	NU225359	13/05/2004	DASSH data set; questionable record; no other record of <i>O. celtica</i> found for Farne Is; volunteer sighting; a casual observation reported by the public; to be checked.
Oyster Cove Goodrington Sands, South Devon	SX895587	08/10/2006	Incorrect record due to data entry error
Gorah Rocks, Nr Start point Devon	SX791361	14/06/2010	Incorrect record due to data entry error
Wembury, South Devon	SX533483	28/03/2009	Porcupine Marine Natural History Society dataset; incorrect record (transcription error)
Wembury Point, South Devon	SX502481	20/10/2013	Record not confirmed. An intensive search by author on 13/3/2017 failed to find any onchidellids on rocks or in crevices.
Branscombe Bay, South Devon	SY203884	23/01/2007	Incorrect record due to data entry error
Survey 491, Gorah Rocks, South Devon	SX791361	14/06/2010	Incorrect record due to data entry error
MarClim® dataset supplied directly by dataset holder, January 2017			
Lyme Regis, Dorset	SY345920	17/04/2008	Incorrect data entry/transcription error (Nova Mieszkowska, pers.comm.)
North Haven, Skomer South Wales	SM735093	2/10/2008	Intensive search by author on 16/5/2017 failed to find any onchidellids on rocks or in crevices
South Haven, Skomer South Wales	SM733088	2/10/2008	Not verified; to be checked by recorder.
Abercastle, South Wales	SM851338	16/10/2008	Intensive search by author on 15/5/2017 failed to find any onchidellids on rocks or in crevices

Table 1: Post-1987 records of *O. celtica* outside of Cornwall and north Devon, 2017

Devon. But there are also several records of it being present on shores beyond Croyde Bay and Rame Head (Table 1) which suggest a northward extension of the range of *O. celtica* since 1987. These records are especially significant as they could be used as evidence of the effects of climate change: according to Lewis (1976), 'southern' species, such as *O. celtica*, at the limits of their distribution on British shores, are expected to extend their range northwards in response to any warming of the seas (Lewis

1976). However, on checking the records in Table 1, most have been shown to be incorrect, or have yet to be confirmed.

In addition to the above post-1987 records shown in Table 1, Hayward and Ryland (1993) give the distribution of *O. celtica* as "Coasts of Cornwall and south Devon, locally abundant." The reference to south Devon suggests that *O. celtica* dispersed north across Plymouth Sound. But this record is probably based on

the inclusion of *O. celtica* in the Plymouth Marine Fauna (Marine Biological Association 1957). Although Plymouth is in south Devon, the only record for *O. celtica* in the Fauna is for Whitsand Bay, which is in south Cornwall. There is no Devon record for *O. celtica* in the Fauna. There were several records of *O. celtica* for south Devon in datasets accessed through the NBN Gateway in January 2017 (Table 1). Except for one record for Wembury, all of these have subsequently been found to be incorrect. On Monday March 13th, on the field trip which followed the Porcupine Conference, the author searched during the morning ebb tide for *O. celtica* from Wembury beach to Wembury Point. No onchidellids could be found, despite searching intensively for *O. celtica* on open rock and in cervices (carefully prized open so that the slate could be returned with minimum disruption). Therefore, the presence

of *O. celtica* at Wembury was not confirmed, and there is no convincing evidence that *O. celtica* has managed to colonise any shores in south Devon.

There is an unverified but very interesting report that *O. celtica* has been found at West Angle, Pembrokeshire (Francis Bunker, pers. comm. to Phil Newman, May 2017). Although intensive searches for *O. celtica* at Abercastle and South Haven, Skomer, failed to find any *O. celtica*, these shores are relatively sheltered and do not have a mussel/barnacle biotope associated with the occurrence of *O. celtica*. In contrast, West Angle is an exposed shore that appears to be a much better candidate for *O. celtica* colonisation. West Angle is directly north west of Croyde Bay across the Bristol Channel where there's a thriving onchidellid population.

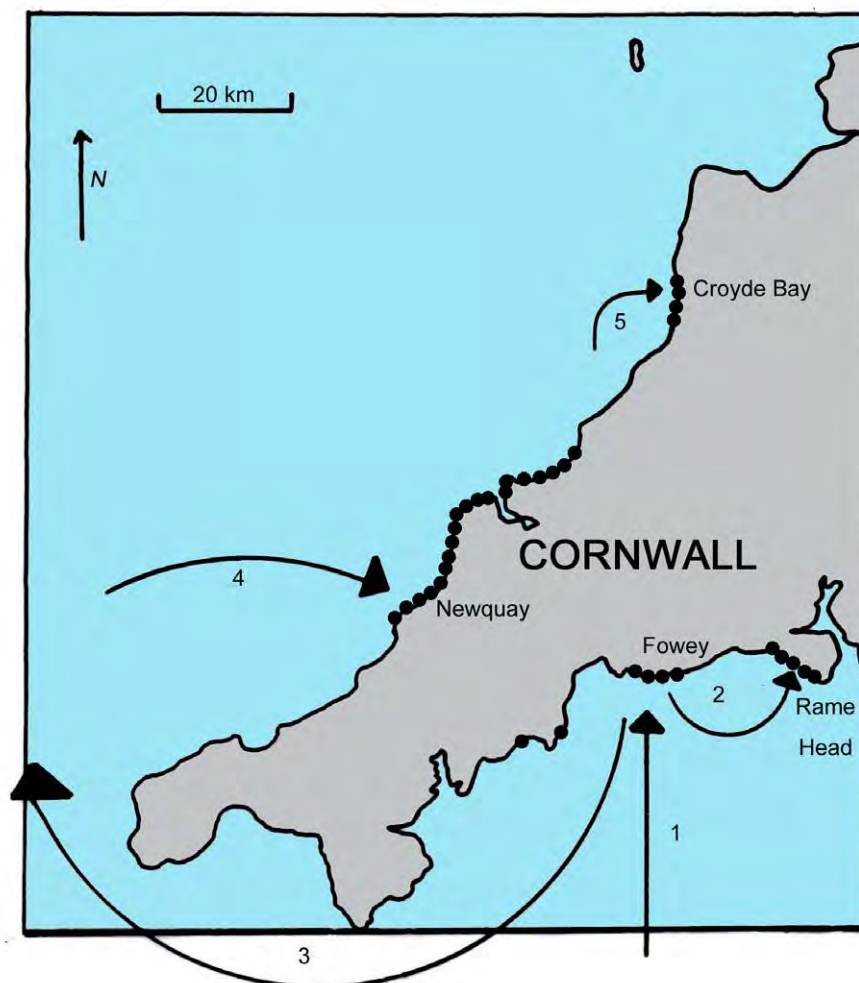


Fig. 2: Map of *O. celtica* distribution based on Tween (1987a) with arrows added to show the possible route of dispersion around the southwest peninsula

Location	Reference
Brittany, France	Cuvier, 1817, cited in Tween 1987a
Lantivet Bay: east of Fowey, S. Cornwall	Given in Forbes & Hanley (1852) as the first British record; find commonly attributed to J. Couch (e.g. Turk 1971) but actually found by his son Richard Quiller Couch in 1851 (Johns 2010)
Whitsand Bay, S. Cornwall, nr. Plymouth	Jefferys (1869) reporting a find by Spencer Bate
Fistral Bay, Newquay, N. Cornwall	Russell (1925)
Daymer Bay, N. Cornwall	Turk (1971)
Croyde Bay, N. Devon	Tween (1987a)

Table 2: Chronology of 'first finds' of *O. celtica*

O. celtica dispersion

Even if *O. celtica* extends its distribution northwards, it should not be assumed that climate change is the only possible cause. The Celtic Sea Slug might be a relatively recent introduction onto British shores that is slowly extending its distribution, irrespective of climate change. The chronological order in which *O. celtica* was first recorded in France and Great Britain (Table 2) hint that it might be a relatively recent introduction onto British shores from France (Figure 2).

The records in Table 2 suggest that British populations of *O. celtica* might have originated from Brittany (1), possibly having been transported in ships trading between Fowey and Roscoff in the eighteenth and nineteenth century. After colonising shores near Fowey (2) on the south coast of Cornwall, *O. celtica* might have dispersed eastwards to Whitsand Bay (3), then westwards around the Land's End peninsula (3) where it has not gained a foot hold, and northwards to Newquay and Bude (4) in north Cornwall and Croyde Bay in north Devon (5). It might still be in the process of colonizing more northerly British shores today. The absence of confirmed records of *O. celtica* in south Devon and Pembrokeshire might be due to the soft sediment of the shores of Plymouth Sound and the Severn acting as significant barriers to dispersion.

It is usually assumed that direct-developing marine species such as *O. celtica*, which do not have a planktonic larval stage, have limited powers of dispersal (Cumming 2013). However, it has recently been demonstrated that direct-development need not prevent an onchidellid from dispersing relatively swiftly

and effectively over long distances. The direct developing species *O. marginata* has been able, by rafting on floating substrata (especially macroalgae), to colonise remote islands in the southern hemisphere (Cumming 2013; Cumming *et al.* 2014).

Chaouti *et al.* (2017), suggest that *O. celtica* also uses floating algae to carry it in surface currents to new locations. They state: "The species can be found in shallow waters until depths of 25m on hard substrates (rock pools, boulders/crevices/overhangs, open rocks and rock platforms, sandstone rocks and rock walls), sandy bottoms or mostly associated to aquatic vegetation (inside macroalgal holdfasts)." Although the source of this statement is not referenced, it is probably based on the incorrect record of *O. celtica* in sublittoral samples made during a study of a laminarian forest at Lough Ine, Ireland (Norton *et al.* 1977; Kitching 1987). To the author's knowledge, there is no other reference to *O. celtica* in holdfasts. *Onchidella celtica* does not occur in laminarian holdfasts in Cornwall, even on shores where the sea slug is abundant (extensive personal observations) and, it is unlikely that floating seaweeds are a significant means of dispersal for *O. celtica*.

In contrast with the kelp-dwelling *O. marginata*, *O. celtica* dispersal is likely to be slow. Occasionally, as seen at Polzeath (personal observations), adults may lose their way home and find themselves in new territory, thereby gradually extending the geographical range of the population. Individuals are easily dislodged by a freak wave or some other disturbance, and might be carried by currents into new areas. This could explain the occurrence of the

occasional individual in locations well beyond the normal geographical range of *O. celtica*. For example, it is possible that the specimens found in the Clyde area of Scotland (Smith 1987) were dislodged individuals carried there by the North Atlantic Drift which sweeps up the west coast of England towards the Clyde. Perhaps some crawl-aways (young onchidellids that have emerged from eggs) are swept out of a crevice by the outflow of seawater as the tide comes in and goes out. Or dispersal might be accomplished by some other mechanism, such as the anthropogenic transfer of sessile adults or crawl-aways (e.g. in batches of mussels collected for food, or on stones used for ballast).

Conclusions

This study highlights the importance of checking records of a species in a new location before using the records as evidence for changes in distribution. False records can occur as a result of misidentifications, for example confusing a dorid (Norton *et al.* 1977) or a lamellarian (e.g. *Lamellaria perspicua* (Linnaeus, 1758), <http://www.ispotnature.org/node/447487>) with an onchidellid. They can also occur due to data entry or transcription errors.

NBN Gateway and MarClim® datasets include 'absence' as well as 'presence' records for *O. celtica*. An 'absence' record does not mean that a species is not present in a locality, merely that it has not been found during a particular survey. False absence records (false negatives) are likely to be common for *O. celtica* because it spends most of its time hidden in its refuge. When it emerges, it does so on an ebb tide and usually returns to its refuge before the time of low tide (Kent 2017 in prep.). Therefore, a search made for *O. celtica* on a rising tide is unlikely to find any individuals present, even on a shore where it is known to be abundant.

When using changes in the occurrence of a species as an environmental indicator, false negatives are far less significant than false positives. *Onchidella celtica* was selected as a potential climate change indicator for MarClim® surveys. However, so far, its potential has not been fulfilled. Apart from

its inclusion in the list of species searched for, it did not feature in the final report of the surveys (Mieszkowska *et al.* 2005). Nova Mieszkowska, the lead author for the report, informed me (pers.comm. January 2017) that she doesn't use *O. celtica* as an indicator species predominantly because it doesn't occur at many locations around the UK therefore it isn't a good species to track changes in range or abundance. Nevertheless, *O. celtica* continues to be one of 22 climate change indicator species in *The Shore Thing* surveys (an initiative of the Marine Biological Association working with schools and community groups around the British Isles to collect information on rocky sea shore life, a project which follows on from MarClim). Therefore records, such as those in Table 1 which suggest a northerly extension of *O. celtica* from Croyde Bay to south Wales, North Wales, Scotland, the Farne Is., and Lyme Regis, and from south Cornwall to south Devon and Lyme Regis, could be used as evidence of climate change. The main conclusion of the present study is that these records are either wrong, limited to only single specimens, or are unconfirmed and cannot be used as evidence of a northerly extension of the species.

Until an overwintering, breeding population of *O. celtica* has been recorded at a new location, the geographical range of *O. celtica* in Great Britain and Ireland should be described as "confined to exposed parts of the south and north coasts of Cornwall and north Devon, where it may be locally abundant".

Acknowledgements

This study would not have been possible without the generous help of the following who facilitated access to datasets and helped me check the records:

Fiona Crouch, Esther Hughes and Nova Mieszkowska (Marine Biological Association); Mark Burton, Kate Lock and Phil Newman (Skomer Marine Nature Reserve team); Jon Moore (PMNHS), and Christina Simkanin (Smithsonian Environmental Research Center). I'd also like to thank Prof. Steve Hawkins for his helpful comments on an early draft.

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The Undulate Ray Project

Martin and Sheilah Openshaw

Paradise, as sold by travel agents, is a tropical island with white sand and palm trees swaying in the gentle breeze. For an undulate ray, it seems that the temperate waters of the English Channel are far more appealing.

Since 2009, undulate rays have been classified on the IUCN Red List as 'Endangered' (IUCN 2014.3), yet they are locally common. Their range is from the Gulf of Guinea to the English Channel and Southern Ireland. Catches for both commercial and recreational fishing of the undulate ray had declined leading to an EU ban on landing undulate rays, but today the fishermen in the English Channel are telling a very different tale, one of undulate rays being in abundance and in disbelief that the species could be endangered.

At the Porcupine Conference in 2015 we told of a ray 'Hot Spot' along Kimmeridge Ledges, Dorset (Openshaw & Openshaw 2015), and explained how undulate rays could be individually recognised from the pattern on the dorsal side. A further 2 seasons' work and the addition of computerised recognition software has provided some interesting data; the majority of rays we see are undulates, and approximately one third of them are fish returning to the site, sometimes not having been seen for two or three years.

The intriguing question and the basis for the current project, is "Where do 'our' fish go when not on the site?" *The Undulate Ray Project* aims to combine the photo recognition with citizen science to track the location and possible movements of undulate rays along the south coast of the British Isles. The location of nursery sites is of particular interest, therefore,

as part of the Outreach programme, we are promoting the Great Eggcase Hunt, a project already running by the Shark Trust. The percentage of egg cases reported underwater is very low and therefore we are encouraging divers to keep a look-out for them.

The Undulate Ray Project is aimed at divers, commercial fishermen and anglers and we are asking them to send us photographs of undulate rays seen along the south coast, from Devon through Dorset, Hampshire and the Isle of Wight. It was launched in January at the Dorset Seasearch winter gathering and we were amazed and pleased to get 2476 visitors to the website within the first 3 days; writing in June we have now had over 10,000 visitors to the website. We have spoken at a number of gatherings of divers and anglers; one dive club has (after checking with PADI) used our presentation as part of their 'Shark Aware' qualification; and Wight Dolphins BSAC club have taken over the analysis of the undulate rays around the Isle of Wight. We have over 129 members of our Facebook page and are very pleased with the number of organisations who have given their support (check the links page of the website).

A steady stream of photographs is coming in and we have had our first match, it's not a ray that we have seen on the original site but it is still early days. We acknowledge every contribution and each ray is checked against the other fish in the project. To get the best chance of matching photographs, and to evaluate the performance of the software with a large database of photographs, we check each fish twice, once within the area it was seen and again in the entire range of the project. The computer recognition software identifies potential matching photographs and the final analysis is done manually by both of us.

When a match occurs, we contact the original contributors, not only to tell them that 'their' fish has turned up again, but to ask them to choose a name. Any fish seen on more than one day, continues to get a name, in alphabetical order and we're currently starting our second run through the alphabet with "Alex" and "Blanc" both named since the Porcupine conference.

We know the process works on our localised site and the data from there provide the basis for *The Undulate Ray Project*. From 208 sightings of rays on the site, the clear majority (170) are undulates, and approximately one third of these are fish identified as returning to the site, sometimes not having been seen for two or three years.

Of the 170 recorded sightings with undulates, we have photographs that can be used to identify the individual fish for 143 of those occasions; taking repeat sightings into account, this represents 96 individual undulate rays. 24 of these have been seen on more than one day and therefore we have given them a name, 2 spotted rays also have names having been seen twice. Based on these figures we have a 24% return rate to the site¹.

Repeat sightings of the same fish occur days, months or years apart. We do not see the same fish many times, "Billy" remains our most frequently seen individual, having been photographed only 5 times. The scarcity of single individuals being seen many times suggests that the rays may visit the area on a periodic basis. A significant percentage of the overall rays (approximately 1 in 4) are seen on repeat occasions, often after 2 or 3 years. This suggests that the overall population visiting the site on a regular basis is not huge, perhaps only a few hundred fish. These observations concur with work done by the Marine Research Laboratory and 'Raias Arrábida' (Sousa *et al.* In prep.) in Portugal (both presented at the European Elasmobranch Conference and pending publication) and indicate that the populations do move around.

¹ Please note the figures are to the end of May 2017 and may differ to those quoted at the Porcupine Conference in March 2017

We are only 5 months into the current *Undulate Ray Project* and are pleased with the response from SCUBA divers and anglers. We look forward to publishing our results in due course, but until then, we ask Porcupine members to visit our website (<http://undulateray.uk/>), join our Facebook group (The Undulate Ray Project) and tell as many people as possible, because who knows who will send the next match.



THE UNDULATE RAY PROJECT

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Black bream nesting behaviour in the UK: a call for information

Matt Doggett, Martin Openshaw &
Sheilah Openshaw

At the Plymouth Porcupine Annual Meeting in March 2017 we presented a summary of our observations of black bream *Spondyliosoma cantharus* (Linnaeus, 1758) nesting behaviours from a variety of study sites in Dorset, the main site being close to Kimmeridge Bay. Here we present a brief synopsis of our behavioural observations and a demonstration of nest structural diversity. We hope that by illustrating the latter we can encourage more divers to report their observations to us and thereby help document black bream breeding sites.

Black bream are naturally cautious fish and rarely seen by divers; this makes direct observations of their nesting behaviour something of a challenge. Over a number of seasons using remote cameras placed by divers around black bream nests, we have been able to monitor the timing and duration of spawning as well as natural parental care behaviours. The work has provided a unique, first-hand insight into the events that unfold under field conditions and has captured a huge variety of video and stills images to

aid our understanding of this enigmatic fish (Figure 1).

Most descriptions of black bream breeding behaviour rely on a series of excellent observations made by Wilson (1958) in Plymouth Aquarium. Whilst many of those observations have proved accurate, a realistic understanding of factors such as egg predation i.e. predatory species and predation rates and the time spent tending to eggs can only be made by gathering evidence in the field.

Breeding observations

Black bream nests are highly variable in form (see later), but essentially involve the excavation of mobile sediments down to reveal bedrock, boulders or compacted shells or gravel. It is to this exposed, solid substrate that the female adheres her eggs during spawning.

