The Phycologist

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BPS Winter 2017 Meeting review

Student Reports

BPS Life Members Biographies

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2017
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Editorial

Well – what an exciting year so far! Things can only get better after reading this spring edition of *The Phycologist*. We have our review of our last annual meeting along with the abstracts, reports from the Manton Prize and Poster Prize winners, and many student reports. We also have an update to changes to the Freshwater Algal Flora of the British Isles, and details of some of our upcoming meetings and field courses.

Excitingly we also have a couple of biographies of two of our Life Members, Professors Martin Wilkinson and David John.

As an early reminder, don't forget about the next BPS meeting at Southend. Further details will appear on the website shortly.

Remember - do keep sending in your contributions. Write to us with your phycological views, news, work events, or any matter you wish to share with readers of The Phycologist*. YOUR input is required; all relevant material will be considered (job adverts, science reports, book reviews, news items of topical interest, meeting announcements, research news, and suggestions for future articles are always welcome). Without YOU the newsletter would not exist.*

As a reminder, previous issues of *The Phycologist* can be downloaded at http://www.brphycsoc.org/phycologist.lasso.

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Cover image : Bangor

Review of the 65th Annual Meeting
School of Ocean Sciences, Bangor University

Jane Pottas, BPS Secretary

The 65th BPS annual meeting was held at the School of Ocean Sciences, Bangor University and it marked a return to the January fixture after a brief flirtation with holding the meeting in the summer. The change in the timing of the meeting was a short experiment but the perceived advantages of better weather in the summer and fewer transport problems resulting from heavy snow or strong winds in January were offset by the many competing calls on people's time – family holidays; university commitments – module boards, programme boards, graduation ceremonies; field work; research; and the many other conferences with dates already established in the calendar. There was some trepidation about reverting to a January meeting and the possible effect on numbers but in the event 87 people registered and the meeting was a great success with 41 talks and 25 posters.

The job of organising the meeting fell to Andy Davies who let slip last year that he could take on the task and barely had the words fallen from his lips when "could" became "would" and his offer was gratefully accepted by Council. A word to the wise – be careful what you say in the vicinity of a Council member on the prowl. Their innocent demeanour hides a ruthless inner tiger that will seize on any and all offers of help when it comes to running the Society. Andy proved himself to be the right person for the job and a programme quickly began to take shape. A webpage with online registration soon followed and bookings began to roll in. Some of us failed to appreciate that payment of registration fees did not include payment for the conference dinner and only realised our mistake when we turned up at the registration desk. Andy took all this in his stride and calmly set about making arrangements to accommodate everyone at the dinner in between making sure that every aspect of the conference ran smoothly. All this in addition to coping with a poorly pet at home.

The venue for the meeting was the Marine Centre Wales, surely one of the best kept secrets in Anglesey. It could be, perhaps is, an outpost of GCHQ as there are no signs to it. Fortunately Andy had thought of this too and provided a map to help us find our way there. Pre meeting activities included a rib ride adventure tour for the adrenaline junkies or a trip to Beaumaris for others who prefer their entertainment to be on terra firma and without recourse to diphenhydramine. On the first evening there was a drinks reception, sponsored by Taylor and Francis. This was also an opportunity to read the posters which were on display. Two by Chris Carter attracted a lot of attention. They both required observers to wear special glasses (provided) to see the images of freshwater algae in 3D. Viewed without the glasses the photographs appeared queasily out of focus – too much wine taken? – but on donning the special glasses the pictures were transformed and it seemed as though the algae could be lifted off the paper. Quite stunning. During the evening there was an exhibition and sale of jewellery inspired by algae (https://guildcrafts.org.uk/members/tim-blades/). I'll be wearing my silver *Acetabularia* earrings at all phycological events plus any others when algae-related accoutrements are called for. The evening continued with the Student Social and Buffet in a local hostelry, although other pubs and restaurants were suggested for people who preferred a quieter meal, presumably the same people who opted for the trip to Beaumaris.

