

BULLETIN of the PORCUPINE MARINE NATURAL HISTORY SOCIETY

Spring 2019 — Number 11



Bulletin of the

Porcupine Marine Natural History Society

No. 11 Spring 2019

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Aims of the Society

- To promote a wider understanding of the biology, ecology and distribution of marine organisms.
- To stimulate interest in marine biodiversity, especially in young people.
- To encourage interaction and exchange of information between those with interests in different aspects of marine biology, amateur and professional alike.

Porcupine MNHS welcomes new members - scientists, students, divers, naturalists and all those interested in marine life.

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 (individuals can choose to receive either a paper or pdf version; students only receive the pdf) which include proceedings from scientific meetings, field visits, observations and news.

Membership fees: Individual £18 Student £10

Ordinary Council Members

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Editorial

After reading Jon's "How I became...." and seeing all the folk (many Porcupines included) who have inspired Jon towards having an innate understanding of the marine world, it has made me reflect on what the Society does and what the role of the Porcupine Council is. What do we do as the Council for Porcupine and fellow Porcupines, and what can Porcupines do for the Society?

The aims of the Society are printed on the inside cover of this *Bulletin* and it is the Council's responsibility to guide the society towards those aims. How are we doing? As a quick summary, I see Porcupine currently promoting a wider understanding through our 'roaming' annual conference and field trips to all parts of the UK, and I believe we reach out to members to encourage interaction and exchange of information through the *Bulletin*, Facebook and Twitter. But what else could we do in stimulating interest in marine biology, especially in young people? Do you have ideas? If so then we would like to hear them.



Porcupine Marine

@PorcupineMNHSS Follows you

Porcupine Marine Natural History Society. Tweets mainly on UK and Ireland marine life ID, taxonomy, marine biology and ecology and research and conservation.

The Porcupine council is an eclectic mix of professionals and non-professionals connected by a passion for marine natural history. It is also an ever evolving group and would welcome anyone who feels they have something to offer, has skills that we can use and would like to contribute to making Porcupine what it is.

So what does being on the Council mean? If you have an Honorary role then there is a little more work behind the scenes related to planning events, looking ahead, keeping up with the membership, caring for the finances, managing the website and preparing the *Bulletin*. Other roles support the honorary roles, bringing ideas and ensuring that the aims of the Society are kept in focus. Of course that is the 'work' side but there is a fun side too! Being on the Council has given me some unique and unforgettable experiences and opportunities. I clearly remember the first council meeting I attended – I was immensely excited to be going to a meeting in what, since a small child, has always been my favourite place in London, the Natural History Museum. The icing on the cake was walking with Roger Bamber through the back corridors, listening to him talk animatedly about scientific names and the background to some of his favourites. I was awe struck and inspired by how his humour, passion and his, sometimes remarkably obscure, knowledge. This led to some highly entertaining email conversations and me learning how he came to invent the name of a new species of pycnogonid, of the genus *Tanystylum*, collected from Hong Kong. He called it *Tanystylum sinoabductus*, see page 43 for the meaning of the name.

If you feel you would like the opportunity to join the Porcupine Council, have some fun and mix with like-minded marine folk to make Porcupine even better then please do contact any of us – by phone, email or face to face at the conference or on a field trip. We would welcome you with open arms, some entertaining conversations and, quite possibly, cake!



Vicki Howe, Hon. Editor



16th MBA Postgraduate Conference

Newcastle University
5th-8th May



The MBA postgraduate conference has a reputation for providing a welcoming and open platform where postgraduates can share their marine science research. This

year will be no different as the conference will deliver the same friendly and encouraging environment but with a touch of the famous Northern hospitality.

We aim to bring together marine scientists, stimulate discussion about ongoing research and generate ideas that may lead to future collaborations.

Open to all current postgraduates/postgraduates within three years of graduation/early-career scientists (i.e. research assistants).

Booking closes 31st March 2019. See <http://mbapg19.co.uk> for details.



MBA Short Courses, Plymouth

Introduction to Plankton
11th-12th May

A two-day series of talks and practical sessions for non-specialists, aimed at giving a very broad introduction to the wide range of amazing planktonic organisms that can be sampled by towing a fine-mesh net through the

sea, their identification, biology, distribution and importance in the global ecosystem. This course is suitable for beginners, but more experienced naturalists are welcome too.

Visit <http://www.mba.ac.uk/events> for further details and how to book.

St Andrews Bioblitz 2019

7th-8th June



Join in with the annual 24-hour biodiversity survey 'St Andrews Bioblitz 2019'.

During Bioblitz we will survey wildlife around the Gatty Marine Laboratory/Scottish Ocean's Institute at East Sands. All sessions are open to the public. Come and learn about the plants and animals from our experts and contribute to this scientific survey.

For more information please check the Bioblitz Facebook page: <https://www.facebook.com/StABioblitz/>

National Oceanography Centre, Southampton, Open Day



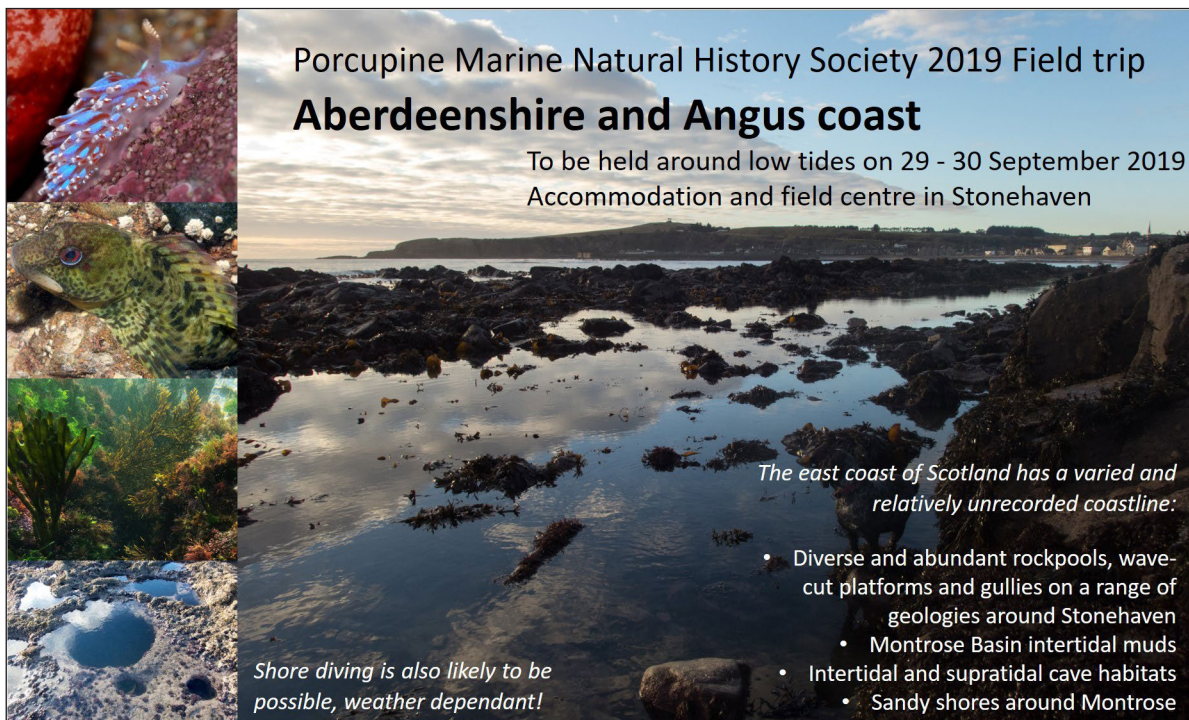
National
Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Saturday 8th June

For one day of the year, the National Oceanography Centre (NOC) in Southampton opens its doors to the public, giving a unique view of the ground breaking science and engineering undertaken across the NOC.

The day is a mix of hands-on science, exhibits and talks, with content aimed at all age groups. This is a unique opportunity to get close to their fleet of robotic vehicles and to talk to their scientists and engineers about the work that they do.

This event is free to attend, but registration is required and will open in May 2019.



Porcupine Marine Natural History Society 2019 Field trip
Aberdeenshire and Angus coast

To be held around low tides on 29 - 30 September 2019
 Accommodation and field centre in Stonehaven

The east coast of Scotland has a varied and relatively unrecorded coastline:

- Diverse and abundant rockpools, wave-cut platforms and gullies on a range of geologies around Stonehaven
- Montrose Basin intertidal muds
- Intertidal and supratidal cave habitats
- Sandy shores around Montrose

Shore diving is also likely to be possible, weather dependant!

Festival of Nature

Bath: 1st June
Bristol 8th-9th June

Festival of Nature is the largest UK event of its kind, bringing the natural world to life across the West of England in a week-long programme of events across the region. The Festival is a vibrant celebration of science, art and nature providing an amazing platform for visitors, contributors, volunteers and organisations to engage, learn and take positive action together.

Find out more at <https://www.bnhc.org.uk/festival-of-nature/>

Porcupine Marine Natural History Society Field Trip 2019

29–30 September

This is the 1st announcement (see above) for what looks to be a fantastic venue for this year's PMNHS field trip. Further details will be emailed out to members as they become available as well as posted on the website so keep your eyes peeled!

9th Unknown Wales 2019

A day to celebrate Welsh wildlife
Amgueddfa Cymru-National Museum Wales,



Cardiff, Saturday 26th October

This one-day meeting celebrates Welsh wildlife, highlighting the icons as well as the less well-known flora and fauna. The day will showcase new discoveries and new thinking on nature in Wales, whether on land or in the sea, through a series of short talks.

Details of the conference will be uploaded as they are available at: <https://www.welshwildlife.org/unknown-wales/unknown-wales-2019/>

WANTED !

Have you seen this worm? (or the other one?)



Eyelash worms (*Myxicola* spp.: Annelida, Polychaeta) are large(-ish) sabellid fan worms found in soft sediment habitats including mud, maerl and soft sand, all around the UK. Two varieties may be spotted by divers, those with dark 'eyelashes' (left image) around the edge of the crown and those without (right image). The latter form may also be seen in a variety of colour shades including pink, orange and green. At the moment, distribution maps are only available under one species name although we believe that these forms represent two different species. I am undertaking a project to investigate the two forms but want to gather as much data as possible on their distribution through photo records too.

If you have any photos of these worms, from any British or Irish location, on any date, I would be interested in seeing your photos (so long as presence or absence of the 'eyelashes' is clear). Please send your records (with photos) together with the location, date and, if possible, depth it was taken at to: Teresa.Darbyshire@museumwales.ac.uk. Photos can be sent at any resolution so long as the image is clear. All copyright data will be maintained with the images.

It is hoped we can clarify this issue that has been taxing many people for a long time and hopefully produce more accurate distribution maps and improve identification for the future.

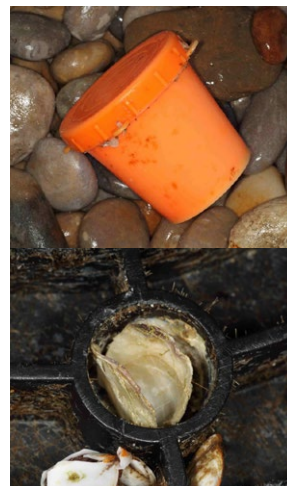
Please help!

A Plea for Plastic Waste!!

If anyone encounters large plastic items such as bait pots, buoys etc. washed ashore can you look closely to see if there are any bivalves attached? I'm looking for rafting bivalves - those that attach themselves to items using a byssus - in particular that have likely travelled across the Atlantic. Goose barnacles on items are usually a good sign that it has been floating around for a while. The bivalves attach in amongst them. Data from any locality are useful, but information on Welsh beaches would be particularly welcome. I have some data for the SW England and Ireland but nothing from Wales as yet.

If you could send me an email or text as to the location of the item and if you have time for a snapshot of the bivalve that would be amazing.

Please contact: Anna.holmes@museumwales.ac.uk; 07816 052046 with any information.





Field Studies Council in Pembrokeshire

7th Marine Research Symposium

Saturday 6th April (9am – 5pm)
Dale Village Hall

INVITATION

Dale Fort Field Centre is one of 19 field centres run by the Field Studies Council. It first opened its doors in 1947 becoming the UK's, and probably the world's, first Marine-based Field Centre. Our sister field centre at Orielton has also been delivering marine based field studies since 1963.

FSC Dale Fort is hosting its 7th Marine Research Symposium on Saturday 6th April 2019, which is an opportunity to showcase marine and coastal ecological research, conservation and education initiatives. To accommodate more people, we have moved the venue from the field centre to Dale Village Hall, although lunch will still be at Dale Fort.



Dale Fort Field Centre

The Symposium will consist of a series of papers (delivered as presentations or posters) on past and current work being carried out in and around Pembrokeshire, and further afield.

In the afternoon, there will also be a **ROCKY SHORE BIOBLITZ** – a field excursion to Jetty Beach to take advantage of the good low tide, where people are encouraged to assist with recording all the species we can find, with local experts on hand. The list will be submitted to national and regional databases.

The Symposium is open to anyone - students or HE staff currently working in marine research, conservationists and rangers, interested naturalists or members of the public who want to find out more about the marine environment.

Attendance costs £15, which includes light refreshments and a buffet lunch – advance booking essential. This fee is waived for people giving presentations or posters. If you are interested in presenting a poster, please get in touch.

We can also offer B&B accommodation at one of the Pembrokeshire centres for those travelling from further afield – accommodation is limited, so please book early if you require this.

To book a symposium place or accommodation, email
admin.pb@field-studies-council.org or ring 01646 636205

For queries about the programme or structure of the day please contact Helen Lewis:
email h.lewis@field-studies-council.org or ring 01646 636205.

PMNHS Field Trip to Lyme Bay

1. The shore report

Frances Dipper

Surveyors: FD (Frances Dipper), AJ (Adam Jenkins), PF (Peter Forrest), LB (Lin Baldock), FC (Fiona Crouch), DK (David Kipling), SB (Sarah Bowen), PT (Peter Tinsley)

[Note: Species name authorities provided in Tables 1 & 2]

Lyme Regis – home to ammonites (Ammon's Horn), belemnites (devil's fingers), ichthyosaurs, plesiosaurs, Mary Anning, my brother and innumerable tourists – saw an influx of Porcupines in May last year. This was the first of (unusually) two PMNHS field trips for 2018, followed by a visit to the Mullet Peninsula on the Irish west coast in September. As has become the norm, this trip combined a shore team looking at the intertidal region, with Seasearch divers checking out the sublittoral. The weather was mostly kind, allowing sandwiches to be consumed on sun-warmed rocks, though the divers got a bit of a buffeting from the wind. The shore surveys were co-ordinated by myself whilst the diving was organised by Lin Baldock who lives locally. So too does Charlotte Bolton, the Seasearch National Coordinator, who ensured no-one was allowed home without filling in their Seasearch forms. Although time and tide did not allow the divers and shore recorders to mix and mingle very much, we did manage an evening meal together in a local pub in the true spirit of all Porcupines. Notwithstanding the salty state of the Seasearch team, straight from their dives, much beer was drunk and plenty of information exchanged.

Shore surveys

Due to low-tide timings and only a small shore team staying (or living) in disparate locations, it proved impractical (and unnecessary) to arrange a 'laboratory' for specimen identification. During the four days of survey, a meeting point was arranged each day to cover the main sites with rocky shores. These are in relatively short supply within Lyme Bay and need a good spring tide to reveal their full glory. Shore access is limited due to extensive areas of unstable cliff and (beautifully) wild

coast. The areas between the rocky shores consist mostly of shingle and sand and accessing the chosen areas often involved a long, but pleasant trudge, all the time keeping an eye out for any interesting fossils the hordes might have missed. The glint of 'Fool's Gold' (iron pyrites) is everywhere but sometimes a near-perfect ammonite is washed out amongst the nuggets. (I once spent a fascinating two weeks as a student doing a holiday job in the Natural History Museum, working on ways to preserve such fossils, which can 'rust' and disintegrate). As with all Porcupine surveys, species recording was the main aim, but in addition one particular aim was to collect and collate records for honeycomb reef worm, *Sabellaria alveolata*, and also to add records to Lin Baldock's burgeoning 'Dorset Seaweed Atlas'.

What the shore party lacked in numbers (four, plus four of the divers on non-diving days), it made up for in enthusiasm but not all taxa could be covered in detail. Adam Jenkins provided an impressive list of 'small beasties' from weed washings on the first day in Lyme Regis (Table 1), and seaweeds were well-covered by Lin Baldock at Charmouth Ledges and East Ebb and not so well-covered by myself at the other sites. Table 2 lists all other species recorded during the shore and diving surveys. Peter Tinsley (Living Seas Manager Dorset Wildlife Trust and previous PMNHS council member) joined us at East Ebb on the Saturday.

Broad Ledge, Lyme Regis 16th May 2018
SY346922

Surveyors: FD, AJ, PF

Broad Ledge lies below Church Cliffs and the coastal defence scheme wall at the east end of Lyme Regis. It is a wide expanse of shale and limestone ledges with shallow, silty rockpools and scattered boulders. It is a classic site with a long history of intertidal recording, and has a good variety of macrofauna and seaweeds and seemed an excellent area to start as it is easily accessible. The divers also set out from Lyme Regis harbour aboard *Blue Turtle* for a day of surveying "some diverse rocky ground about 5km SE of Lyme Regis and maerl-rich ground a bit closer to Lyme Regis".

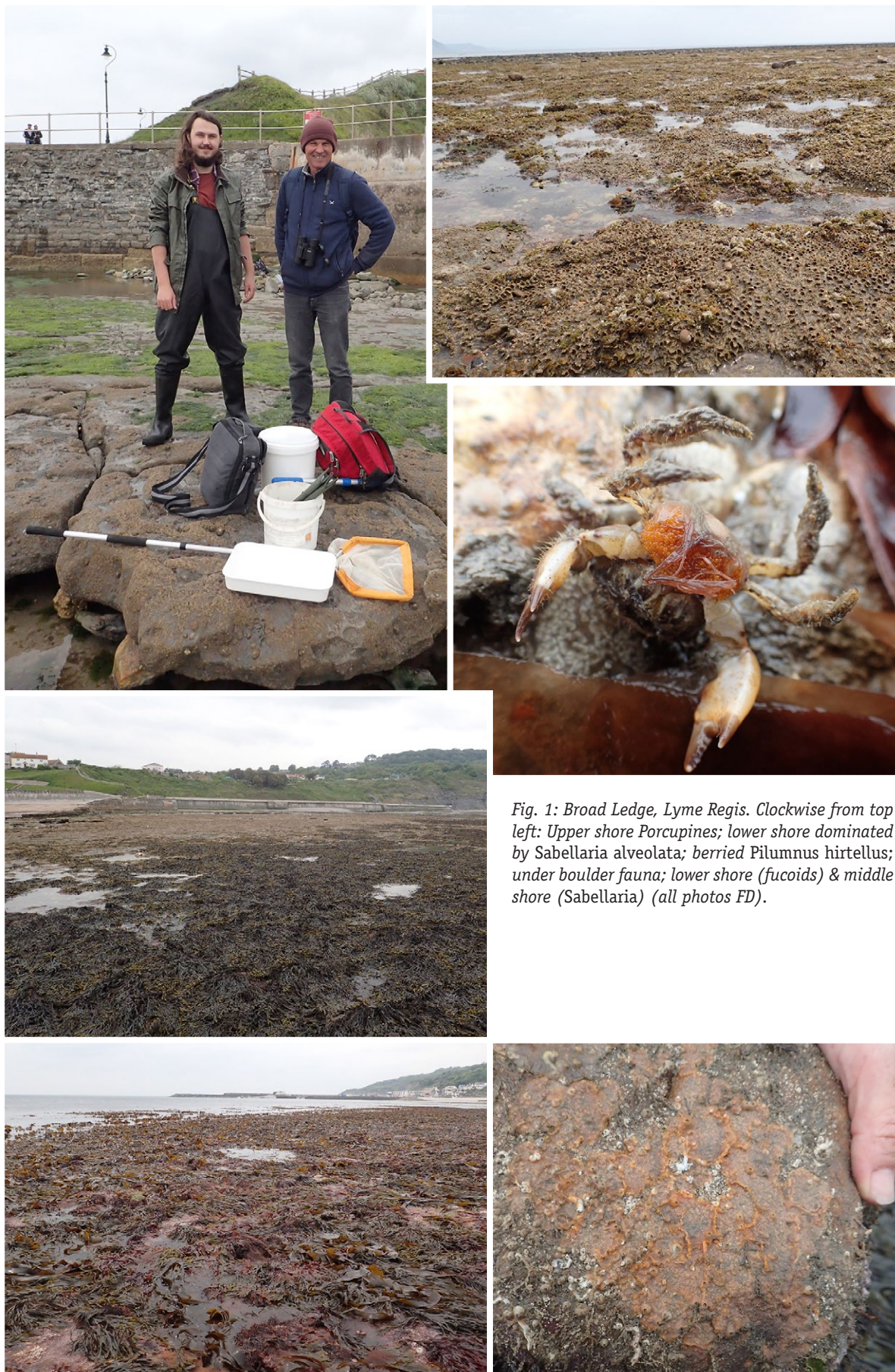


Fig. 1: Broad Ledge, Lyme Regis. Clockwise from top left: Upper shore Porcupines; lower shore dominated by *Sabellaria alveolata*; berried *Pilumnus hirtellus*; under boulder fauna; lower shore (fucoids) & middle shore (*Sabellaria*) (all photos FD).

The upper shore rocky platform backs up to the sea wall protecting the cliffs and was dominated by barnacles and *Ulva* spp. with toothed topshell, *Phorcus lineatus*, which I shall forever think of as *Monodonta*, a much more expressive genus name. Here *Ulva* shared shallow rockpools with wireweed, *Sargassum muticum*, with one very extensive pool totally dominated by it. There are also sandy patches along parts of the upper shore.