Black bream arrive at sites along the south coast during March and April each spring. Early territorial claims by males can lead to some serious fighting over the available space and perhaps the best nest sites. After some posturing and darkening in colour, we have observed male fish fighting for periods of over one-minute with obvious injuries such as torn fins and bodily scars. Over a few days, ownership is settled and the males' attention



Fig. 1: A male black bream at its nest as a shoal of females passes overhead. The eggs are present on the large flat boulder slab.

turns more toward attracting females rather than engaging in neighbourly disputes.

Male bream will attract females to their nests by darkening in colour to display vivid, vertical white bars. They will rise above their nests a little, lean to one side and flick their bodies toward females passing overhead. If interested, a female will swim down to a nest, apparently inspecting both it and the resident male. Male-female interactions can include 'nuzzling' of one another's ventral areas while swimming over the nest surface. The females also inspect the nest surface, apparently feeling it with their pelvic fins and mouths. Excited females darken in colour revealing a horizontal white stripe or 'patch' behind the pectoral fins and making identification of the two sexes relatively simple. We often observed several different females visiting a nest during this time, some paying more interest than others; we assume they visit multiple nests before making their final mate choice.

After spawning (we have yet to capture this on camera and it is reported to occur around dawn) the females leave the nest and the males guard the eggs until they hatch. The duration of this parental care period varies between 2-4 weeks, possibly even less, depending on the water temperature. Eggs spawned during June develop and hatch considerably sooner than those spawned earlier during April or May. Unable to dive every day during this time we could not make accurate *in situ* records of incubation periods for individual nests, so our estimates of the parental care period remain approximate. At our main study site we have identified two spawning events during each year of observation; one in late April/early May and another in June with eggs sometimes present on nests into July.

For a male bream, parental care involves guarding the eggs against actual and would-be predators and keeping the eggs free of sediment and other debris distributed by the current. A male leaving the nest for any duration risks his brood being predated by any number of passing or waiting predators including goldsinny wrasse *Ctenolabrus rupestris* (Linnaeus, 1758), ballan wrasse *Labrus bergylta* Ascanius, 1767, corkwing

wrasse *Symphodus melops* (Linnaeus, 1758), pouting *Trisopterus luscus* (Linnaeus, 1758), black gobies *Gobius niger* Linnaeus, 1758, painted gobies *Pomatoschistus pictus* (Malm, 1865), netted dog whelks *Tritia reticulata* (Linnaeus, 1758) and even neighbouring male black bream. We have not observed egg predation by crustaceans at any of our study sites. All our observations of successful predation occurred soon after the cameras were placed and the male bream had been scared off the nest by the divers. These data provide a useful indication as to the impacts on a nest when a male fish is removed by recreational or commercial fishermen, or otherwise. With a male in residence we have never observed successful egg predation despite numerous attempts by fish around the nest. Guarding males will repel predators with varying degrees of aggression from simply darkening in colour and raising their fins to chasing or even biting them if they are too close. Netted dog whelks were removed by mouth and deposited outside the nest boundary.

Nest guarding males spend more than half their time swimming low over the eggs, frequently feeling them with their pelvic fins and often fanning them vigorously with their caudal fins to remove sediment and debris. Other tasks include shoring up the ramparts by pushing and lifting rocks or fanning sediments which may shift with each turn of the tide. Algae and other items passing in the current may be inspected as food items and either eaten or removed from the nest area. Feeding by male bream during the nesting phase appears to be rare and opportunistic at best.

Despite gathering upwards of 80 hours of footage over the project to date, each new piece of video captured has the potential to reveal something new about black bream or other marine life around the nests. As divers, we often observe mobile marine fauna as it reacts to us with varying degrees of tolerance. Our footage has also captured free-swimming undulate and spotted rays, snoozing smooth-hounds, cuttlefish and squid cruising past and wandering crabs all going about their daily lives without diver disturbance. A small amount of our project footage can be viewed online at www.mattdoggett.com/the-black-

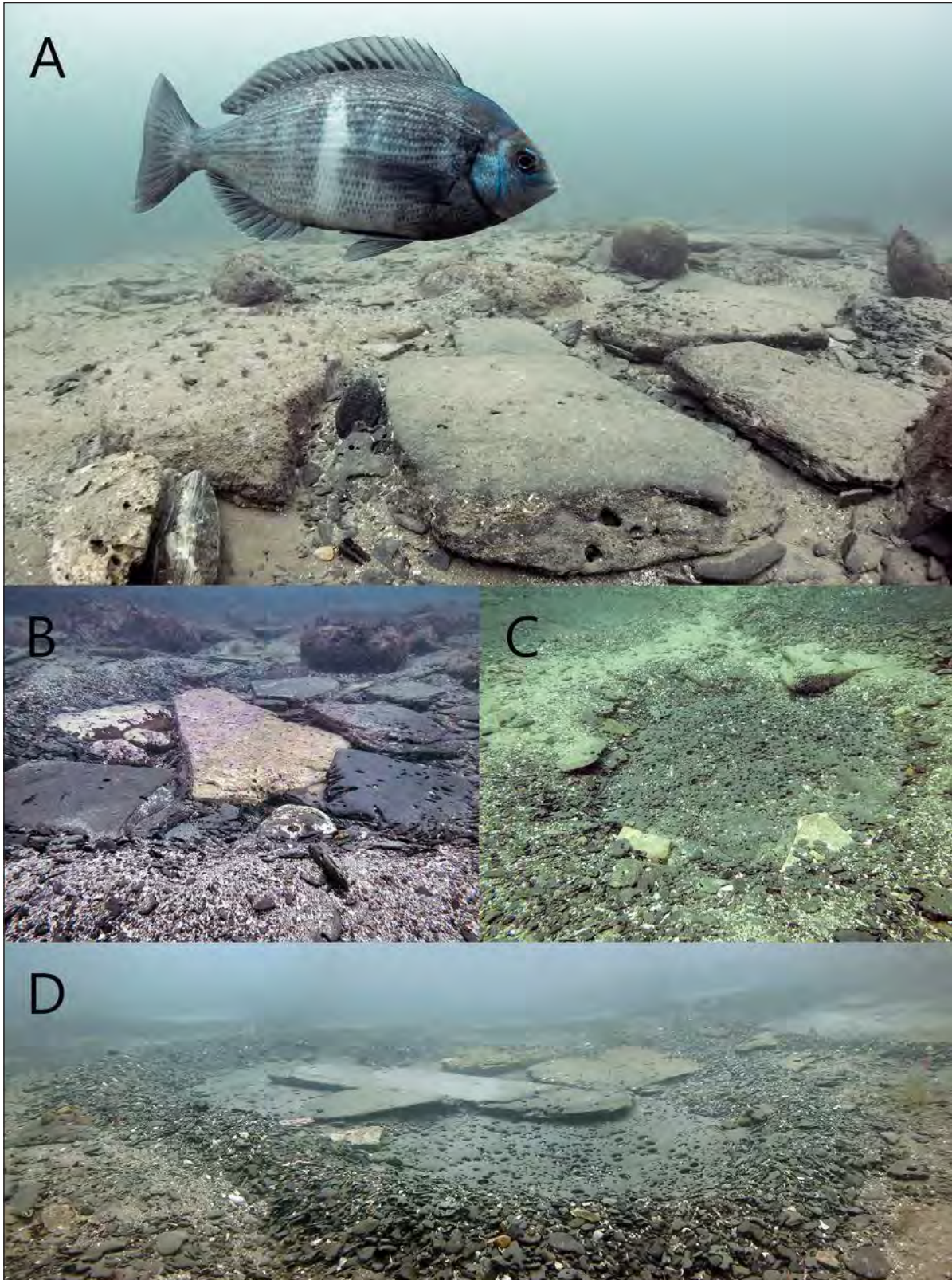


Fig. 2: A selection of nests at the Kimmeridge study site: (A) a male guarding three flat slabs, each containing eggs; (B) a cluster of exposed small boulders with intermittent ramparts; (C) a circular excavation down to piddock-bored bedrock with gravel and cobbles forming a continuous rampart; (D) an oval-shaped nest >2m long with a continuous gravel rampart and large areas of exposed bedrock and large slabs containing the eggs.



Fig. 3: Continuous, dense nests near Kimmeridge Bay forming a 'moonscape' across the seabed.

bream-project and we hope to update this page with more information in the near future.

Nest structures

In visiting several breeding sites between Purbeck and Poole Bay, we have identified a wide variety of nest sizes, shapes, densities and structures, dictated in the main by any particular site's geology. We have identified nest sites in depths of 6–22 m and it is likely that they will be found deeper still. As described above, black bream nests are essentially open excavations of the seabed revealing a hard substrate beneath, to which the eggs can adhere. Depending on the type and quantity of mobile substrate to be excavated, nests may or may not have obvious boundaries or 'ramparts' defining their limits. Nests are often constructed immediately

adjacent to areas of reef or shipwrecks and it is assumed that these provide some shelter from prevailing currents.

At our main study site, the nests are located in a band of varying width of up to 20–30 m at the base of a 3–4 m high reef wall. The benthic substrate consists of loose, mobile pebbles with a small sand and gravel fraction over piddock-bored bedrock. Flat slabs of cobbles and boulders of varying sizes exist throughout the area; some of these can be moved by the fish whilst others cannot. Depending on the precise nest location within the site, eggs were adhered to the bedrock or the flat boulders following their exposure by the nesting bream (Figure 2). Nest size may be dependent to some extent on male size and status with some nests measuring <1 m



Fig. 4: One of the nests in a narrow band along Kimmeridge Ledges at the base of a low-lying reef. Eggs are visible as light patches on the dark bedrock. A second nest containing eggs is visible in the bottom right corner.

in diameter and containing a single patch of eggs whilst others exceeded 2 m in width and/or length and contained up to five patches of eggs, potentially from different females. In areas of extensive gravel-covered bedrock, the seabed can often appear like a moonscape with a high density of nests (Figure 3).

At sites along Kimmeridge Ledges and Lulworth Banks, depending on the exposure to

prevailing currents, nests have been observed at varying densities. Narrow bands just a single nest wide may be observed around the base of some reefs where tidal exposure is strongest (Figure 4) before opening out to more extensive aggregations where more shelter becomes available.

Nests in Swanage Bay are known to occur all around Tanvill Ledge over soft, friable clay/

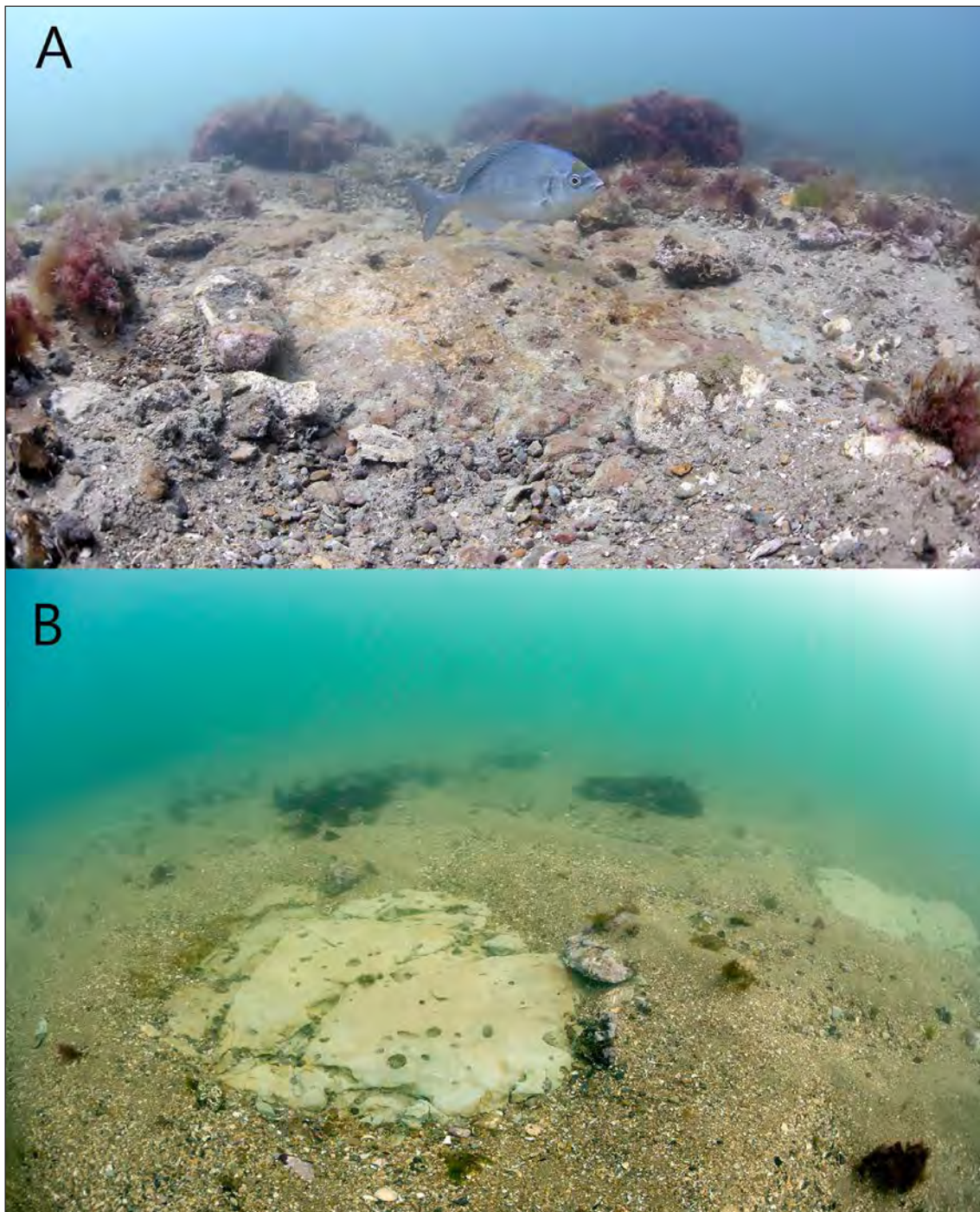


Fig. 5: Nests in Swanage Bay might be (A) well-camouflaged close to the reefs where the bedrock and sediments are similar in colour or (B) more obvious among mobile gravels. Eggs are harder to observe against a lighter-coloured bedrock.

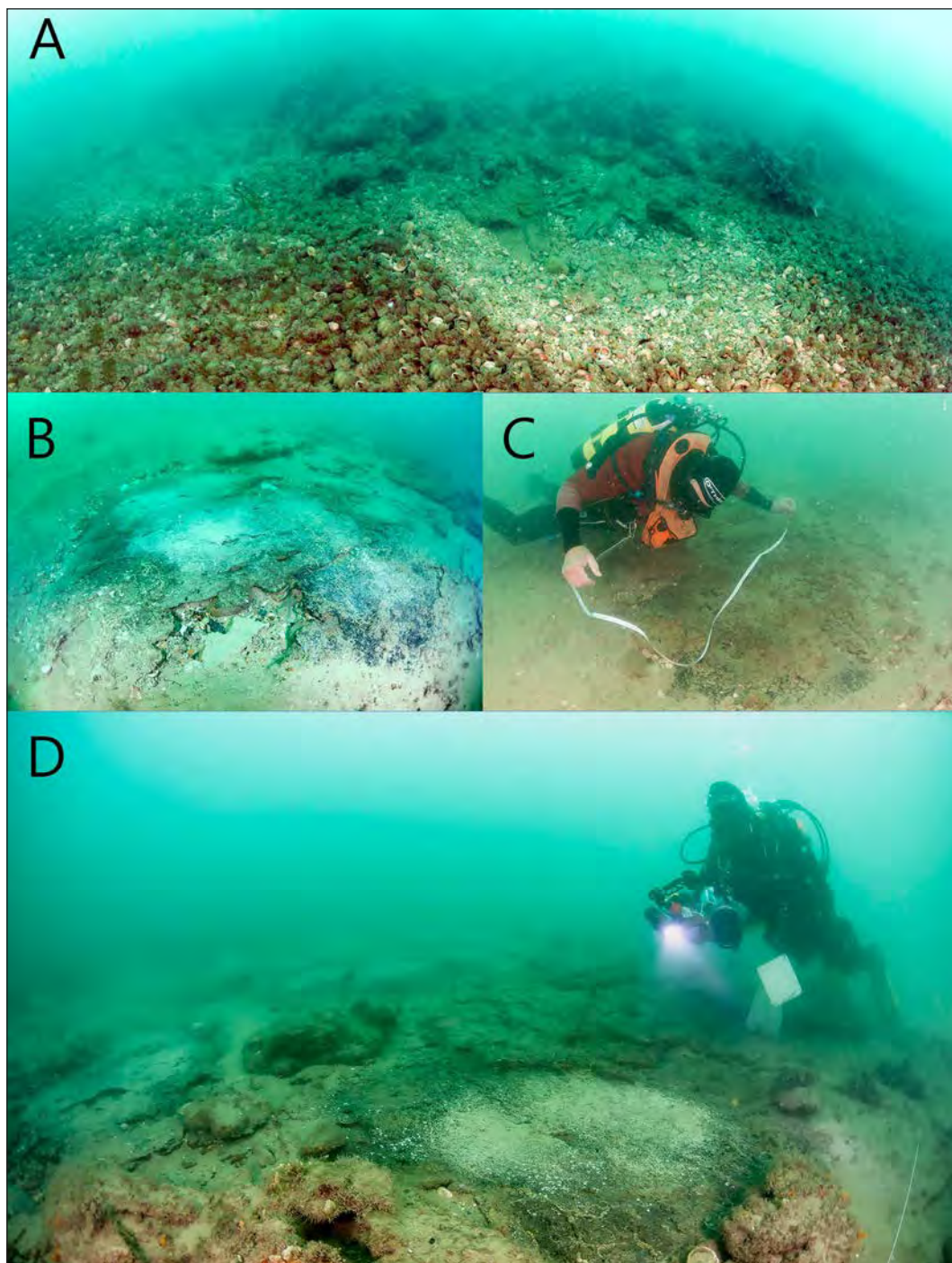


Fig. 6: In Poole Bay nests take varying forms: (A) among *Crepidula* beds visible as light-coloured patches; (B) excavated from sand down to bedrock; (C) a nest barely noticeable within the silty sediment and becoming overgrown with algae; (D) nests at the base of the reef have their form dictated by the surrounding bedrock.

sandstone. Nests with a slippery surface immediately north of the ledge often contain no eggs whereas those with a harder surface to the south often do. The lighter-coloured bedrock can make the nests easy to spot during the spawning season although one often needs to look closely to spot the translucent eggs when they are present (Figure 5).

In Poole Bay, nests have been recorded on bedrock (following excavation of sand, gravel and pebbles) and also on compacted layers of dead slipper limpet *Crepidula fornicata* (Linnaeus, 1758) shells (Figure 6). In the case of the latter, loose shells are excavated from the surface layers revealing an unfouled, compacted layer beneath. Other nests can be



Fig. 7: Circular black bream nests in Cardigan Bay, Wales excavated down to a layer of compacted gravel (image courtesy of I. Cundy).

so 'flat' to the seabed that any diver could reasonably swim over them without realising that there was a nest there at all. Those nests around the reefs in the bay have their structure dictated by the nature of the surrounding bedrock (Figure 6).

Finally, in Cardigan Bay in Wales, black bream nests have been recorded in 6–10 m depth among mobile gravels with excavations down to a compacted gravel layer beneath (I. Cundy, pers. comm.) (Figure 7). Without significant bedrock intrusions and with heavier gravel sediments less prone to shifting in the tide, the nests take a near-perfect circular form.

Post-breeding, the longevity of nest structures seems dependent on both the current strength and substrates in an area and the timing of the next storm events. As we witnessed in May 2015, even a day or two of strong wind and waves can erase any evidence of nesting literally overnight. Where this does not happen, old nest structures may remain visible as dense patches of algae throughout the summer and autumn as algae readily colonise the bare surfaces left behind after the eggs have hatched.