The meeting continued the following morning with the opening session (chaired by Andy) which included three Presidential addresses. We were spared the ramblings of one President, The Donald, who was at the time giving a press conference at Trump Towers reassuring the free world that he was divesting himself of any conflicts of interest by handing his business empire to his sons. Mercifully instead we were being addressed by the BPS Overseas VP, Koen Sabbe, whose talk was about life in shifting sands which in retrospect seems particularly and serendipitously apposite - although he was talking about diatoms not the handling of corporate assets. Next, the President of FEPS, Olivier De Clerck, gave an overview of the role of the Federation of European Phycological Societies providing a useful perspective on the links between the phycological societies in Europe. This was followed by the BPS Presidential address given by Gill Malin whose thought provoking talk considered how the next generation of phycologists will be trained; how current expertise will be retained; how and where algae could be embedded in the National Curriculum; how the BPS can connect with amateur algae enthusiasts and the public; plus a number of other issues including the proactive lobbying of funders and policy makers. After a break for refreshments and informal discussion there was a special session on fucoid biology which was followed by lunch. The afternoon session was the Manton Prize student talks all of which were excellent – the standard is always high and invariably the judges have a difficult decision to make about who should win the prize. This year's winner was Charlotte Walker for her talk entitled, "Plenty more coccolithophores in the sea; exploring calcification in different species". The winner of the student poster prize was Miriam Bernard for her poster "Laboratory and field studies on the interaction between kelps and filamentous algal endophytes".

The next item in the programme was the AGM. A sufficient number of people stayed for the meeting (or had nowhere else to go) so the meeting was quorate and

although it started a little later than planned it finished in time for all to repair to their lodgings to get their glad rags on ready for the meeting dinner in Reichel Hall. Reichel Hall is Bangor University's conference and events venue and is on the mainland and once again Andy's organisational skills came to the fore and he had arranged a shuttle run by minibus to get everyone over from Anglesey to the dinner. Andy and his team of assistants drove the minibuses. Is there no end to this man's talents?

The meeting had a good mix of talks and there were sufficient to justify parallel sessions on the Thursday. As the sessions were in separate buildings changing venues between talks required a certain amount of physical agility. It is well known that algae have health giving properties and delegates who were interested in talks in both sessions certainly got a good physical workout. There were sessions on Ecology and Change, Physiology and Biochemistry, Taxonomy and Applied Phycology and a special session on Microalgae and Carbon Cycling. As always the annual meeting was an opportunity to catch up with old friends and a chance to recharge the algal batteries. It is also a great place to discuss and exchange ideas in a stimulating and convivial setting. Doubts about bad weather affecting the conference were not realised although there were blizzards on the A55 as I was driving home. So, once again, thank you to Andy (last seen soaring over the Menai Straits, his cape flying in the wind) and his team for their sterling efforts in organising a splendid meeting.

My only criticism is that the BPS ceilidh seems to have disappeared from the programme and there hasn't been one for a number of years now. Maybe there will be one at the 2018 meeting in Southend. Ever the optimist, I live in hope. Over to you, Graham.

Student Bursary Report

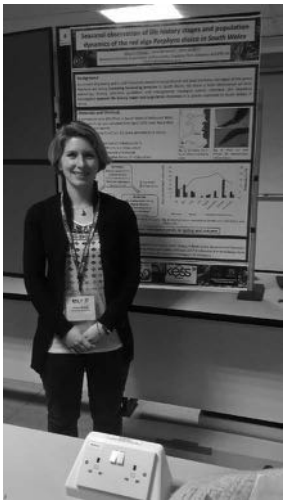
65th Annual Meeting of the British Phycological Society

Jessica Knoop, Swansea University, Department of Biosciences, Swansea, UK, 885073@swansea.ac.uk

On Wednesday the 11th of January it was time again – the 65th Annual Meeting started early afternoon held by the School of Ocean Sciences Bangor University in Menai Bridge with two pre-Meeting Activities. While parts of us were exploring the Menai Strait on a RIB tour, others were visiting Beaumaris with its impressive but never finished castle build by Edward I.