The upper middle shore platform was dominated by foliose seaweeds especially *Scytosiphon lomentaria*, *Corallina officinalis* and *Osmundea* spp. as well as patches of honeycomb reef worm, *Sabellaria alveolata*, the amount and extent of which increased moving seaward. The latter was low lying and not built up into reefs. Limpets, *Patella vulgata*, barnacles, common periwinkle, *Littorina littorea* and topshells, *Steromphala umbilicalis* and *S. cineraria* were also common. Large areas of the lower parts of the middle shore platform were dominated by low-lying *S. alveolata* with patches of foliose seaweeds especially in runnels and pools.

The lower shore platform was dominated by furoid seaweeds mostly *Fucus serratus* with a fairly abrupt change from *Sabellaria* and foliose seaweeds to this, although the level of the line of change varied along the shore. In some parts, there was a narrow zone dominated by acorn barnacles, *Semibalanus balanoides*, between the two. Foliose algae were common, underlying between and on the *Fucus* especially towards low water mark. *Corallina*, *Ceramium* and *Palmaria palmata* were common or abundant as were coralline and other crusts whilst *Cladophora rupestris* was frequent. *Lomentaria articulata* was common draping small vertical edges of bedrock. Small boulders and cobbles lying in shallow pools were encrusted on the underside with orange bryozoans, tube worms (*Spirobranchus* sp. and *Spirorbinae*) and fringes of small hydroids. *Corallina* was abundant in these pools and some were filled with *Sargassum*.

At low water, a sublittoral fringe forest of kelp oar weed *Laminaria digitata* was visible just below low water and kelp was also scattered amongst the *F. serratus* just above this.

Honeycomb reef worm, *Sabellaria alveolata*, was present in quantity and dominated the rocky platform over a large area of the middle shore. The growths were low-lying rather than mounded.

Golden Cap Seatown 17th May 2018 SY407917

Surveyors: FD only (with JB safety support)

Golden Cap is the highest cliff along the Jurassic Coast, and, in fact along the whole south coast of England. The shore below it is an irregular spit of boulders, slabs of fallen rock and flat bedrock ledges extending out seawards from the base of the unstable cliff face and mud slides. On either side of the headland, the shore is composed of banked up shingle. The shore is accessed from Seatown to the east and a kilometre or so (pleasant) trudge along the shingle. High tides sometimes reach right up to the backing mud slides and cliff, where there is a danger from falling rocks and debris.

The upper shore boulders were irregular in size and shape, pitted and progressively fewer in number going down the shore, as would be expected since they originate from the cliff itself. Some were bare whilst others had a cover of acorn barnacles, *Chthamalus montagui*. Barnacles lower down were not checked for species. Immediately below the upper shore boulder jumble, relatively smooth horizontal bedrock ledges run down the shore with overlying boulders, and scattered rockpools. The lower shore was a wide platform with a maximum extent of about 50-60 m at the furthest point at extreme low water and a fringe of broken rock along the edges.

This is a 'red seaweed shore' with relatively few opportunities for a rich fauna, either sessile or mobile, and too exposed for furoids. Many of the middle shore boulders had heavy fringes of bunny ears, *Lomentaria articulata*, pepper dulse, *Osmundea pinnatifida*, and luxurious swatches of comb weed, *Plocamium* (probably *maggsiae*). The tops of the boulders were barnacle-dominated here, but seaweed-dominated on the lower shore, often with dense areas of carrageen, *Chondrus crispus*. The bedrock platform in the middle shore was silty with abundant sea lettuce, *Ulva lactuca* and silt-



Fig. 2: Golden Cap, Seatown. Clockwise from top left: Approach from east; Osmundea on middle shore boulder; lower shore platform and sublittoral fringe; sublittoral fringe kelp and red seaweeds; Sabellaria alveolata on boulder; lower shore seaweed-covered platform; Anemonia viridis middle shore; (all photos FD).

covered coral weeds (mainly *Corallina* spp. plus *Jania rubens* in pools). Snakelocks anemone, *Anemonia viridis*, were common in groups. There were also occasional dense patches of dulse, *Palmaria palmata*. *Sargassum* was occasional to frequent in pools, even tiny ones.

The lower shore platform had a total cover of red seaweeds mainly three species *Corallina officinalis*, plus *Ceramium* and *Plocamium maggsiae*. Others included occasional hairy sand weed, *Cladostephus spongiosus*. A kelp forest of oar weed, *Laminaria digitata* was clearly visible in the sublittoral fringe, with some scattered individuals extending up onto the platform.

Honeycomb reef worm, *Sabellaria alveolata*, was only present on low water boulders at the eastern edge of the site. The patches were small and there were no 'reefs' as such.

Charmouth Ledges (Bar Ledges) 18th May 2018 SY360929

Surveyors: FD, LB, FC, DK, SB

Charmouth is the next town to the east of Lyme Regis, about two km as the crow flies. A short walk west along the shingle beach, there is a series of rocky ledges that extend seawards, backed by shingle. These are marked as Bar Ledges on the OS Explorer map 16 with a further set of ledges to the west, marked as Canary Ledges. The shingle, cobble and sand beach to the west of Charmouth stretches about 2 km from the mouth of the river Char to Lyme Regis along the base of Black Ven, one of the largest and most active landslides in Europe. At low tide it is an easy walk between the two towns, provided careful account is taken of the tide. We surveyed parts of the ledges within about half a kilometre from Charmouth, with its big car park, welcoming café, loos and visitor centre! The beach is a haven for fossil hunters though in theory no hammering of cliffs is allowed.

The shore consisted predominantly of extensive boulders with an inmix of cobbles and pebbles and sloped very gently seawards. In one part of the lower shore, an extensive area of water was cut off to form a 'lagoon' by a ridge of boulders. On the lower shore there were also long fingers of rocky, seaweed-covered

platform, similar to, but less extensive than the platforms at Golden Cap. The boulders were bare at the very top of the shore, with a short scraggy zone of spiral wrack, *Fucus spiralis*, on the upper shore. Below this the middle and lower shore boulders were barnacle-dominated with limpets, *Patella*, dogwhelks, *Nucella lapillus* and periwinkles, *Littorina* spp. Lower shore boulders were fringed with seaweeds mainly sea lettuce, *U. lactuca*, pepper dulse, *Osmundea pinnatifida*, and 'ropes' of the filamentous red alga rope weed *Callithamnion tetricum*. Large areas of lower middle shore and lower shore boulder tops were dominated by mounds of honeycomb reef worm, *S. alveolata*.

The lower shore bedrock platforms were dominated by *Sabellaria* (see below) and red seaweeds, especially carrageen, *C. crispus*. Other reds included false pepper dulse, *Osmundea hybrida*, *Ceramium* spp., common coral weed, *Corallina officinalis* and purple claw weed, *Cystoclonium purpureum*.

Between the main survey area of boulders and ridges and Charmouth were low, stepped rock ridges draped with *Fucus*. The soft rock was heavily bored by common piddock, *Pholas dactylus*. Common prawns, *Palaemon serratus*, were common in pools at the bases of the 'steps'. Muddy sand areas between the rock ridges were colonised by red seaweed on the raised humps (species not identified as time, tide and coffee did not allow!).

Honeycomb reef worm, *Sabellaria alveolata* was abundant at this site which provided ideal habitat in the form of boulders with a good supply of sand/mud in between and under them. It formed substantial mounds on the tops and sides of the boulders, but not continuous reefs. It was mostly absent from the more exposed boulders along the seaward edge of the 'lagoon'. *Sabellaria* was also abundant on the bedrock platforms, as a thin layer, interspersed with a dense cover of red seaweeds (and possibly also beneath).

East Ebb Seatown 19th May 2018 SY429912

Surveyors: FD, LB, PT, PF

This site is about 0.8 km east from Seatown, accessed by walking along the shingle shore.



Fig. 3: Charmouth Ledges. Clockwise from top left: Upper shore boulders; lower shore boulders; Sabellaria alveolata colony; Sabellaria reef; view of shore and cliffs; lower shore platform with Chondrus crispus; rope weed Callithamnion tetricum pressed specimen (all photos FD).

Like Golden Cap it is on a headland but unlike that site, the rocky area is entirely of boulders.

The boulders run on eastwards a further kilometre or so as far as Great Ebb. Another kilometre of sand and shingle brings you to Eype Mouth. We surveyed the area at the East Ebb headland.

This exposed shore consisted of irregular and densely packed boulders, which presented an access challenge for those of mature years (i.e. me). At the headland point, these run right up to the cliff with no shingle available to walk along. The upper shore boulders were relatively bare, with scattered barnacles *Chthamalus montagui*, green gut weeds, *Ulva intestinalis*, and *U. compressa*, clusters of *Melarhaphe neritoides* in crevices and occasional toothed topshell, *Phorcus lineatus*. Fucoid seaweeds were sparse throughout the shore with occasional patches of bladder wrack, *Fucus vesiculosus*, in the middle regions. Only serrated wrack, *F. serratus*, was common, on the lower shore boulders, mixed in with the kelp oar weed, *Laminaria digitata*, in pools and down into the sublittoral fringe area. Lower shore boulders had fringes of red seaweeds especially pepper dulse, *Osmundea pinnatifida*, several *Ceramium* species, coral weed, *C. officinalis*, bunny ears, *L. articulata*, dulse, *P. palmata* and rope weed, *Callithamnion tetricum* (a southern species not in the Seasearch guide). Lower shore pools increased the diversity, with *Polysiphonia* spp., red rags, *Dilsea carnosus*, clawed fork weed, *Furcellaria lumbricalis* and siphoned feather weed, *Heterosiphonia plumosa*.

Honeycomb reef worm, *Sabellaria alveolata*, was not recorded at this site.

Species	Authority	Qualifier
ANNELIDA: POLYCHAETA		
<i>Harmothoe impar</i>	(Johnston, 1839)	aggregate
<i>Syllis variegata</i>	Grube, 1860	
<i>Galathowenia oculata</i>	(Zachs, 1923)	
<i>Aonides paucibranchiata</i>	Southern, 1914	
<i>Sabellaria alveolata</i>	(Linnaeus, 1767)	
ARTHROPODA		
Amphipoda		
<i>Microdeutopus chelifer</i>	(Spence Bate, 1862)	
<i>Cheirocratus</i> sp.	Norman, 1867	female
<i>Dexamine spinosa</i>	(Montagu, 1813)	
<i>Hyale stebbingi</i>	Chevreaux, 1888	
<i>Erichthonius punctatus</i>	(Spence Bate, 1857)	
<i>Jassa falcata</i>	(Montagu, 1808)	
Cumacea		
<i>Bodotria scorpioides</i>	(Montagu, 1804)	
Decapoda		
<i>Palaemon elegans</i>	Rathke, 1837	
<i>Liocarcinus depurator</i>	(Linnaeus, 1758)	
Decapoda spp.	Latreille, 1802	megalopa
Isopoda		
<i>Cleantis prismatica</i>	(Risso, 1826)	
<i>Idotea</i> sp.	Fabricius, 1798	Juv
<i>Idotea balthica</i>	(Pallas, 1772)	
<i>Idotea granulosa</i>	Rathke, 1843	
<i>Jaera</i> sp.	Leach, 1814	female
<i>Jaera (Jaera) prae-hirsuta</i>	Forsman, 1949	
<i>Dynamene bidentata</i>	(Adams, 1800)	
Ostracoda sp.	Latreille, 1802	
MOLLUSCA		
Bivalvia		
<i>Kurtiella bidentata</i>	(Montagu, 1803)	
Gastropoda		
<i>Retusa obtusa</i>	(Montagu, 1803)	
<i>Diodora graeca</i>	(Linnaeus, 1758)	
<i>Rissoa parva</i>	(da Costa, 1778)	
<i>Tricolia pullus</i>	(Linnaeus, 1758)	
ECHINODERMATA		
Ophiuroidea		
<i>Amphipholis squamata</i>	(Delle Chiaje, 1828)	

Table 1: Small animal species collected and identified by Adam Jenkins from Broad Ledges, Lyme Regis, not included in dataset for all sites given in Table 2. Specimens collected from weed washings and the algal turf.



Fig. 4: East Ebb Seatown. Images from top left down) View from Seatown; shallow upper shore pool; lower shore and kelp fringe; shore looking east; (top right) Melarhaphe neritoides in upper shore crevice



PMNHS Field Trip to Lyme Bay

2. Diving report

Lin Baldock

The Dive Team: Elena Bollati, Charlotte Bolton, Sarah Bowen, Fiona Crouch, Matt Doggett, David Kipling, Mike Markey, Cathryn Quick, Sally Sharrock, Chris Webb.

On the 16th May 2018, we were based out of Lyme Regis on the dive boat *Blue Turtle* with skipper Rob King. The weather was kind to us and we soon reached our selected targets picked from the detailed multibeam bathymetry. Underwater visibility was a tremendous 8–10 m but the water temperature a fairly bracing 11°C for us southerners.

Level Playing Field

Location: 50° 41.593'N 002° 53.252'W

Depth: 22m bsl (below sea level)

This site was selected as being representative of a large area of rocky reef in Lyme Bay, as revealed by the DoRIS multibeam data. It proved to be an area of sparse stony reef, essentially cobbles, pebbles and stone gravel spectacularly dominated by sea squirts, especially *Phallusia mammillata* (Cuvier, 1815), interspersed with colourful clumps of *Pyura microcosmus* (Savigny, 1816) with a scattering of *Microcosmus claudicans* (Savigny, 1816). The trumpet anemone *Aiptasia couchii* Gosse, a nationally scarce species with its headquarters in Dorset, was frequent and Fiona Crouch photographed *Mesacmaea mitchelli* (Gosse, 1853) – only the 10th record for Dorset.

There must be hectares of this habitat now protected from the ravages of mobile fishing gear under the Lyme Bay Statutory Instrument. Over 70 taxa were recorded from the site and Porcupines Sarah Bowen and David Kipling were enthralled by the display of sea squirts!

South of Charmouth

Location: 50° 43.152'N 002° 52.915'W

Depth: 11–12m bsl

Our dive started on a gently sloping seabed of pebbles and slipper limpets *Crepidula fornicata* (Linnaeus, 1758) in soft, silty sediment with sea squirts (mostly the rich red of *Polycarpa*



Fig. 1: A colourful clump of *Pyura microcosmus* ©Mike Markey

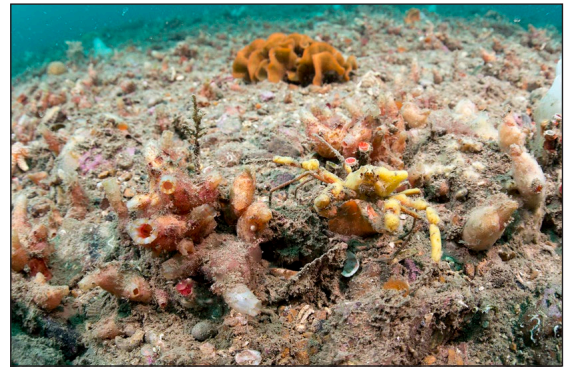


Fig. 2: Leach's spider crab squats among clumps of sea squirts swathed in yellow sponge. ©Matt Doggett



Fig. 3: *Mesacmaea mitchelli* (Policeman's Helmet anemone), the 10th record for Dorset. ©Fiona Crouch



Fig. 4: A busy Porcupine photographs *Pentapora foliacea* (Ellis & Solander, 1786) and *Phallusia mammillata*. ©Matt Doggett.



Fig. 5: Porcupines embark on Ruby J for dives in Lyme Bay. ©Lin Baldock

errans Hartmeyer, 1909) and sponge crusts rising to a low limestone ledge backed by level bedrock with sparse foliose red algae and more sea squirts. Again *Aiptasia couchii* was common in both habitats. This shallower site was selected in the hope of recording seaweeds. Though sparse, the list was respectable with 18 algal taxa listed.

Gatesy's Garden

Location: 50° 41.564'N 002° 47.487'W

Depth: 22-24m bsl

The second day (17th May) we sailed from West Bay on board *Ruby J* with Neil Birdsall as our enthusiastic skipper. Our first target was Gatesy's Garden, an area of bedrock and



Fig. 6: Large *Pentapora* colonies, Gatesy's Garden. ©Lin Baldock

boulder reef 2.5 km southwest of West Bay with seafans, of all sizes, a feature of the site. Things were all rather silty, but again there was good diversity, with over 70 taxa recorded.

Golden Cap Mud Margin

Location: 50° 42.847'N 002° 50.999'W

Depth: 11-13m bsl

Our second dive was beneath the steep eroding cliffs of Golden Cap at the edge of a shallow boulder reef. The task for three of us was to report back to the skipper on the significance of the seabed reflection he was getting on his side scan. Our dive proved to be essentially three habitats: lower infralittoral boulder reef, fine rippled sand over mudstone and low lying mixed ground of boulders, cobbles and *Crepidula* shells, showing quite distinctly on the side-scan. Again around 70 taxa were recorded on the boulder reef with much sparser fauna evident on the two sediment habitats.

A full report on the dives will be provided for the next edition of the *Bulletin*. The data will be secured as a Porcupine field trip through the Dorset Seasearch database and made available through the NBN Atlas.

Taxon	Authority	Common name	Broad Ledges Lyme Regis	Golden Cap Seatown	Bar Ledges Charmouth	East Ebb Seatown
PORIFERA						
<i>Terpios gelatinosus</i>	(Bowerbank, 1866)	royal blue sponge	Under-Bo LS			
Porifera indet yellow crust		yellow sponge crust	Under-Bo LS			
CNIDARIA						
<i>Actinia equina</i>	(Linnaeus, 1758)	beadlet anemone			P	
<i>Actinia fragacea</i>	Tugwell, 1856	strawberry anemone			R (LS)	
<i>Anemonia viridis</i>	(Forsskål, 1775)	snakelocks anemone		C (rock flats LS)		
ANNELIDA						
<i>Eulalia viridis</i>	(Linnaeus, 1767)	green leaf worm	P (ID not verified)			
<i>Lanice conchilega</i>	(Pallas, 1766)	sandmason worm	O			
<i>Sabellaria alveolata</i>	(Linnaeus, 1767)	honeycomb reef worm	A-D (top of MS)	F (small patches)	A (LS)	
<i>Spirobranchus</i> sp.	Blainville, 1818	keelworm	F			F-C (LS)
<i>Spirorbinae</i> spp.		spiral worm	P			
CRUSTACEA						
<i>Athanas nitescens</i>	(Leach, 1813)	hooded shrimp	P			
<i>Cancer pagurus</i>	Linnaeus, 1758	edible crab	R (juv)			
<i>Carcinus maenas</i>	(Linnaeus, 1758)	green shore crab	O (juvs)			R
<i>Cithamalus montagui</i>	Southward, 1976	acorn barnacle		D (Bo US)		C (US Bo)
<i>Necora puber</i>	(Linnaeus, 1767)	velvet swimming crab	P			
<i>Palaemon serratus</i>	(Pennant, 1777)	common prawn			P	
<i>Pilumnus hirtellus</i>	(Linnaeus, 1761)	hairy crab	R (berried LS)			
<i>Pisidia longicornis</i>	(Linnaeus, 1767)	long-clawed porcelain crab	F			
<i>Porcellana platycheles</i>	(Pennant, 1777)	broad-clawed porcelain crab		R (under rocks MS)		O (under sm rocks)
<i>Semibalanus balanoides</i>	(Linnaeus, 1767)	acorn barnacle	A (in zone MS)	P		P
MOLLUSCA						
<i>Pholas dactylus</i>	Linnaeus, 1758	common piddock		A (squirting holes)		
<i>Hinia reticulata</i>	(Linnaeus, 1758)	netted dog whelk	R (LS)			
<i>Lepidochitona cinerea</i>	(Linnaeus, 1767)	grey chiton	C (esp. US)			
<i>Littorina littorea</i>	(Linnaeus, 1758)	common periwinkle	F	F-C (MS Bo)	F	F
<i>Littorina saxatilis</i>	(Olivi, 1792)	rough periwinkle	P			P (US)

Table 2: Species list from all intertidal sites, excluding those reported in Table 1. Note that 24 additional seaweed species were added by Lin Baldock for the two sites (Charmouth Ledges and East Ebb Seatown) where she joined us. These may also be present at the other two sites but needed her expertise to identify them. D dominant; A abundant; C common; F frequent; O occasional; R rare; P present. US upper shore; MS middle shore; LS lower shore. Bo = Boulder.

Taxon	Authority	Common name	Broad Ledges Lyme Regis	Golden Cap Seatown	Bar Ledges Charmouth	East Ebb Seatown
<i>Melastophloeus neritoides</i>	(Linnaeus, 1758)	small periwinkle				F (US crevices)
<i>Nucella lapillus</i>	(Linnaeus, 1758)	dogwhelk	F	F-C	C (LS)	F (MS, LS)
<i>Patella pellucida</i>	Linnaeus, 1758	blue rayed limpet	R (on kelp)			
<i>Patella vulgata</i>	Linnaeus, 1758	common limpet	F	C-A (US, MS)	C	C-A
<i>Phorcus lineatus</i>	(da Costa, 1778)	thick topshell	C (US)	C (US Bo)	F (US)	O (US)
<i>Steromphala cineraria</i>	(Linnaeus, 1758)	grey top shell		C (US Bo)	F	P
<i>Steromphala umbilicalis</i>	(da Costa, 1778)	flat top shell		C (US Bo)	F	F
<i>Tonicella rubra</i>	(Linnaeus, 1767)	northern red chiton	P			
<i>Trivia monacha</i>	(da Costa, 1778)	European cowrie	O (LS)			
BRYOZOA						
<i>Electra pilosa</i>	(Linnaeus, 1767)	frosty sea mat	F (<i>F serratus</i> LS)			
Bryozoa orange		orange bryozoan crust	LS (under-Bo)			
<i>Ascidia</i> sp.	Linnaeus, 1767					
<i>Botrylloides leachii</i>	(Savigny, 1816)	colonial seasquirt	P (LS)			
PISCES						
<i>Apletodon</i> sp.	Briggs, 1955	clingfish	R (kelp SLF)			
<i>Gobiusculus flavescens</i>	(Fabricius, 1779)	two-spot goby				P (LWS)
<i>Lotidae</i> sp.		rockling	1 (juv in pool LS)			
RHODOPHYTA						
<i>Calithamnion tetricum</i>	(Dillwyn) S.F.Gray, 1821	rope weed	P	C (Bo)		C (Bo sides)
<i>Caulacanthus okamurae</i>	Yamada, 1933	Japanese pom pom weed			C (turf MS)	
<i>Ceramium</i> spp.	Roth, 1797	banded pincer weeds	A (LS <i>Fserratus</i>)	D-A (flats, Bo LWS)	F (flats, Bo)	C (LS)
<i>Ceramium deslongchampsii</i>	Chauvin ex Duby, 1830	banded pincer weed			P	P
<i>Ceramium secundatum</i>	Lyngbye, 1819	banded pincer weed			(LS in sand)	
<i>Chondrus crispus</i>	Stackhouse, 1797	carrageen	F (LS)	C-A (Bo LWS)	A (exposed form, flats)	C-A (LWS)
<i>Corallina officinalis</i>	Linnaeus, 1758	coral weed	C-A (top of MS)	A-D (flats, Bo LWS)	C	F
Corallinaceae sp.		encrusting pink algae		C (lining pools)		F
<i>Gyostoclonium purpureum</i>	(Hudson) Batters, 1902	purple claw weed			F-C (flats)	F-C (LS)
<i>Dilsea carnosa</i>	(Schmiedel) Kuntze, 1898	red rags		R (deep pool edges LWS)		R (pools LWS)
<i>Dumontia contorta</i>	(S.G.Gmelin) Ruprecht, 1850	dumont's twisted weed	A (MS)			P

Table 2 (cont.): Species list from all intertidal sites, excluding those reported in Table 1. Note that 24 additional seaweed species were added by Lin Baldock for the two sites (Charmouth Ledges and East Ebb Seatown) where she joined us. These may also be present at the other two sites but needed her expertise to identify them. D dominant; A abundant; C common; F frequent; O occasional; R rare; P present. US upper shore; MS middle shore; LS lower shore. Bo = Boulder.