In summary, it would appear that in Dorset at least, black bream will nest almost anywhere that suitable substrate and shelter from prevailing currents exist. We believe this

could be the case throughout the south coast and possibly in areas of the Irish Sea. The full extent of black bream nesting areas will probably never be known given the cost and short window of opportunity each season for remote monitoring by sidescan or multibeam surveys.

Request for information

Divers can help us fill some of the gaps in our knowledge by reporting any actual or potential nesting areas to us that they may see. Useful information to accompany such reports would be a short description with wide-angle images of the nests and surrounding habitats and substrates, latitude and longitude (as accurate as possible) and the date. Information on the presence of eggs (including close-up images) and any sightings of adult fish would also be welcome.

Please send details of any possible nesting areas to Matt Doggett at mattdoggett@hotmail.com.

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(All images by Matt Doggett and Martin Openshaw)

Parasites in the plankton

Dave Conway

A large proportion of marine groups have parasitic representatives, some of which have planktonic stages or parasitise planktonic organisms. The parasites most commonly seen in plankton samples are unicellular organisms, platyhelminths, nematodes, isopods, copepods and cirripedes. The exact nature and consequences of the association between the parasites and their hosts is not always clear, so the term parasite is used loosely here. In a stable ecosystem, parasites play an important role in controlling their host numbers, so it could be argued that high parasite diversity is an indication of its health.

Due to the rather bizarre niche they occupy, many parasites have developed amazing life-cycles and adaptations. However, many species have not been well researched and most is known about those that have economic or health consequences.

When sorting preserved plankton samples, parasites are sometimes seen inside or attached to other organisms or free in the sample after having been detached or because they have been caught as they were transferring between intermediate hosts. However, due to the preservation process, some of the small parasites shrink into unidentifiable blobs. To observe and really appreciate the diversity and abundance of parasites in the plankton it is best to look at live samples, especially

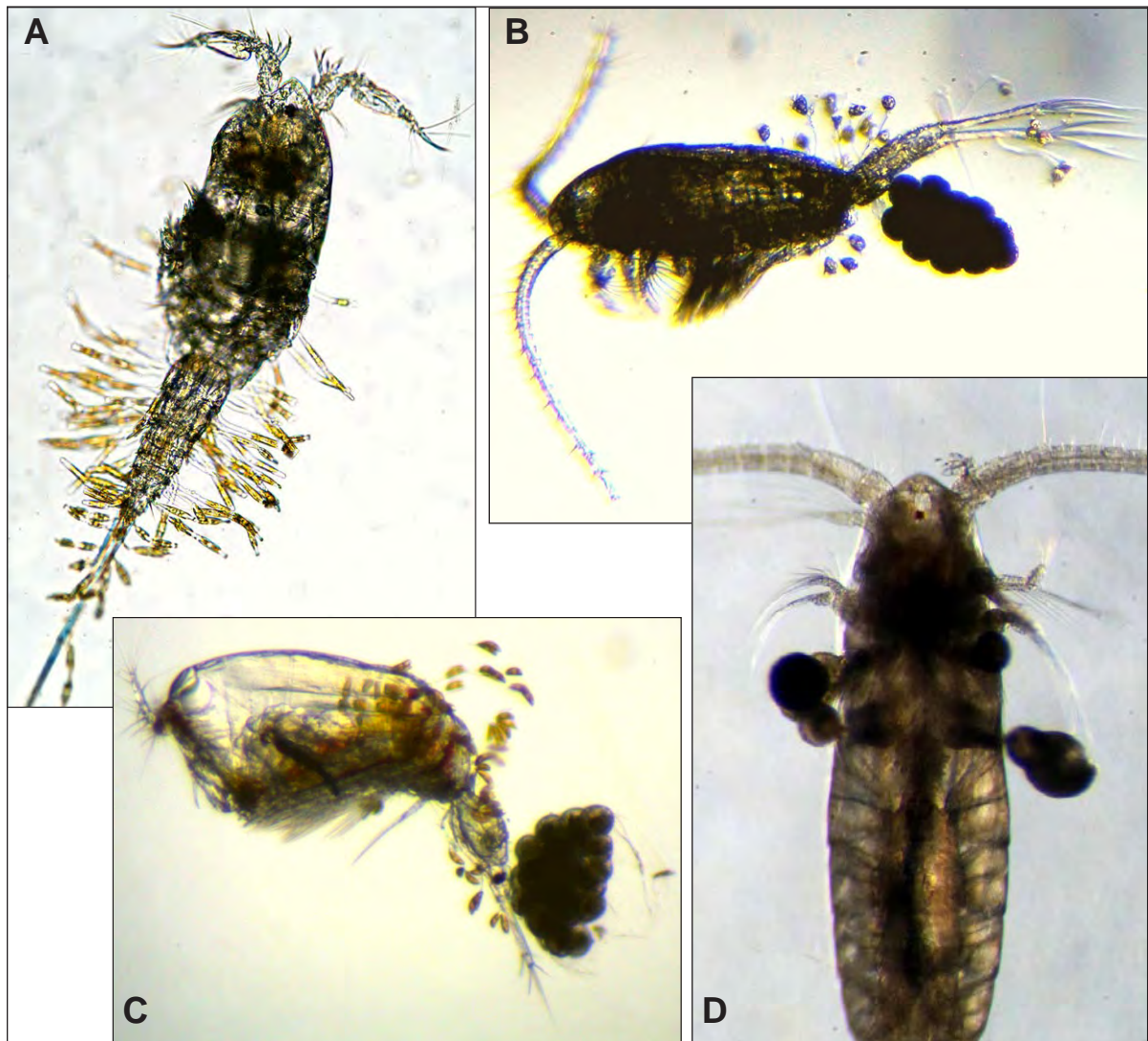


Fig. 1: Copepods bearing various unicellular organisms. a) *Euterpina acutifrons* (Dana, 1847) with algae. b) *Eurytemora affinis* (Poppe, 1880) with ciliates. c) *Ditrichocorycaeus anglicus* Lubbock, 1857 with possibly the alga *Pseudohimantidium* sp. d) *Calanus helgolandicus* (Claus, 1863) with the alveolate parasite *Ellobiopsis chattoni* Caullery, 1910.

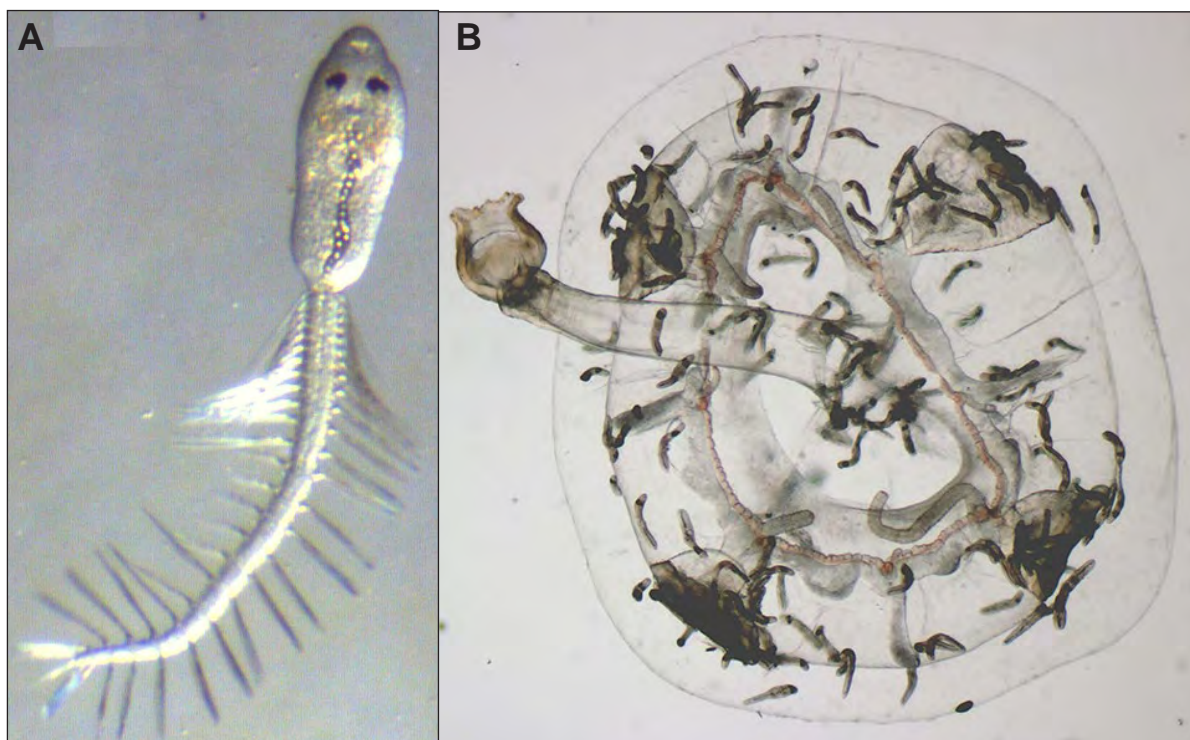


Fig. 2. Trematode parasites. a) Trematode cercaria larva. b) The medusae *Liriope tetraphylla* (Chamisso & Eisenhardt, 1821) infested with approximately 100 cercaria larvae.

from shallow inshore areas such as marinas, where the closeness of organisms means the opportunities for parasitic associations are much greater.

Unicellular organisms

Many marine parasites are unicellular organisms, but their classification keeps changing. While algae might not immediately be thought of as having parasitic representatives, around 7% of dinoflagellates are parasites (Skovgaard & Saiz 2006; Shields 1994). The dinoflagellate *Ichthyodinium chabelardi* Hollande & J. Cachon, 1952 is a lethal fish egg parasite, particularly of mackerel and sardine, and can cause 46% egg mortality, a major consideration if you were modelling fish survival. Algae and ciliates are also commonly found as epibionts on the surface of crustaceans such as copepods (Figure 1a-d), prawns and shrimps. The predatory copepod *Ditrichocorycaeus anglicus* (Lubbock, 1857) (Figure 1c) is regularly found inshore festooned with epibionts and seems to be particularly targeted. The various epibionts possibly only use these crustaceans as a platform, but their attachments can block the genital openings, interfere with swimming and

feeding, reducing egg production and general fitness. In prawn culture, mortality has been shown to increase due to infestations on the gills, restricting respiratory exchange (Johnson *et al.* 2009). Epibionts increase the visibility of their host, so probably also make them more vulnerable to predation. In crustacean fisheries and aquaculture a coating of epibionts may also render the product unsaleable.

The alveolate parasite *Ellobiopsis chattoni* Caullery, 1910 (Figure 1d) attaches to the anterior limbs of several species of copepods, affecting swimming, feeding, fecundity and increasing mortality.

Platyhelminths

Parasitic trematodes and cestodes are common external and internal parasites of fish. In a typical trematode life cycle, eggs are expelled from the female into the sea. A larva emerges from the egg that then infests a benthic mollusc, such as a gastropod or nudibranch. A cercaria larva then escapes (Figure 2a) that swims to an intermediate planktonic host such as a medusa, ctenophore or chaetognath (Ohtsuka *et al.* 2009; Diaz Briz *et al.* 2012). It sheds its feathery tail and waits for this

intermediate host to be fed upon by a fish, to complete the cycle. Medusae typically carry only a few parasites, but occasionally can carry an amazingly high load (Figure 2b).

Nematodes

Nematoda is one of the largest phyla and over half the species are parasitic (Zhang 2013). They are often seen inside chaetognaths (Figure 3) or copepods, where they can grow to occupy a large proportion of the body cavity. A common genus is *Anisakis*, which is a stomach worm of marine mammals, especially seals. Eggs pass out in the faeces and juveniles that hatch are eaten by a range of planktonic invertebrates, where they remain until this intermediate host is eaten by a fish or squid, and subsequently a seal to complete the life cycle. If flesh infested with these nematodes is eaten by humans in sashimi, ceviche or other seafood dishes that have not at some stage been subjected to cooking or freezing, the nematodes can attempt to burrow into the intestine, causing a reaction leading to swelling and gut blockage, a condition known as anisakiasis (Berger & Marr 2006). In Japan around 1,000 cases are reported annually and the problem is potentially becoming more widespread because of the spread in the popularity of eating raw seafood.

Isopods

Around 8% of these marine relations of the common garden woodlouse are parasitic on other crustacea (Williams & Boyko 2012). The two main parasitic groups are collectively referred to as epicarideans, as one of their

juvenile stages is called an epicaridium (Figure 4a). They are unique in that they typically parasitise two different crustacean hosts during their life cycle, intermediate and definitive hosts, and include both endo- and ectoparasites (Boyko & Wolff 2014). Some are also hyperparasitic (parasites of other parasites), including other parasitic isopods. The adult female releases the pelagic epicaridium larva that searches out, attaches to and feeds on the intermediate host, typically a pelagic copepod (Figure 4b). It moults into a microniscus stage and then after several further moults, a cryptoniscus stage leaves the intermediate host and is pelagic until it finds and attaches to the definitive host, on which it moults into an adult. Definitive hosts include barnacles, isopods, ostracods and decapods etc. As they feed on host ovarian and other body fluids, epicarideans can cause partial or complete infertility in both their intermediate and definitive hosts. Parasitisation may also affect the appearance, morphology and behaviour of hosts and may have an economic impact by reducing productivity of a variety of commercially important species (or of their prey) and negatively affecting saleability.

Other parasitic isopods regularly taken in plankton samples are the juvenile and occasional adult stages of Family Gnathiidae (Grutter & Poulin 1998). These bizarre looking isopods found from the littoral zone to the deep sea, are the most common parasite of coral reef fish and one of the main parasites removed by cleaner fish. Adults are benthic, probably do not feed and are typically found in crevices on the sea bed or associated with



Fig. 3: A young nematode inside the chaetognath *Parasagitta setosa* (J. Müller, 1847).

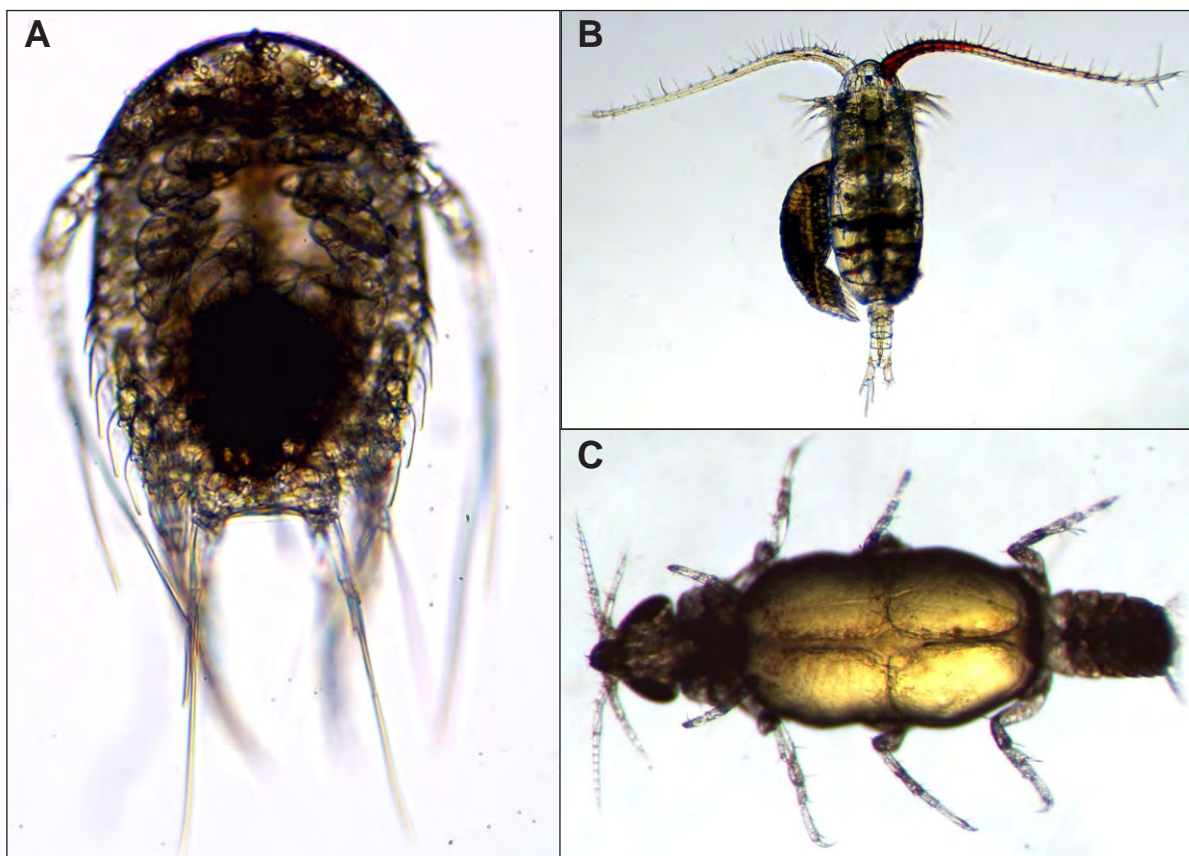


Fig. 4: Parasitic isopods. a) *Epicaridium* larva. b) *Microniscus* stage on a copepod. c) *Praniza* stage.

barnacle aggregations, sponges, polychaete tubes etc. In a detailed study of one species, a stage known as a zuphea emerges from the egg and starts the parasitic cycle by finding then feeding on a fish for minutes to several hours. They are initially quite slender, but on completion of feeding they leave the fish very bloated and are called the praniza stage (Figure 4c). They moult, probably on the sea bottom in the shelter of sponges or barnacle aggregations etc. to become the slender zuphea 2 stage. This finds another host fish and the above cycle is repeated two more times before they moult into adults.

One of the best known isopod parasites, typically causing shudders when images are seen, are the tongue biting isopods (Parker & Booth 2013). These enter the mouth of a fish through the gill openings. The first one in becomes a female and bites the tongue, attaches to the stump and remains there functioning like a tongue. They were the feature of the 2012 horror film, "The Bay", in which the residents of a coastal American town

are attacked by the isopods following leaching of hormones from chicken farms into the local bay and turned into zombies.