In the early evening most participants met during the registration and Icebreaker in the Cemlyn Jones Laboratory. Posters were launched for presentations and the room was quickly filled with excited chatting as new and old colleagues met, united by their interest in Phycology. The next morning started with the general opening and a warm welcome by Andrew Davies, who did a fantastic job in organising facilities and a smooth order of events. The opening was followed by the first special session focusing on the intertidal dominating fucoids. A diverse range of questions were addressed, from whether adaptive capacities of temperate fucoids will be sufficient surviving climate change (Alexander Jueterbock) or if an Object-based image analysis approach is feasible in mapping and monitoring intertidal seaweed communities (Paula Lightfood).

A main event of the Annual BPS meetings is the Irène Manton Prize, which awards the best student oral presentation and poster. This year, a total of eight students presented their diverse work, judged by a jury according to scientific content and presentation style criteria. Presentations covered a wide variety of research projects including genetical, ecological and applied topics from micro- to macroalgae. All student presentations were on a high professional standard, making the announcement of the best student presentation a difficult task. Finally, Charlotte Walker could convince the Jury, presenting her current work about new insights into the role of calcification in coccolithophores. The best poster,



standing out because of its clear structure and easy way to read, was presented by Miriam Bernard, showing her results about "Laboratory and field studies on the interaction between kelps and filamentous algal endophytes".

The second day ended with the meeting dinner with excellent food as well as inspiring and vivifying conversations.

On Friday morning the attendees could chose between two different sessions, either listening to presentations related to Ecology, which was opened with two talks about the fascinating world of diatoms, moving over microphytobenthic biofilms in coral reefs towards the ecology of kelp forests and their community. Algal physiology and biochemistry topics were covered in the second session.

I am very grateful for the received student fund in order to participate in the 65th Annual Meeting in Bangor. It was a unique opportunity to discuss my current research with many experts and to establish new contacts. Therefore, I would like to thank the BPS for the financial support and the great experience!

Advance notice for your diaries

The British Phycological Society 66th Annual Meeting will be held in Southend, Essex.

From Tuesday 9th to Thursday 11th January 2018 (arrivals from Monday 8th)

The venue is the Park Inn hotel on the seafront in Southend (https://www.parkinn.co.uk/hotel-southendonsea). Further details will be posted on the BPS website as the programme is developed. BPS Council look forward to seeing many of you there in 2018.

Professor Graham J. C. Underwood, Executive Dean, Faculty of Science and Health,

Professor of Marine and Freshwater Biology, University of Essex.

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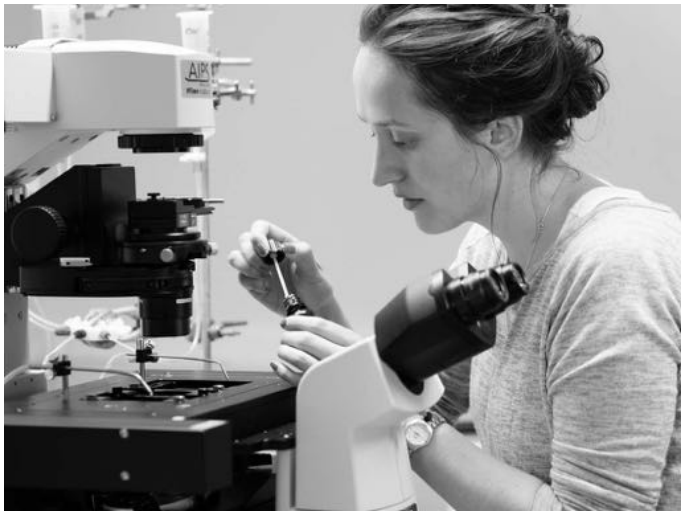
MANTON PRIZE WINNER

Charlotte Walker

The Marine Biological Association of the UK and National Oceanography Centre, Southampton



If you had told me as I graduated with a BSc Hons in Biological Sciences that I would be studying for a PhD in microalgae physiology in 5 years' time I would not have believed you. Not a chance. This now influences my philosophy; go for it and you may even surprise yourself.