Taxon	Authority	Common name	Broad Ledges Lyme Regis	Golden Cap Seatown	Bar Ledges Charmouth	East Ebb Seatown
<i>Furcellaria lumbricalis</i>	(Hudson) J.V.Lamouroux, 1813	clawed forked weed				A (pools LS)
<i>Gaillona hookeri</i>	(Dillwyn) Athanasiadis, 2016	Hooker's siphon weed				P
<i>Gelidium pulchellum</i>	(Turner) Kützinger, 1868	beautiful straggle weed	P (top of MS)			
<i>Gracilaria gracilis</i>	(Stackhouse) M.Steentoft, L.M.Irvine & W.F.Farnham, 1995	slender wart weed			0	
<i>Gymnogongrus crenulatus</i>	(Turner) J.Agardh, 1851	Norwegian fan weed			R	
<i>Halosaccicocolax lundii</i>	Edelstein, 1972	dulse parasite				(on <i>Palmaria</i>)
<i>Heterosiphonia plumosa</i>	(J.Ellis) Batters, 1902	siphoned feather weed				P (pools LS)
<i>Jania squamata</i>	(Linnaeus) J.H.Kim, Guiry & H.-G.Choi, 2007	creeping coral weed	F-C (LS)	F (check spp)		
<i>Jania rubens</i> var. <i>rubens</i>	(Linnaeus) J.V.Lamouroux, 1816	slender beaded coral weed		0 (pools)		
<i>Jania rubens</i> var. <i>comiculata</i>		slender beaded coral weed			P	
<i>Lomentaria articulata</i>	(Hudson) Lyngbye, 1819	bunny ears	C (edge of platform)	F-C (Bo sides)	P	C (LS Bo)
<i>Osmundea hybrida</i>	(A.P.de Candolle) K.W.Nam, 1994	false pepper dulse			F (patches on flats)	
<i>Osmundea osmunda</i>	(S.G.Gmelin) K.W.Nam & Maggs, 1994	royal fern weed	0 (shallow pools LS)	C-A (Bo LS, ELWS)	P	
<i>Osmundea pinnatifida</i>	(Hudson) Stackhouse, 1809	pepper dulse	F (LS)	P	0-F (Bo LS)	F-C (MS - LS)
<i>Palmaria palmata</i>	(Linnaeus) Weber & Mohr, 1805	dulse	C-A (MS LS)	C-A (flats, Bo LS)	R-0	F (LWS)
<i>Placanium</i> sp.	J.V.Lamouroux, 1813	comb weed	A (LS)			
<i>Placanium cartilagineum</i>	(Linnaeus) P.S.Dixon, 1967	comb weed			C (LS)	P
<i>Placanium maggiae</i>	G.W.Saunders & K.V.Lehmkühl, 2005	comb weed		A (flats, Bo LS)		C (LS)
<i>Plumaria plumosa</i>	(Hudson) Kuntze, 1891	soft feather weed				P
<i>Polyides rotunda</i>	(Hudson) Gaillon, 1828	discoid forked weed	P	0 (near pools)		
<i>Polysiphonia</i> sp.	Greville, 1823	siphon weed	P	P	P	F-C (pools LS)
<i>Polysiphonia stricta</i>	(Mertens ex Dillwyn) Greville, 1824	siphon weed				P
<i>Porphyra</i> sp.	C.Agardh, 1824	laver	F (US)			
<i>Porphyra dioica</i>	J.Brodie & L.M.Irvine, 1997	laver			P	
<i>Rhodomela confervoides</i>	(Hudson) P.C.Silva, 1952	straggly bush weed			P	
<i>Vertebrata fucooides</i>	(Hudson) Kuntze, 1891	siphon weed			F	P
<i>Vertebrata nigra</i>	(Hudson) Diaz-Tapia & Maggs, 2017	siphon weed			C (sand veneer LS)	
<i>Vertebrata thuyoides</i>	(Harvey) Kuntze, 1891	siphon weed				P

Table 2 (cont.): Species list from all intertidal sites, excluding those reported in Table 1. Note that 24 additional seaweed species were added by Lin Baldock for the two sites (Charmouth Ledges and East Ebb Seatown) where she joined us. These may also be present at the other two sites but needed her expertise to identify them. D dominant; A abundant; C common; F frequent; 0 occasional; R rare; P present. US upper shore; MS middle shore; LS lower shore. Bo = Boulder.

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CHLOROPHYTA						
<i>Blidingia minima</i>	(Nägeli ex Kützling) Kylin, 1947	green weed				
<i>Cladophora laeteviens</i>	(Dillwyn) Kützling, 1843	green branched weed			C (Bo US)	C (Bo US)
<i>Cladophora rupestris</i>	(Linnaeus) Kützling, 1843	common green branched weed	O-F (under <i>F. serratus</i> LS)		R	
<i>Spongomorpha aeruginosa</i>	(Linnaeus) Hoek, 1963	spongy weed			P	P
<i>Ulva compressa</i>	Linnaeus, 1753	gutweed				C (Bo US)
<i>Ulva flexuosa</i>	Wulfen, 1803	gutweed			P	
<i>Ulva intestinalis</i>	Linnaeus, 1753	gutweed		P		
<i>Ulva lactuca</i>	Linnaeus, 1753	sea lettuce	A (in patches MS)	A (flats, pools LS)	P	
<i>Ulva linza</i>	Linnaeus, 1753	gutweed				C (Bo US)
<i>Urospora penicilliformis</i>	(Roth) Areschoug, 1866	green weed			P	C (Bo US)
<i>Ulothrix flacca</i>	(Dillwyn) Thuret, 1863	green weed			P	
PHAEOPHYCEAE						
<i>Cladostephus spongiosus</i>	(Hudson) C. Agardh, 1817	hairy sand weed		O (flats)	A (flats edges)	
<i>Dictyota dichotoma</i>	(Hudson) J.V. Lamouroux, 1809	brown fan weed	P	F-C (flats, Bo ELWS)		F (LS)
<i>Fucus serratus</i>	Linnaeus, 1753	toothed wrack	(Dominant on LS)	O	R	O-F (LS)
<i>Fucus spiralis</i>	Linnaeus, 1753	twisted wrack			(Band on US)	
<i>Fucus vesiculosus</i>	Linnaeus, 1753	bladder wrack	Short band	R		O (MS)
<i>Halidrys siliquosa</i>	(Linnaeus) Lyngbye, 1819	sea oak		O (ELWS)		P (deep pools ELWS)
<i>Halopteris filicina</i>	(Grateloup) Kützling, 1843	sea fern weed		F (pools on LS flats)	P	
<i>Laminaria digitata</i>	(Hudson) J.V. Lamouroux, 1813	oarweed	D (forest fringe)	D (forest fringe)		D (forest fringe)
<i>Saccharina latissima</i>	(Linnaeus) C.E. Lane, C. Mayes, Druehl & G.W. Saunders, 2006	sugar kelp	R	R		
<i>Sargassum muticum</i>	(Yendo) Fensholt, 1955	wireweed		O-F (pools)		
ASCOMYCOTA (LICHEN)						
<i>Lichina pygmaea</i>	(Lightf.) C. Agardh, 1817	black lichen		P		F (US)
<i>Verrucaria maura</i>	Wahlenberg, 1803	tar lichen		P		F (US)

Table 2 (cont.): Species list from all intertidal sites, excluding those reported in Table 1. Note that 24 additional seaweed species were added by Lin Baldock for the two sites (Charmouth Ledges and East Ebb Seatown) where she joined us. These may also be present at the other two sites but needed her expertise to identify them. D dominant; A abundant; C common; F frequent; O occasional; R rare; P present. US upper shore; MS middle shore; LS lower shore. Bo = Boulder.

The serpulid reefs of Loch Creran (Argyll)

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Introduction

I first encountered the serpulid reefs of Loch Creran during a dive trip in 1991. Although impressive in itself, the diverse and abundant life of the muddy seabed paled into insignificance when the silhouette of a serpulid reef emerged from the gloom as I approached it through the chill water. A complex vase-shaped structure rising almost a metre above the seabed and seething with life (Figure 1), the framework of the reef was built of intertwined tubes of *Serpula vermicularis* Linnaeus, 1767 with delicate feathery rosettes of red and orange feeding radioles emerging from the mouths of the tubes. Amongst the meshwork of tubes were a myriad of other creatures seeking the advantage of the high attachment point. There were more of these associated creatures than can be mentioned, but they included numerous hydroids, sea squirts, brittle stars and a variety of additional tubeworm species. At

that first encounter I felt that these reefs were remarkable structures, and my opinion remains the same almost 30 years later.

The reef builders

Serpula vermicularis is one of the innumerable species of marine bristle worms known as polychaetes. It is a member of the 'serpulid' family and serpulids, like a number of other polychaetes, live permanently within a fixed tube and filter out food particles from the passing seawater. The tubes of *S. vermicularis* are composed of a shelly material that is deposited by a glandular 'collar' just behind the head of the animal. The tubes are about the thickness of a drinking straw but can reach up to 30 cm in length. The tubes provide protection from predators, a means of attachment to rocks and a means of raising the worm above the seabed into more rapidly flowing water where filter feeding is more productive. They feed by spreading delicate feathery 'radioles' into the water and capture potential food items on a layer of mucus which is then transported back to the mouth. If alerted to the presence of a potential predator by vibration or passing shadows the radioles flash back into the tube and the entrance is plugged and sealed by the distinctive funnel-shaped operculum (Figure 2). The bristles on the body of the worm are specially adapted to grip the inner walls of the

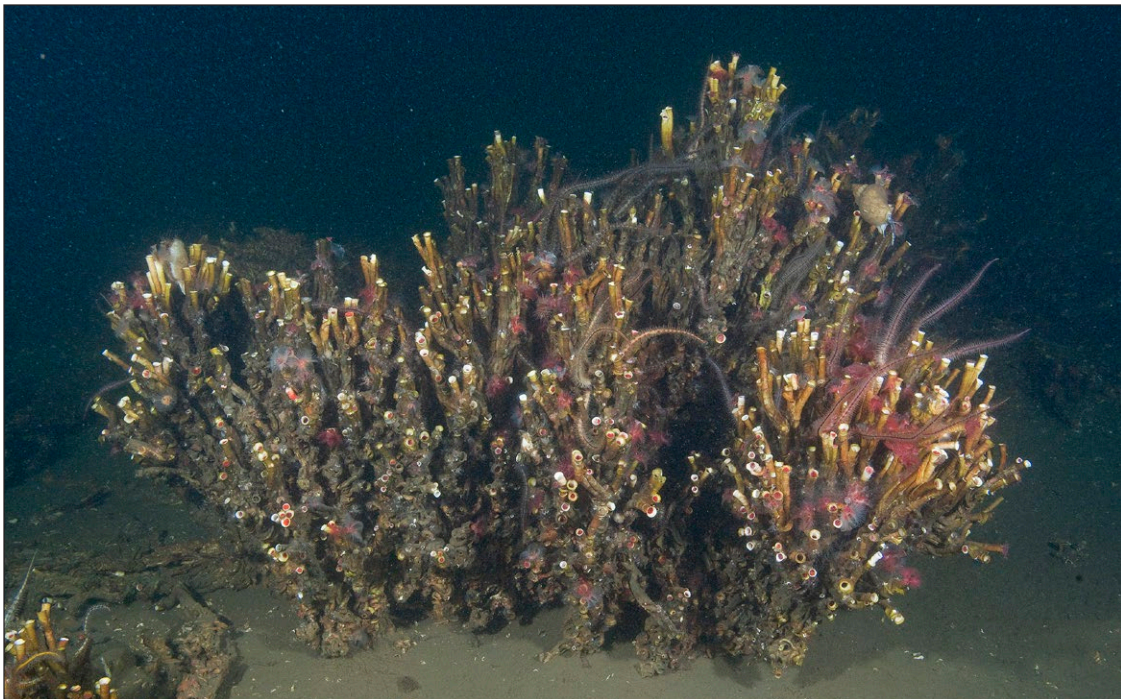


Fig. 1: Serpulid reef in Loch Creran (Photo: G. Saunders)



Fig. 2: Detail of feeding radioles and operculum (Photo: G. Saunders)

tube with such tenacity that the body cannot be drawn out from the tube if a fish or crab succeeds in seizing the radioles. The predator may tear off and eat the radioles but these can be regenerated provided the worm remains secure in its tube.

Although *S. vermicularis* is the primary reef builder, other species may also play a significant role. For example, another serpulid worm called *Spirobranchus triqueter* (Linnaeus, 1758) is often a major component of the reef structure. Its tubes are considerably smaller than those of *S. vermicularis* but it cements its tubes onto those of *S. vermicularis* and binds adjacent tubes together strengthening the overall structure.

Why the reefs are special

Apart from their aesthetic appeal and spectacular appearance, the reefs are also special because of their rarity and the high biodiversity of the communities of organisms living amongst the complex meshwork of tubes. It is not the worms themselves that are rare. *Serpula vermicularis* is widely distributed in the northeast Atlantic and is found all around the coast of the British Isles. It is not uncommon, but generally occurs only as single individuals or small aggregations of tubes on rocky surfaces. The sites at which massive aggregations develop to form large

freestanding reefs are very rare. Within the British Isles, reefs have been reported from only three locations on the west coast of Ireland and four locations on the west coast of Scotland (Figure 3). The extent and density of the reefs have not been formally mapped at many of these sites but available data indicate that they are considerably more well-developed and extensive within Loch Creran than they are at any other known site (Moore *et al.* 2009). The high biodiversity of the reef habitat is immediately apparent and medium to large



Fig. 3: Locations with records of serpulid reef development in the British Isles



Fig. 4: Collapsed and fragmented reefs in Loch Creran (Photo: G. Saunders)

reefs have been found to support in excess of 150 taxa (Chapman *et al.* 2011). This level of species richness is several times higher than would be expected in a comparable area of the neighbouring seabed.

Evidence of change in the Creran reefs

Over recent years there has been a pronounced and rather alarming deterioration of the serpulid reefs of Loch Creran. We first became aware of the change in 2013 when looking for suitable sites for filming by the BBC. We visited a number of sites of formerly well-developed and pristine reefs only to discover that a large proportion of the reefs were now reduced to rubble (Figure 4). This observation stimulated

further investigations and during the winter of 2014/15 we undertook a project to investigate the magnitude, extent and possible cause of the deterioration (Tulbure 2015). Initially, we revisited four sites and repeated a series of quantitative video transects which had first been conducted in 2005 (Moore *et al.* 2006). The footage from 2005 and from 2014 was re-assessed to yield estimates of the overall percentage of collapsed reef. The results were striking and consistent at all four sites. The percentage of collapsed reef was about 20% or less on the 2005 video and about 80% or more on the 2014 video. Having formally demonstrated the reality of the deterioration we then surveyed a further 28 sites around the

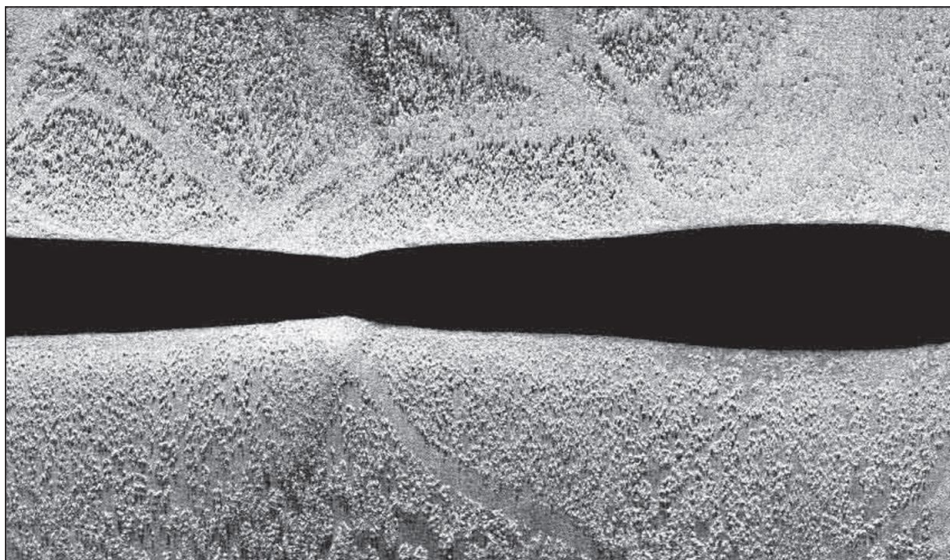


Fig. 5: Side scan sonar imagery showing dredge track impacts on reefs in Loch Creran (From Moore *et al.* 2006)

loch to assess the extent of the damage. This showed that the deterioration was widespread with the majority of reefs collapsed and broken at almost all of the sites visited.

Potential reasons for the change in the Creran reefs

An immediate priority was to try and establish the cause of the deterioration in the reefs and a range of potential causes have been considered. Direct damage by dredges or trawls was one obvious candidate. Such damage has occurred in the past and has been documented by previous studies (Figure 5: Moore *et al.* 2006). However, the current pattern of damage is not consistent with trawl damage. If trawls were responsible we would expect to see evidence of dragged and shattered reef material. However, our observations indicate that the reefs appear to have collapsed and disintegrated *in situ* at most locations. Also, dredging would be likely to miss at least a few pockets of reefs so we would expect to find occasional stands of pristine reefs amongst the damage. No such remaining pockets of reef have been encountered. Damage within any given area appears largely uniform and widespread.

Another possibility is that an ecological shift has occurred within the loch and has impacted the reefs. This might arise in a variety of ways. Altered conditions could cause increased macroalgal growth on the reefs or increased settlement by sessile filter feeders like solitary sea squirts (Figure 6). As well as compromising the filter feeding of the worms, such increased fouling of the reefs would create increased drag on the reef structure making them more prone to collapse. Although some divers have commented upon the abundance of macroalgae and sea squirts on the collapsed reefs the formal assessment of this possible cause is hindered by lack of an adequate time-series of data on the reef communities. We are currently reviewing archived images and video of reefs with the aim of assessing if they show any evidence of consistent changes in the abundance of fouling organisms.

Other possible sources of impact could be changes in abundance of large decapods like brown crabs or squat lobsters (Figure 7) which burrow beneath the reefs causing them to become undermined. Grazers such as sea



Fig. 6: Serpulid reef with attached sea squirts and algae (Photo: G. Saunders)

urchins could also potentially damage reef structures leading to collapse. However, time-series data on the abundance of these taxa is again not available and casual observations do not support the theory that there has been any significant change in their abundance. Change in the plankton is another plausible factor. Change in the loch water chemistry due to whatever cause could reduce the amount of planktonic food available to the filter feeding worms. Alternatively, such changes could reduce the survivorship of the planktonic larvae of the worms such that too few juveniles become established to maintain the reefs. But in either case, although you might anticipate a slow die off of worms on the reefs there is no obvious reason to suppose this process would lead to rapid collapse and fragmentation of the reefs.