Copepods

There are around 13,000 species of copepods described and around half of these are endo- or ectoparasites, having associations with, fish, marine mammals, and a variety of invertebrates including molluscs and tunicates (Huys 2014). The best known parasitic species are the "sea lice" in Family Caligidae (Figure 5a). These ectoparasites attach to a wide range of fish species, usually with limited impact, but when fish are crammed together in fish farms there can be 97% infestation and high loadings, resulting in damage to the fish skins and introducing disease, causing stress etc. Control costs of these parasites in salmon farms in the UK is reported to be approximately £33 million annually. They are highly adapted to living on the surface of fish with strong hooked limbs and a flattened body surrounded by a suction disc. When they settle on the fish they typically quickly attach by an anterior filament

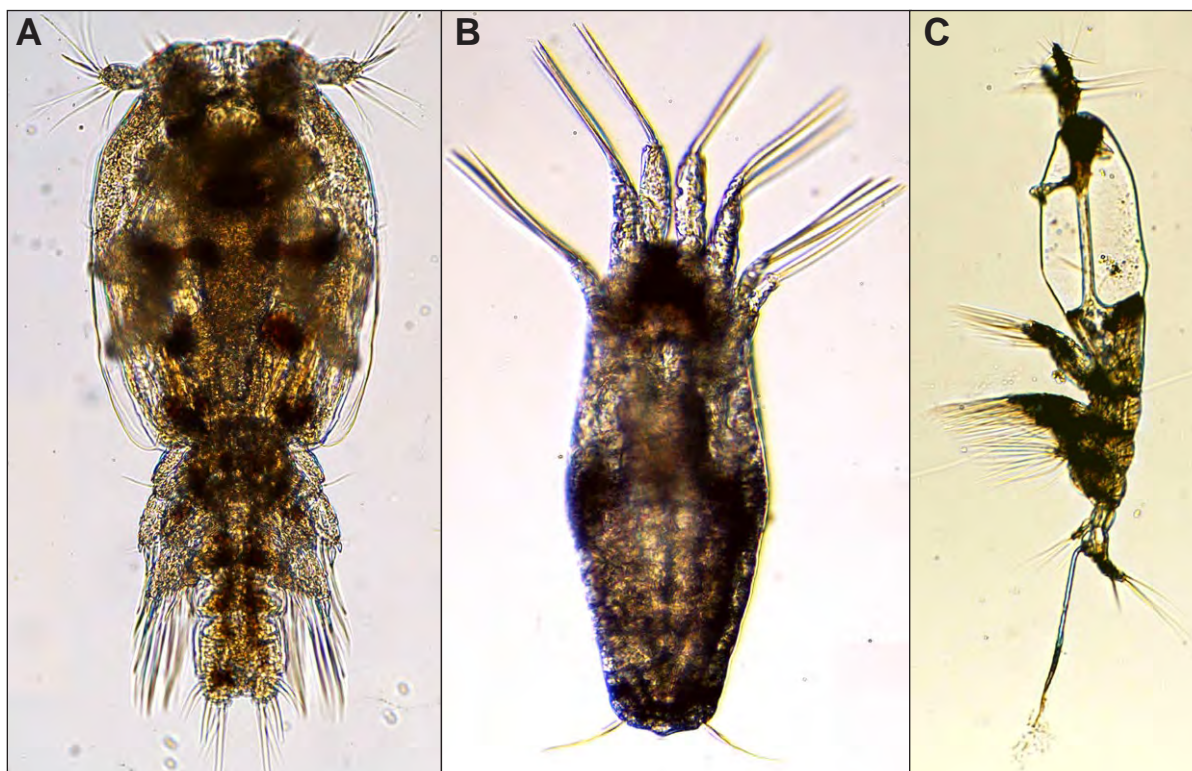


Fig. 5: Parasitic copepods. a) *Caligoid* copepodite. b) *Caligoid* nauplius. c) Female monstrilloid copepod.

and feed on tissue, body fluids and mucus while swinging around on their tether. Their life cycle is very compressed compared to free living copepods, with typically two nauplius stages (Figure 5b) and one copepodite stage, the infestive stage. Several moults take place while on the fish

Another spectacular copepod parasitic family, generally found in shallow waters, are the Monstrillidae (Figure 5c). Adults can easily be distinguished from other copepod groups by their elongate cylindrical shape, lack of mouth-parts and gut (so cannot feed). There are no egg sacs, as is common in copepods; instead there is a pair of slender, trailing spines, emerging from the ventral genital somite. Clusters of eggs are attached to these spines by means of a mucous secretion. The pre-adults, adults and first nauplius are free-swimming, while all other stages are parasitic in benthic polychaetes and gastropods. Eggs hatch into non-feeding nauplius larvae that find a host and burrow into its tissues, enter the blood system and transform into a sac-like body bearing root-like processes. When development is complete they leave their host as a copepodite and rapidly moult once into adults.

Cirripedes

One of the most unusual parasitic group are barnacles of the parasitic Superorder Rhizocephala. These mainly parasitise crustaceans such as crabs and shrimps. Depending on species, either a nauplius larva with a pair of frontal horns, so resembling other cirripede nauplii, or the later cyprid stage are released (Conway 2012; Høeg *et al.* 2014a). The female cyprid larva typically attaches to its crustacean host and metamorphoses into a larva called a kentrogon. This produces embryonic cells that are injected into the host and which then penetrate throughout the host forming root-like branches. In at least crabs, the genitals are destroyed, behaviour changes and external sacs without appendages that resemble crab egg-sacs are produced on the abdomen. Both sexes care for the parasite as if it were its own young! After fertilization by a male cyprid, non-feeding nauplius larvae are released. Probably the most familiar rhizocephalan species is *Sacculina carcini* Thompson, 1836 from Family Sacculinidae that is found on several species of crabs and whose nauplii (Figure 6a) can be quite numerous in plankton samples.

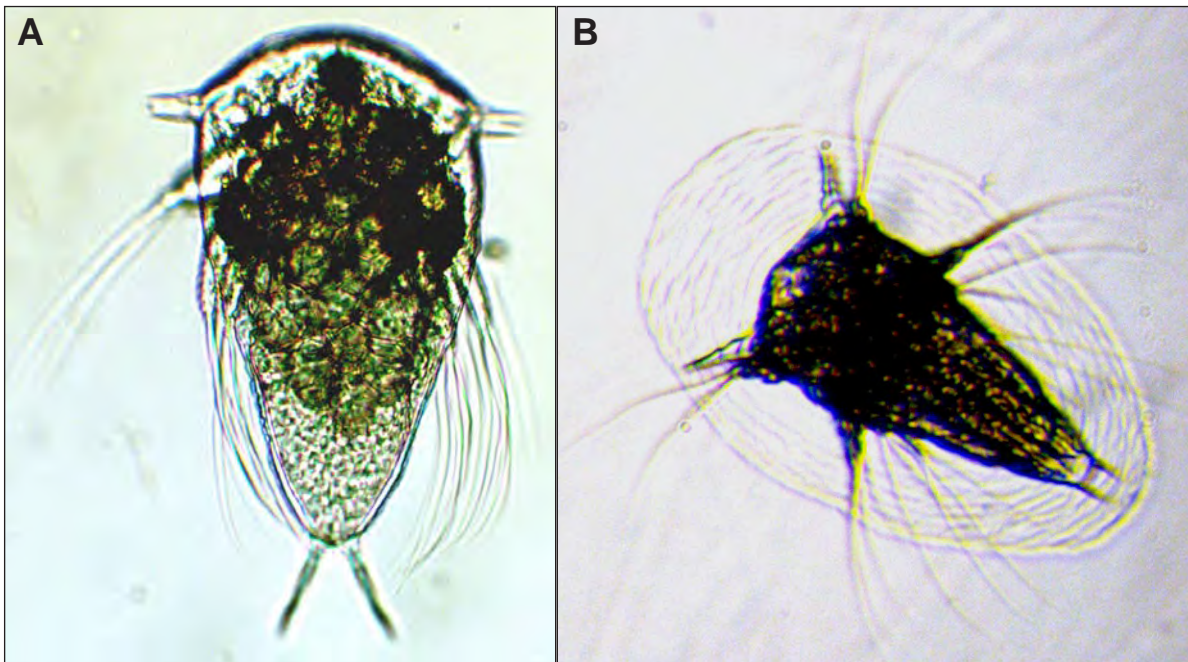


Fig. 6. Parasitic barnacles. a) *Sacculina carcini* Thompson, 1836 nauplius. b) *Peltogaster paguri* Rathke, 1842 nauplius.

Rhizocephalan barnacle nauplii in families Peltogastridae and Lernaediscidae differ from the Sacculinidae in having a transparent oval collar around the body above the carapace from the second nauplius stage. In *Peltogaster paguri* Rathke, 1842 (Figure 6b) the collar is very large, its surface ornamented by a very conspicuous reticulated pattern of ridges, resembling a fish scale. The collar is thought to enhance flotation, although it appears rather unwieldy.

Facetotectans

Around 1899, some curious small crustacean larvae were sampled from the southern North Sea and also from off the West Indies. They could not immediately be classified, but morphological and recent molecular

evidence shows that they are closely related to barnacles, their development also including nauplius and cyprid stages (Conway 2012; Høeg *et al.* 2014b)(Figure 7a, b). They are placed in a separate infraclass, Facetotecta, the name deriving from the diamond-like faceting on their carapace (Figure 7a). Intriguingly, only larval stages have ever knowingly been found, the identity of the adults remaining a mystery, but they are believed to be internal parasites of some undetermined invertebrates. Larvae have now been recorded, mainly from inshore locations, from the Arctic to tropical waters of all oceans, apart from the Antarctic. As most larvae are small, some <0.2 mm in width, they will be poorly sampled unless a fine mesh plankton net is used. Their known distribution thus reflects where fine mesh net



Fig. 7. Facetotectan larvae. a) Moults of a nauplius stage. b) Cyprid stage.

sampling has been carried out in inshore areas, by researchers who can distinguish the larvae from those of other crustaceans. Morphological examination of facetotectan larvae at one site in Japan indicated that there were more than 40 different species present, an amazing biodiversity.

Images: Images were taken of live specimens using very basic equipment, a Sony NEX-F3 camera attached to a Wild M5 stereo microscope or a Zeiss Standard 19 trinocular compound microscope.

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Anne Bunker

Exploration and Discoveries - The value of Seasearch divers

Paul Kay & Charlotte Bolton

Seasearch is a volunteer diver survey program which helps to extend our knowledge of what lives in our seas. It is made possible by scuba divers who are prepared to spend their time systematically recording information about the seabed. The role of amateur volunteer divers in surveying the near-shore marine environment is presented here in its historical and present context.

The Victorian view of the underwater world owed much to the imagination and little to the reality of UK seas. Wrecks were depicted as intact, even down to the standing rigging. But even in the shallow depths to which we can safely dive, the waters are rarely calm enough that wrecks remain intact for any significant time. Wood rots and steel ships break up and create artificial reefs, soon becoming smothered in marine life.

Our knowledge of what lives in our seas may seem to be well established and obviously we have known about many species for a very long time. So the common anemones found around the British and Irish coasts are still the same as those found over a century ago, although we now realise that each species has its niche and that historical drawings showing *Anemonia viridis* (Forsskål, 1775) (Snakelocks), *Actinia equina* (Linnaeus, 1758) (Beadlet) and *Metridium dianthus* (Ellis, 1768) (Plumose) together is a matter

of convenience and perhaps ignorance rather than due to reality.

Older drawings are often based on dead animals, and for fish, too many identification books still rely on drawings from, and even photographic images of, dead fish. Contrast this with birds, which are rarely shot in order to identify them these days. Other species look very different in reality to the imaginative artistic depictions. So many creatures have been known about from our waters for a very long time. Others though are far more recent finds and have relied on scuba diving and the increasing popularity of underwater photography to reveal their existence. One such example is the Red or Portuguese Blenny (*Parablennius ruber* (Valenciennes, 1836)), which may be an indicator of warming seas, or may have been here all the time.

Baillon's wrasse (*Symphodus bailloni* (Valenciennes, 1839)) is now known from western Ireland and the south English coast where it has become a fairly common sighting. Some rare fishes can now be unequivocally identified from photographs, such as the very distinctive Red-mouthed Goby (*Gobius cruentatus* Gmelin, 1789; Figure 1, left). Positive identification of other species is also far easier from a living specimen *in situ*. For example, the two dark blotches and 'V' marking of Eckstrom's Topknot (*Zeugopterus regius* (Bonnaterre, 1788); Figure 1, right) fade on death. Previously overlooked fish such as Diminutive goby and Guillet's goby (mature adults are only 24mm long) are now also being recorded by Seasearchers (Figure 2, left and right respectively).

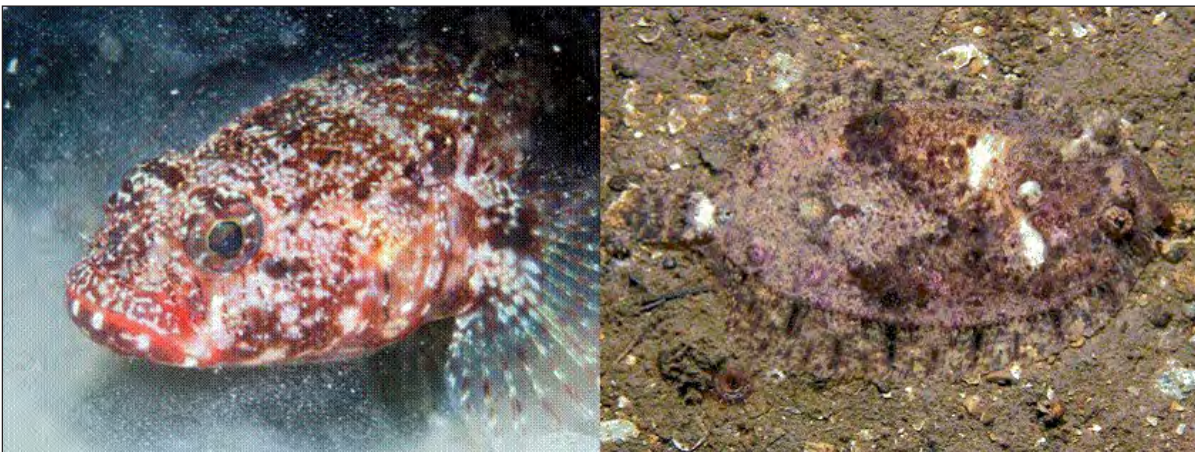


Fig. 1: (left) The distinctive Red-mouthed goby *Gobius cruentatus*; (right) Eckstrom's Topknot, *Zeugopterus regius* (Photos: Paul Kay)



Fig. 2: (left) Diminutive goby, *Lebetus scorpioides* (Collett, 1874); (right) Guillet's goby, *Lebetus guillei* (Le Danois, 1913) (Photos: Paul Kay)

Records of small anemones like *Gonactinia prolifera* (Sars, 1835) (5mm tall) and *Halcampa chrysanthellum* (Peach in Johnston, 1847) (10mm diameter, the 'out of focus' anemone) are also starting to appear (Figure 3, top and bottom respectively).

Photographs of tiny *Edwardsia* anemone species are of great interest as they can reveal identities which are surprising. Recently confirmed as a first record in the UK (Scotland) is *Edwardsia delapiae* Carlgren & Stephenson, 1928, also a the first record outside of Ireland,



Fig. 3: (top) *Gonactinia prolifera*; (bottom) *Halcampa chrysanthellum* (Photos: Paul Kay)

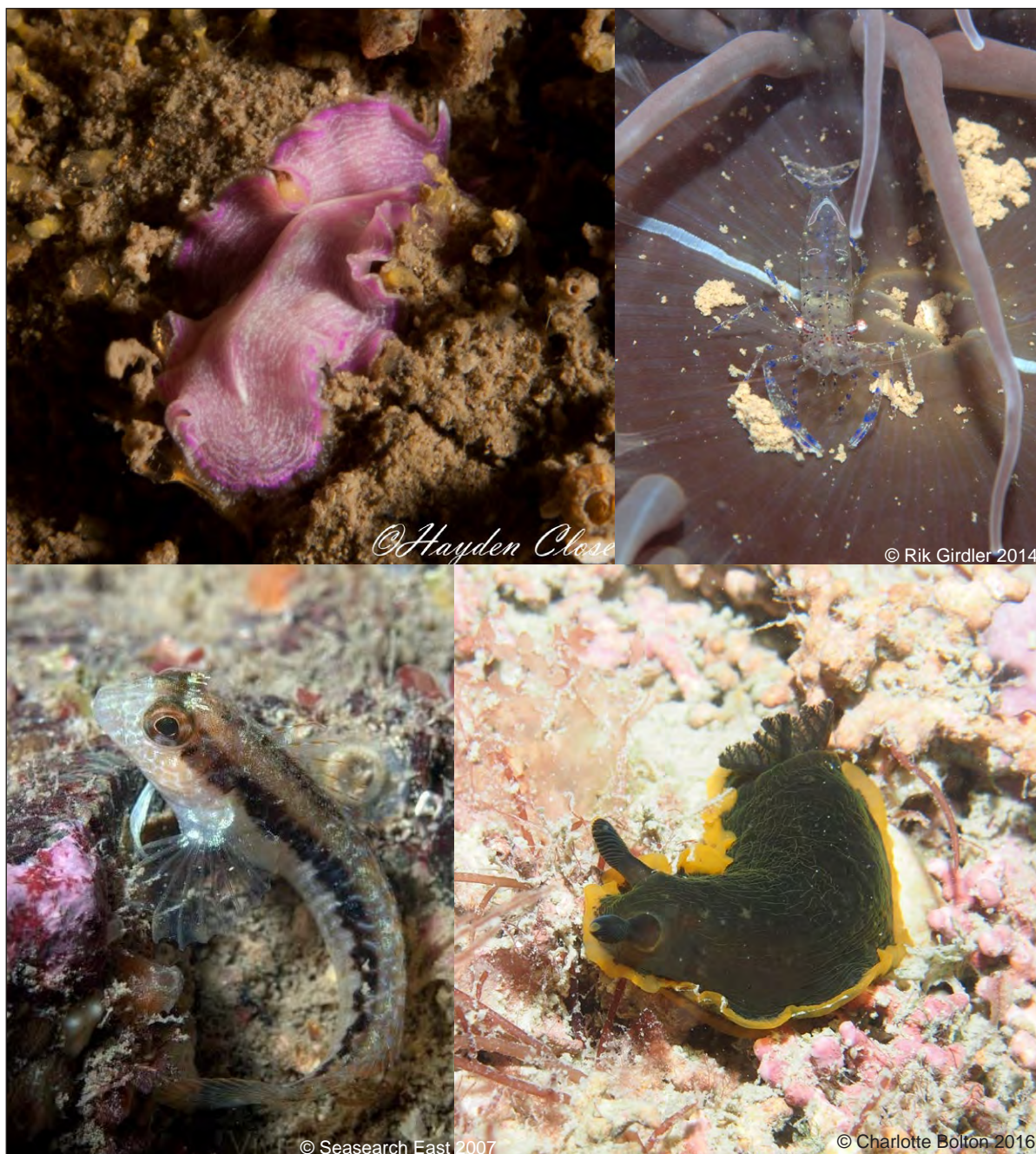


Fig. 4: (clockwise from top left) *Prosthecereus roseus*, first UK record (Photo: Hayden Close); *Periclimenes sagittifer*, first UK record (Photo: Rik Girdler); *Dendrodoris limbata*, possible first UK record (Photo: Charlotte Bolton); *Parablennius pilicornis*, possible first UK record (Photo: Seasearch East).

where it is only found in the Valentia Harbour and Port Magee Channel Special Area of Conservation in County Kerry.

So we still know surprisingly little about what lives in our own seas. But Seasearch divers are starting to make some exciting discoveries, many of the sightings being first records of a species in the UK. Here we highlight some of these (Figure 4, clockwise from top left):

First UK records:

- *Prosthecereus roseus* Lang, 1884
(Hayden Close and Steph Eccles, Pembrokeshire, August 2016)
- *Periclimenes sagittifer* (Norman, 1861)
(Matt Doggett and Polly Whyte, Swanage Pier, September 2007),

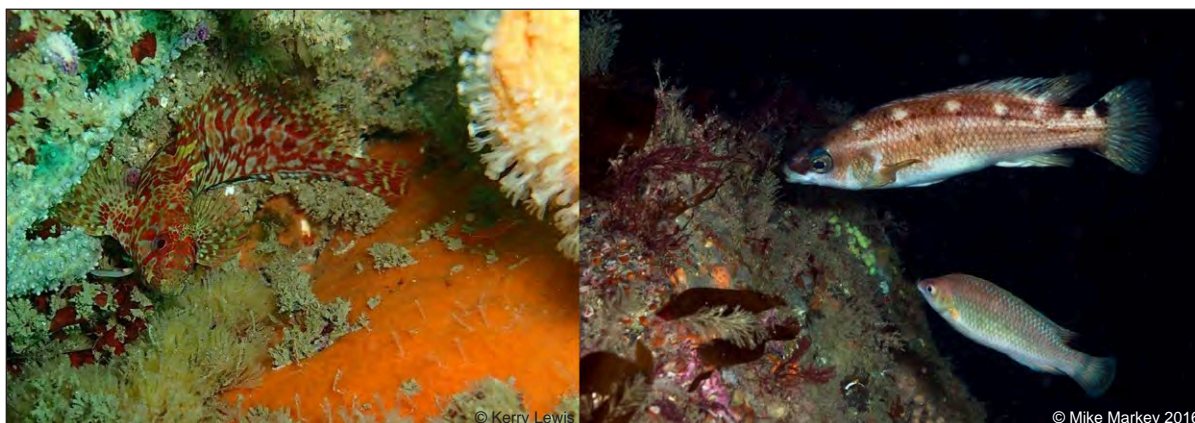


Fig. 5: Red blenny, *Parablennius ruber* (left); scale-eyed wrasse *Acantholabrus palloni* (right).