After my BSc, happy but rather tired from the last 17 consecutive years in education, I thought of nothing more than leaving the UK behind in the dust. Something that still baffles me is how I secured a job in the Bahamas, working with the Bahamas National Trust, diving, running my own team and engaging in community outreach. 18 months later as a self-proclaimed shoe hating, lionfish spearing, aspiring naturalist I decided to head home to the UK, my family and attempt a marine biology career path.

My interest in marine microalgae was ignited and solidified during my MRes studies with Plymouth University and the Sir Alistair Hardy Foundation for Ocean Science. SAHFOS conduct regular plankton surveys using continuous plankton recorder (CPR) and ships of opportunity (commercial and passenger) enabling them to be one of the biggest marine surveys in the world, 113,605 nautical miles covered in 2016 alone. Here I adapted an assay for detecting potential Harmful Algae Bloom (HAB) forming genus of the pennate diatoms *Pseudo-nitzschia* using molecular methods (qPCR and HRM). The study focussed on a Western English Channel transect of water samples collected by a device installed in the CPR and was a successful but challenging experience.

I'm now completing my PhD on coccolithophore physiology at the MBA, supervised by the brilliant Dr Glen Wheeler, Prof. Colin Brownlee and Prof. Toby Tyrrell (NOC, Southampton). Coccolithophores are a biogeochemical punch-packing group of microalgae which are characterised by their ability to form calcite plates, coccoliths. Coccoliths are produced internally and extruded to the cell surface where they make up what is effectively a shell (coccosphere) around the cell body.

Although we know coccolithophore calcification is of great biogeochemical importance, the mechanisms behind the process and the role are not fully understood. Coccolithophore biology has been dominated by research focussed on the most globally abundant species, *Emiliania huxleyi*. One of the reasons for debate surrounding the role of calcification is that *E. huxleyi* can readily exist in a non-calcified state in laboratory culture without a significant impact on cell fitness. However, researchers are beginning to acknowledge that the reason *E. huxleyi* is so ecologically successful is because it may be atypical, in regards to other species of coccolithophore. My PhD focuses on calcification and is driven by the hypothesis: not all coccolithophores calcify by the same mechanism, or for the same reason.

My BPS2017 presentation was centred on comparing the calcification reliance of *Coccolithus braarudii* (formerly *Coccolithus pelagicus*) to *E. huxleyi*. We have identified major physiological differences between these species and demonstrated that inhibition of calcification has a major impact on *C. braarudii* fitness. These findings suggest that calcification may have distinct cellular roles between species, which may have important implications for our understanding of the evolution and ecology of coccolithophores and their response to our changing oceans (Walker et al. in prep).

In the Manton Prize session I really enjoyed Nathan Chrismas discussing cyanobacteria and Seth Thomas presenting his work on Diatoms and DMSP. I was also lucky to be scheduled with my friend and fellow SPITFIRE/MBA PhD student Graham Epstein, who delivered a great talk on his research on the invasive kelp *Undaria pinnatifida*. It was a thoroughly interesting meeting in general but fantastic that the student session was given such attention.

Presenting at BPS2017 was both a nerve-wracking and a hugely positive experience. What I tried to apply and advice I would give to all fellow nervous presenters is to 'fake confidence and you'll feel confident', after a minute or two of a (slightly forced) smile and you quickly find yourself moving into genuine enjoyment. In a nutshell, or a coccosphere (!): We all know our PhDs are really interesting, but it helps to tell the story with genuine enthusiasm to bring others into that mind-set with you.

Finally, I would like my lasting sentiment to be one of thanks: I am extremely grateful for the BPS for organising BPS 2017 and supporting my travel to Bangor for the meeting, I am grateful to my supervisors for their invaluable and patient guidance throughout my PhD studies, and am indebted to my friends, family and colleagues that enable me to complete these studies with a smile.