Our prime suspect to explain the observations was storm damage. Some particularly severe storms occurred during the winter of 2011/12 causing widespread damage on the west coast of Scotland. The wave-driven oscillations during such storms could easily be the cause of *in situ* collapse and fragmentation of reefs. We investigated this in 2014/15 by attempting to relate the level of damage in different parts of the loch to differences in exposure to wave action based on location relative to the prevailing winds (Tulbure 2015). This did not show a clear and obvious relationship. However, the weather data used in this

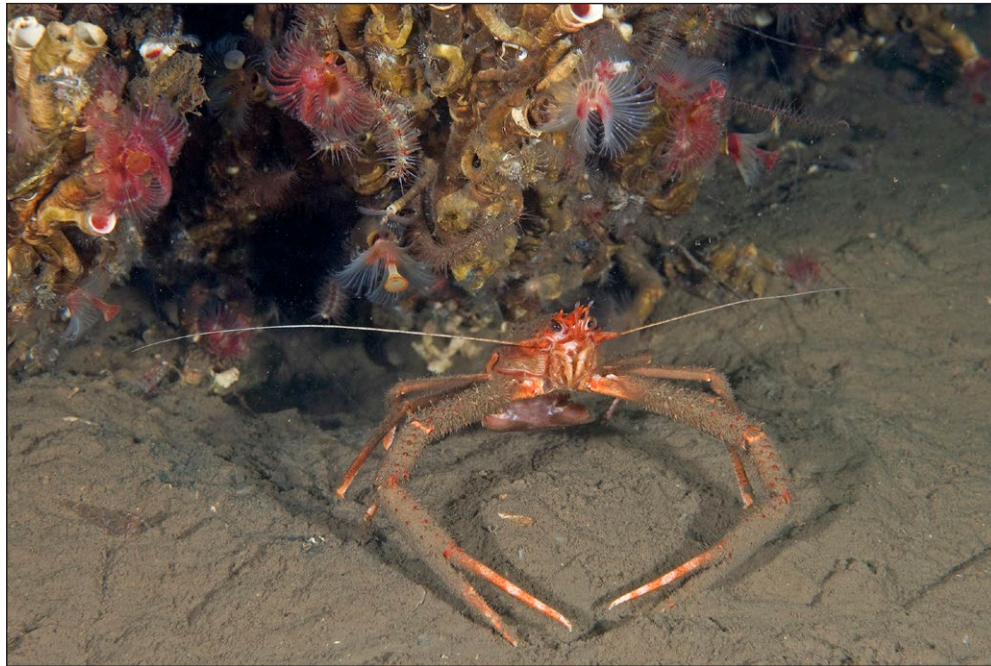


Fig. 7: Squat lobster burrow below serpulid reef (Photo: G. Saunders)

assessment was at a relatively coarse level of resolution and the 28 sites surveyed may have been too few to reveal the true patterns of damage. Since then we have gathered estimates of reef damage at additional sites and a fresh assessment of the data is underway using higher resolution weather data.

The long-term view of the change

As is the case with much of the marine environment, we lack a long-term understanding of natural change and variation of serpulid reefs. It is possible that reef abundance may vary on a decadal timescale due to factors that are not understood (Hughes 2011). The first documented record of serpulid reefs in Loch Creran dates from the 1880s (Smith 1887). Following this record there is then a gap of about a century until in the 1980s there are diver records of well-established reefs in Creran (Connor 1990). We are examining the limited available evidence from this missing period of time. For example, there is some indication that dredge surveys in the 1970s were conducted at sites where we would have expected reefs to be present but the data from the dredge contents does not indicate reef presence (Harbour 2017). This might indicate that the reefs developed sometime between the 1970s and 1980s and so may not be long-term persistent features. Since the 1980s however, it seems that the reefs remained

well established and extensive until sometime around 2010. A survey in 2005 (Moore *et al.* 2006) is the last available time point of reliable data showing extensive healthy reefs and some unpublished localised data from 2009 appears to also indicate healthy reefs. The 2014 survey (Tulbure 2015) is the first reliable evidence of widespread deterioration although it seems this damage had occurred prior to 2013.

Time series data on reefs at other locations is also inconclusive. Of the other Scottish sites, well-developed reefs were noted in Loch Sween in the 1970s (Bosence 1979) but subsequently died out for unknown reasons. No recovery appears to have taken place and recent surveys have found no trace of living reefs (Moore *et al.* 2013). The reefs in Loch Teacuis are also an interesting case. The reefs were first detected and surveyed in 2006 (Dodd *et al.* 2009). The site had previously been surveyed in 1996 with no reefs detected. It is difficult to be certain if the earlier surveys just happened to miss the reefs (possibly because survey sites were few and reefs sparse) or if the reefs had only developed between 1996 and 2006. A return visit to Teacuis in 2015 found an extensive and pronounced deterioration of reefs similar to that observed in Loch Creran (Kamphausen 2015). Although very far from conclusive, these observations would seem to indicate that the reefs may be transitory features which

develop when conditions are suitable, persist for a number of years before declining once more as conditions change. Recent (2017) records of reefs in Loch Ailort are yet to be fully assessed. We intend to examine prior survey data from this area to establish if there is a sufficient baseline to judge if the reefs are a new feature of the site.

In 2016 we decided to try and look back further in time by taking deep sediment cores from amongst the reefs in Loch Creran (Figure 8: Harbour 2017). Divers collected cores of just under 1 m in length from 8 locations around the loch. The cores were cut into 10 cm slices and these slices were scrutinised for the presence of serpulid reef fragments. The general finding of this study was that fragments were found in most of the slices all the way from the surface sediment down to a depth of almost a metre. Taken at face value this seems to suggest the reefs are persistent features and have been continually present over the time period that it has taken for a metre of sediment to accumulate on the seabed. The difficulty is that we have no real idea of what time period this relates to. Sediment accumulation rates can vary over time and can vary locally within a loch basin so we are unable to assign an age to the serpulid reef fragments based on their depth in the sediment. The presence of fragments in every 10 cm slice does not rule out decadal fluctuations in reef abundance if a 10 cm slice might represent a period of hundreds of years. Direct dating of the fragments is the only way forward and we are currently progressing this.

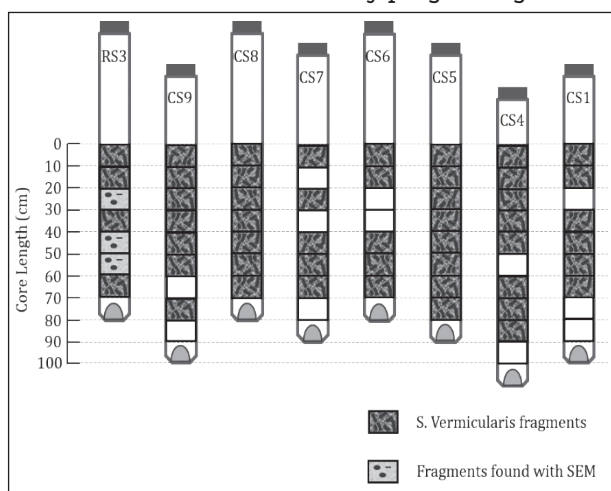


Fig. 8: Cores divided into sections at 10 cm intervals. Presence of *S. vermicularis* fragments in sections is denoted by patterned shading. (From Harbour 2017)

The costs of processing a sufficient number of samples to answer the question is a challenge and there are technical difficulties in getting a sufficiently precise date from such small and degraded tube fragments.

The prospect for reef recovery

The prognosis for reef recovery and the probable timescale of that recovery is of considerable interest. So far, there is no clear evidence of distinctly new reefs developing on the collapsed fragments and rubble. However, in some areas many of the collapsed reefs still support large numbers of living worms. Some of these worms may have been alive at the time the reefs collapsed but some may be more recently established worms and in time further recruits will lead to the development of well-formed reefs. There is too much uncertainty about the lifespan of individual worms and about the date of collapse to relate the two. Collection and laboratory examination of some of the living reefs could potentially provide an answer but we are reluctant to cause further damage by destructive sampling of this vulnerable habitat. We have, however, collected samples of apparently dead reef fragments to look for evidence of their colonisation by juvenile worms (Pedicini 2017). This work is ongoing with additional fragments recently collected and under examination at the moment. The current picture is that colonisation of the dead reef fragments is extremely limited with no evidence for development of 'proto reefs' or significant aggregations.

But there is a cause for optimism. As part of a PhD research project a range of artificial substrates were deployed in Loch Creran in order to investigate the potential for promoting the restoration of degraded areas of reefs (Cook 2016). These units were deployed in 2012 (Figure 9) and by 2017 (Figure 10) well-developed reefs were forming on a number of the units. So these reefs have certainly developed since the widespread collapse of reefs within the loch. This demonstrates that environmental conditions within the loch remain suitable for reef development. But the question remains of why we are not witnessing similar development of reefs on the fragments of broken reef scattered over the loch. It may be connected to elevation above the substrate. The artificial units which show



Fig. 9: Cultch pack of scallop shell soon after deployment in 2012 (Photo: R. Cook)

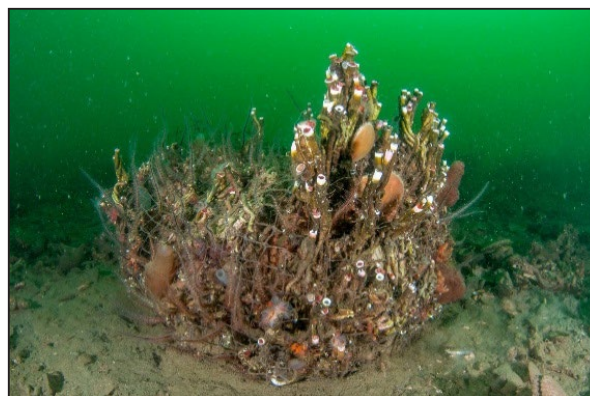


Fig. 10: Cultch pack of scallop shell with developing serpulid reef in 2017 (Photo: R. Cook)

the most convincing reef development are those which have a combination of a complex structure and are raised well above the seabed. The natural reef rubble does have a suitably complex structure but many of the fragments are only raised a few centimetres above the sediment. It may be that this is not enough to encourage rapid development of new reefs. Perhaps in time the larger fragments may begin to regenerate reefs but it is unclear how long this process will take. The option of deploying further structures on the seabed to artificially promote the reef recovery remains under consideration.

Conclusion

Many questions about the ecology of the reefs and the potential for actively managing their recovery remain unanswered. Over the years many individuals have contributed to the current state of knowledge on the serpulid reefs and the work is ongoing. We continue to work in close collaboration with Scottish Natural Heritage and a PhD research student is currently working on addressing some of the questions. Past undergraduate and postgraduate student projects have contributed to the knowledge and this process continues with two students currently researching the reefs and we anticipate others will advance research into serpulid reefs.

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Historical changes in Edinburgh's rock intertidal macroalgae

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Introduction

The Water Framework Directive (WFD) uses macroalgae as a biological quality element for defining ecological status of transitional or coastal water bodies (Wells *et al.* 2007). The number of algal species in the intertidal zone is inversely correlated with exposure to desiccation, insolation, and extreme temperatures (Cubit 1984). Macroalgal communities contribute as primary producers providing suitable habitats for benthic organisms (Williams & Smith 2007), responding to nutrient loads, water pollution and change in the use of land, i.e. coastal defences, dikes etc. These anthropogenic alterations on coastal habitats cause changes in plant and animal communities. In particular, seaweeds might be affected by a decrease in suitable habitats for their development, as well as a change in water quality conditions.

Throughout this century, the Edinburgh shoreline has been heavily impacted by different levels of anthropogenic pressure due to nutrient-enrichment by domestic pollution and land reclamation. For example, Granton and Joppa were recognised by the Victorians for their species diversity and have since been strongly modified by sewage pollution (Smyth 1968, Johnston 1972, Wilkinson *et al.* 1987).

After the Victorian period, Granton has been dominated by mats of polychaetes such as *Fabricia stellaris* (Müller, 1774) and *Polydora ciliata* (Johnston, 1838) (Wilkinson *et al.* 1987). The development of these communities has been suggested to be related to an increase in suspended matter in the water column, resulting in a reduction of light for photosynthesis and limiting establishment of

macroalgal communities. The rock substrate in this area is sandstone, with surfaces ranging from horizontal to nearly vertical. Over the years, sand and man-made structures have covered parts of the original formations.

Joppa, on the other hand, is a horizontal bedrock substrate, rich in rock pools, and exposed to wave action. The rock substrate is sandstone, mudstones and limestone. Joppa is currently a mussel-barnacle dominated climax community shore (Wilkinson *et al.* 1987). Its upper intertidal zone was reduced because of the construction of a seawall, a protective defence.

The objective of the study is to evaluate macroalgae community diversity, by using a current full species list for Joppa and Granton, data from previous surveys, as well as historical data.

Methods

The Firth of Forth holds extensive algal records starting from the 19th century. For this study, two locations were identified along the Edinburgh shoreline: Granton (Grid reference NT2377) and Joppa (Grid reference NT321733). Previously, Granton has been recorded by Greville (1824), Lindsay (1886), Rattray (1886), Traill (1880, 1881, 1882a, 1882b), Wilkinson & Scanlan (1986–1987-unpublished), and Wells (2002). Joppa has been recorded by Traill (1880, 1881, 1882a, 1882b), Wilkinson & Scanlan (1986–1987 unpublished), and Wells (2002).

The study shores were visited between November 2017 and February 2018. For all data presented, we utilized three types of records: (1) Data from current surveys (2) Data from RBGE Herbarium (3) Data from previous surveys, not present at RBGE Herbarium. Data collected was compared and analyzed with previous records from 2000/2001.

The methodology follows previous surveys, where the area was divided in relation to vertical zonation regarding tidal height. As indicators of vertical zonation bands, fucoids in the following order were used from high to low tidal zones: *Pelvetia canaliculata* (Linnaeus) Decaisne & Thuret, *Fucus spiralis*

L., *Fucus vesiculosus* L., *Ascophyllum nodosum* (Linnaeus) Le Jolis and *Fucus serratus* L., Species lists were recorded monthly in each site, with collections of critical specimens brought back to the laboratory for further examination. Sampling was completed coinciding with low tide conditions on the intertidal rocky shores. Macroalgae were considered to be any algae forming structures or mats visible to the naked eye.

Species richness was used as an estimate of community diversity, since it is considered a robust measure that changes with a change in environment induced by human activity (Wilkinson *et al.* 1987). In contrast, species composition has been suggested to be less reliable as a measure of community diversity for macrophytes (Wilkinson *et al.* 1987). Identification was done using dissecting and compound microscopes, taxonomic keys and local checklists, to the lowest possible taxonomic level.

Herbarium data

The importance of herbarium data for studying changes in the environment, community ecology and for studies on phytogeography and phenology is unquestionable (Groom *et al.* 2014). In this study we compared data from the past with the present, to help us



Fig. 1: Shore at Joppa, Winter 2017.

to determine patterns of algal distribution. All macroalgal specimens found within the collection housed at Royal Botanic Garden Edinburgh (E) for Joppa and Granton were digitised. Species names and classification

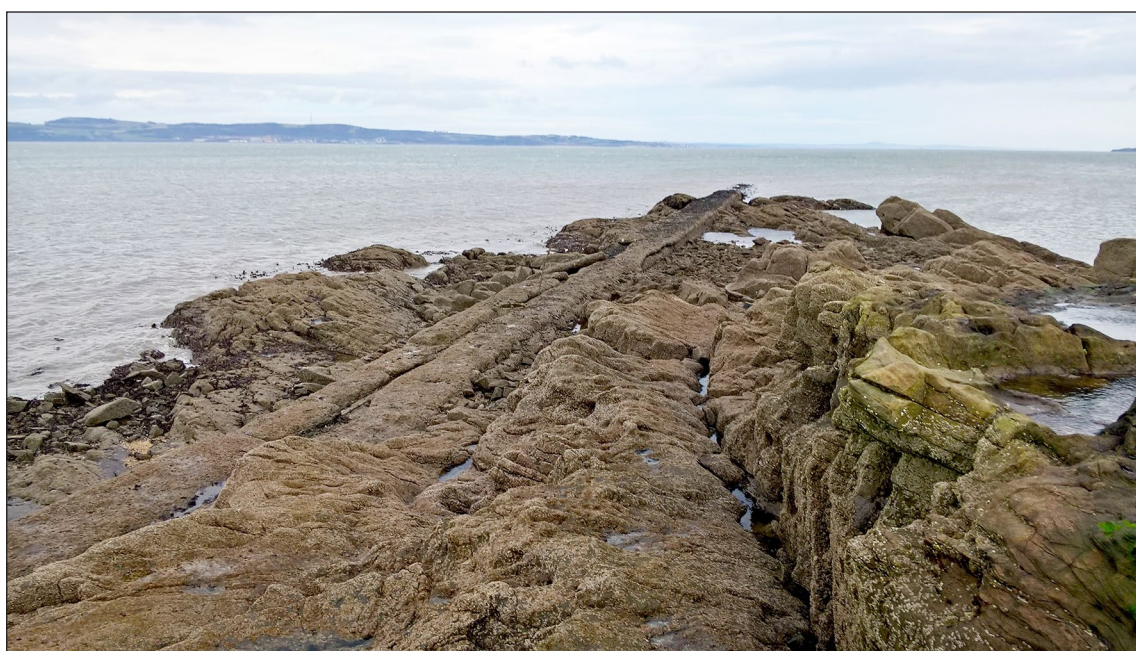


Fig. 2: Shore at Granton, Winter 2017.

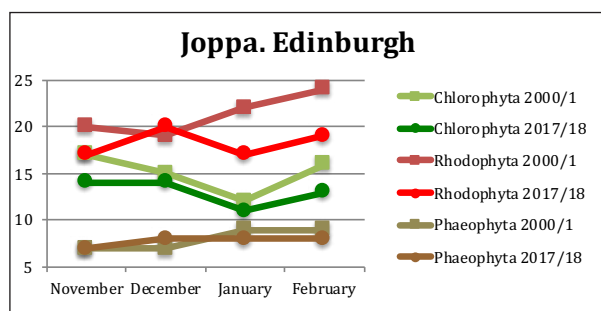


Fig. 3: Number of macroalgal species during wintertime for Joppa.

were confirmed with AlgaeBase and updated in the herbarium database if necessary. Data digitised and used in this study were collected from the 18th century to the 1990s.

Results

In the most recent surveys (by Aroa Sampedro-Fernandez) 72 (Joppa, Figure 1) and 68 (Granton, Figure 2) species were found. In Joppa, the total Rhodophyta species count was 35, Chlorophyta 25 species, and Phaeophyta 12. On the other hand, Granton followed a similar total distribution, with 32 members of Rhodophyta, 28 Chlorophyta and 18 Phaeophyta.

In the present study at Joppa (Figures 1 & 3) species richness of brown and green algae has not substantially changed between 2000/1 – 2017/18. For instance, brown algae only differ in one species between December and February, being equal in November. Green algae for the period 2000/1 shifts from a maximum of 17 to a minimum of 12 species, compared to the period 2017/18 when the maximum was 14 and the minimum 11. Red seaweeds show greater variance between the survey dates, with January and February showing the biggest differences. For example, for the period 2000/1, 22 red seaweeds were found in January, and 24 in February. More recently, in 2018 we found 17 red seaweeds in January, and 19 in February.

The overall data suggest that, for both studies, the total number of species found starts to increase in February. Overall, marginally more species were found in the 2000/1 surveys as compared with 2017/18. Rankings of richness according to major

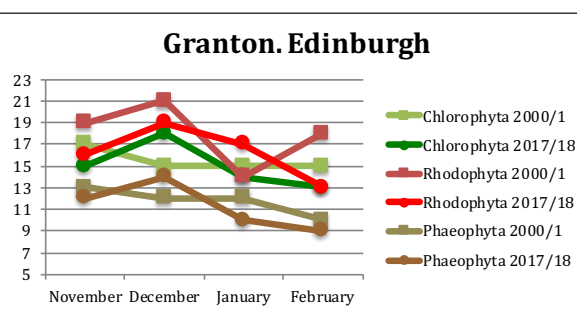


Fig. 4: Comparison of the number of species during wintertime for Granton.

groups is largely consistent across survey years, with highest richness for reds, lowest for browns and intermediate values for greens, and mostly consistent across months (Figures 3 & 4).

The second location selected for these studies was Granton (Figure 2 & 4), on the west side of Edinburgh. The richness of taxa changed only slightly between the two survey periods (Figure 4). Richness of red algae in 2000/1 was lowest in January, and highest December. The total brown seaweeds found remain almost constant, with a minimum in November 2001 and a maximum in February 2000.

For the second survey (2017-2018), red algae distribution does not track richness from the 2000/1 survey, but rather shifts from a maximum of 19 in December to a minimum of 13 species in February. We found that brown algae total species is largely constant with a difference of up to only two species. In contrast, richness of reds and green is less consistent among months and across years.

Historical changes

At Joppa, historic data (Table 1) show that 59% of the total found by Traill in 1886 were found again between 1977-1979. After the City of Edinburgh sewage system was installed in 1978, resulting in the abatement of raw outfalls, we see an increase in the number of algae, up to 85 species, representing 82% of the total found by Traill. The winter diversity of algae documented here in 2017/18 appears largely similar to that reported by Wells in 2000/1.

The situation in Granton (Table 1) is different from what we found in historical data for

Table 1: Richness changes in macroalgae over time for Joppa and Granton

Joppa	Author	Total
	Traill 1886	103
	Wilkinson & Scanlan 1977-1979	61
	Wilkinson & Scanlan 1986-1987	71
	Wells 2000-2001	85
	Wells 2000-2001 (only winter)	44
Granton		
	Sampedro 2017-2018 (only winter)	39
	Traill (1885)	65
	Wilkinson & Scanlan (1986-1987)	65
	Wells (2000-2001)	80
	Wells 2000-2001 (only winter)	45
	Sampedro 2017-2018 (only winter)	43

Joppa. Traill's monograph (1885) does not always detail site references, and his data imply that not all the species found were included in the total list for Granton. We expect that the total species count of 65 is a reflection of incomplete data in Traill's monograph, since Wilkinson & Scanlan found the same number of species in 1986-1987, with the apparent recovery of species diversity documented by Wells (2000/1).

Discussion

Land reclamation and sewage pollution might be important factors influencing macroalgae species richness. Before the Edinburgh Sewage Scheme, the most important source of pollution at Joppa was due to the discharge of untreated sewage into the low water mark. Johnston (1972) reported a severe reduction in species at Joppa in relation to Traill's time. At Granton, direct impact, rather than that due to any toxic effect, was from suspended solids (Knight & Johnston 1981) reducing light penetration through the water and reducing algae settlement. The response to pollution from West Granton Sewer was characterized by mats of polychaetes covering the rocks, with macroalgal communities apparently prevented from establishing.

Within the shores investigated for the present study, data from Wells and this study show that algal richness is largely stable for the

period between 2000-2018. In Joppa, after the 1980s, a mussel-barnacle dominated shore induced by pollution, formed a very stable climax community that remains constant nowadays and limits re-colonization. There is a clear recovery inbetween data collected in the 1980s and 2000, possibly due to a successful reduction of effluent outfall from Seafield, although the total number of species is still far from Traill's findings. In looking at winter data alone, a small decrease in species totals noted between the 2000/1 and 2017/8 data might be caused by a difference in external factors such as weather, or as a result of differences in experience of the surveyors between surveys.