Possible first UK records:

- *Dendrodoris limbata* (Cuvier, 1804)
(Sue Daly, Jersey, June 2014)
- *Parablennius pilicornis* (Cuvier, 1829)
(Rob Spray and Dawn Watson, Plymouth, November 2007)

Other first records (Figure 5, above):

- *Parablennius ruber* - first Welsh record of the red blenny (Kerry Lewis, The Smalls, Pembs, July 2016)
- scale-rayed wrasse, *Acantholabrus palloni* (Risso, 1810) - first Seasearch National Biodiversity Network (NBN) record (historical records exist in Local Record Centres and angling archives) (Mike Markey, SE Cornwall, October 2016).

For many other species, Seasearch records represent over 90% of those publicly available via the NBN. Figure 6 below shows *Polysyncraton bilobatum* Lafargue, 1968, *Bolteniopsis prenanti* Harant, 1927, *Tripterygion delaisi* Cadenat & Blache, 1970, *Amphianthus dohrnii* (Koch, 1878) and *Simnia hiscocki* Lorenz & Melaun, 2011, all photographed and recorded by volunteer divers.

In 2018, Seasearch (under that name) will have been running for 30 years. Thousands of people have been involved during that period and in the years prior to the first official 'Seasearch survey' – without their dedicated efforts we would still be blissfully ignorant of the wondrous marine life in the temperate UK waters. Here's to the next thirty years!



Fig. 6: Tunicate *Polysyncraton bilobatum* (top left); tunicate *Bolteniopsis prenanti* (Bottom left); yellow black-faced blenny, *Tripterygion delaisi* (centre); sea fan anemone *Amphianthus dohrnii* (top right); false cowrie *Simnia hiscocki* (bottom right).

Photographing Max: The use of red light and high quality images to record *Maxmuelleria lankesteri* (Echiura, Bonelliidae)

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Introduction

High quality images are now accepted as a valuable tool in the identification and recording of species and the recording of behaviour. Rapid advances in image capture technology and lighting have extended the boundaries of what is achievable in the field. The acquisition of high quality images of *Maxmuelleria lankesteri* (Herdman, 1898) probosces allowed large amounts of data to be gathered from a 40 minute dive, much of which was subsequently found to support previously-published information. The acquisition of images was made possible by the use of red light to locate *M. lankesteri* probosces. Although there are records of the use of infra-red light to observe this species (Hughes *et al.* 1993) the use of visible red light to locate and shoot video of this species in daylight hours and fully dark conditions is thought to be novel.

In October 2016, a dive team was commissioned by the Wildlife Trusts to investigate a population of *M. lankesteri* known from a grab survey in Hythe Bay, Kent. The job had been postponed multiple times over two summers due to poor weather/underwater visibility coinciding with neap tides, so in October 2016 divers were dropped into 20 m of water and were unsurprised to find 1 m of visibility and complete blackness below 10 m depth. The aim was to see if *M. lankesteri* could be found, get photographs if possible and get information on colony extent.

Why look for Max?

Maxmuelleria lankesteri is a mud-dwelling annelid (echiuran). If the National Biodiversity Network Atlas is consulted, there are only 202 records for this species shown in a distribution that is widespread but disjointed with records from the west coast of Scotland, the Irish Sea, Tremadog Bay and the Channel coast

of the UK. Other records (World Register of Marine Species) show up in the Kattegat and Skaggeak and in deep water off the eastern coast of the United States.

Maxmuelleria lankesteri is a spoon worm, but unlike the better known *Bonellia viridis* Rolando, 1822 and *Amalosoma eddystonense* Stephen, 1956 which each have a bifurcate feeding proboscis (spoon), *M. lankesteri* has a single proboscis. In the ultra-sheltered conditions of Scottish sea loch basins it produces characteristic large conical or rounded "volcanoes" of its burrow ejecta (Hughes *et al.* 1996). These mounds are at one entrance of the U-shaped burrow. Feeding usually occurs at the other (mound-less) entrance although instances of feeding from the mound entrance have been observed (Hughes *et al.* 1997). Radiating trails left by the feeding proboscis are also characteristic of the species.

The worm is an important bioturbator (Hughes *et al.* 1996) and habitat modifier in Scottish sea lochs and in the Irish Sea, occurring with other burrowing megafauna. It is sedentary, thought to be long-lived, its reproductive cycle is uncertain (a K strategy with limited powers of dispersal is inferred from large, yolky eggs) and males are unknown. Predation is very rarely observed with only one record of the worm turning up in fish stomach contents (Southern 1913). Hughes *et al.* (1993) record that there were no instances of apparent predation of the echiuran seen in >1500 hours of video observation of activity around *M. lankesteri* burrow openings.

The worm feeds only at night or in dark conditions and is extremely light-shy (Hughes *et al.* 1996). Who dives on mud in dark conditions or at night?

The large mounds and radiating proboscis trails result in records from towed video, but in sites with water movement, mounds are smaller (and when smaller are similar to those made by other species), flatter or imperceptible and proboscis trails do not persist. Burrow entrances are small round holes like those made by sundry other burrowers. Video resolution may not be sufficient to register pale green, silt-covered feeding probosces even if they are on the surface in the video view.

Maxmuelleria lankesteri is hard to sample with grab or dredge. The animal itself is soft and fragile and if resting in the bottom of the burrow, it may be below sampling depth. When worms or parts are sampled, the body wall breaks down if exposed to daylight (Hughes *et al.* 1996) further complicating successful identification.

There is no structure to the burrow wall i.e. no tube to persist in grab or dredge samples although Hughes *et al.* 1993 report that Kershaw *et al.* used box cores to sample intact burrows and noted that the worm incorporated faecal pellets into its burrow walls.

In short, Max is shy, enigmatic and very likely under-recorded.

What the divers saw

Max was not seen on the first dive site, which was muddy sand in 12 m of water and 1 m visibility (dark below 10 m). A deeper site was chosen for the next two dives the following day in anticipation of muddier conditions. Two consecutive dives were made either side of predicted slack water, each by a buddy pair of divers consisting of a taxonomist/photographer and an in-water standby diver. Each pair was tracked by a GPS logger mounted on a surface marker buoy and travelled approximately 40 m. Visibility was 1 m or less and at working depth the divers were in complete darkness with no discernible light even when looking directly upwards.

Water temperature was 16°C. Dive 1 started at 16:03 BST and dive 2 at 17:49 BST, both lasting 40 minutes.

On the first dive, *M. lankesteri* probosces were seen on the surface almost immediately but because they retracted into their burrows as the diver approached, they were very hard to photograph. This pair took several photos of a pair of *Pagurus bernhardus* (Linnaeus, 1758) fighting over a detached *M. lankesteri* proboscis (Figure 1A). *Maxmuelleria lankesteri* probosces and very small mounds were seen throughout the dive. Success! Max was found and photographed in her habitat.

On the second dive the divers found exactly the same: lots of very shy worms with pictures

of proboscis tips as they disappeared (Figure 1B). This dive pair used a housed DSLR with a Nikon SB105 strobe, a GoPro mounted above the camera port and a video light on a long arm to work as a dive light and to light the video. The dive light could produce red light, so knowing that red light does not penetrate to 20 m, red light was tried. The effect was marked (Figure 1C). The worm probosces remained stationary under red light unless a 'hot spot' visible in the centre of the camera screen was allowed to impinge on them. Small and black under the red light, covered in sediment to the edges and difficult to spot, each proboscis was easy to sneak up to and photograph; for example Figure 1D.

Stills photographs of 20 individual worms were taken, some probosces (among the most extended) were photographed twice with the second picture capturing the proboscis as it withdrew. More individual worms were recorded on video. The last ten minutes of this dive were videoed continuously under white light.

Images (stills and video) were analysed and an initial report made which included observations of proboscis form and behaviour gleaned from the images.

Observations

1. *M. lankesteri* probosces were observed on the sediment surface during daylight hours on this site.
2. *M. lankesteri* probosces were found to be present throughout both dives.
3. During dive 2 it was observed that *M. lankesteri* probosces reacted not at all or very weakly to incident red light. The video light used had three red light settings, the highest of which showed a 'hot spot' in the centre of the light beam when viewed in the GoPro screen and in the video clips. Worms would react to the incidence of this higher intensity red light, apparently coincident with this hot spot reaching the proboscis. Probosces viewed under red light were harder to spot as the green colour typical of these structures was rendered black and contrast with the surroundings was reduced (Figure 1C). Probosces were most difficult to see under the lowest setting.

4. Throughout dive 1 and at the start of dive 2, *M. lankesteri* probosces reacted strongly to incident white light with each proboscis seen withdrawing into the burrow as the light/diver approached. Photography was possible but images show only the proboscis tip disappearing into the burrow. Figure 1B shows a *M. lankesteri* proboscis spotted in white light and photographed in 'panic' withdrawal. Inset shows a 'spooned' proboscis tip with raised edge (upper arrow), harvested material and a puff of escaping material (lower arrow). A burrow entrance or exit of the same form is at 5 o'clock in the main image.

5. Dive 2 took place on 11th October 2016 between 17:49 and 18:30 BST. Sunset on that date was 19:09 BST. Towards the end of the dive (the last 10 minutes were videoed under white light) it was found that the probosces of *M. lankesteri* reacted less strongly to incident white light from the dive light. It became easier to take more than one still photograph of an individual proboscis. Frequency of photographs of individual probosces was limited by the recycling time of the strobe (approximately 2 seconds).

6. Throughout the dive when a flash photograph was taken of a proboscis, there was a lag of approximately 2 seconds before the worm reacted and the proboscis was rapidly withdrawn into the burrow.

7. Early in the dive it was possible to take two shots of individual worms spotted under red light with far-extended probosces, the second shot being taken as the proboscis withdrew.

8. *M. lankesteri* was common on this site. Burrows of identical appearance to those down which probosces disappeared were very numerous and sometimes several were only centimetres apart. Approximately one quarter of the burrows observed during dive 2 showed a withdrawing proboscis. Pair 1 estimated 25–100 *M. lankesteri* per m² (Flint 2016) by counting burrows/mounds. In the prevailing conditions it was assumed that all open burrows were active but mounds were small or not discernible (observation 9).

9. Review of video and stills showed that *M. lankesteri* 'volcano' ejecta mounds were present, but far smaller and flatter than the

40 cm diameter by 30 cm high cones known from the ultra-sheltered conditions in Scottish sites like Loch Sween.

10. Faecal pellets of the form cited as typical of this species by Hughes *et al.* (1996) (uniform diameter, rounded ends reported by earlier workers), were observed in several stills photographs, on mounds, on probosces and on the sea bed away from both (Figure 1E).

11. Using red light, the probosces seen lying on the sediment surface were of different lengths from approximately 1 cm to approximately 6 cm. No actual measurements were taken. A small apparent variation in width was also noted. Proboscis tracks of up to 30 cm long have been reported by Hughes (1996).

12. When stills pictures of holes were reviewed it was seen that some (Figure 1F) were actually mounds with faecal pellets present. Holes, with or without mounds were of apparently uniform size (approximately 6 mm). Figure 1G indicates scale with use of a finger. No measurements were made.

13. A large proportion of images shows a proboscis with a broadened distal end with a noticeable upward-facing bevel (Figure 1H). In paired sequential images of the same proboscis the first had a 'bevel end', the second (rapidly withdrawing) had a 'spoon end'. See observations 7 and 18 and Figure 1B.

14. In 'bevel-ended' probosces (especially when far-extended), a gap of sediment-free green surface can be seen nearest the proximal end of the structure.

15. Proboscis extension was not observed during the dive so it is inferred that extension is slow.

16. The upper proboscis surface is concave in cross-section when extending. Harvested material collects in this concavity and does not adhere to the convex sides of the main section of the proboscis (Figure 1H).

17. The proboscis appears to produce mucus to bind the harvested sediment to the proboscis surface (Figure 1I).

18. The distal end contracts on withdrawal to form a 'spoon' end and the concavity of the proboscis surface becomes more pronounced

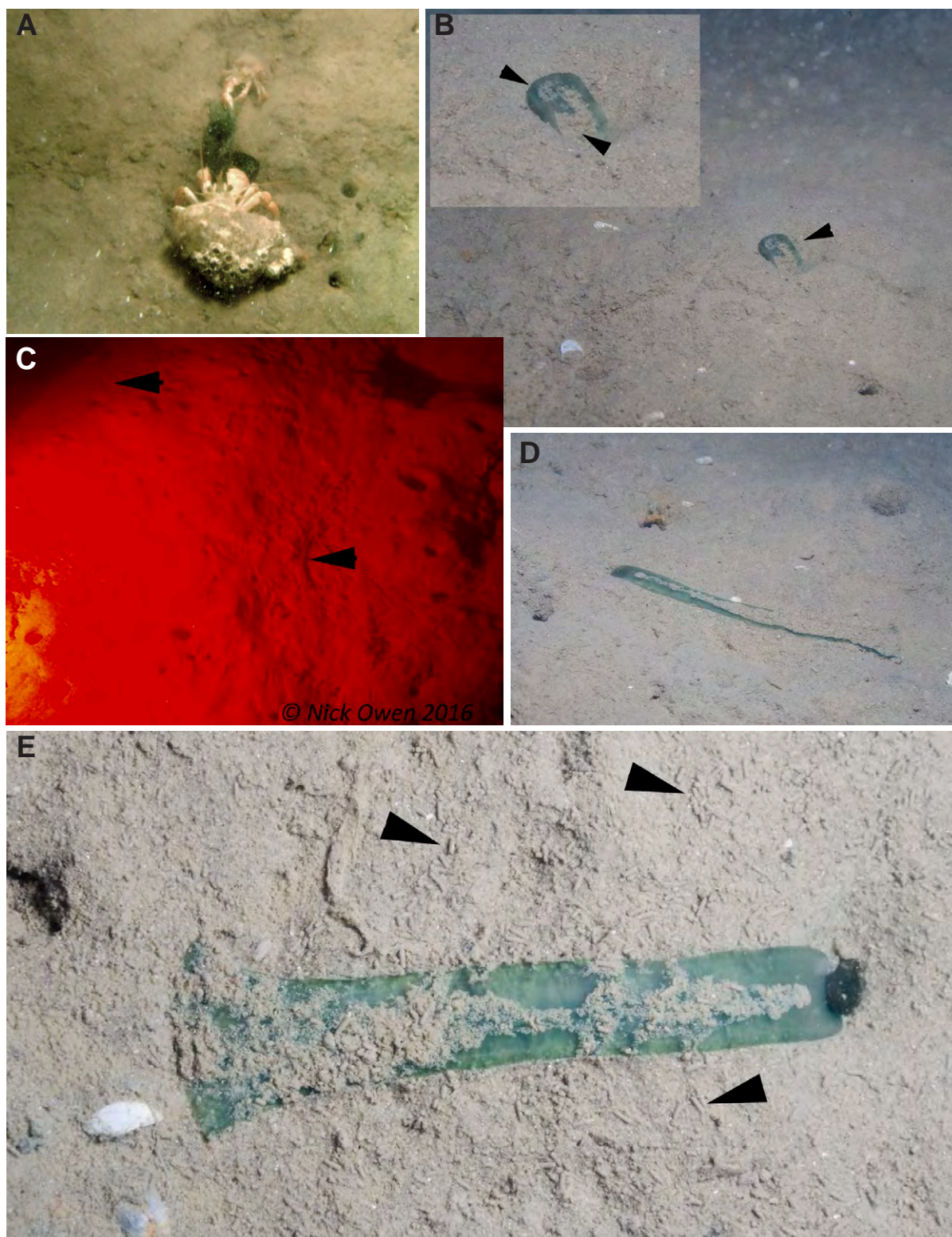


Figure 1: Underwater observational images of *Maxmuelleria lankesteri*.

- A. Two *Pagurus bernhardus* fighting over a *Maxmuelleria lankesteri* proboscis © Dominic Flint 2016.
- B. *Maxmuelleria lankesteri* proboscis spotted in white light and photographed in 'panic' withdrawal.
- C. Video still of two *Maxmuelleria lankesteri* probosces (arrowed) apparently motionless under red light.
- D. *Maxmuelleria lankesteri* proboscis located under red light and photographed 'unawares'.
- E. *Maxmuelleria lankesteri* proboscis showing uniform-sized faecal pellets (some arrowed) with rounded ends.

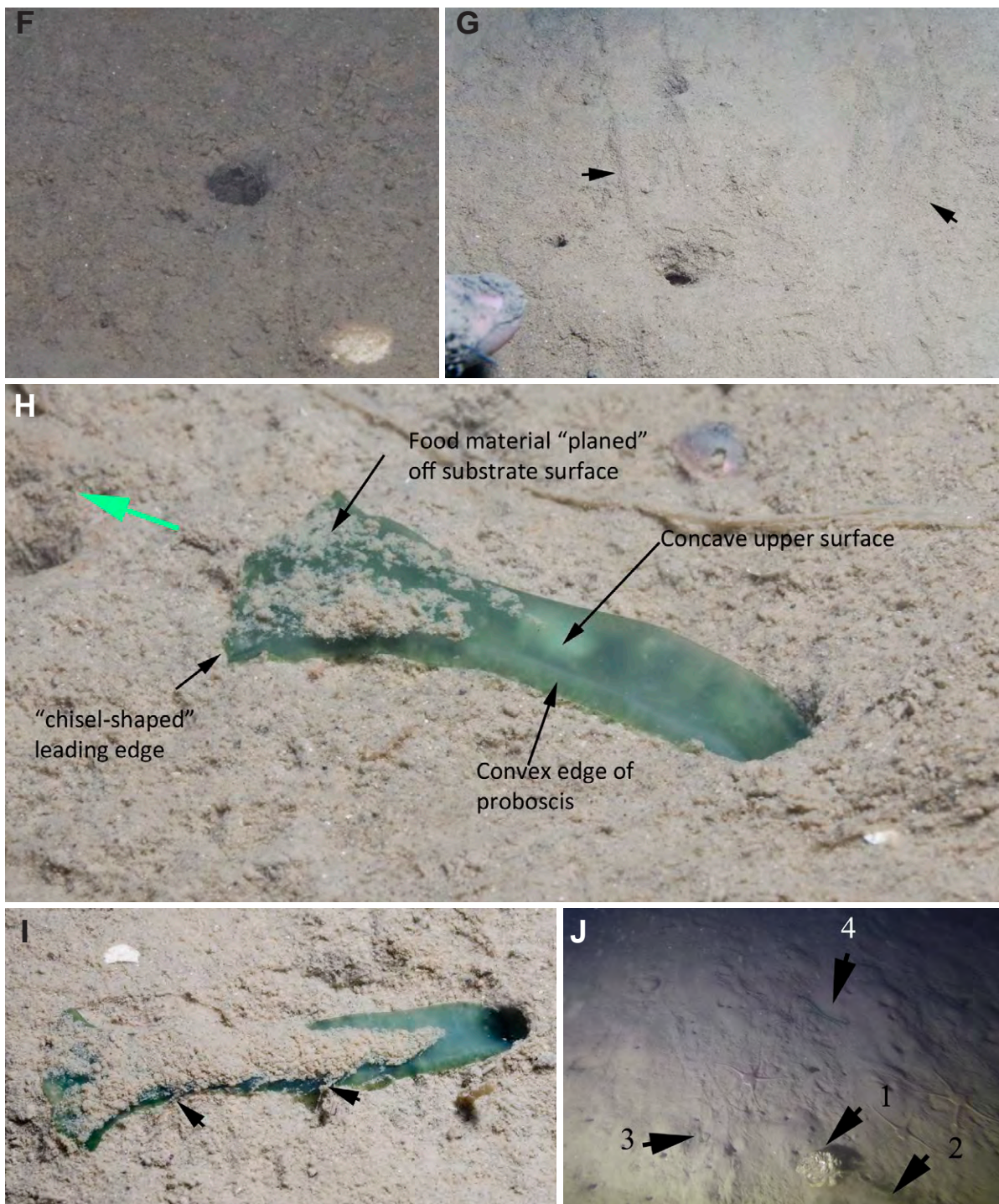


Figure 1 (cont.): Underwater observational images of *Maxmuelleria lankesteri*.