POSTER PRIZE WINNER

Miriam Barnard

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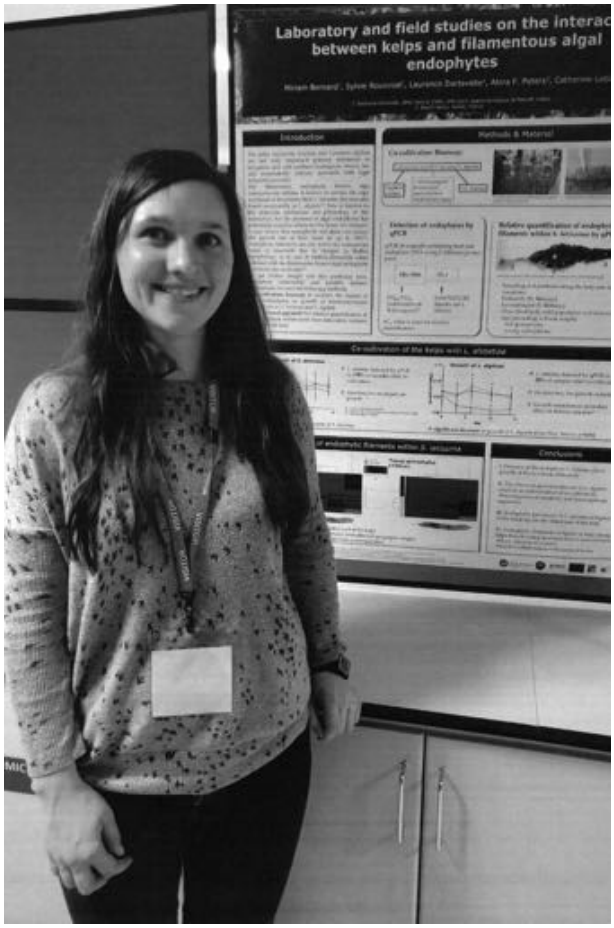

From 11th to 13th January 2017, The School of Ocean Sciences - part of Bangor University, played host to a bloom of phycologists, as the BPS Winter Meeting 2017 descended upon the Anglesey campus. Accompanied by the backdrop of the picturesque Menai Bridge, the scene was set for two days of interesting presentations and heated scientific discussion.

To kick things off, the pre-meeting activities gave a friendly atmosphere to the event, whilst also provided interesting information about the area around Menai Bridge. As the first BPS meeting for many of the students in attendance, particular emphasis was given to creating social and networking opportunities - realised by the ice breaker reception, meeting dinner, and poster sessions that gave us the possibility to make new acquaintances, strike new partnerships and discuss our work with other attendees in a friendly atmosphere.

Thanks to the financial support by the BPS we three students had the opportunity to present our work on 'the establishment of Osmundea pinnatifida mariculture' (Cecilia Biancacci); the interaction of kelps with filamentous algal endophytes (Miriam Bernard) and factors affecting DMSP synthesis rates and intracellular half-life in diatoms (Seth Thomas).

What was evident from the offset was that not only the studied organisms, but also the methodological approaches presented in the poster sessions were exceptionally diverse. Topics encompassed the entire scale of phycological research, ranging from ecological field surveys to the chemical analysis of lipid compositions in microalgae. Some participants chose to inspire us with pictures of their microscopic work such as the beautiful pictures of freshwater microalgae presented by Chris Carter. Molecular biological approaches were covered amongst others by Alastair Skeffington who made us think critically about the results obtained from proteomics databases. Other posters highlighted institutions and tools that are important for us as phycologists such as the CCAP, the Algal collections at the National Museums of Liverpool and the AlgaeVision Website, a searchable photo catalogue of freshwater and subaerial algae.

Overall, the diverse collection of posters gave us the opportunity to widen our knowledge on different aspects of algal biology and get in touch with other researchers working on similar topics. Out of the 25 posters 10 were presented by students and I (Miriam) was very thankful for being rewarded with the prize for the best poster. This award as well as the good feedback and helpful advice I received during this meeting encouraged the confidence in my project and gave me a lot of new ideas for my future research.