On the other hand, Granton has changed since the new Edinburgh Sewage Scheme in 1978. Before the sewage system improved, effluent outfall from dye and gas works was directly discharged in Granton, with a predominance of polychaetes covering the rocks. After the 1980s, sand accumulation due to land reclamation started to cover some of the rocks studied during the 19th century, reducing the available area for macroalgal colonization. Barnacles and seaweeds began to cover the area that once was dominated by polychaetes.

By the beginning of the 21st century, mussels started to dominate Granton, although the total number of seaweed species found was higher than in 1987. It is important to take into account that, even in a mussel dominated shore, the number of seaweed species may remain constant, or even increase, although with lower abundance. At present, the pipe that once was discharging directly to the sea is covered in sediment. Barnacles are starting to replace mussels and, although we only have data for winter months, total number of species has increased.

Conclusions

After the devastating effects of industrialization and raw sewage outfalls, the overall trends documented here show a picture of regionally high richness in macroalgae. Our results show that both shores are in an apparent recovery relative to the

richness of Traill's surveys, who described Joppa as luxurious in seaweeds. Surveys carried out by Wilkinson & Scanlan in the 1980s (Wilkinson *et al.* 1987) recorded the beginning of a period of recovery, a recovery that appears to have reached a somewhat stable plateau, based on two comparable surveys over a four-month winter period. Further work on the summer richness may be able to document the generality of this trend. Given that the pollution and land reclamation impacts which affected Joppa and Granton have been largely stabilized, algal communities are changing, possibly in response to other global changes including temperature rises and ocean acidification, and these data can provide a baseline for further work.

Full species data for Granton and Joppa, from November 2017 to February 2018, including tidal height can be obtained by contacting the corresponding author (Sampedro-Fernandez).

Acknowledgements

We thank Amy Styles and all The Conservation Volunteers team for their confidence and for making a program such as Natural Talent succeed. We are also very grateful to Dr. Martin Wilkinson for his seaweed wisdom and survey skills. Thanks are also due to Dr. Rebecca Yahr, from the Royal Botanic Garden Edinburgh, for her constant support. Finally, we all thank Dr. Clare Scanlan for sharing her knowledge, and the seaweed team from the Scottish Association for Marine Science, especially Dr Hannah Grist.

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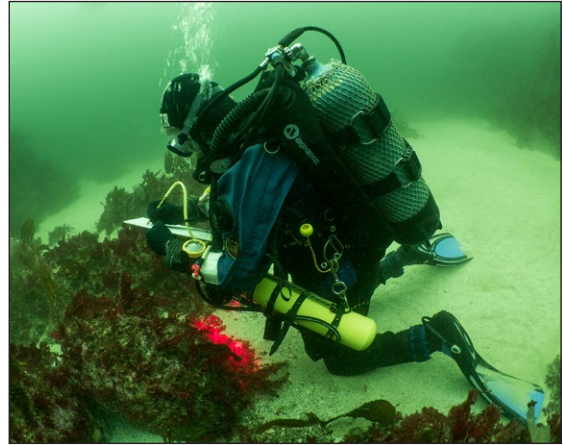
Seasearch Scotland

Natalie Hirst

Scotland Seasearch Coordinator

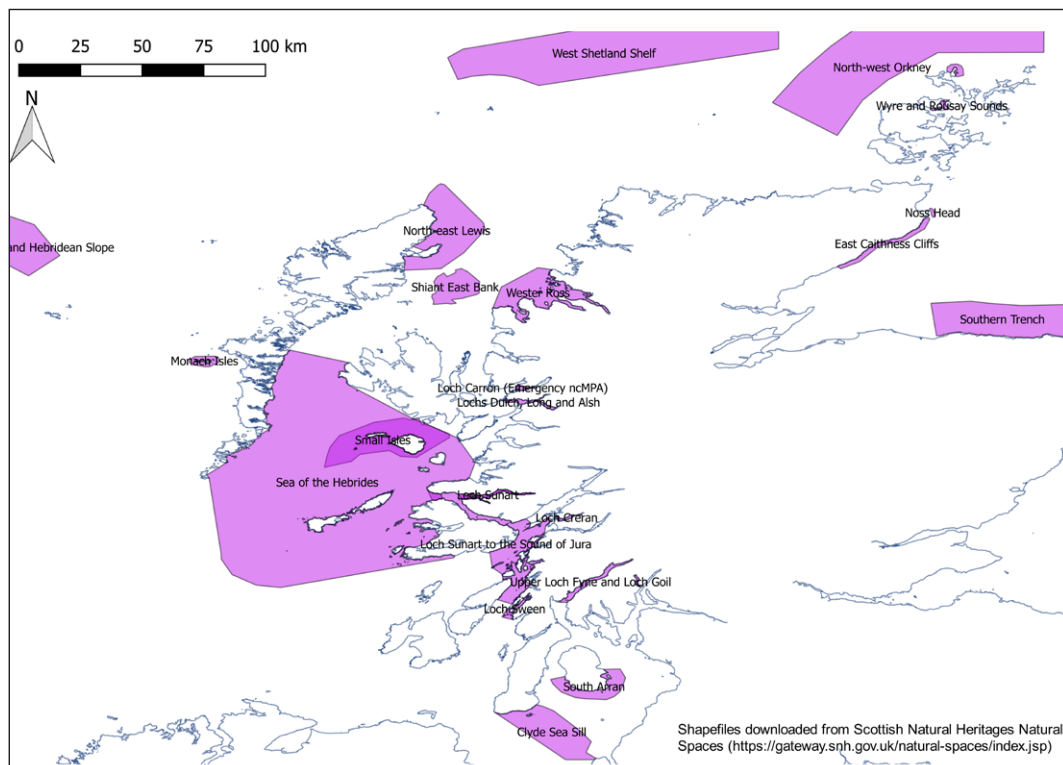
Seasearch has just celebrated its thirtieth birthday. This project for volunteer scuba divers, to record what they see under water and contribute to managing and protecting the marine environment was a pioneer for citizen science projects. Now there are many projects that interested amateurs can help with, reflecting increased awareness of conservation issues and people's enthusiasm to make a difference.

I joined Seasearch in 2005, undertaking the Observer course while studying marine biology at Bangor University. Identification skills are not much taught at universities these days so Seasearch offered a fantastic opportunity to learn from experienced volunteers. Thirteen years later I am very proud to be the Seasearch Scotland Coordinator. Every week throws up a new challenge. It is inspiring seeing the passion that people all over the region have for their local areas and to hear about their innovative surveys and dive locations.



Carole Horne surveying on Outliers trip

Sixty percent of the UK coastline is in Scotland. That's a lot of sea to know about and to manage, so Seasearch data has been invaluable and informed designation of marine protected areas (MPAs) including Loch Fyne and Loch Goil, Loch Sween, Loch Sunart, Lochs Duich, Long and Alsh, Wester Ross and the Small Isles, and South Arran. In 2014, thirty MPAs were designated in Scotland. This network covers approximately 20% of Scottish seas, protecting habitats such as maerl beds and coral gardens and species like the flapper skate (previously known as the common skate). The



Scotland Nature Conservation Marine Protected Areas



Google Earth map showing some of the headline survey sites of 2018

Scottish Government is to continue consultation on further new MPAs with a view to the sites being designated by the end of 2019. These sites, including the Southern Trench between Buckie and Peterhead, the Shiant East Bank in the North Minch, and the nearby North-East Lewis and the Sea of the Hebrides, have been long called for to establish extra zones to safeguard the ecosystems, with the waters populated by Risso's dolphins, minke whales and other species.

Crucially, following the initial designations in 2014, Scotland has a monitoring strategy to ensure that the MPA network protects the species and habitats the MPAs are designated for and supports recovery in Scotland's seas. Seasearch works closely with Scottish Natural Heritage and Marine Scotland as part of this strategy and I look forward to continuing the work and encouraging them to keep Scotland at the forefront of marine conservation. This will include putting in place the remaining designations with robust and fit for purpose management and monitoring measures.

There are two ways that Seasearch data will be used:

1. Aiding in spot checking the network now in place to monitor for change and
2. To highlight further areas in need of protection for further rounds of designations.

With the large geographical area and the complicated coastline providing unique conditions and targeted conservation needs, it is vital to work with other community groups and organisations so we can all share resources, ideas and approaches.

To help achieve these goals, in 2018 we carried out training and dive surveys from Kilmarnock in the south to as far north as Cape Wrath and Orkney. In March, when winter still held the Highlands firmly in its grip, seven hardy Seasearchers dived the barmy waters of Loch Carron to fill data gaps on *Limaria hians* (Gmelin, 1791), (Flame shell) distribution, and record habitat features including horse mussel beds and maerl beds. Limiting the dive times and allowing warm up time between dives made the March diving possible and it was expertly overseen by North East divers Chris and Cathy Hollindale. Loch Carron made headlines in 2018 when proactive local divers and Seasearchers recorded damage to the flame shell bed reefs caused by scallop dredgers, resulting in an emergency MPA designation. Seasearch identified interesting potential relationships between the flame shell beds and kelp stipes that stabilise the environment and recorded unusual species like the tiny *Lebetus scorpioides* (Collett, 1874), diminutive goby.

An exciting aspect of Seasearch is getting the opportunity to dive places that dive charters don't normally go. The outliers of Sula Sgeir and North Rona, off the most northern edge of Scotland are two such places. North Rona, seventy-one kilometres north north-east of Butt of Lewis, is the most remote island in the British Isles to have been inhabited on a long-term basis. Together with Sula Sgeir it is a Site of Special Scientific Interest, a National Nature Reserve and a Special Protection Area being particularly important for seabirds (including 5000 breeding pairs of gannets) and grey seals.

After more than a year of planning the weather in late August unfortunately prevented us reaching the outliers aboard MV *Halton*. After a warm up dive in the shelter of Orkney we made our way on a lumpy sea to Strathy Point on the northern Scottish Mainland, where the high winds kept us for the majority of our week before we returned to Orkney. Although

we didn't make it to the outlier islands I had some really memorable dives in the extremely exposed rugged seascape of caves and gullies, seeing amazing wildlife adapted to the high energy environment by clinging close to the rock wall surfaces and stunning 20m+ visibility. One of the best dives was to the east of the aptly named Cape Wrath. The outer, stark bare walls of the gullies here were inhabited by only the slightest crusts of bryozoans and hydroids, with carpets of *Clathrina coriacea* (Montagu, 1814) sponge and *Dendrodoa grossularia* (Van Beneden, 1846) seasquirts on the inner gullies. The gullies opened into bright cavernous spaces penetrated by sunlight from gaps in the rock above, illuminating bright pink encrusting algae covering gigantic boulders.

Particularly rewarding finds on this trip were a number of flapper skate eggs recorded by Peter Bardsley and Jim Anderson. Because these egg cases are large they are at risk of being caught in towed fishing gear, along with newly hatched skates. Flapper skate is critically endangered due to over fishing and although there is data on the distribution of adults there is no information about egg laying sites or nursery grounds. There is some protection in place (Loch Sunart to the Sound of Jura Nature Conservation MPA) but flapper skate populations are likely to take a long time to recover because although the skate is long-lived (up to a hundred years old) it is slow to mature and only reproduces every other year. Raising awareness of what to look for and targeted dives by Seasearch Scotland has led to more records of flapper skate being submitted and is a good example of citizen science making a real difference to the conservation of an endangered species.

Data collection is the main goal of Seasearch but as demonstrated with the flapper skate egg recording, education underpins the data collection. Seasearch coordinators including myself and Owen Paisely (Argyll and Bute) attend seminars, meetings and workshops with the thirteen England area coordinators. We work with other conservation organisations¹ and community groups² to devise and source survey plans, data requirements and volunteers in the places that need them.

Since the Scottish MPA network was designated in 2014, Seasearch has collected an average 258 record forms a year from a hundred active diving volunteers. Training courses at beginner, advanced and specialist levels have been delivered every year, boosting the number of qualified Seasearchers by 12-32 people a year, ensuring a steady stream of enthusiastic volunteers to keep the work going, hopefully for another 30 years and more!

Thank you to everyone involved over the last 30 years for your hard work and dedication. I have so much appreciation for your willingness to go the extra mile, even in the depths of winter, to collect the records that make such a big contribution to marine conservation in Scotland. We have had a lot of fun too, drunk a lot of tea and eaten a lot of cake. If you feel like popping on a snorkel or going for a dive with a purpose, Seasearch might just be for you.

Seasearch website: <http://www.seasearch.org.uk>

Shark Trust website link to Flapper skate page: <https://www.sharktrust.org/en/common skate results>

¹ organisations like Flora and Fauna International, The Marine Conservation Society, The Royal Society for the Protection of Birds, The Wildlife Information Centre.

² including South Skye Sealochs Initiative, Community Association of Lochs and Sounds (CAOLS) and Community of Arran Seabed Trust (COAST).

SeaSearch Images (opposite page, clockwise from top left):

A. Awaiting pick up during the outliers trip by MV Halton;

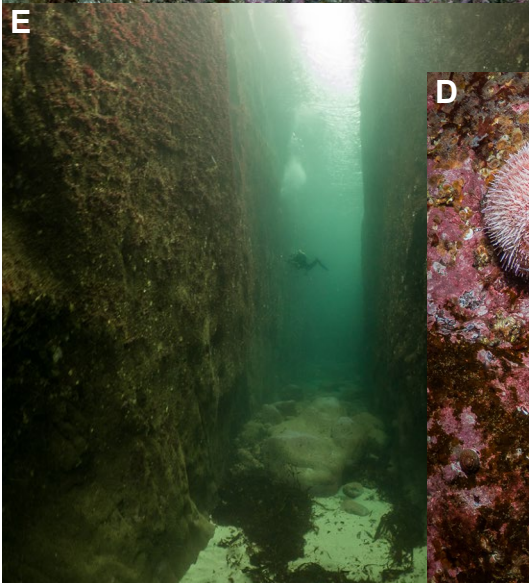
B. Beautiful diverse life at entrance to gullies near Strathly Point;

C. Divers on Outliers trip (© Mark Kirkland);

D. Octopus on the run (© Mark Kirkland);

E. Diver exploring gullies, North Coast;

F. Amazing diverse life off the Northern Coast of Scotland (© Mark Kirkland).



Sediment veneers

Nick Owen

Introduction

The impetus to write this article came originally from diving in Dorset and observing the effects of thin layers of sediment on sessile communities. References to those effects and to 'veneers' in the literature were hard to come by, despite veneers often being seen in the infralittoral and circalittoral, not just in Dorset. Seasearch Dorset in summer 2018 trialled a pair of documents aimed at showing how to recognise sediment veneers and hoping to encourage divers to record them on existing Seasearch forms so as to maintain continuity of records and stimulate the production of more, searchable veneer records. This article looks at sediment veneers with the aim of stimulating discussion about their importance as biotopes in their own right and as a component in the matrix of habitats necessary to support a diverse, resilient and productive marine ecology.

Why veneers are important

Mobile sediment on hard surfaces is a powerful modifier of the sessile community on that hard surface. Seasearch dives in Dorset over recent years have highlighted the fact that veneers are frequent in the sublittoral of the county and are important because they:

1. Are quite common in Dorset.
2. Are seldom recorded.
3. Harbour species which appear to specialise in veneers e.g. sponges including the nationally scarce sponge *Adreus fascicularis* (Bowerbank, 1866) and algae including *Cladostephus spongiosus* (Hudson) C.Agardh, 1817 and *Ahnfeltia plicata* (Hudson) E.M.Fries, 1836.
4. Are often a poor fit with currently-adopted biotopes in the Infralittoral and Circalittoral Rock sections of the Marine Habitat classification (Connor *et al.* 2004).
5. Can be difficult to record with remote techniques like drop-down video, cores or grab sampling.
6. Are likely (if allowed to develop naturally) to

be a component of a matrix of benthic habitats and therefore to be important in the foraging of commercially exploitable mobile species at different phases of their life cycles.

What is a veneer?

This article uses the working definition:

"Sediment Veneer: A deposit of sediment on top of reef which is thin and/or mobile enough that sessile species can colonise and grow on the hard surface of the reef through or under the sediment veneer. Two geological components (reef and overlying sediment) combine their effects towards determining the community."

This is an expansion into ecology of a geological definition:

"Veneer: A thin, widespread layer of sediment covering an older surface."

Source: <https://theodora.com/geology/glossaryuv.html>

An example of a veneer:

Coarse mobile sand over bedrock or boulders.

Figures 1A–C show images of a sediment veneer from shallow water off the cliffs of Durlstone Head near Swanage, Dorset. They were taken in May 2018 with a housed DSLR and a GoPro in 8 m visibility and around 9 m depth of water. Further details in Owen (2018a, b). This site has large areas of clean, mobile sand over flat bedrock offshore of Purbeck Stone cliffs with a subtidal fringe of boulders.

Veneers may be composed of sediment of a range of grain sizes, including silt and gravel and there is scope for a veneer at a given point to be composed of different sizes of sediment.

Features of sediment veneers

1) Biology

The demonstrable existence of perennial sessile species attached to hard surfaces and growing through or under a layer of sediment is the main criterion for suggesting that sediment in that location is a veneer.

Plants

Live (pink) coralline crusts can often be uncovered by a diver fanning away a layer of



Fig. 1A: On the right there are blobs of algae. From this picture (or a low resolution video run) the algae might be assumed to be drift; B: GoPro close-up of the blob indicated by a black arrow - the diver's finger is touching bedrock through the layer of sand. The alga was growing on rock and was black scour weed (*Ahnfeltia plicata*) a long-lived red alga resistant to scour and to covering by sand; C: macro shot of the 'blob' - this clump had comb weed (*Plocamium* sp.) growing on it and the bryozoan *Electra pilosa*.

sediment in the infralittoral and circalittoral zones. Although it is possible that there may be some transmission of light through shallow layers of some sediment (especially silt-free shell fragments or sand grains) and these plants can tick over at very low light levels (or periods of no light at all) for extended periods, it can be confidently inferred that the sediment covering must move in order to allow light to reach the buried plants.

Ahnfeltia plicata is one of a suite of erect red and brown algae e.g. *Halurus equisetifolius* (Lightfoot) Kützinger, 1843, *Halopithys incurva* (Hudson) Batters, 1902, *Phyllophora crispa* (Hudson) P.S.Dixon, 1964, *Xiphosiphonia ardreana* (Maggs & Hommersand) Savoie & G.W.Saunders, 2016 and *Cladostephus spongiosus* found in the Dorset infralittoral zone that often grow through sandy veneers (Bunker *et al.* 2017).

Animals

Sponges: *Polymastia penicillus* (Montagu, 1814) is one of a number of papillate sponges often found in Dorset on rock with a covering of sediment. *Polymastia penicillus* is often seen with just the tops of its papillae showing above



Fig. 2: *Polymastia penicillus* from Grove Point, Portland. 16-18m BSL

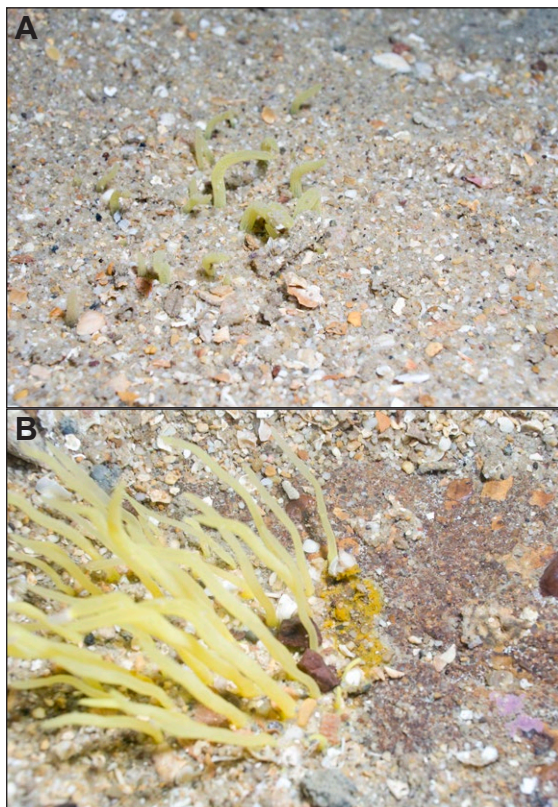


Fig. 3A: *Polymastia* sp. from Cefas G, off Swanage as found and (B) after fanning away a layer of clean coarse sand and shell/carapace fragments. Longest papillae: about 40mm. Note small patches of coralline crust to the right. Although in a different family (*Halichondriidae*) *Ciocalypa penicillus* is often found in similar situations whilst *Polymastia boletiformis* seems to be just as often observed on clean rock. 20-25m BSL

the sediment (Figure 2; Ackers *et al.* 2007). Fanning away sediment reveals the cushion-like base of the sponge and the rock beneath (Figure 3A, B).

Several arborescent sponges are often seen on veneer sites, notably the nationally scarce *Adreus fascicularis* (Figure 4), which in Dorset

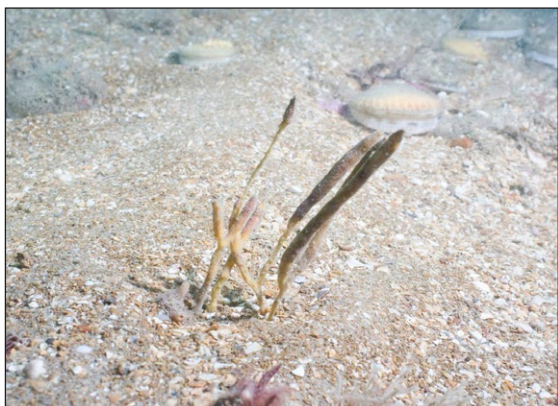


Fig. 4: *Adreus fascicularis*, Lulworth Banks Crater East, 23m BSL

is not uncommon and seems to be something of a veneer specialist.

Eunicella verrucosa (Pallas, 1766), although often thought of as a 'reef' species (and listed as a characterising species of several reef biotopes) is very often found on veneers in Dorset (Figure 5), especially where the veneer is composed of silt rather than the sand or clean shell fragments described above. In recent years in the Lyme Bay Closed area, it has been seen vigorously colonising areas of mixed silt and shell fragments over rock.