F. Close-up of mound with scattered faecal pellets. Note shape of burrow exit.

G. Close-up of burrow with proboscis trails (arrowed) and finger for scale.

H. Morphology of extending proboscis.

I. Extending proboscis with mucus (arrowed) visible.

J. Still from a video clip of a *Pagurus bernhardus* apparently hunting *Maxmuelleria lankesteri* probosces. Arrows indicate (1) *P. bernhardus*, (2) its 'rooster tail' of silt, (3) the first 'target' and two more probosces and (4) the crab's second 'target'.

(Figure 1B). The worm withdraws the whole proboscis with harvested material on the surface into the burrow.

19. 'Panic withdrawal' of probosces (observation 6) after flash photography often resulted in a puff of escaping sediment (Figure 1B) as the distal end of the proboscis disappeared down the burrow. The implication is that mucus (observed on the edges of the proboscis, Figure 1I) does not bind the harvested material firmly to the proboscis surface.

20. Once retracted, the proboscis leaves a trail on the surface of the sediment surrounding the burrow and radiating from it (Figure 1G).

21. This trail may show strings of mucus especially at the edges.

22. More than one trail was observed from a few burrows (Figure 1G) in which cases the trails radiated out from the burrow in different directions.

23. The extending proboscis may be 'steerable' as the abruptly curved right hand proboscis trail in Figure 1G suggests.

24. On this site, proboscis trails were superficially similar to trails left by the gastropod *Tritia reticulata* (Linnaeus, 1758), which were deeper and slightly wider. *Tritia reticulata* trails are more likely to curve or meander. Although *T. reticulata* trails were seen to pass over burrow entrances, that this was the passage of a *T. reticulata* was obvious because in the prevailing conditions, *T. reticulata* trails could be seen to extend further than the reach of a proboscis.

25. As well as the photographs of *Pagurus bernhardus* tussling over a proboscis from pair 1, pair 2 observed individual *P. bernhardus* running into the lighted area at top speed, apparently heading straight for a *M. lankesteri* proboscis. As the proboscis vanished into the burrow, the crab would stop or abruptly change direction and head for another proboscis. Figure 1J is a screen shot from a video clip that captured this with arrows indicating the *P. bernhardus* (1), its 'rooster tail' of silt (2), the first 'target' and two more probosci (3) and finally the crab's second 'target' (4). The crab stopped as both probosces at 4 disappeared.

Conclusions

1. At the time of the survey the population of *M. lankesteri* studied was large but of undetermined size and extent. Estimates based on mound counts where mounds are small and flattened or upon hole counts are problematic. Estimates based on proboscis counts (especially in daylight hours) may be underestimates.

2. Under dark conditions in daylight hours *M. lankesteri* in this population were actively feeding.

3. During daylight hours this population of *M. lankesteri* was highly sensitive to white light and much less sensitive to red light. Red light could be used to find and observe individual worm probosces.

4. Once found using red light, video (red lit) and high quality stills (white lit) could be taken of individual worms. These images yielded information which to a large extent was later found to support previously published observations on the behaviour of this species.

5. Use of red light in dark conditions or at night may be useful in increasing the knowledge of the ecology and distribution of this enigmatic and under-recorded species.

6. Based on size of burrows and lengths of observed probosces, the probable average size of individual *M. lankesteri* from Kent is significantly smaller than in Scottish sea loch and Irish Sea populations recorded by Hughes and co-workers. More information and specimens are needed.

7. More work is needed to understand the importance of this species to 'mud' biodiversity, its role in biotopes and its possible vulnerability to anthropogenic disturbance of subtidal mud substrates.

It must be borne in mind that the images upon which the bulk of the observations in the text were made and upon which these conclusions are based were made during the course of two 40-minute dives on one site on one day and that the bulk of the observations were drawn from images captured during only one 40-minute dive. This is slender evidence, but the quality of images gained

utilising a novel technique to locate feeding probosci of *M. lankesteri* add authority to the observations gained from the images and render it worthwhile to report them. It is hoped that this article will generate increased interest in this species and its ecology and that many more workers will use red light to observe species and habitats in dark conditions.

Acknowledgements

The Wildlife Trusts commissioned and funded the diving which was organised by Dominic Flint and Peter Mills.

Dive buddy George Burroughs for exemplary cloud-free in-water safety cover including managing the GPS surface marker buoy whilst in periods of complete darkness except for a dim red light.

David Hughes of SAMS for patiently answering questions.

All images © Nick Owen 2016 unless indicated otherwise.

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Appendix

Details of red light used for observations. Details from website www.nauticam.co.uk for FIT Pro LED 2600 but confirmed as identical by the importer 08/05/17, A Tattersall, pers. comm.

FIT Pro LED2500 Flare video light.

Switchable in a loop from white flood (3 power settings) to white spot (3 power settings) to red (3 power settings) to ultra violet (one power setting) to white flood.

Beam Angle: Red 120 degree

Lumens: Red 200

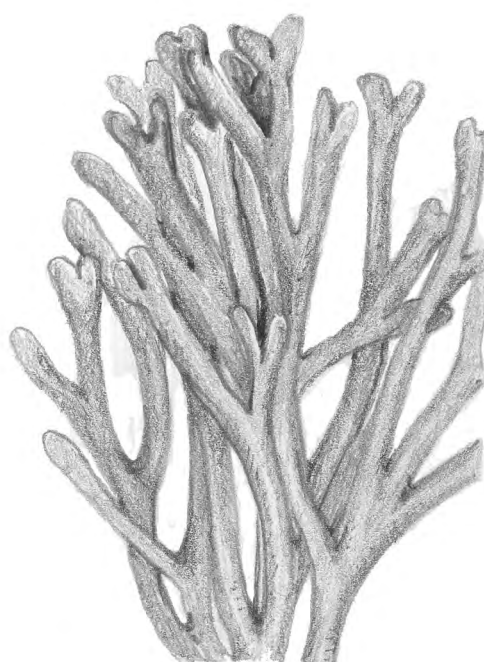
LED spec: 2 X CREE XP-EN3*2PCS (red, 620nm)

Colour temperature, red

High 1393K 130.02lm

Mid 1382K 96.12lm

Low 1377K 17.30lm



Anne Bunker

Lazarus: a pictorial biography of a seafan

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An isolated colony of Eunicella verrucosa (Pallas, 1766), one of only four known in Poole Bay, has recovered well after being crushed under a boulder and significantly damaged.

On 20 August 2000, a pink seafan was found on one of the many patch reefs in Poole Bay. It was the first to be seen in the area and extended the current known range in the English Channel of this protected species by over 20 km eastwards from its previous limit near Kimmeridge (Tinsley 2006)(see Notes). The colony was examined, photographed, measured and freed from the bonds of an old fishing line that was wrapped around it near the base. A local commercial pot fisherman who regularly fished the area was advised of its presence.



Fig. 1: As found in August 2000

The colony was on the west side of an irregular pyrite reef on a sloping bedrock face, close to the edge of the reef and rather less than 1 m above the adjacent silty sand seabed at 16 m bsl. The current in this part of the bay is not particularly strong: the flood current runs approximately north along the side of the reef with a maximum speed that is probably never much more than half a knot, whilst the ebb runs in a south westerly direction across

the reef at speeds up to 1.5 kt. The seafan is shielded from some of the ebb current by the body of the reef. The plane of the fan was approximately perpendicular to the edge of the reef, i.e. at right angles to the flood current but angled at 45° to the direction of the ebb. The reef itself is covered with silty sponge and bryozoan turf and provides shelter for a variety of crustaceans and fish. Although the presence of the seafan had been made known to the authorities through the Finding Sanctuary programme the reef was not included in the Poole Rocks MCZ that was designated in December 2012.



Fig. 2: The seafan in 2003

When first found the colony had a rather unusual two lobed shape, with two equal main stems arising from a common base: this division has persisted up to the present with the two parts developing more or less equally, though it is now much less obvious unless viewed from the edge of the colony as the two lobes have overlapped. One side of the seafan was bundled up into an un-natural shape by fishing line, hidden underneath the fouling around the base of the colony (Figure 1). On a follow-up visit eight days later the colony was measured and photographed as found, the width being reported as 18 cm and the height 25 cm, and then the fishing line was removed. After the removal of the fishing line, the fan did not immediately spring back into a more natural form. Apart from its misshapen form, although there was some light fouling around the base of the colony (on the fishing line rather than the structure itself) the fan appeared to be healthy.

Occasional visits were made in subsequent years to check on the health and wellbeing of



Fig. 3: One of the large and magnificently healthy seafans from further east in Poole Bay

the seafan: no problems were found, though it retained a rather untidy bifurcated appearance (Figure 2).

Meanwhile three further fans were discovered in the bay at widely scattered locations ranging from 170 m to 4.3 km east of the original one. Two of these three were large specimens with very dense branching and are likely to be several decades old (Figure 3): no juvenile seafans have ever been seen in Poole Bay.



Fig. 4 (top): August 2006: trapped under a boulder . . .

Fig. 5 (below): . . . and released

On one of these visits, on 22 August 2006, it seemed initially as if the seafan was missing, until a few tips of branches were found poking out from underneath a large, flat boulder (Figure 4). From the nature of the life on the upper surface, it was clear that the boulder must have been flipped over onto the seafan: it is most likely that the boulder had been snagged by the back-line on a string of lobster pots. The protruding branch tips that were the only visible parts of the colony still bore living soft tissue and extended polyps. Two divers working together managed to roll the stone away and hence to free the seafan, which was found to be in very poor condition. It was squashed into an almost unrecognisable shape and soft tissue had died back in many places, leaving skeleton completely exposed at the tips of some branches and in several places along the stems. Some of this damage can be seen in Figure 5.

The framework was still quite springy and the base still securely attached to the reef; on release, one of the two main stems did immediately recover somewhat from its horizontal position under the boulder. The other stem, however, remained splayed out away from its partner and almost parallel with the surface of the bedrock (Figure 5), so that the separation between the two main sections of the fan that had been obvious previously, was exaggerated further.

A year later, the seafan received another visit to see whether it had survived. The two main stems were still widely spread, though the more squashed of the two had regained some of its reach into the water column (Figure 6); the



Fig. 6: August 2007: recovery under way, but still a straggly mess



Fig. 7 (top): August 2007: some branch tips recovered, a few still bare

Fig. 8 (below): August 2008: new soft tissue creeping back over previously bare skeleton

colony was clean and polyps were extended, and there were clear signs that soft tissue was growing back over previously bare parts of the skeleton (Figures 7, 8). Some of the tips that had lost their soft tissue under the boulder had a complete new covering and were detectable only by the slightly paler colour of the new growth, which was a little more pink than orange as the original had been. There seemed to have been further growth in the soft tissue of the base too (Figure 9), though this could not be assessed objectively as no measurements of the base had ever been taken.



Fig. 9: Possible new growth around the base: a response to being damaged?

It was around this point that the seafan came to be called Lazarus, since it was clear that rolling the stone away had given it a new lease of life. Whilst seafans occur as separate male and female colonies it is not known whether Lazarus is actually a male.



Fig. 10: A healthy-looking Lazarus in 2010 - but threatened with fishing line again

A further visit in October 2010 found Lazarus to be in the pink of condition, despite being draped once again in fishing line (Figure 10). Both main branches were standing up and both sections had filled in considerably with many new side branches. The separation between the two main sections that had been visible even before Lazarus was damaged under the boulder had become much less obvious and the profile of the whole was much more like a 'normal' seafan.

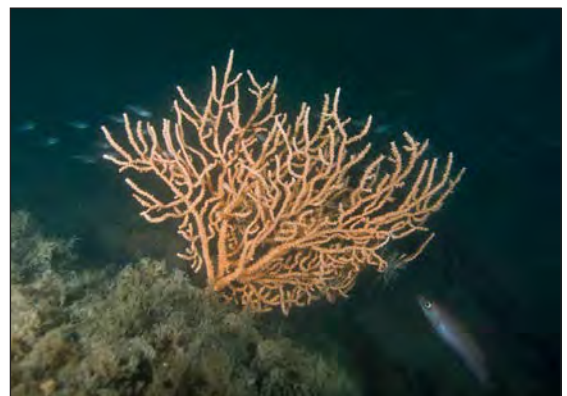


Fig. 11: Lazarus in June 2014

The most recent visit in this ongoing watch over Lazarus took place on 22 June 2014. The good condition of the seafan that had been reported four years previously appeared to have been maintained (Figure 11). One hydroid was seen attached to a branch on the lobe of the fan that was most flattened under the boulder in 2006, though its presence does not seem to be related

to any damage caused then since the hydroid was not present on the same clearly healthy branch in 2010; very light drifting weed was the only other fouling that was noted. Most noticeably the fan as a whole had filled in with side branches to the sort of density shown by its counterparts further east (Figures 3 & 11). Both lobes of the fan had continued to develop well and they had overlapped to a great extent; there was a clear 'sub-fan' on a branch a short way up one of the original main stems. As a result the whole colony had a clear multi-layered structure (Figure 12), a feature shared with two other large seafans in Poole Bay. Lazarus was measured as 33 cm wide x 22 cm high, much wider and slightly less high than it was when first found fourteen years before. It is possible that both of these changes are due, to some extent, to the re-shaping of the colony, initially following the removal of fishing line that had bound the fan into an un-naturally tall narrow shape and later through damage caused by the boulder incident, though lateral growth also can be detected in the images taken during this fourteen year period. Measurements being taken by different people at different times with no effort made to establish any consistency or objectivity may also have introduced discrepancies, so it is hoped to develop a 'seafan gauge' before the next visit.

It is clear that given appropriate conditions even quite badly damaged seafans can survive, and prosper (See *Abrasion and physical disturbance* in Hiscock 2007). The roughness of the pyrite reef probably helped by giving Lazarus a very firm foothold, allowing the seafan to bend but not become detached from the rock, and the very healthy condition of the few other seafans in Poole Bay points to a favourable environment despite being at the eastern limit of the species' current distribution. Lazarus could easily be over thirty years old, but is clearly not ready to give up yet.

Notes

Two records indicate the possible presence of *Eunicella verrucosa* in the southern North Sea:

(i) Manuel (1981) says "Older records suggest that this species occurred in the English Channel almost to the Thames Estuary (Margate) but its present eastward limits are



Fig. 12: Three fans in one colony

unknown": the basis for this 'older records' claim is unclear.

(ii) A specimen was found during a survey carried out by CEFAS on 16 December 1992, offshore from the Scheldt Estuary (<http://www.gbif.org/occurrence/324332551/verbatim>)

The record is held by the Marine Biological Association.

Acknowledgements

Thanks are due to Lin Baldock, Jenny Mallinson, Peter Tinsley and Nigel Topham for providing images and information. Images are © Mike Markey.

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**Epibiont attachment of the brown
alga *Cladostephus spongiosum*
(Hudson) C. Agardh, 1817
(Phaeophyceae: Sphacelariaceae)
on the Auger Shell *Turritella*
communis Risso, 1826 (Gastropoda:
Cerithiidea: Turritellidae)**

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On 1 September 2015, Ms Barbara Browne (Friarstown, Knockmore, Ballina, Co Mayo) discovered hundreds of recently dead Auger Shells *Turritella communis* Risso, 1826 stranded at extreme low tide level on the sandy shore of Gurteen Beach (53°22'49.06" N, 009°57'13.87" W), Roundstone, Connemara, Co Galway (western Ireland). Desiccated fronds of the brown alga *Cladostephus spongiosum* (Hudson) C. Agardh, 1817 were attached by their discoid holdfasts to the external aperture of the auger shells (Figures 1A–E). It is thought that the alga became attached to the auger shells while the gastropod was still alive and *in situ* in the substratum. As far as we are aware, there are no previously published reports of *C. spongiosum* as an epibiont on *T. communis*.

In the NE Atlantic, *C. spongiosum* ranges from Norway and Iceland southwards via the Mediterranean to Madeira (NW Africa). In the NW Atlantic, it has been recorded from Greenland southwards via the USA to Mexico, and in the SW Atlantic, from temperate waters of South America (Argentina and Chile), to the Antarctic. Elsewhere, the species has been recorded from Australia, Tasmania and New Zealand (Morton & Picton 2016, Guiry 2017).

Cladostephus spongiosum is a common and distinctive species, with fairly stiffly branched fronds, measuring up to 25 cm in length, and with characteristic closely packed whorls of branchlets. The species is generally found attached to rocks and stones in lower intertidal pools and shallow subtidal areas down to

depths of 6 m around Britain and Ireland. Cotton (1912) provided detailed descriptions of the coastal habitats and communities occupied by *C. spongiosum* on Clare Island, Co Mayo (western Ireland).

Turritella communis ranges from northern Norway (Lofoten Islands) southwards to the Mediterranean, Black Sea and North Africa, and is locally abundant in Irish and UK waters from low water spring tide levels down to depths of 200 m (McMillan 1968; Poppe & Goto 1991; Snigirov *et al.* 2013). This gregarious semi-infaunal ciliary suspension feeder is mainly found in muddy gravel or sandy substrates, and although generally sessile, it has occasionally been observed crawling on the surface (Yonge 1946; Allmon, 2011). *Turritella communis* shells average around 30 mm in length and exceptionally up to 55 mm. In UK waters, Carter (2008) noted that very large numbers of empty auger shells are frequently found washed up on the shore.

Turritella communis has a wide range of predators, including fish and birds, and are frequently parasitized internally by renicolid digenean trematodes such as *Cercaria pythionike* Rothschild, 1938 and *C. doricha* Rothschild, 1938 (Hutton 1955; Campbell *et al.* 2007), and externally by gastropods such as *Brachystomia eulimoides* (Handley, 1844) and Bonnet Limpet *Capulus ungaricus* (L.) (Poppe & Goto 1991). Wilson (1976) noted that the empty auger shells are often colonized by sipunculid worms and provide an attachment substrate for the coral *Caryophyllia smithii* Stokes & Broderip (1828). Empty auger shells are also used as temporary homes by various species of hermit crabs (Paguridae) (Ingle 1993; Manjón-Cabeza & García Raso 1999).

According to Seaborn (2014), epibiont-basibiont relationships are complex and may have positive, negative or neutral effects on both organisms. For example, the hydrodynamic effects of epibionts may increase drag and lift on basibionts in environments with high water flow, such as wave swept intertidal zones. O'Connor *et al.* (2006) noted that epibiotic algae growing on *Mytilus* mussels increased dislodgement during storms, regardless of the size of the algae.