The main themes touched on during the conference included Physiology and Biochemistry, Ecology and Change, Systematics and Applied Phycology and Conservation. Furthermore "special sessions" were organized to address a prominent area of research or interest.

The introduction given by BPS Overseas President, Koen Sabbe, the President of the Federation of Phycological Socie-

ties, Olivier De Clerck, and the BPS President Gill Malin, was followed by the first special session: Dominating the intertidal: the biology of fucoids, featuring a modern approach underling the effects of global warming on these species, focusing on habitat monitoring and conservation, and finally the ecological modelling and the evolution of these seaweeds.

This section has been followed by the Manton Prize session. Each BPS meeting features a student presentation session, named after the late Irene Manton, a world leading phycologist and exceptional microscopist who left a legacy to the society. To present in such a prestigious session was a real honour, and a great way to begin my presentation career. BPS 2017 was the first time that I have given a presentation of this kind, so naturally I - and undoubtedly many of the other students - experienced real nerves before the start of the presentations.

The calibre of presenting up to this point from all speakers at the conference had been a level above that which I was used to, so as the future of the society, the students felt the need to rise to a similar level. In keeping with the rest of the conference, the themes discussed in the Manton Prize session were as interesting as they were diverse. Topics varied from my own research area - DMSP synthesis in diatoms, all the way up to larger macro algae such as invasive kelp species in the South West of the UK, and back down to the topic of this year's winner, Charlotte Walker, who very eloquently addressed her findings of silicate transporters in a range of coccolithophore species, and the associated impacts of these in terms of calcification ability.

Despite my own nerves, and aspirations of taking home the Manton Prize, Charlotte was a more than worthy winner. Her natural and clear presenting style, combined with interesting and well presented data along with the application of findings to wider phycology echoed the standard of the more senior presenters at the conference.

While Charlotte claimed the prize, the competition was fierce, with all students delivering stellar presentations in their given fields. This made the experience even more beneficial for myself, knowing that your research feels at home being presented in a student session where the standard of research is high, is comforting - even if a little daunting - for any PhD student.

Come the close of the session, I believe that all members of the audience felt relieved, that the future of BPS was in good hands and looking incredibly bright indeed.

For the second day the conference was divided into three main areas, giving every participant the possibility to broaden their knowledge on particular research interests.

The session "Ecology and Change", focused on micro- and macro algal ecology, environmental interactions, and anthropogenic changes, whereas different approaches for molecular and morphological analyses for systematics and modern taxonomy were presented in the session "Taxonomy and applied Phycology". The third session "Physiology and Biochemistry" covered different parameters involved in algae growth, including stressors, life histories cycles, and uptake of nutrients. The partition of the BPS Meeting in different areas has allowed to cover more matters at the same time, giving the opportunity to each attendee to participate to the more close to their interests. The high level and variety of the given talks have led to illuminating discussions and to the opportunity of exchange ideas and experiences amongst the participants. A complete list of all the names of the speakers that have taken part to these two days conference can be found in the meeting programme.

One final special session focused on "Microalgae and Carbon cycling", addressing the microalgae in global biogeochemical cycles and ecosystem function.

A broad variety of topics were covered and presented in an excellent way thanks to the participation of professors, researchers and students, creating a great opportunity to increase our knowledge and interest about seaweeds in a friendly and pleasant atmosphere. The discussion and exchange of our work with other participants was an enriching experience that brought up a lot of valuable new ideas and aspects for our present and future research.

We are thankful to the British Phycological Society to have given us the opportunities to take part in this interesting event and to Andy Davies and his team for the organization. We are looking forward to participating in the next Winter BPS meeting.

British Phycological Society Winter Meeting 2017

Abstracts

Life in shifting sands: functional ecology of marine benthic diatoms

Koen Sabbe

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Marine tidal flats are highly dynamic and variable environments, with pronounced shifts in resource availability and environmental disturbance occurring at multiple scales of space and time. Yet diatoms, minute algae living encased in glass cell walls, thrive in these shifting sands. Recent studies in our lab and elsewhere now show that at least part of their success can be attributed to highly performant behavioral, physiological and molecular adaptations, specialized life cycle strategies and intricate interactions with other diatoms, protists and bacteria within complex microbial consortia. I will draw from recent work carried out in our lab to illustrate aspects of marine benthic diatom functional ecology, including photophysiology, life cycle regulation, diatom-diatom and diatom-bacteria interactions. Finally, I will show how functional trait-based approaches can advance our understanding of the importance of diatom diversity for the functioning of these benthic microbial consortia.