2) Veneer sediment characteristics

Mobility. Macroalgae and sessile fauna require hard surfaces on which to settle and establish. The presence of a blanket of unconsolidated material over a hard surface is assumed to prevent settlement on that hard surface. It therefore follows that at some point in time suitably 'clean' surfaces must exist to allow settlement and that they must remain 'clean' long enough to allow establishment.

Mobility - scour. Particulate sediment moving across a hard surface will act as an abrasive and so produce scour. Scour will act to limit establishment of recently-settled organisms and if sufficiently pronounced would remove established individuals. In early 2014 many Lyme Bay *Eunicella* were observed with their tough brown core exposed at the base and pink outer tissue re-growing downwards from above (Figure 5). This was taken to be due to scour produced by back-and-forth movement of sediment over bedrock caused by wave action in a series of severe winter storms.

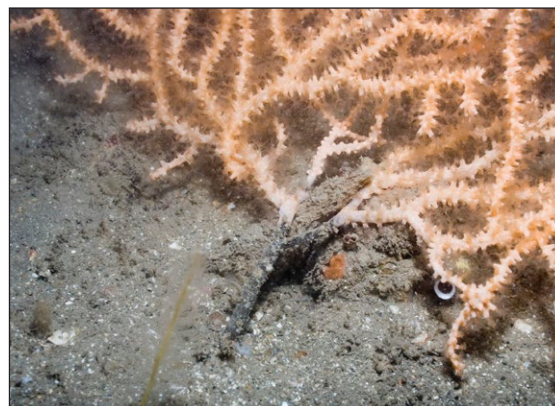


Fig. 5: *Eunicella verrucosa* with eroded base and re-growing live tissue dated 07/06/2014, 26m BSL



Fig. 6: A 'blanketing band' revealed by movement of a silt/shell fragment veneer. Note relatively abrupt demarcation line. Beer Fans 22-23m BSL.

Mobility - blanketing. Fine sediment with smaller particles (typically found in less-energetic environments) would be less abrasive than larger particles, but would cover flora and sessile fauna on hard surfaces. Prolonged 'blanketing' by sediment would act to kill established filter feeders by denying access to the water column for feeding and would kill established algae by cutting off light for photosynthesis.

Scour and blanketing together will combine to limit establishment of susceptible species, but for species resistant to their effects, a niche will exist where competition from a range of other (susceptible) species is reduced (Figure 6).

Mobility - periodicity. Sediments may be frequently mobile or may be mobile on an annual or even longer basis. How often a veneer at a hypothetical Point A moves will depend on the local hydrological regime and the size and density of the particles. Even if the veneer at Point A were to remain at the same average thickness, how often the veneer at Point A moves will affect the rock-fast (veneer) community. Sediments of larger

particle size need more energy to be mobilised, therefore would be moved less frequently than smaller-sized particles. In certain circumstances the periodicity of a sediment veneer may be affected by biogenic factors, e.g. black bream (*Spondylus cantharus* (Linnaeus, 1758)) nesting behaviour.

It should be remembered that diver or drop-down video observations can only be made in the most benign conditions and that despite the sediment veneer being mobile, the underlying hard substrata may not move for long periods of time, if at all.

Mobility – differential mobility. Veneers may be composed of sediment of a range of sizes including silt and gravel and there is scope for a veneer at Point A to be composed of different sizes of sediment which may be layered. For instance, sand may overlie sand and gravel or mixed pebbles and gravel and sand. The top sand layer may move during summer 'rough weather', gravel and sand during storms and pebbles (along with the rest) during severe storms only. The material of the topmost (finest) layer will be found throughout the deposit.

Mobility – particle size, shape and density

When analysing sediments, usual practice is to take a sample and then run it through a series of sieves to work out the sizes of particles present and then classify it based on those sizes and relative proportions. Many attempts have been made to render the almost infinite variability of sea bed substratum understandable and amenable to such an analysis. <http://jncc.defra.gov.uk/page-5566>.

UKSeaMap (2010) has a helpful diagram (a modified Folk sediment trigon) that illustrates sediment types (gravel, silt and mud) and mixtures of types.

The sessile community at a given point will be determined to a large degree by particle size, shape and density, so these properties need to be recorded. Unfortunately this is difficult in diving surveys and even if a sample is taken for later analysis, lighter fractions are likely to be lost more easily than heavier ones, biasing results. Where there is a component of fine sediment, sampling may significantly affect visibility and require special planning for the dive.

Large, dense, abrasive particles produced by erosion of hard rock or by erosion of soft rock containing a proportion of large clasts scour severely when they move. They tend to be seen

in high energy environments (smaller, less dense particles get carried away in the water column). Soft rock (e.g. shale) produces flat clasts which are more-easily 'lofted' into the water column, settle more slowly and are less effective in producing scour. Small particles ('silt') are seen to accumulate in low energy environments and contribute less to scour and more to 'blanketing'.

Often not recorded separately are biogenically-derived sediment particles. Small particles such as bacterial 'snot' or clay particles not resolvable by the naked eye fall outside what a diver can discern. However, particles that can be seen (perhaps in a good macro photograph) especially when they can be picked up by un-gloved fingers can be recorded. The importance of doing so is illustrated by the observation from many sites in Lyme Bay of accumulations of silt mixed with fragments of shell/carapace. Such fragments of exoskeleton are lighter than mineral clasts, softer, more easily lofted into the water column and settle more slowly than mineral clasts. They often seem to be produced locally, especially when (on examination) they turn out to be pieces of barnacle test or other material that are by-products of the predation of sessile invertebrates.



Fig. 7: St Austell Bay, November 2017, active maerl bed with 25% live and 75% dead maerl in swales.

In more energetic sites, sediment composed principally of shell/carapace fragments can be seen. These particles are less erosive than mineral clasts of similar size and this factor may be important in how this type of veneer acts upon the community growing through it or beneath it.

Along the Purbeck coast east of St Albans Head, there are large deposits of fossil maerl fragments. Rounded, soft and of low density, dead maerl fragments are less erosive and more mobile than mineral clasts of similar size. That they constitute a large sequestered CO₂ reserve makes them worthy of note if for no other reason and should be recorded as dead maerl, rather than as gravel or just 'sediment'.

Dead maerl can also be seen in Figure 7. The maerl bed here remains active with about 25% live material which can be seen mixed through large (1-1.5 m base, 1/3 m high) mobile swales as well as against the bases of the swales and in the gaps between (live maerl is significantly more dense than dead maerl of similar size). Veneer species in the area of St Austell Bay surveyed were limited to coralline crusts on bedrock or larger clasts and very large *Lanice* and *Chaetopterus* tubes.

Sediment infauna. If sediment infauna (especially long-lived species) are present, then in all likelihood the sediment in that location is not a veneer. However, the presence of limited numbers of annual species or juveniles of long-lived species should not be taken to preclude sediment in a given location from being classified as a veneer.

Sediment epifauna. The presence of mobile fauna commonly recorded on the surface of sediment, e.g. *Ophiura albida* Forbes, 1839, *Aequipecten opercularis* (Linnaeus, 1758), *Callionymus* spp., juvenile *Pecten maximus* (Linnaeus, 1758) should not be taken as indicating that sediment at Point A is not a veneer. These species are mobile and Point A may not be far from an area of deeper material that qualifies as 'sediment' where the rock beneath is exposed only in exceptional circumstances.

Depth of sediment. The author has so far seen and recorded veneers of 200 mm depth with

life beneath and growing through. These have been either a mix of sand and shell gravel or dead maerl and shell gravel and highly mobile.

When does sediment on the rock become 'veneer'?

Mobility is the main factor in deciding whether a substratum is sediment or rock. At one end of any seabed substratum classification you have rock: a stable surface only changing with erosive forces. Divers enjoy this as rocky reef. Boulders often get included as 'rock'. At the other end is silt or sand which is a constant feature at a given point – 'sediment with life apparent' or 'barren sediment'. In between are 'sediments' composed of clasts of many sizes through shingle and cobbles to boulders that move in storms.

Although they are reef, stony reefs (Irving 2009) can also be thought of as being metastable larger-clast sediment (often a mixture of sizes) with the faces of larger clasts being stable enough and with faces exposed for long enough periods to allow the development of flora/fauna requiring a hard surface. 'Sediment' qualifying as stony reef would not also qualify as a sediment veneer.

If at a given point (Point A), sediment on the rock moves away only very rarely and has time to build up an infaunal community independent of any hard surface, you do not have a sediment veneer, rather a sediment community dominates. But whilst you can rule out the existence of a sediment veneer (in the terms used in this article) if you see long-lived infauna (holothurians, worms, bivalves) you cannot rule out the possibility of a thin layer of sediment with no infauna on rock developing veneer ecology. You may be seeing Point A in spring after a stormy winter when scour has wiped the hard surface clean of life. Or you may be seeing it after passage or repeated passage of bottom-towed gear has had a similar effect.

The case for protection of sediment veneers

Sediment veneers are mentioned in EU Habitats Directive documentation (European Commission DG Environment 2013) as deserving of protection as part of the 'reefs' section but those references are obscure. The

specific passage is: *“Such hard substrata that are covered by a thin and mobile veneer of sediment are classed as reefs if the associated biota are dependent on the hard substratum rather than the overlying sediment”*.

Whilst the author has heard veneers dismissed as being ‘transitions’ between sediment and reef, this is not a valid reason for ignoring veneers. Sediment veneers are important because:

- They may support specialist species rarely found in either ‘main’ habitat.
- They are often important in fulfilling the requirements of mobile species primarily resident in either (or both) ‘main’ habitat.
- Especially where part of a habitat mosaic, veneers may be important in the resource utilisation of juveniles of species of either ‘main’ habitat at different growth stages of those juveniles.
- By definition, the sediment component of sediment veneers is mobile. Should the mobility of the sediment component at Point A change, it would be expected that this would affect the biota at that point. It is therefore reasonable to assert that given sufficient baseline data, veneers could fulfil a ‘Canary in the coalmine’ role for determining whether or not changes in the severity or frequency of ‘storminess’ as a possible result of climate change are actually affecting marine biodiversity.
- Sediment veneers are affected by physical disturbance, whether by regular tidal effects, by storm events or passage of bottom-towed gear. The question of whether these latter two ‘methods’ of disturbance are equivalent is an important one. It is possible that the effect of storm events is more ‘selective’ than that of bottom-towed gear in how the biota of veneered hard substrata is affected. In a severe storm event that moves sand, silt, gravel and pebbles in 20 m of water, for instance, small boulders may remain in place and provide lee shelter or refugia in crevices which retain their orientation. Bottom-towed

gear is easily capable of moving small boulders and would therefore be likely to disrupt such shelters/refugia, so making subsequent recovery much slower by completely ‘re-setting’ the habitat to re-colonisation by bare rock pioneers.

Conclusions

1. Sediment veneers are important but tricky to record and are overlooked. Biotopes should be written for them so that recognition of sediment veneers as part of wide-scale habitat mosaics is improved.

2. Evidence is accumulating to support the idea that veneers can develop long-lived assemblages of flora and fauna when left undisturbed by anthropogenic activity. Under the current system of feature-based protection, sediment veneers should receive protection as part of ‘reef’ features, but it is arguable that this only happens by default.

3. Evidence is accumulating that veneers are important enough to merit protection in their own right, but perhaps the best way to solve this ‘recognition gap’ is to accept that area-based protection of marine habitats is the best way forward.

Glossary

Clast: A fragment of rock broken off larger rock. A separate piece of mineral geological detritus broken or eroded out of a geological deposit and of a size ranging from that able to be picked up individually in the fingers to boulder size. Source: Various, geology.

Geogenic: Of a clast or particle produced by physical geological processes. **Biogenic:** A feature or item produced by biological processes.

Gravel: Clasts of 4 mm to 16 mm. Should not be assumed to be composed of geogenic material only.

Habitat Mosaic: Different habitats (biotopes) occurring in close juxtaposition. The distribution of these habitats is often patchy, with any given recorded biotope frequently presenting as a number of patches. Each patch in isolation is often smaller than the 5 m x 5 m minimum required to be counted as a biotope.

Veneers can frequently be observed around the edges of rocks protruding out of sediment, for example. In Lyme Bay, the converse is often true with 'reef species' occurring in ribbons of low-relief verticals on little rock ledges or around the edges of flat, slabby boulders.

Periodicity: The periodicity of a sediment veneer refers to how frequently it moves or 'clears' the hard surface beneath. Clearance might be every time there is a storm, only when a south-westerly coincides with a spring tide or only in severe winter storms. Clearance might be on average monthly, or at intervals of many months.

Stony Reef: The 'reefs' 'habitat category includes bedrock, stony and biogenic variants.'

"Stony reefs may comprise areas of boulders or cobble (cobbles are generally considered as being between 64 and 256 mm diameter)" ... "which arise from the seafloor and provide a suitable substratum for the attachment of benthic communities of algae (where shallow enough) and animal species". Source: Irving (2009) – European Commission DG.

Swale: A ridge or long dune of sediment superimposed on a hard substratum. Think of the top third of a sine wave peak separated from the next swale by flat terrain. Source: Obscure. Personal experience of public access surfacing where a 'swale' is a long, gentle, symmetrical hump aimed at channelling water off a downhill section to control erosion without tripping a horse or impeding a cycle.

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The naming of *Tanystylum sinoabductus*

Dec 2008. In Roger Bamber's words:

"My favourite of the names I have invented (pride and arrogance in one go) was for a new species of pycnogonid of the genus Tanystylum, collected from Hong Kong, which I called Tanystylum sinoabductus, as in "sino" – Chinese, "abductus" – to abduct, remove, thus "Chinese take-away".

(Bamber, R.N. 1992. Some pycnogonids from the South China Sea. *Asian Marine Biology* 9: 193–203.)



Photo of the holotype of Tanystylum sinoabductus Bamber, 1992 from National Museum Wales collections: NMW.Z.1992.020.1

Cymothoid isopods in UK Waters

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Introduction

Cymothoid isopods are obligate fish parasites, found globally in marine, fresh and brackish waters (except in polar regions). The family Cymothoidae (Crustacea: Isopoda) is mostly confined to shallow waters (less than 200 m), with only 10 species being recorded at depths greater than 500 m (Smit *et al.* 2014). Around 40 genera are currently known with more than 380 species (Smit *et al.* 2014; WoRMS 2018). Cymothoids are some of the largest known isopods, reaching 75 mm in length (Brusca 1981). They are perhaps better known colloquially as ‘fish lice’ or ‘tongue-biters’, and strike horror in many who are made aware of them. Cymothoids are known to attach to their fish hosts in a number of ways, which relate to their morphology and can also aid in their identification. There are ‘buccal or gill-attaching’ species, which are not immediately apparent to the observer. These parasites are often encountered by fishermen, anglers or fishmongers after capture of the infected fish. On death of the host, the isopods will often crawl out from the mouth or gill cavity, to be discovered free in the net or on the deck of a boat. There are ‘skin-attaching’ species, which will cling onto the exterior surface of their hosts, using their powerful and wickedly sharp dactyls (or claws, the terminal part of the leg) to pierce the host tissue and prevent detachment. They will generally attach to the host in particular attachment sites (e.g. near the tail or on the head) and this information can sometimes aid in identification of the isopod to genus and species. There is also a smaller group of bizarre ‘flesh-burrowing’ species, which is largely confined to freshwaters, in South America and Asia (Brusca 1981).

Cymothoids are characterised by the possession of seven pairs of prehensile legs armed with recurved dactyls capable of closing back in on the carpus of the leg and thus enabling them to firmly attach to the host. Indeed, the first three pairs of legs oppose the last four pairs, further reducing the chances of dislodgement (Lincoln 1971).

In UK waters there are a number of species that are increasingly reported and it is the intention of this article to introduce these to Porcupine readers to raise awareness and improve the recording of these wonderfully bizarre and often overlooked isopods.

Historical records of UK Cymothoidae

In 1996, the buccal-inhabiting cymothoid *Ceratothoa steindachneri* Koelbel, 1878 was discovered parasitizing the lesser weever fish, *Echiichthys vipera* (Cuvier) in Whitsand Bay Cornwall (Horton 2000). This finding was considered unusual since cymothoids are more usually found in tropical and warm temperate latitudes (Brusca 1981). The study of this host-parasite association over a three-year PhD program allowed the mapping of its distribution at the time (Horton & Okamura 2002) and it was then confined to south west Britain (Whitsand Bay, Whitesands Bay & Perran Bay). It was thought that the finding of a breeding population of the species was probably a result of a range expansion related to climate change. The distribution of the species has not been studied since 2002, although there are now additional confirmed records from weever populations in the Channel Islands (<https://societejersiaise.wordpress.com/2009/09/13/new-species-of-isopod-for-the-channel-islands-ceratothoa-steindachneri/>) and the Hayle Estuary (David Fenwick, pers comm. See photographs here: http://www.aphotomarine.com/isopoda_ceratothoa_steindachneri.html).

Since the completion of the PhD, the senior author (TH) has been sent records including photographs and specimens of cymothoids found in UK waters, and these records have become more frequent in recent years. However, according to the literature, cymothoids have been recorded in the UK since the 1900s.

In 1905, Tattersall noted that the family Cymothoidae, is “entirely unknown from boreal waters, and only three species approach anywhere near to the British and Irish area”. These were: *Anilocra asilus* Stebbing, 1893 [now recognised as a synonym of *Anilocra frontalis* H. Milne Edwards, 1840, see Trilles 1994] and *A. physodes* (Linnaeus, 1758), both of which had, at that time, been recorded from the Channel Islands [as *Anilocra mediterranea* Leach, 1818, see Norman 1868 and Koehler 1885) and *Nerocila neapolitana* Schioedte & Meinert, 1881 [now recognised as a synonym of *Nerocila orbignyi* (Guérin-Méneville, 1832)] which had been found by Norman in Plymouth (Tattersall 1905).

The Plymouth Marine Fauna (Marine Biological Association 1957) reports the presence of two species: *Anilocra physodes*, collected on a Red Mullet in 1951, being the first record for the British Isles (excluding Channel Islands) and *Nerocila neapolitana*, identified by A.M. Norman and reported in the *Crustacea of Devon & Cornwall* (Norman & Scott 1906). This was noted as “the first record of this genus in our seas” and had been taken 5 or 6 miles south of the Mewstone (Norman & Scott 1906).

Lincoln (1971) notes that “*Anilocra physodes* is a particularly common species found on a variety of shore fish around the British Isles, especially *Labrus* species (wrasses, corks) but also gobies, blennies and even sticklebacks.” A year later, Holthuis (1972), reporting on the first record of *Anilocra* from the North Sea, points out that while *Anilocra* is a common name in Roscoff, France, the species is scarce on the English south coast. Holthuis (1978) changes the identification of the *Anilocra* specimen from the southern North Sea to *Anilocra frontalis* after the specimens were re-determined by Trilles (1977). He also reports on the finding of *Nerocila maculata* H. Milne Edwards, 1840 in the southern North Sea.

Trilles was at this time conducting extensive studies of the Cymothoidae of the French coasts. He reported extensively on *Anilocra* and *Nerocila* and noted that on French

coasts there are five species recorded (*Anilocra physodes*, *Anilocra frontalis*, *Nerocila bivittata*, *Nerocila maculata*, *Nerocila orbignyi*). Trilles (1975) reports the known geographical and host preferences for each species. He indicates that *Anilocra physodes* and *Anilocra frontalis* are found in the Mediterranean, but also mentions the records from the Channel as follows:

“Some authors have mentioned [*Anilocra physodes*] occurs not only in the Mediterranean, but also in the English Channel. This is due to the fact that they certainly had a mixture of samples of *Anilocra physodes* and *Anilocra frontalis*. As to the presence of *Anilocra physodes* in the Gulf of Gascogne, in Portugal ... and at the North Atlantic coast and South of Spain... it would need to be confirmed.”

Therefore, according to the literature there are potentially five cymothoid species in the UK: *Ceratothoa steindachneri*, Koelbel, 1878; *Anilocra physodes* (Linnaeus, 1758); *Anilocra frontalis*, H. Milne Edwards, 1840; *Nerocila orbignyi* (Guérin-Méneville, 1832); and *Nerocila maculata* H. Milne Edwards, 1840.

However, other than for *C. steindachneri*, the literature records have not been confirmed and there are clearly issues with the taxonomic identity and validity of the species found in our waters. Part of the problem results from the difficulty in differentiating between the two species of *Anilocra* and the modern taxonomic decisions regarding the validity of the species *Nerocila maculata* (which is regarded as a synonym of *Nerocila orbignyi* by Bruce 1987). The relevant papers for identifying the species date from the 1960s and 1970s, are written in French, and may be difficult to obtain. In order to record these species accurately an updated understanding of these species is needed.

Differentiating the three genera known in UK waters

The three genera found in the UK, *Nerocila*, *Anilocra* and *Ceratothoa*, can be relatively easily distinguished morphologically and according to location on the host as follows:

1. - Externally attaching; head not immersed in pereonite 1; posterior margin of head trisinate; basal articles of first antennae not touching, separated by rostrum/clypeus2

- Buccal-inhabiting; head immersed in pereonite 1; posterior margin of cephalon not trisinate; basal articles of first antennae are expanded and touching*Ceratothoa*

2. - Head generally narrowing anteriorly forming a projection, which is produced ventrally between first antennae; posterolateral angles of pereonites 2-6 not extended; coxal plates short, just reaching or falling short of posterior border of respective segments.....*Anilocra*

- Head not narrowing anteriorly; bases of first antennae separated by clypeus; posterolateral angles of pereonites 2-6 clearly extended, increasingly so posteriorly; coxal plates long, usually extended to or falling just short of posterior border of respective segment*Nerocila*

Morphological features can be seen in Figure 1. Additional information about the host on which the parasite is found will also aid in distinguishing the genera. *Ceratothoa* is only found in the buccal cavity of fish, and does not attach externally. In the UK, there is only one species, found infecting the lesser weever fish. *Anilocra* and *Nerocila* are both externally attaching genera.