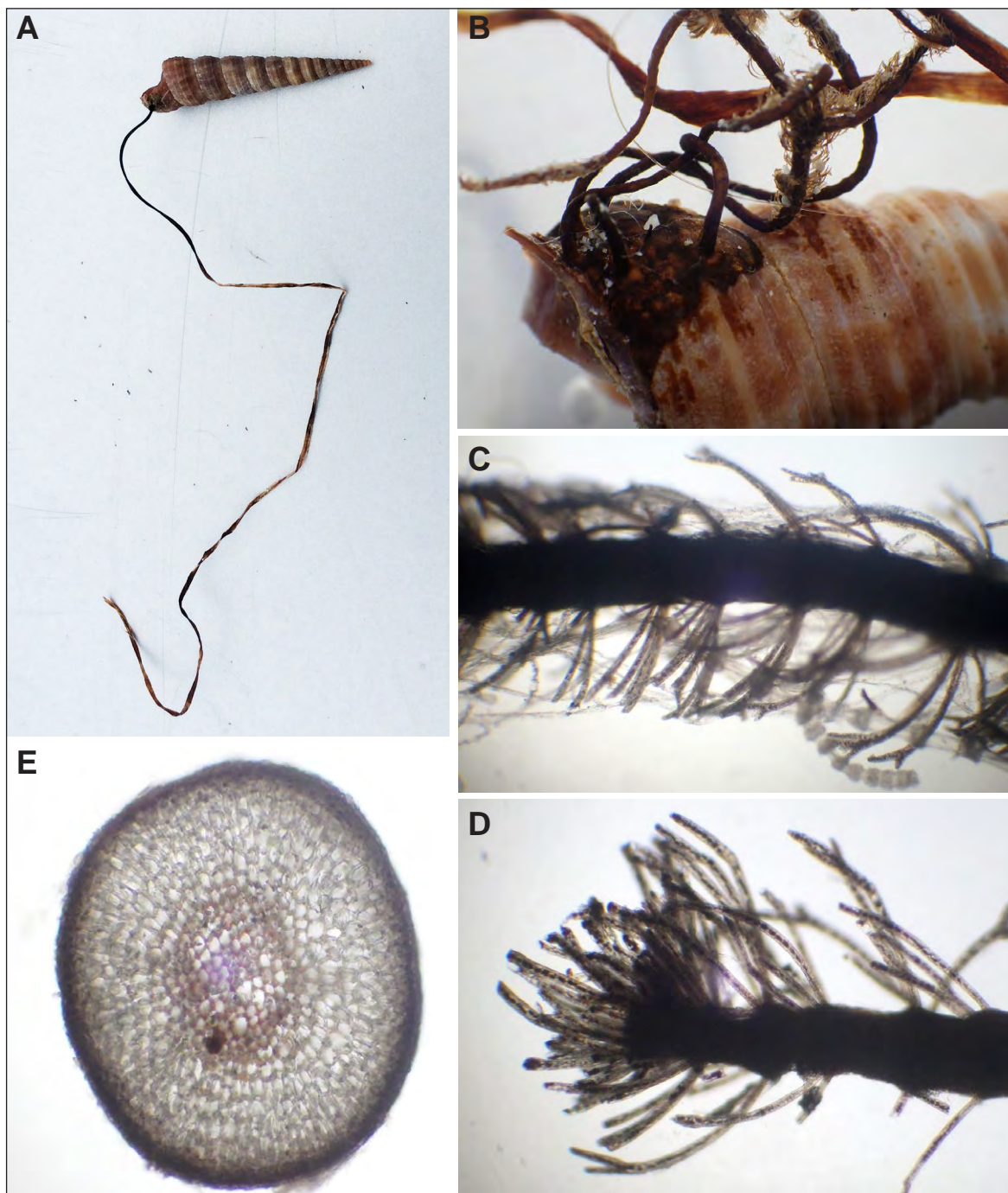


Fig. 1: A. Frond of *Cladostephus spongiosum* attached to Auger Shell *Turritella communis*, measuring 49 mm TL; B. Holdfasts of *C. spongiosum* attached to external aperture of *T. communis*; C. Frond (mid section) of *C. spongiosum* showing characteristic closely packed whorls of branchlets; D. Frond tip of *C. spongiosum* showing characteristic closely packed whorls of branchlets; E. Cross section of *C. spongiosum* frond. (Photos: A–B. Declan Quigely; C–E. David Fenwick)

In the absence of rocks and stones, the partially exposed aperture of auger shells may provide a hard substrate for *C. spongiosum* to colonise in an otherwise unstable sedimentary environment, while the attached alga may provide *T. communis* with some level of protective camouflage. However, this

apparently positive relationship may only be an ephemeral phenomenon and eventually prove negative for both organisms when exposed to exceptionally low tides and/or adverse climatic conditions.

Acknowledgements

We are grateful to Barbara Browne and Ethna Viney (Thallabawn, Westport, Co Mayo) for bring the current specimens to our attention, Professor Michael Guiry (Martin Ryan Institute, NUI, Galway) for confirming the identity of the alga, and Julia Nunn (Centre for Environmental Data and Recording - CEDaR, Cultra, Holywood, Co Down) for her advice.

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Anne Bunker

Question Time

Frank Evans

For many years the Met. Office recruited selected merchant ships to prepare and transmit weather reports during their voyages. The ships' weather logs also carried a space for biological observations; these latter were collected at the end of the voyage and sent to various scientists for comment. Fish and invertebrates came my way and selected observations and my comments were published in the *Marine Observer*, the former house journal of the Marine Branch of the Met. Office (Barfield 2016). Listed among the observations were reports of fish found on the decks of ships, including several records of the hatchet fish, *Argyroteleus daucus* (Cuvier, 1829) (see figure below). This small luminescent fish is found over much of the North Atlantic, living at depth during the day and approaching the surface at night.

However, the ship records are all from a very restricted area of the Bay of Biscay as opposed to being oceanwide as might be expected from the routes of merchant ships. Moreover, the

fish were sometimes found at a considerable height above the water level, for instance on the forecastle head of one large vessel and on the monkey island of another. The monkey island is a platform which is above the wheelhouse. Two questions arose, how did the fish arrive on the deck, so many feet above the sea, and why were the findings confined to such a narrow locality?

Marine Observer records were examined, January 1956 to July 2003, when publication ceased. Hatchet fish were reported in the following localities:

Feb. 1977 46° 31' N, 07° 02' W

Apr. 1979 45° 06' N, 08° 00' W

Jan. 1981 47° 00' N, 07° 00' W

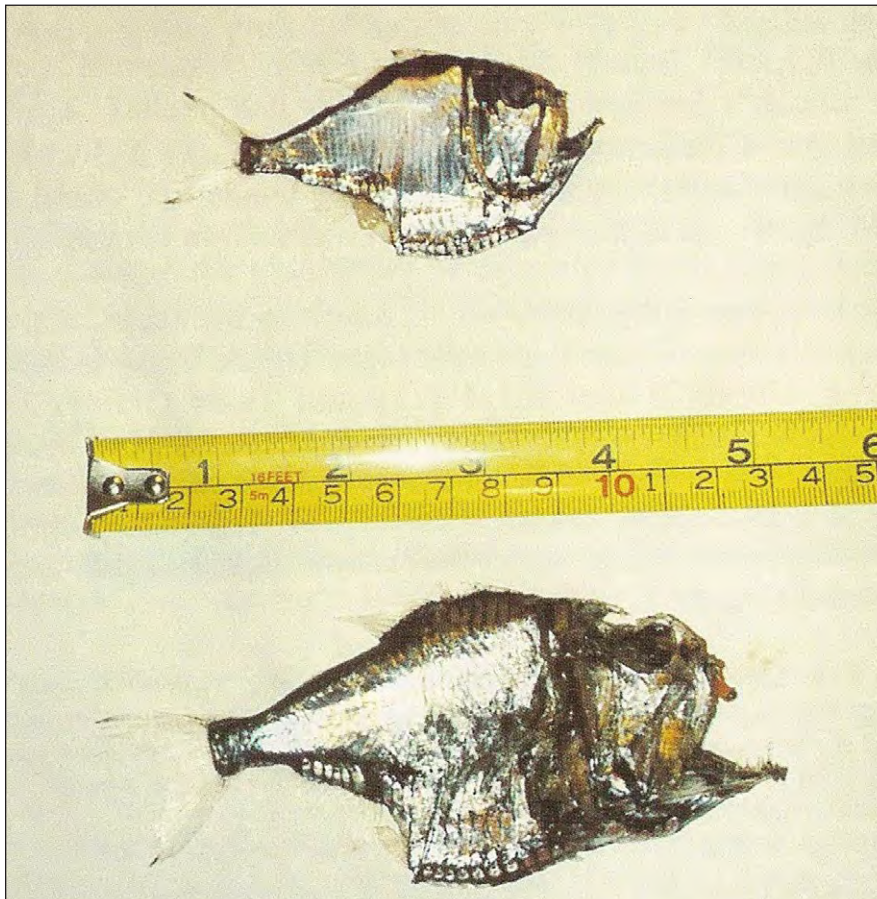
Apr. 1986 47° 00' N, 07° 00' W

Dec. 1996 41° 31' N, 09° 59' W

Mar. 1999 No posn.,

Terneuzen to New Orleans.

What explanation can be offered for these curious restrictions? A possible solution is offered on page 62.



Feb. 1977	46° 31' N, 07° 02' W	Hatchet fish on monkey island, fresh.
Apr. 1979	45° 06' N, 08° 00' W	Hatchet fish hit lookout on forecastle head on head.
Jan. 1981	47° 00' N, 07° 00' W	Hatchet <i>Argyropelecus olfersi</i> .
Apr. 1986	47° 00' N, 07° 00' W	Hatchet, dawn, luminesc., many gulls, one dropped it (fish illustr.).
Dec. 1996	41° 31' N, 09° 59' W	Two hatchets (colour photos).
Mar. 1999	No posn.	Terneuzen to New Orleans. Hatchet (b/w photo).

Table 1: Hatchet fish reports with abbreviated published comments from the Marine Observer, examined Jan. 1956-July 2003.

A suggested solution notes that in April 1979 the lookout on the forecastle head of one ship was hit on the head by a hatchet fish and again in April 1986 a fish was dropped, at dawn, when many gulls were seen.

The restricted locality of occurrence, some 120 nautical miles southwestward of Ushant, Finisterre, may be because gulls, which are largely inshore birds, were at the extreme of their hunting range. There they were encountering truly oceanic water at the very base of the continental slope and so at the edge of distribution of the hatchet fish, in a very narrow overlapping area.

Reference

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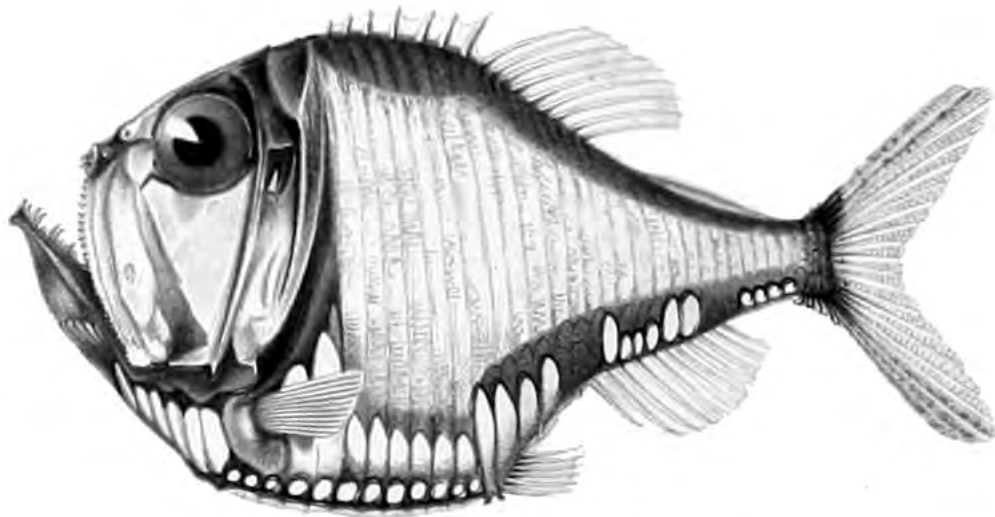


Illustration of *Argyropelecus olfersi* from Collett (1896)

Spermwatch (Using Citizen Scientists to Help Understand Reproductive Resilience)

Sarah Long

Capturing our Coast is on the lookout for sperm!

Spermwatch is a yearly campaign organised by the South East hub for Capturing our Coast, a nationwide citizen science conservation project. The campaign involves citizen scientists recording the spawning of the lugworm *Arenicola marina* (Linnaeus, 1758), during autumn and winter, across the UK. The lugworm spends most of its life in soft sediments. For fertilization to occur, the male releases sperm in the form of 'puddles' on to the sand surface at low tide. These subsequently get washed into the burrows of the female, resulting in fertilisation of the eggs.

Specific environmental conditions are needed for a population to spawn in synchrony, but with some populations that are geographically close together spawning over 2 months apart (Watson *et al.* 2000). However, little is known about the precise cues for gamete release, which is why scientists need help to fill these knowledge gaps. The data collected by the

public will not only help to answer specific questions about the sex life of lugworms, but will also be used to assess the reproductive resilience of populations in the face of a changing and more unpredictable climate. Zoe Morrall, Project Officer of CoCoast South East said "It's a great opportunity for the public to get involved, especially in the campaign's second year as many of our volunteers will know what they are looking for. It will also help us gather more data to further understand the lugworms sex life!"

In 2016, out of a total 302 surveys, 3 spawning events were recorded around the UK coast. These were found in the south east and north east of England in early November, and in Wales in mid-November, indicating a potential difference in reproduction times around the UK. Having proven both popular and successful after its launch in October 2016, the project will continue in 2017, and is open to people of all ages and walks of life.

Reference

Watson, G.J., Williams, M.E., & Bentley, M.G., 2000. Can synchronous spawning be predicted from environmental parameters? A case study of the lugworm *Arenicola marina* (L.). *Marine Biology*, **36**: 1003–1017.

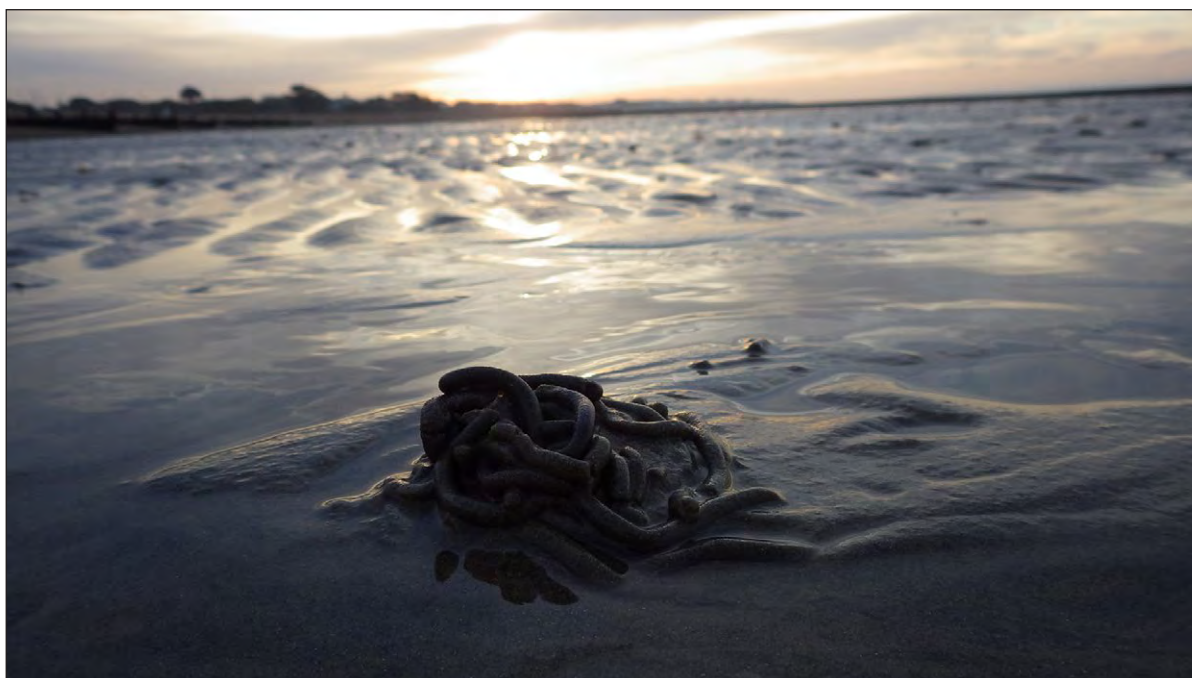


Fig. 1: Cast of *Arenicola marina*. (Photo: Capturing our Coast)

A year in the life of a Saline Lagoons Trainee

Katherine Whyte

National Museums Scotland

Email: katherinefwhyte@gmail.com

Each year The Conservation Volunteers (funded by the Esmée Fairbairn Foundation) offer traineeships that target identified skills shortages in the conservation sector. I'm on one of those and am known as a Natural Talent Trainee – and am currently in the last week of my year-long traineeship based at National Museums Scotland.

Through the Natural Talent UK programme trainees are given the opportunity to develop an expertise in a specific taxonomic group, habitat, or a mixture of both. This year there have been six Natural Talent Trainees, each focussing on different specialisations and based at different host institutions across the UK. The programme aims to expand our knowledge and the public's awareness of the UK's least well-known species, ranging from non-marine molluscs and invasive species to deadwood beetles and aphids.

My traineeship was about saline lagoons: coastal lochs that have a sporadic connection to the sea. The habitat provided by each lagoon is unique and changeable and some unusual invertebrates can only be found within lagoons making them a priority for conservation. Over the past few years the Invertebrate Biology team at National Museums Scotland have studied numerous saline lagoons, collecting

data on the diversity and distribution of lagoon species across Scotland. Working with them has been a fantastic learning experience for me and I have had many great opportunities over the year.

Perhaps the most memorable experiences of my traineeship have been on fieldwork. The majority of lagoons in Scotland are in remote corners of the west coast as well as on the islands, and so I have been lucky to work in many beautiful places (Figure 1). I will certainly never forget our month of daily ten mile hikes (in waders!) across remote bogs on Uist in the Outer Hebrides. Neither will I forget our fieldwork in Argyll when we had to break through a solid layer of ice just to get our sampling net in.

Although memorable, fieldwork was only one part of my traineeship. My day-to-day role at the museum was focussed on learning about saline lagoon invertebrates and developing skills in species identification. The animals found in lagoons are known for being particularly challenging to identify and so, through much practice, I have learnt how to identify the key groups and species. The features I've been studying range from the unusual (looking at tentacle banding patterns on hydrobiid snails (Figure 2) to the bizarre (looking at how hairy the legs are on marine isopods), but it has been a fascinating insight into the world of these small marine invertebrates.

Another key part of my role as a Natural Talent Trainee was public outreach (Figure 3).



Fig. 1: Off to survey a saline lagoon in Assynt



Fig. 2: Lagoon mudsnails (*Hydrobiidae*); only 3 mm long!

Working to engage the public, and especially children, with nature has been very rewarding. In particular, I remember a girl at one of my events in Edinburgh who was fascinated with the miniscule mudsnails I showed her under the microscope; she kept coming back and back to the stall for another look. It has been interesting to talk to all kinds of people, from children to academic researchers, about species that are often overlooked and to inspire interest in their conservation.

The diverse skillset I have developed this year goes far beyond field surveys and species identification. I have learnt about saline lagoon ecology, specimen preservation techniques, the logistics of fieldwork and the value of nature outreach through events and social

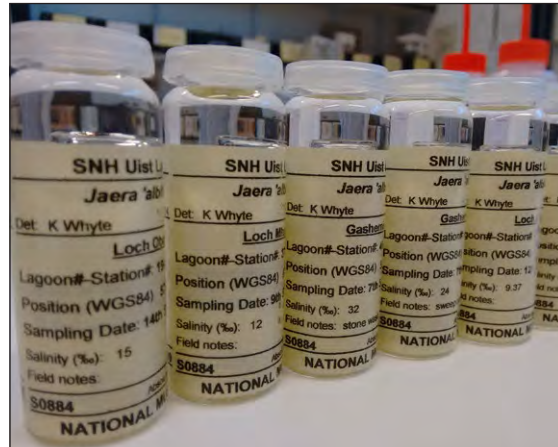


Fig. 4: Some of my lagoon voucher specimens in the National Museums Scotland collections

media. There have been many achievements over the year, including presenting my work at the MASTS (Marine Alliance for Science and Technology for Scotland) Annual Science Meeting and adding hundreds of voucher specimens to the museum collections (Figure 4). My hope is that these contributions will aid future researchers in protecting and understanding these threatened lagoons and their curious residents.