A decade of FEPS: an introduction to the past, present and future of a Federation of European Phycological Societies

Olivier De Clerck

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A decade ago, a revival of interest in establishing a Federation of European Phycological Societies had developed. By the time of 4th European Phycological Congress (EPC4, Oviedo 2006) a Founders Group of seven national phycological societies, each being represented on a Founders Council, had agreed on the principles, structure and aims of the Federation of European Phycological Societies. The foundation of FEPS at EPC4 was accompanied by a warm welcome to further national phycological societies/groups throughout Europe. And indeed in subsequent years another four societies joined. FEPS has been successful in the organization of 2 more EPC's (Rhodes, London) and behind the screens the organization of the next EPC which will be hosted by the Croatian Phycological Society (2019) has started already. In the meantime FEPS has launched a quarterly electronic journal, *Perspectives in Phycological,* covering all domains of phycology, including the contributions of phycological research to current and emerging issues in environmental, health and industrial sectors. A rightful question is, whether FEPS is more than an organizer of a congress once every four years or the publisher of an upcoming review journal. The answer is unequivocal yes. As president of FEPS, I strongly believe in the added transnational value of a Federation of Phycological Societies. Giving specific examples I will demonstrate how FEPS can be complementary to the national societies and fill voids in the present European phycological landscape. We have identified a number of initiatives related to biodiscovery, education and data accessibility, the first of which we hope to turn into a reality in the coming year already. These initiatives will however, not be realized unless the national societies play an active role in sustaining them, and FEPS offering structural support for transnational initiatives.

How and why to tell the world about phycology?

Gill Malin

Centre for Ocean and Atmospheric Sciences (COAS), School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ.

The overall aim of the *British Phycological Society* is to advance research and education by the encouragement and pursuit of all aspects of the study of algae. Our constitution also says that to further these aims we should increase public awareness of the importance and applications of algae, and contribute to public debate on issues involving algae. The academic landscape has changed dramatically since BPS was established in 1952 and also in more recent years. In the

past phycology was mostly taught in botany departments and these and modules focussing on phycology are now rare. In addition, many people who are working on algae in academia and industry don't consider themselves phycologists, yet the subject continues to attract young people fascinated by algae. The Earth is also facing accelerating environmental change and population growth which brings increasing food, water and energy security issues. In this changing world aquatic ecosystems are coming under increasing pressure and the important roles that algae play and could fulfil are increasingly recognised. Ahead of the BPS 60th anniversary in July 2012 the BPS Council debated how to shape the future of the society. Work is ongoing but there is much more that could be done – where should we focus and how? In this presentation I will outline that discussion and additional thoughts on how we could progress - I will be looking to the audience for input and suggestions. Topics will include: training the next generation of phycologists; retaining expertise; embedding algae in the National Curriculum; connecting with amateur algae enthusiasts and the public; stand-alone meetings to focus on specific topics; the sustainable utilisation of algae; forging links with other societies and commercial partners; identifying phycological research priorities and emerging issues in science and policy; proactive lobbying of funders, policy makers and others.