Identification to species

While identification of *Ceratothoa* in the UK is clear, identification of species of *Anilocra* and *Nerocila* is more difficult. Trilles provides detailed illustrations of the species of both genera (Trilles 1965, 1968, 1975; Trilles & Raibaut 1971, 1973). However, despite these illustrations, the distinctions between them remain unclear.

According to Trilles (1975), *Anilocra physodes* is a rather ubiquitous species that parasitizes various fish species with a clear predominance on fish from the families Sparidae and Centranchidae. He also states that this species is only found in the Mediterranean, which should preclude it from being found on British coasts. Indeed, Trilles (1975, 1977)



Fig. 1: Dorsal views (left to right) of *Nerocila orbigny*, *Anilocra cf. physodes*, and *Ceratothoa steindachneri*, all collected from UK waters. Photograph copyright L-R: Steve Trewella, Heather Buttivant, Tammy Horton]

indicates in his synonymies that specimens identified from the UK, from Atlantic French coasts and the southern North Sea belong to *A. frontalis*, and that records of *A. physodes* from these areas are in error.

Anilocra frontalis is mostly collected on fish of the family Labridae but has also been reported on numerous other species including cod, pollack, whiting, and a variety of blennies and gobies (see host records in Trilles 1975).

Trilles points to a number of means of differentiating the two species. In particular, he states that these two species differ not only morphologically, but also:

- by their parasitic specificity: *Anilocra frontalis* is parasitic on Labridae, while *Anilocra physodes* most often attaches to Sparidae or Centracanthidae;
- by their position on the host: *A. frontalis* is usually fixed very forward on the fish, above the operculum, behind the eye and above the relative level of the lateral line. Whereas *Anilocra physodes* is usually fixed above the lateral line and very clearly behind the posterior edge of the operculum.

Morphological characters of adult females (Figure 2) from Trilles (1965) include:

Anilocra physodes females measure 18–50 mm in length and are characterized by their globular form, little ovoid. The head is well-developed, anteriorly the cephalon is truncated. The eyes are well-developed. Lateroposterior edges of pereonites I, VI and VII are clearly prolonged and auriform (ear-shaped!). The telson is shield-shaped and presents distally a pointed tip. The endopods of the uropods generally do not exceed the posterior edge of the telson.

Anilocra frontalis females measure 15–35 mm in length, are globular and distinctly ovoid. The width of the pereonites increases markedly from the first to the fifth. The head is well-developed but clearly extended anteriorly and more acuminate. It is rounded at its distal end. The eyes are visible but reduced. Without auriform extensions of the pereonites I, VI and VII, present in *Anilocra*

physodes. The telson is semicircular, rounded at its distal end; the uropods go clearly beyond its posterior edge.

Unfortunately, these characters are not consistent in specimens that we have seen, nor in photographed specimens. In most cases, the specimens display a combination of these characters e.g. the large eyes, truncated head anterior of *A. physodes* but without the auriform extensions of the pereonites, and yet found on the fixation point, host and geographical locality expected for *A. frontalis*. This means that, at the present time, we cannot confidently identify specimens of *Anilocra* as either *A. physodes* or *A. frontalis*. More specimens are needed and a comparison of specimens from the type localities of both species and certainly with material from the Mediterranean is needed.

Specimen records

There are now numerous records of *Anilocra* in UK waters, and indeed breeding populations are known in Dorset at both Kimmeridge Bay and Swanage Pier, with manca larvae and small males being collected regularly in light traps (Steve Trewella, pers comm.) The NBN Atlas holds records of cymothoids: *Anilocra frontalis* – 6 records from Seasearch, Channel Islands, between 2013 and 2014. No indication of host. *Anilocra* sp. 1–26 records and a single record of *Anilocra physodes* (Channel Islands Seasearch).

There are currently no records of *Nerocila* in the National Biodiversity Network but we have received a number of specimens since 2010 that were identified as *Nerocila orbignyi*. These have been collected on a variety of fish species, including thick-lipped grey mullet, mackerel and herring.

There are a number of specimens in the Natural History Museum in London, mostly from the Channel Islands. We will now be working to trace all records of cymothoids from UK waters held in museum collections.

In addition to physical specimens, we have been sent numerous photographs of specimens (sometimes attached to the host) which can usually be identified to the

Identification	Host	Location	Specimens
<i>Anilocra</i> cf. <i>physodes</i>	On head of black bream, <i>Spondylosoma cantharus</i> (Linnaeus, 1758)	Christchurch Bay, Hampshire, 09/2006. Coll. Jenny Mallinson.	1 large female, 1 male
<i>Anilocra</i> cf. <i>physodes</i>	On head of black bream, <i>Spondylosoma cantharus</i> (Linnaeus, 1758)	Dungeness Point.	1 large female
<i>Anilocra frontalis</i>	Ballan (<i>Labrus bergylta</i> Ascanius, 1767) & Corkwing (<i>Symphodus melops</i> (Linnaeus, 1758)) wrasse (Labridae)	QEII Marina, St Peter Port, Guernsey Coll. Richard Lord.	5 specimens, small, all males
<i>Nerocila orbignyi</i>	Mackerel (<i>Scomber scombrus</i> Linnaeus, 1758)	Swanage, 09/08/2008, Collected by Steve Trewella	1 large female
<i>Nerocila orbignyi</i>	Herring (<i>Clupea harengus</i> Linnaeus, 1758)	Southampton Water, 50° 54.30' N, 001° 27.54' W to 54° 54.48' N, 001° 27.80' W, 04/12/2010, Coll. Robin Soames.	1 large female
<i>Nerocila orbignyi</i>	Herring (<i>Clupea harengus</i> Linnaeus, 1758)	Southampton Water, close to 50.90° N 1.441° W, 21/12/17. Coll. Robin Soames.	1 large female
Photograph only			
<i>Nerocila orbignyi</i>	Thick lipped grey mullet (<i>Chelon labrosus</i> (Risso, 1827)), attached at vent/base of the anal fin.	Newlyn harbour (SW4645128545), 28-01-18, Coll. Jenny Kent.	1 large female
<i>Anilocra</i> sp.	On head of Pouting (<i>Trisopterus luscus</i> (Linnaeus, 1758))	Plymouth area, coll. by Fisherman. 04/2014	1 large female
<i>Anilocra</i> sp.	Corkwing Wrasse (<i>Symphodus melops</i> (Linnaeus, 1758))	Hannafore, West Looe, Cornwall, 02/04/2018. Coll. Heather Buttivant.	1 large female, 1 male
<i>Anilocra</i> sp.	Corkwing Wrasse (<i>Symphodus melops</i> (Linnaeus, 1758))	Swanage Pier, Coll. Steve Trewella	1 large female
<i>Anilocra</i> sp.	2-spot goby (<i>Gobiusculus flavescens</i> (Fabricius, 1779))	Kimmeridge Bay, Coll. Steve Trewella	1 male
<i>Anilocra</i> sp.	Ballan Wrasse (<i>Labrus bergylta</i> Ascanius, 1767)	Chesil Bay, Coll. Steve Trewella	1 large female
<i>Anilocra</i> sp.	Pollack (<i>Pollachius virens</i> (Linnaeus, 1758))	Kimmeridge Bay, Coll. Steve Trewella	1 large female, 1 male
<i>Anilocra</i> sp.	Pouting (<i>Trisopterus luscus</i> (Linnaeus, 1758))	Newtons Cove, Coll. Steve Trewella	1 large male

Table 1: Records of UK *Anilocra* and *Nerocila* from photographs & specimens sent to Tammy Horton.

genus level at least (Table 1). Unfortunately, determination to species is not possible in many cases as the necessary features are not visible. A selection of these photographs are included here for reference (Figure 2).

Molecular barcoding

In addition to morphological characterisation of the specimens from the UK for comparison with Mediterranean specimens, we are also extracting DNA from suitable specimens,

which will be used to generate genetic barcodes (cytochrome oxidase 1). This will aid in the confirmation of the identification of these difficult species. Tissue samples from confirmed identified specimens of each of the entities found in the UK and in the Mediterranean are needed in order to determine if these are from the same species or if there are unrecognised cryptic *Anilocra* and *Nerocila* species within the North Atlantic and Mediterranean fauna.

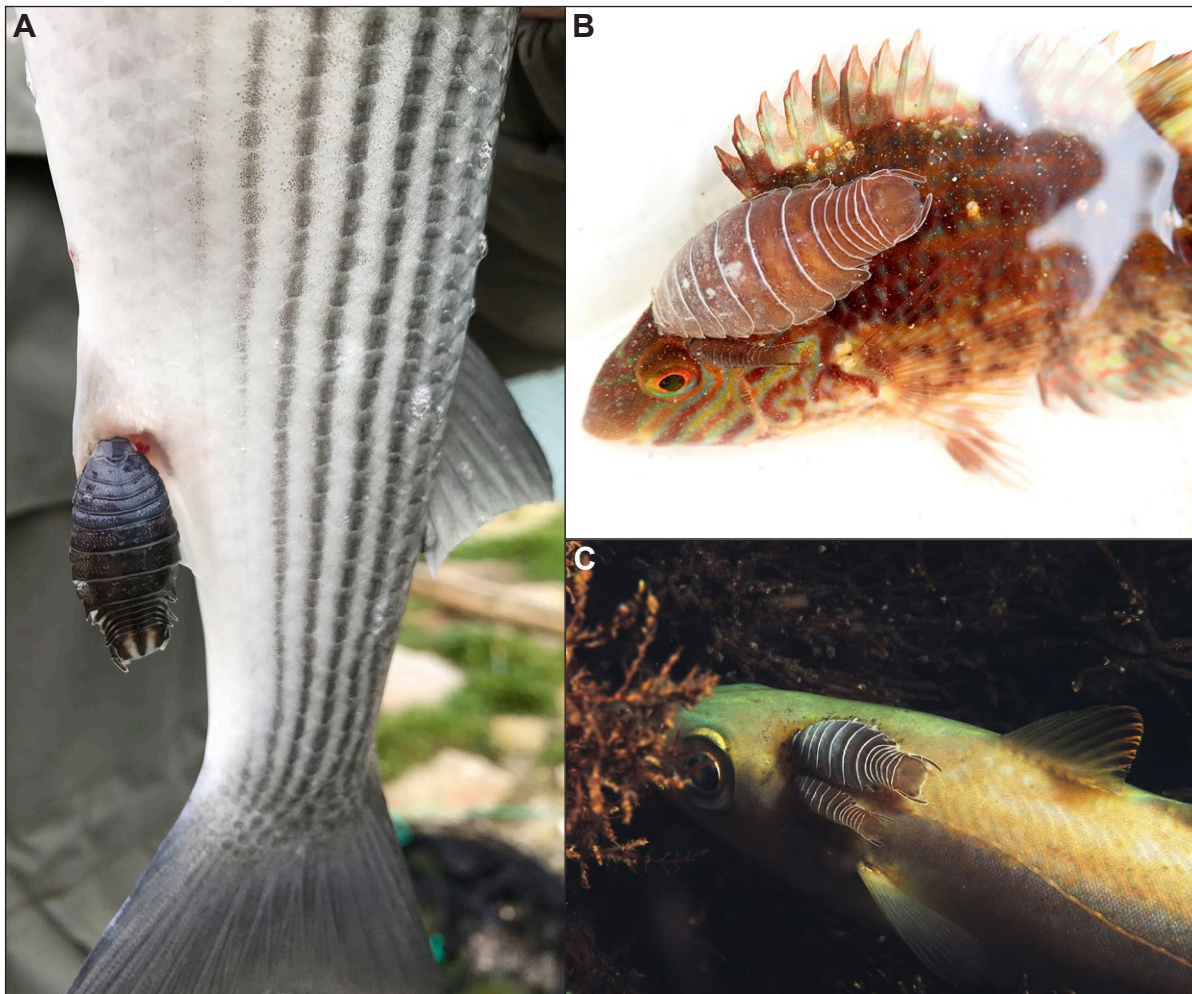


Fig. 2A: *Nerocila* sp. on mullet, Plymouth (Photo: J. Kent); B: *Anilocra* sp. on corkwing wrasse, Hannafore (Photo: H. Buttivant); C: *Anilocra* sp. on pollack, Kimmeridge (Photo: S. Trewelha)

We need as many specimens and records from UK waters as possible. We are particularly interested in obtaining specimens suitable for molecular analyses (in 95% ethanol). If you manage to collect a specimen, please either freeze or place in 95% ethanol and send to Tammy Horton at the National Oceanography Centre, Southampton.

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**An observation of feeding
behaviour by *Pachygrapsus
marmoratus* (marbled crab) on
recently stranded, living *Pelagia
noctiluca* (mauve stinger):
Eolian Islands, southern Tyrrhenian
Sea, Mediterranean, June 2018**

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Farr (1978) noted the absence, within the scientific literature, of reports of crustacea feeding on medusae, with a review from almost a decade previously finding just three crustacean species preying on live jellyfish (Phillips *et al.* 1969). Fast forward almost thirty years and in an in-depth review of predation on pelagic coelenterates it was identified that in general, gelatinous organisms were still not recognised as prey with some reports writing them off as largely, food-web 'dead ends' (Arai 2005). Twelve years later, in a note on benthic scavengers and predators of jellyfish it is noted that despite mounting evidence to the contrary jellyfish were still on occasion being labelled 'dead-ends' or, rarely predated (Ates 2017).

It takes concentration, focus and a keen eye to spot feeding behaviour rarely documented in the literature so I should make it clear that this behaviour was first observed and commented upon not by me, but by my four and half year old daughter, Giorgia whilst playing on a stony beach frequented by visitors to the island of Salina.

The Eolian Islands are, unsurprisingly, windy, the clue is in the name. On windy days it is not unusual to see medusae, principally *Pelagia noctiluca* (Forsskål 1775), washed up on the shore by the wind driven waves. Sometimes the waves pick them up again and wash them back out to sea. So if you're a crab, living between the stones on the shoreline, you have to be quick. Having been tuned into this activity it was easy enough for us to find other examples of the same behaviour. Figure 1 shows a small



Fig. 1: Marbled crab with stranded jellyfish in rocks

marbled crab next to a stranded mauve stinger. The jellyfish could be seen pulsing and was clearly still living despite being stranded on sun-baked rocks. The crab proceeded to use its claws to pick away at the mass of the jellyfish. Obtaining a reasonable photograph was challenging as naturally enough, the crab was wary and when approached would quickly scuttle for cover beneath the stones.

Crabs are noted as, 'widespread as well as common predators or scavengers of jellyfish' (Ates 2017). In Table 1 of this paper the author lists those species which have been recorded as consuming live or dead jellyfish. Inevitably the list cannot be exhaustive but there are 26 decapod crustaceans listed and *Pachygrapsus marmoratus* (Fabricius, 1787), is not one of them.

Predation of moribund *Physalia physalis* (Linnaeus, 1758), (Portuguese man o' war), by shore birds and ghost crabs (e.g. *Ocypode quadrata* (Fabricius, 1887)) was noted in the Mississippi Sound as long ago as 1969 (Phillips *et al.*). More recently the same behaviour was observed in South Africa near the border with Mozambique within the Cape Vidal World Heritage Site (near the town of St. Lucia). Here a species of ghost crab were taking the tentacles of this Siphonophorae down into their burrows but rejecting the bladders (Bray

& Steyl, pers comm). Many stranded *Physalia* were seen with ghost crabs actively harvesting this resource.

Studies to date have relied on stomach content analysis as there has been little alternative. But as McInnes *et al.* (2017) point out in their study of black-browed albatross, stomach contents analysis “cannot detect most gelatinous prey”. These authors used DNA metabarcoding of scats to show that scyphozoan jellyfish formed a significant part of the diet of this top predator even suggesting it was selective rather than opportunistic. So the lack of evidence in the scientific literature for marbled crab predation of jellyfish prey is perhaps not surprising. No doubt someone will undertake a molecular study at some point and with jellyfish populations on the increase it’s not just the black-browed albatross that may benefit.

Pachygrapsus marmoratus clearly have a flexible omnivorous diet (Silva *et al.* 2009; Cannicci *et al.* 2002). It has been suggested that marbled crab are not simply generalist and opportunistic feeders but that they may be selective feeders regulating consumption of animal and plant material to support their needs (Cannicci *et al.* 2002). The question is how important might jellyfish predation be to populations of marbled crab in the Aeolian archipelago? How steady is the supply of this potential part of the crabs’ diet in these islands? Is it pure opportunism and a general scavenging ability which enables them to exploit this food source or is there something more in play here? Bearing in mind the small size of the crabs observed here and the possibly unfavourable (marginal?) nature of the habitat, do all age groups take such prey equally? Silva *et al.* (2009) report that studies have shown the species to be, ‘active during nocturnal low-tides’. This behaviour was observed during daylight. Presumably, it also occurs at night. But given that a nocturnally active predator is prepared to feed in full daylight this suggests that either it is tuned in to take whatever it can get or, it is on the lookout for jellyfish and takes them whenever the opportunity arises.

“There are three principal means of acquiring knowledge... observation of nature, reflection, and experimentation. Observation collects facts; reflection combines them; experimentation verifies the result of that combination.”

Denis Diderot

“We cannot create observers by saying ‘observe’, but by giving them the power and the means for this observation and these means are procured through education of the senses.”

Maria Montessori

“A few observations and much reasoning lead to error; many observations and a little reasoning to truth.”

Alexis Carrel

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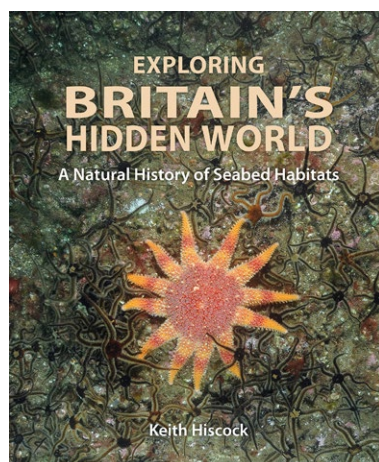
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Exploring Britain's Hidden Worlds: A Natural History of Seabed Habitats – Keith Hiscock

Published by Wild Nature Press, 2018, 272 pp.

Available in hardback £22.50

(<https://wildnaturepress.com/>)



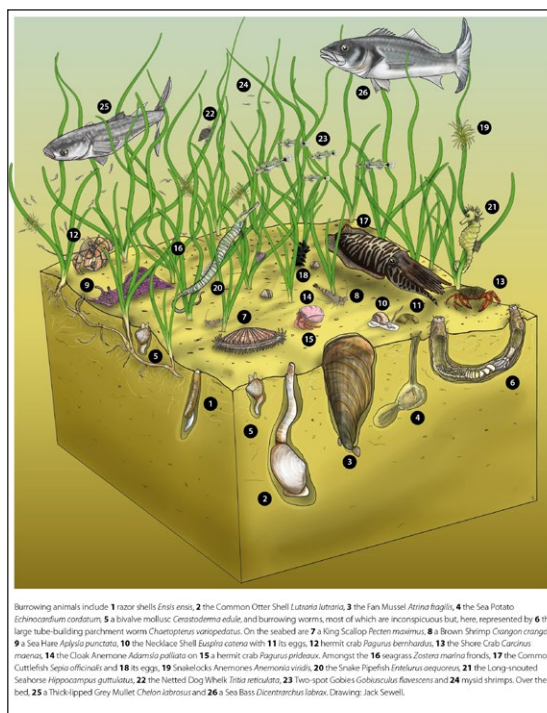
Book review by Paula Lightfoot

Knowledge of seabed habitats is crucial for marine spatial planning, including the designation, management and monitoring of Marine Protected Areas. The Marine Habitat Classification for Britain and Ireland (Connor *et al.*, 2004) provides a standard way of classifying and describing intertidal and subtidal habitats and their associated species communities, known as 'biotopes'. This enables comparison between sites, identification of ecologically important areas, sensitivity assessments, and monitoring of individual sites to detect change over time. It is compatible with the European Nature Information System (EUNIS) and has become such a useful tool for marine surveys that today's practitioners and students probably take it for granted! Read this book to find out how it all came about...

Exploring Britain's Hidden World provides a detailed yet highly accessible introduction to our diverse shallow sea habitats and the wonderful marine life they support. Drawing on over 50 years' experience as a marine ecologist, Keith Hiscock shares his unique knowledge and insight into Britain's seabed habitats; how they are defined and classified, where they occur and why, how they are changing and how we can protect them.

The first two chapters provide historic context, describing the quest for knowledge about Britain's seabed habitats from early dredging explorations by 19th century naturalists to the rise of SCUBA diving in the 1970s and the Marine Nature Conservation Review (MNCR) led by the author in the 1980s-90s. Porcupine Marine Natural History Society gets a mention here, because many MNCR surveyors were also active members of the Society! Chapter 2 culminates with a section entitled 'How we made sense of it all (Biotopes)', in which the author introduces the Marine Habitat Classification, explains how it was developed through analysis of survey data and illustrates its hierarchical structure. This structure is informed by ecological knowledge of how physical environmental factors such as seabed type, light availability, wave energy, currents and salinity affect the distribution of species communities. The following chapter 'Shaping the seabed environment' explores these relationships between environmental factors and species communities in detail, supported by useful examples and illustrations.