My traineeship has given me many valuable experiences and skills that I will continue to draw on throughout my future career. I have enjoyed every aspect of the experience. It has been a fast and exciting year, and definitely a memorable one.



Fig. 3: Showcasing the local lagoon wildlife at Ullapool Pier Day

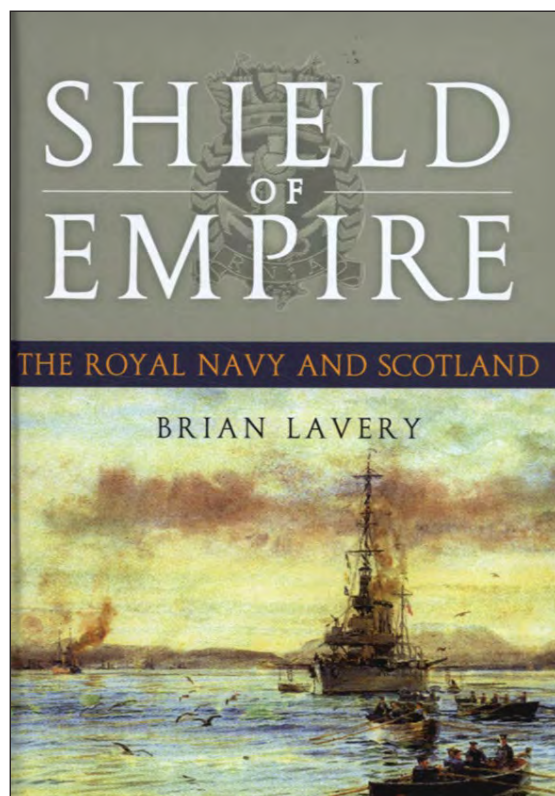
HMS Porcupine in an earlier role

Doug Herdson

While researching HMS *Porcupine* for a talk to the Maritime History group of my local University of the Third Age (U3A), I was surprised to come across a reference to HMS *Porcupine* in an earlier marine biology related role. In 'The Shield of Empire. The Royal Navy and Scotland.' by Brian Lavery (published by Birlinn in 2006) the chapter 'Nineteenth-century Neglect' includes a Section on Fishery Protection. Can you guess the name of one of the protection vessels?

Here is a transcript from page 167:

"For centuries the fishermen of Loch Fyne had used drift nets to catch herring for the expanding Glasgow and Clydeside market. In the 1830s the men of Tarbert began to use a new method, misleadingly known as 'trawling', though more correctly called 'ring netting'. They started by surrounding a shoal of herring with a drift net and then hauling it in, and soon began to design nets specifically for the new method. It required a smaller boat 'and less capital investment than drift-netting, but it soon inspired the wrath of other fishermen, especially in Inveraray. In 1851 an Act was passed to ban all nets other than drift nets in the herring fishery. The Fishery Board's ship Princess Royal was sent to Loch Fyne to enforce the new rules, along with HMS Porcupine, a paddle gunboat on loan from the Admiralty. A few nets were seized but prosecutions proved difficult. Early in the 1853 season the Porcupine was involved in a violent incident. One of her boats searched the Tarbert skiff Annan and found nothing. Then the helmsman of the skiff, Colin McKeich, hailed another boat to warn them of the naval presence and was shot and wounded from another of the Porcupine's boats. Philip Turner, gunner of the Porcupine and Peter Rennie, a marine from Hawick, were accused of the shooting and tried at Inveraray. They were sentenced to three months' imprisonment but petitions were organised in their favour and they were soon granted royal pardons. The Porcupine remained active in Loch Fyne with little success until 1854, when the Crimean War forced her withdrawal."



So, in 1854, HMS *Porcupine* sailed off to the Baltic, where, as part of the Crimean War, it took part in a number of minor engagements under the command of Lieutenant Commander George Melville Jackson for the next two years. [Some reports give Captain Henry Charles Otter as commander at this time; but he does not appear to have assumed command until May 1856, when he went on to carry out survey work along the west coast of Scotland. H. C. Otter apparently commanded HMS *Firefly* in the Baltic.]

It is interesting that another paddle vessel, the HMS *Lightning*, which in 1868 carried out the first short oceanographic cruise in British waters, was also engaged in the Baltic at this time. In 1854-5 HMS *Lightning* was carrying out important surveying and pathfinding duties, under a captain who was very experienced in these matters, namely Bartholomew James Sullivan. Sullivan had previously been Second Lieutenant on the second voyage of HMS *Beagle*, and was a close friend of Charles Darwin.

A Letter from My Grandma – Don't laugh, she's very old!

Frank Evans

The other day I went up to our local Christian bookshop and saw a "HONK IF YOU LOVE JESUS" bumper sticker. I was feeling particularly happy that day because I had just come from a thrilling choir performance, followed by a thunderous prayer meeting, so I bought the sticker and put it on my bumper.

Goodness, I'm really glad I did! What an uplifting experience that followed! I was stopped at a red light at a busy junction, just lost in thought about the Lord and how good He is, and I didn't notice that the light had changed. It is a good thing someone else loves Jesus because if he hadn't honked, I'd never have noticed! I found that LOTS of people love Jesus!

Why, while I was sitting there, the guy behind started honking like crazy, and then he leaned out of his window and screamed, "For the love of GOD! GO! GO! GO!" What an exuberant cheerleader he was for Jesus!

Everyone started honking! I just leaned out of my window and started waving and smiling at all those loving people. I even honked my horn a few times to share in the love.

There must have been a man from Whitley Bay or somewhere back there because I heard him yelling something about a "sunny beach". I saw another guy waving in a funny way with only his middle finger stuck up in the air. I asked my teenage great nephew who was in the back seat what that meant. He said that it was probably a Hawaiian good luck sign or something. Well, I've never met anyone from Hawaii, so I leaned out the window and gave him the good luck sign back. My great nephew burst out laughing . . . why even he was enjoying this religious experience! A couple of people were so caught up in the joy of the moment that they got out of their cars and started walking towards me. I expect they wanted to pray or ask what church I attended, but this is when I noticed the light had changed. So, I waved to all my sisters and brothers, and drove on over the crossroads.

I noticed I was the only car that got through the junction before the light changed again and I felt kind of sad that I had to leave them after all the love we had shared. So I slowed the car down, leaned out of the window and gave them all the Hawaiian good luck sign one last time as I drove away.

Praise the Lord for such wonderful folk.

Each year at the Annual Conference dinner, Frank delivers a monologue, keeping us all entertained. For those of you who missed it this year, here it is in print!

A New Atlas of the Seaweeds of Kent – Ian Tittley

The flora past and present with summaries for Essex, London, Sussex and Pas de Calais.

Kent Field Club, 2016. 158 pages.

ISBN: 9780956192660



Book review by Anne R. Bunker

When the Honourable Editor suggested that I might like to review this book I immediately agreed. An A4 hardback full of maps and pictures of seaweeds is just my thing.

This book introduces the reader to the study of seaweeds and their history in the county. The Kent coast, with its habitats and the seaweed communities present, is described in detail with words and pictures. The current status of the flora, and the changes that have occurred to it are considered. The section on the history of seaweed study is fascinating, outlining the collections and collectors of seaweeds in Kent over the centuries.

The atlas section contains distribution maps for almost 300 species. For each species a brief description is provided, followed by comments on its habitat and ecological requirements. There are potentially four maps showing 19th, 20th and 21st century records. The maps are based on almost 14,000 records, the earliest being 1597. In the main maps, red dots indicate confirmed records, green dots are provisional or uncertain records, and yellow dots are drift records. I had difficulty remembering which colour of dots represented provisional or drift and had to keep referring back to the beginning of the section to check. A large visual key at the beginning of the map section may have aided my poor memory while my brain slowly consolidated this simple concept. Maps of records from the

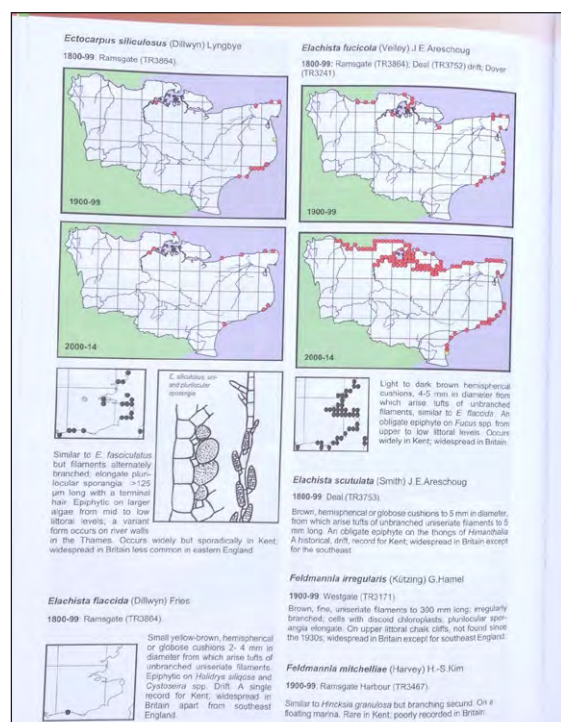
different centuries to allow a comparison works well. Accompanying this printed volume is a CD with post-millennium species maps at the 1 km grid square (monad) scale.

The *New Atlas of the Seaweeds of Kent* has been very useful to me and the other authors of the forthcoming second edition of the *Seasearch Guide to Seaweeds*, enabling us to update the maps (originally derived from A check-list and atlas of the seaweeds of Britain and Ireland by Hardy and Guiry (2003)).

In the conclusion section, Ian has listed what has been identified from the enormous number of records spanning over 400 years. An example is "The relative stability in the seaweed flora apart from the arrival and spread of nine non-native species, the lack of recent records (possible loss) of a few (e.g. *Kuetzingiella holmesii*) and the sporadic occurrence of a few others (e.g. *Desmarestia viridis*)."

The book is thorough and comprehensive. The Kent Field Club to which Ian has belonged for 45 years can be very proud of this publication. It is a valuable legacy of Ian's 50 years of seaweed study and I recommend it to anyone interested in either seaweeds or in the natural history of Kent.

Available from the Kent Field Club for £24 (incl. p&p):
www.kentfieldclub.org.uk



How I become a marine biologist

Dave Conway



I was not channelled into a marine science career because I lived within the sound of breaking waves. Dumfries, where I was born and lived just outside, is the small county town of a predominantly agricultural region in the south of Scotland. The River Nith that runs through the town is certainly tidal right to the centre, but the nearest open sea, the Solway Firth, is around fifteen miles away. While we made many trips to the small beaches of the Firth in the summer months, I spent most of my time ranging around the local countryside or the local streams and rivers, fishing for trout and grayling, but more often catching eels.

Fishing certainly gave me an interest in eating fish, but also in wildlife and I still remember seeing mossy rocks in stream waterfalls covered in migrating elvers, and sinister looking sea lampreys lurking in river bed hollows.

Because of the local economy, there was an expectation that I would eventually work in some area of agriculture, hopefully at a higher level than the seasonal work gathering potatoes, hoeing swedes and milking cows that I used to do. After my two-teacher village primary school start to education I could have gone to a Dumfries secondary school when I was eleven. Instead I did a sixteen mile daily bicycle and bus commute to a school that was particularly science orientated. It became a young offenders institution after I left! Apart from the usual science subjects I also obtained certificates in Agriculture, but am still waiting to put my knowledge on the treatment of fungal diseases of barley into practise.

In 1963, towards the end of my sixth year I saw some unspecified technician positions advertised at the Marine Laboratory in Aberdeen, which involved cruises on research vessels and taking turns at helping the fisheries statistics team measure fish at the fish market. At the time all of this sounded rather appealing. The prospect of getting paid around £6 a week was also pretty attractive, so I applied. Employment prospects at that time



Classes 1 to 4 at Terregles Primary School near Dumfries in 1954. I am on the extreme left sporting a large bandage on my knee and wearing fashionable tackety boots.



Sorting zooplankton at the Aberdeen Marine Laboratory in 1966.

were very good and compared to now, relatively few school-leavers went to university. Doing a PhD was also much rarer than now, even lacking in the CVs of many very senior scientists of the time.

My interview led to me being offered a post in the plankton section. Thanks to some excellent educational cartoons and nature programmes, most people over the age of three now know what plankton is, but in pre-Google days I had to check what I would be working on in an encyclopaedia. Younger people reading this may have to Google what an encyclopaedia is. As it turned out, dealing with slippery fish at the market at 0600h on freezing, black winter mornings, while high in the accumulation of moral fibre, did not have a particularly elevated enjoyment factor. Additionally, the very first two research cruises I went on suffered horrendous weather conditions; the second limping back to port an unprecedented three days late. However, there were many rewarding aspects to the work. My main laboratory duties were to identify and count plankton from samples collected during research cruises from all the areas where Scottish fishermen operated. These ranged from samples from Scottish inshore waters to samples taken off Iceland. Particularly challenging were occasional samples of beautiful bathypelagic species, collected from as deep as 1700 metres. My main claim to fame at the time was dropping a large glass jar of plankton and formalin on the floor of our laboratory just as Sir Alister Hardy, the doyen of UK zooplankton research, walked through the door for a visit with my

boss, who had been part of his team at the University of Hull.

We were encouraged by the laboratory to further our education, so I completed various evening and day release courses. After six years of dabbling at this I used all the qualifications I had accumulated to apply to Aberdeen University to do an honours degree in Zoology. I was given unpaid leave to do this and even worked back at the laboratory during the longer holidays. The combination of university grant and holiday working made me so affluent that I was able to purchase my first vehicle, an Austin Minivan, the ultimate all-purpose utility vehicle of the 1960's.

I returned to full time work at the laboratory when I graduated, but in 1977, for a change of scenery, I managed to get offered a job at the Institute for Marine Environmental Research in Plymouth, now the Plymouth Marine Laboratory (PML). My main work there was on fine scale vertical distribution of a range of plankton species and larval fish mortality, recruitment and modelling studies. As part of the larval fish work I did a series of experimental feeding and digestion studies using turbot larvae from a fish farm, to test some observations I had made while examining the guts of preserved larvae. It was the only time I worked with live animals and what were quite simple experiments gave some very novel results. Working with live animals was so compelling that I used to get into work two hours early to play with them and I wish now that I had done more of it.

In 2000, PML hit their first financial crisis, necessitating redundancies. To divest themselves of some of their more expensive staff, our small group of three were a discrete target, so I ended up with several others facing the firing squad. We had just started a large international EU funded contract on fish survival, as the co-ordinators, so it seemed rather an illogical time to dump us. However, in stepped Steve Hawkins, the then director of the Marine Biological Association (MBA), who arranged positions and facilities for us at the MBA, enabling us to complete the contract, for which we remain extremely grateful.

Money from a NERC retraining scheme was available for people made redundant, to



His Royal Highness Prince Michael of Kent, patron of the "Shoals of Capricorn" programme, visiting a training workshop for the project in the Seychelles in April 2002.

enhance their future employment prospects. I considered testing NERC to see if they would pay for me to retrain by doing a course in Thai Massage, but instead used the funds to pay the fees to do a PhD by Published Works through the University of Plymouth. This is a splendid, reduced pain way to do a PhD if you have produced a number of good publications over a short period, that are related and can be strung together in a thesis to give a convincing yarn. Since then I have worked on other contracts and research, including forcing myself to go on six visits to Mauritius and the Seychelles, but now work part-time, mainly on educational projects, running training courses on zooplankton identification in the UK and sometimes internationally. My work has always revolved around identifying organisms rather than describing them, but while working in the Indian Ocean I happened across two new



School children hearing about plankton during National Science Week at the MBA in April 2015.

species of copepods. To find and describe species new to science is a particularly exciting thing to do, certainly your first one.

As a legacy for future plankton workers, in order to bring together widely scattered information on zooplankton identification, I compiled identification guides to the zooplankton of the western Indian Ocean and northern Europe. They are available online to download free. I also occasionally do part-time contract work identifying zooplankton for various environmental companies who need boxes ticked, but more regularly for the Sir Alister Hardy Foundation. This brings in enough additional resources that I can splurge on more foreign holiday travels each year than I really deserve.

I consider myself very lucky that I stumbled, somewhat by chance, into a career that I have found interesting, stimulating and often challenging and worked with many dedicated and wonderful people.

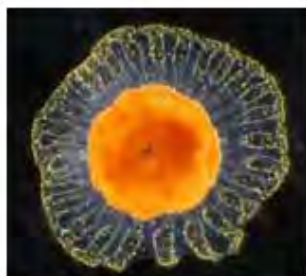


Zooplankton identification workshop at the National Institute of Oceanography Laboratory in Goa, India in December 2003. Loved the elegant attire of the trainees!



A zooplankton identification workshop held at the MBA, Plymouth in March 2016.

Guide to early post-settlement stages of fouling marine invertebrates in Britain



John Bishop, Anna Yunnice, Emily Baxter and Christine Wood
with help from Aaron Hartnell and Christopher Dwane

Version 2 (July 2017)



Marine Biological Association
Occasional Publication No. 29

New Version of 'Early Stages' Fouling Guide

An enlarged second edition of the 'Guide to Early Post-settlement Stages of Fouling Marine Invertebrates in Britain' is now available for download as an Occasional Publication of the MBA at <http://plymsea.ac.uk/7468/>. The first version was part-funded by a small grant from PMNHS. The guide focuses on the early days of development following settlement onto solid structures, when sessile species often differ markedly from the later adult stages depicted in identification books. It includes at least a dozen non-native species, mostly bryozoans and ascidians.

Instructions to authors

Although we can deal with most methods and styles of presentation, it would make our editorial lives easier and speed up publication if contributions to the *Bulletin* could follow these simple guidelines. Please submit material in electronic format where possible either by e-mail or CD.

Title, Author(s) & Address(es)

Title should be concise, informative and in bold type. Include author(s) names each with one full Christian name. In multiauthored contributions, the last name is separated by an ampersand, e.g., John Smith, David G. Jones & Susan White.

Include any institution/place of residence & contact details to appear with your name at the beginning of your article. Multiple author addresses can be linked to authors by superscript numerals.

Text

- Times New Roman font, 12pt, single line spacing, saved as a Word document (.doc/.docx)
- Use bold to highlight headings but do not use any Word 'styles' to format text. Avoid using headers and/or footers where possible.
- Reference tables & figures in the text as Figure 1, Table 1 etc. and in legends as Table 1: , Fig. 1: (individual parts A, B etc should be described also).
- Indicate where figures should be placed e.g. Insert Fig.1 here (send image files separately to text)

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Scientific names

Latin names should be italicized. The entire scientific name should be given in full the first time it is mentioned, but thereafter the genus can be abbreviated — except at the beginning of a sentence. Authorities for taxa follow standard taxonomic guidelines, with a comma before the date; e.g., *Zeuxo holdichi* Bamber, 1990; *Melinna albicincta* Mackie & Pleijel, 1995; *Neanthes irrorata* (Malmgren, 1867).

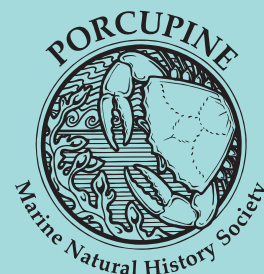
References

- Do not leave a line space between references. Journal titles should be cited in full.
- Citations in text:Brown & Lamare (1994)...or... (Brown & Lamare 1994)..., Dipper (2001)... or...(Dipper 2001).
- The main reference styles are as follows:

Brown, M.T. & 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, London. 96pp.

Ellis, J.R., Lancaster, J.E., Cadman, P.S. & Rogers, S.I. 2002. The marine fauna of the Celtic Sea. In J.D. Nunn (Ed) *Marine Biodiversity in Ireland and adjacent waters. Proceedings of the ECSA Conference, 26-27 April 2001*. Ulster Museum, Belfast. pp. 83-82.



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