The substantial core of the book, comprising over 50% of the content, is the chapter on 'Habitats'. It is subdivided into sections, each dedicated to a type of physiographic

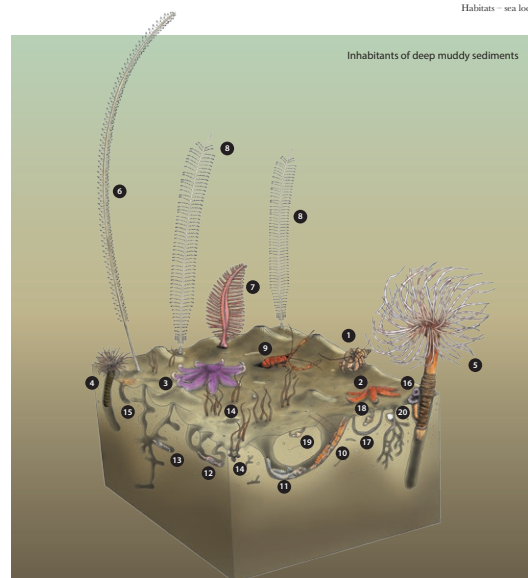


Deep mud

Swim down to the level plains of deep mud in the lochs and the seabed takes on an ethereal appearance. In the dim light, the diver will see forests of sea pens and stunningly beautiful Fireworks Anemones *Pachyseranthus multiplicatus*. The sediment is burrowed by worms and by crustaceans, which may show themselves at the entrances. The most likely burrowing crustacean to be seen is the Rugose Squat Lobster *Munda rugosa*; it is the 'lobster' you will eat if you buy a bowl of lobster tails. If you are lucky, there will be Norway Lobsters, *Nephrops norvegicus* at the entrance to their burrows, perhaps accompanied by Frie's Goby *Leucoragobius friesi*. But the crustaceans that make the most complex burrows will be out of sight. The mud shrimps *Galathea macandrewae* and *Callinassa suberrima* live deep in the mud, often in anoxic conditions. There will be smaller Burrowing Anemones *Cerianthus lloydii*, burrowing brittlestars – most likely *Amphipura filiformis* – and other starfish, such as the northern *Solaster endeca*. A night dive may be particularly exciting as, with torches turned off and a bit of a prod, the Phosphorescent Sea Pens *Pennatulid phosphoreum* are said to 'sparkle like the lights on a Christmas tree'.



Deep muddy sediment at the head of Loch Duich with the Fireworks Anemone *Pachyseranthus multiplicatus* in the foreground and Tall Sea Pens *Funiculina quadrangularis*. Image width c. 1m in the foreground. Seapens, including *Funiculina quadrangularis*, and burrowing megafauna in undisturbed circalittoral fine mud (AS.3611 / SS.Mu.CFMu.SprMeg.Fun).



Based on the seabed near the head of Loch Duich. On the surface of the sediment are 1 a hermit crab Pagurus bernhardus, 2 the Common Starfish Asterias rubens and 3 the Purple Sunstar Solaster endeca. Burrowing species that show at the surface are 4 the Burrowing Anemone Cerianthus lloydii and 5 the Fireworks Anemone Pachyseranthus multiplicatus, 6 the Tall Sea Pen Funiculina quadrangularis, 7 the Phosphorescent Sea Pen Pennatulid phosphoreum and 8 Slender Sea Pens Virgularia mesobis. Mobile species that live in burrows are 9 the Rugose Squat Lobster Munda rugosa and 10 the Norway Lobster Nephrops norvegicus, together with 11 Frie's Goby Leucoragobius friesi. Mostly hidden from view but with connections with the surface are the burrowing mud shrimps 12 Galathea macandrewae and 13 Callinassa suberrima, and 14 brittlestars Amphipura filiformis. There will be other burrowing species, especially polychaete worms such as 15 Nereis, 16 Nottolites, 17 Glycera sp. and brachiopods such as 18 Corbula gibba, 19 Nucula sulcata and 20 Thysania fissus. Seapens, including Funiculina quadrangularis, and burrowing megafauna in undisturbed circalittoral fine mud (AS.3611 / SS.Mu.CFMu.SprMeg.Fun). Drawing: Jack Sewell.

feature, such as open rocky coast, saline lagoon, sea loch or estuary that supports distinctive habitats and communities. Each section begins by describing the physical environment before introducing the species communities through beautiful photographs with detailed captions containing scientific and common names of species and the full biotope name and code. An index to the 79 biotopes described and illustrated in the book is also helpfully provided.

This level of detail and the quality of the photographs make this book a wonderful resource, at once engaging and scientifically informative. Most of the photographs of seabed species and habitats are the author's own, many taken on Porcupine field trips or Seasearch dives, giving extensive geographic coverage from Shetland to the Scillies. The illustrations by Jack Sewell of the Marine Biological Association also deserve a special mention. These meticulously labelled colour illustrations of seabed habitats perfectly complement the text and the photographs, in particular showing the hidden biodiversity present in sediment habitats. The chapter on 'Habitats' also includes fascinating feature

articles on topics which have been presented at Porcupine conferences or in the *Bulletin*, such as the mapping of Norfolk's chalk reef or the study of Black Bream breeding behaviour off the Dorset coast.

Subsequent chapters explore change in seabed habitats due to natural environmental cycles and human activities, explain habitats' vulnerability to impacts and the need for conservation, and finally reflect on the role of technology in improving our understanding of seabed habitats and making information accessible to all. These three chapters all emphasise the role individuals can play in adding to our knowledge of seabed habitats, urging SCUBA divers to submit observations to relevant recording schemes such as Seasearch. As Keith says: "Divers will see species not previously recorded from Britain, will notice losses and gains in abundance of species and habitats, and will witness behaviours such as breeding and settlement. Every record of these observations enhances our knowledge by adding another piece to the jigsaw".

My only minor criticisms of this book are the fact that there are no references cited and that the narrative sometimes has the

conversational tone of an autobiography rather than a reference book, with (in my view) excessive 'name dropping' of the author's former colleagues and collaborators. The absence of references is explained in the Preface, stating that nowadays the reader can search the internet to find relevant references. This may be true, but I feel that research which has advanced our understanding should be acknowledged with a citation. The autobiographical tone is perhaps understandable considering the author's close personal involvement in the study and conservation of the UK's marine habitats over several decades, and other readers may feel it adds to the accessibility of the book and their enjoyment of it.

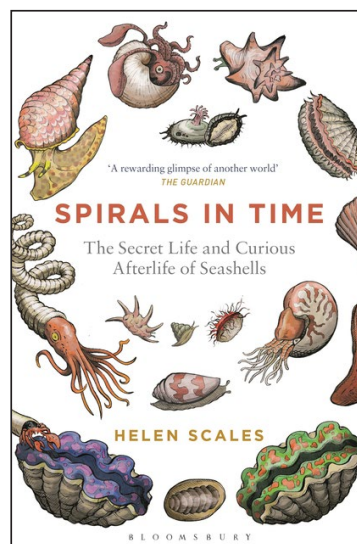
At £22.50 this book is excellent value thanks to sponsorship by several organisations including JNCC, the Marine Biological Association and Natural England. I sincerely recommend it to anyone with an interest in Britain's marine environment (i.e. Porcupines!). It will be of particular interest to Seasearch divers, students of marine biology and anyone involved in surveillance, monitoring and conservation of seabed habitats. This book has certainly inspired me to do more diving and snorkelling outside my 'home patch' of the north east coast, to observe and record the great variety of Britain's biotopes which are so beautifully described and presented here. I'm sure it will inspire many others in the same way!

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Spirals in Time: The Secret Life and Curious Afterlife of Seashells – Helen Scales

*Published by Bloomsbury Sigma, 2015, 304pp.
Available Kindle, hardback (£16.99) & paperback.
(<https://bloomsbury.com/>)*



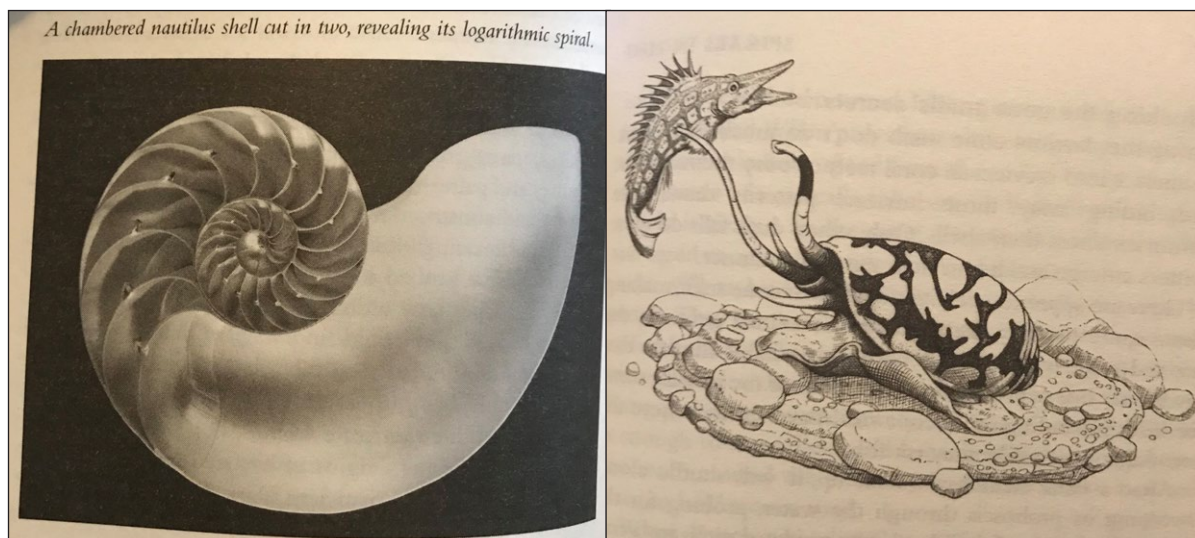
Book review by Natalie Hirst

Spirals in Time is a delightful journey through the history, biological life and death of molluscs, combined with the human interactions and long-standing relationship we have with shells. The book is a wonderful balance of storytelling that's easy to read, with just the right blend of interesting facts and stories from around the world that make this an ideal read for amateurs and professional scientists alike.

The book starts with an overview of the natural life cycle of molluscs, their global distribution and family tree history, including the evolution of their distinctive features such as the rasping tongue, the radula and the powerful foot all species share.

The biology and mechanisms of shell building undertaken by different species are made more accessible by using illustrations and stories of art. There are features exploring the imaginations of people for whom shells have been an inspiration, such as the glass works of palaeontologist David Raup.

Delving deeper into the mechanical equations used, explanations of the natural phenomena of spirals are expertly researched and explained.



These draw on studies from renowned institutes such as UCLA, the University of Pittsburgh and the University of California.

Throughout this book, the author's passion for her topic is clearly evident. The extent of research and knowledge to back up this journey of discovery goes way beyond that of an enthusiastic hobbyist, and this expertise cannot help but enthuse the reader too.

The book is split up into manageable chapters, each with witty titles to keep the feel of the book light-hearted, balancing out scientific text to make it accessible to a wide readership of interested parties. The addition of charming illustrations to begin each chapter is a lovely touch, which also keeps the reader intrigued and helps aid the imagination.

One of my favourite sections of the book explores the use of shells throughout history, highlighting the importance of these natural charms in the world even after the death of the animal within. The harvesting of molluscs for food is obviously a key topic, such as the global booming trade in oysters and mussels but also interesting are stories from the far reaches of the world. These include the use of cowrie shells as currency and the use of byssus threads to weave the highest of value woven garments. The latter explores the harvesting of pen shells for the use of their byssus threads for prized 'sea silk', which some believe traces back to the ancient myth of the golden fleece

searched for by the infamous Jason and the Argonauts. The author not only describes the history behind the use of these materials but the modern day management and conservation of resources by following the stories of people who now dedicate their life to the conservation of these fascinating creatures.

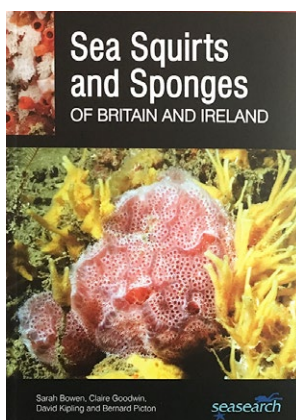
The book is bisected by some beautiful photographic plates showing a mixture of historic drawings and artefacts alongside modern-day illustrations of the importance of shells. My only reservation would be that given the vast amount of information packed into this book it would be nice to have a few more photographs to further bring the stories to life.

The book's finishing chapters explore the curious world of shell collecting throughout history, something I found whimsical and intriguing whilst always linking to the current greater understanding of the need for conservation and research in order to safeguard these wonderful creatures for future generations.

I enjoyed reading this book immensely. It reminded me of my early university days collecting shells when I first started on my journey of discovery as a marine biologist. The sense of wonder and intrigue remains, as well as an appreciation of how much there still is to explore and discover.

Sea Squirts and Sponges of Britain & Ireland – Sarah Bowen, Claire Goodwin, David Kipling & Bernard E. Picton

Published by Wild Nature Press, 2018, 200pp.
Available in paperback £18.00
(<https://wildnaturepress.com/>)



Book review by Alison Bessell

The recent addition of *Sea Squirts and Sponges of Britain and Ireland* to the excellent series of Seasearch books already in existence is very welcome. My job entails large amounts of species identification in a laboratory setting, including sea squirts and sponges and as a result I am very aware of the difficulty of identification of these groups. Being a diver opens your eyes to the fact that the colourless amorphous shapes in a laboratory dish have a very colourful living form, that assists greatly with identification if you can marry the worlds of *in situ* observation, photography and, where required, additional sampling and dissection. What I love about this book is that it clearly explains the difficulties of identifying species from these groups, what the limitations are, where potential confusion exists, within and between the two groups, and potentially how to solve those problems to a certain point if external features are clearly photographed, beautifully exemplified by the pictures provided. Navigating the world of dissection, scientific papers, and the ever changing developments in taxonomic classifications and alterations of species names is not practical for most people so clear information on what we can achieve as Seasearch divers, with limited time at our disposal, is very useful. The additional resources section is also very useful and interesting.

In my experience a common group that are regularly either misidentified or cause confusion are the small solitary sea squirts such as small molgulids and *Polycarpa fibrosa* (Stimpson, 1852). The images presented clearly help to show the difference in siphon structure between them. At the same time, the images show how similar they can be externally, with fibrils and sediment encrustation making identification difficult. These images help to show the diver what type of images need to be acquired to make a confident identification. However these sections also show where more data is required. I have sampled extensively on the south coast and in most samples of sand encrusted sea squirt aggregations, have found mixtures of molgulids and *Polycarpa fibrosa*, among others, and more interestingly, on erect branches of foliose hydroids such as *Hydrallmania* and *Halecium* spp., have found small specimens of *Molgula complanata*, Alder & Hancock, 1870. I agree it is often associated with algal fronds, but is not confined to them. Maybe more records from the south coast need to reflect this.

Another common group that causes a lot of confusion are the botryllid sea squirts. The images presented here helpfully show the zooid arrangement and how, despite these differences, they can mislead the diver regarding identification. It highlights how for some colonies, a high quality close-up picture may be required to be sure of identification. Luckily, as most seasearch divers come equipped with suitable cameras, the level of accuracy is continually improving.

Sponges are a continual challenge regarding identification. There is a tendency to think that a high quality image is going to be sufficient to provide a reliable identification. One of the slightly easier sponges to identify *in situ* is *Myxilla rosacea* (Lieberkühn, 1859), but luckily even here, the book presents this sponge along with species that could cause potential confusion, and suggests that spicule examination could be required. The images alone should serve as fair warning on the external variability of even this, more easily identifiable sponge.

I have been very slack lately with my level of Seasearch contributions and this book has filled me with motivation for the coming year.

How I became a marine biologist

Jon Moore

My first choice of a career failed. From a very early age my ambition was to become a game warden in Africa. I thought I had everything I needed – the books, the hat, the leopard skin wall paper in my bedroom, the collection of animal skulls (and brains!) and even a degree in Zoology. Then I got into diving. Ironically, it was an expedition to Kenya, with the Durham University Sub-Aqua Club, that paved my future path. I took on the role of coral reef surveyor and found that I was quite good at it. Actually, I think it was my un-student-like dedication to cataloguing records with Latin names, rather than playing drinking games in the local bar, that secured me in that role. Not much has changed in the last 39 years!

More tropical diving expeditions followed, but it was an MSc Marine Biology course at Menai Bridge that gave me the qualification I needed to start my career. Even more importantly, it was the inspiration from my tutor Ivor Rees that ignited my passion for marine ecology. He, and others like Peter Allen, also taught me how to identify all those tiny squidgy invertebrates in grab and core samples. It was a wonderful 2 years; I have never worked so hard and played so hard. Newcastle and the

Dove Marine Laboratory came next, for research on plankton communities and more benthic communities. There, I was under the wing first of Frank Evans and then Jack Buchanan: two wonderful characters who, like Ivor, seemed to have an innate understanding of the marine world. I wanted that. I still do.

This article is starting to look like a tribute to some of the people who have inspired me, which seems very appropriate. What's that line about standing on the shoulders of giants? I will therefore mention Bob Earll, who introduced me to marine conservation and got me involved in the MCS Observation Scheme; and Keith Hiscock, who recruited me to my first proper job, at OPRU. OPRU was the Oil Pollution Research Unit (but I prefer the alternative definition: Onanism Perishes Rubber Underpants; if you don't know what Onanism means, you'll have to look it up). Unfortunately, OPRU is no longer with us, because it was a wonderful anachronism in the modern corporate world (a bit like Porcupine!) – a professional marine environmental laboratory and consultancy that was managed by marine natural historians. It was ground breaking and fun and I was in my element. Keith returned my focus from soft sediments to hard substrata, gave me the opportunity to study benthic communities in lots of places and further inspired my quest for knowledge.



The Leopard Reef expedition team, 1979. My first marine biological survey. Also where I developed my occasional penchant for mad-scientist hair (yes that's me, back row, right of centre).



Grab sampling from the RV Prince Madog for my MSc.

The Unit also gave me the opportunity to study the impacts of oil spills and other pressures on marine communities.

That's basically it. I went freelance in 2001, continue to be inspired by many marine biologist colleagues and friends (including Christine, Francis & Tom) and developed an abiding interest in long-term monitoring. And I still feel very lucky that I so often get to enjoy the best of both worlds: studying marine communities in the field and then again in the data we collect.

Jon Moore, PMNHS Treasurer

Anne Bunker

A spring morning in the stable yard of a Georgian manor house, Pembrokeshire, 1987. A young, blonde, tousle-haired biologist enthusiastically discusses dive monitoring with other animated marine scientists. Blackcap song fills the damp sea-misty air as they trail up to the big house for coffee and I am introduced to the people who will teach me so much.

Jon had arrived in Pembrokeshire a year before me. I was a new tutor at Oriulton Field

Centre and was delighted to find that the stable yard housed the Oil Pollution Research Unit (OPRU) where he worked, as well as the centre classrooms and library. Jon was already a Porcupine, along with other OPRU staff (Netty Little, Dale Rostron, Christine Howson, Iain Dixon, Keith Hiscock). Maybe it was Jon who encouraged all of them to join but unbelievably, although we talked often about marine things, it wasn't until years later that he mentioned Porcupine to me! It was probably in 1994, several years after Jon took on the role of treasurer, that he began to tell me about the interesting PMNHS conferences and field meetings he attended.

With an interest in all things marine but particularly in the cryptic fauna, Jon is a mainstay of the Porcupine Council. He particularly enjoys looking at minutiae and will spend hours in an evening identifying tiny bryozoans or hydroids, long after everyone else has lost interest. Jon has his own way of doing things, including marine survey methodologies (and puts us all to shame by proving how lousy we are at recording consistently), which he will discuss endlessly. Accounts and balances and record keeping are probably in the same skill set.



Jon enjoying being a marine biologist (Photo: F. Bunker).

Living only a few miles from Jon I have been lucky enough to travel with him to many of the Society's meetings over the years. The accounts have usually featured in the journeys somehow. For council meetings in London, when I thought it prudent to travel light so as to enjoy the walk through Kensington Gardens to the Natural History Museum, Jon struggled under the weight of a heavy bag containing his laptop for doing Porcupine accounts on the train. When driving, so no opportunity for working while travelling, Jon usually confessed that he had been doing the accounts late the previous night or last minute between surveys and they still needed to be sent to the auditor.

Still tousle-haired (although not so blonde and a little wilder), Jon's enthusiasm for marine biology and Porcupine is as strong as ever but Jon feels it is time to hand his spreadsheets to someone new after twenty-seven years. Most Porcupines will be unaware of the huge amount of time and commitment Jon has devoted to the treasurer role. Although the society is only modest in size, most people paid by cheque until recently and not all at the same time of year, so many trips to the bank were needed. Conferences were a lot of work with cheques in

and cheques out. Then there was grant money and corporation tax. Next there was online banking and then PayPal. Through all of this Jon has kept Porcupine solvent and always presented the most detailed spreadsheets of our finances at the AGMs. This sound financial footing and continuity has played no small part in Porcupine's success. Thank you Jon from all of us, for volunteering so much of your time and doing such a sterling job (and for the entertaining journeys!).



Would you like to contribute to the next *Porcupine Bulletin*?

- We are always open to offers of book reviews, website reviews and reviews of mobile apps!
- Interesting or topical sightings of marine life, or stories of your fieldwork experiences are always enjoyed;
- Informative line drawings of marine life are great for filling in small spaces at the end of articles;
- Articles on any subject relevant to marine natural history
- or anything else that you feel would be of interest to the readership!

In the first instance, please contact Vicki Howe (editor@pmnhs.co.uk) with what you would like to offer. Guidelines to Authors are printed on the back page of the Bulletin, please take note of these when writing your article and particularly with reference to any images you wish to have printed.

Deadlines for contributions are:

Autumn 2019 issue - Friday 7th June 2019

Spring 2020 issue - Friday 6th December 2019



Boffin treasurer ready for action on the shore (Photo: F. Bunker).

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)

Illustrations (Figures and Plates)

- Photographs: greyscale or colour (RGB) JPGs or TIFFs with a resolution of 300 pixels per inch and maximum width of 16 cm. Save at **high quality** (very important).
- Line drawings (particularly maps): EPS (preferred) or TIFF files. If it is a detailed map which will need the full page width, save it with a width of 16 cm. Maps with complicated colouring schemes are difficult to interpret in print – please consider using easily distinguished symbols instead.
- Graphs, histograms, etc. can be supplied as line drawings, or Excel files, each saved as a separate sheet

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

For each illustration, photo etc. submitted, please provide: Filename, Caption, Photographer (if appropriate) and please be aware of any copyright issues.

Do NOT embed images in the text as they cannot be extracted at high enough quality to reproduce in the *Bulletin*. Send as separate image files, preferably with the caption as the file name though this is not essential.

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:

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