North Atlantic fucoids in the light of global warming

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Temperate and arctic intertidal ecosystems are likely to be profoundly affected by the responses of foundational seaweed species to global warming. Foundational seaweeds provide ecosystem services such as 3-dimensional habitats and food for invertebrates and fish, a blue carbon sink, nutrient fixation, and protection of the coastline from erosion. To predict the impact of climate change on fucoid seaweed meadows in the temperate and sub-arctic North Atlantic, we used a multidisciplinary approach, integrating Niche Modeling (biogeographic effect), heat-stress experiments (physiological plasticity), and population genetics (evolutionary responsiveness). Our findings predict and document that rising temperature is the most severe threat among climate change factors for fucoids. While rising temperature threatens fucoid seaweeds in warm-temperate regions, seaweed meadows will likely flourish in the Arctic intertidal with unpredictable changes in the structure and functioning of the Arctic intertidal ecosystem. The threatened southern-edge populations of many temperate seaweeds are ancient glacial refugia and centers of genetic diversity. Genetic diversity is considered to be the key for future adaptation to environmental change and for the long-term survival of species. Thus, a remaining key question is, whether the plastic or adaptive capacities of these populations are sufficient to survive climate change or if temperate fucoids are at risk to lose their centers of adaptive potential to future environmental change. Besides presenting our main findings, I will highlight current knowledge gaps and future directions of research.

Evolutionary processes in fucoid algae

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Climate-driven range shifts create evolutionary opportunities ranging from allopatric differentiation to recombination at contact zones. By analysing genetic markers and developing species distribution models, we inferred effects of range contractions, and expansions on the spatial distribution of the gene pool of several fucoid species. During range expansions distinct gene pools can form contact zones where processes of hybridization and introgression can take place, and as their modified genomes continue the range expansion such effects become magnified. Our results show that range shifts provide unique opportunities for introgressive recombination of genomes at contact zones, and these have played very important roles in fucoid biodiversity.

Mapping intertidal seaweed communities from remote sensing data: an object-based approach

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The distribution and abundance of temperate intertidal seaweed communities around the British Isles have changed in recent decades and further changes are predicted due to ocean warming and acidification. Intertidal habitat maps are needed at both fine and coarse scales to monitor these changes and inform decision-making, but current methods of field survey and manual interpretation of aerial imagery can be time-consuming and subjective.

Object-based image analysis (OBIA) of remote sensing data is an increasingly popular method for producing habitat or land cover maps. Users create automated workflows to segment imagery, creating ecologically meaningful objects which are then classified based on their spectral or geometric properties, relationships to other objects and contextual data.

Using North SWea Marine Protected Areas as study sites,

our research evaluates the potential of OBIA and remote sensing data for mapping and monitoring intertidal seaweed communities. We developed and tested OBIA workflows for interpreting ultra-high resolution imagery collected by an unmanned aerial vehicle (UAV) to map intertidal habitats at two thematic scales, comparing the accuracy, consistency and reproducibility of three supervised classification approaches. To evaluate the change-detection capability of OBIA in the intertidal environment, we developed and compared two methods for quantifying change in extent and distribution of seaweed communities from freely available aerial and LiDAR time-series data.

This talk will present and discuss our findings. We demonstrate that OBIA offers robust methods of mapping intertidal seaweed communities from ultra-high resolution UAV imagery (mean accuracy 83.4% ± 3.8%) and lower resolution aerial and LiDAR imagery (mean accuracy 71.0% ± 1.6%) and of detecting change in seaweed coverage.

Developed in partnership with the responsible monitoring authorities, OBIA methods could integrate ecological knowledge and remote sensing data as a basis for cost-effective intertidal monitoring protocols, providing solutions for large-scale rapid assessment and more targeted, detailed surveys.

Fucoid macroalgae as ecosystem engineers: where natural history meets ecological theory

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Canopy forming fucoid macroalgae play a fundamental role as habitat formers or ecosystem engineers on temperate rocky shores worldwide. By modifying environmental conditions, fucoid canopies have a huge impact on species identities in understorey communities and modulate the direction and strength of interactions both among and within species. Here I review 2 decades of experimental work focusing on the community structuring roles of fucoids, placed within a context of global environmental change. Manipulative experiments on sheltered rocky shores have shown how the long lived canopy alga *Ascophyllum nodosum* may indirectly influence the balance between keystone grazers and algal domination of the substratum. Such interpretations were only possible owing to the long-term (12 year) nature of this work. Extension of such work to simulate realistic levels of disturbance has shown that loss of canopy at small spatial scales can have important consequences to fucoid recruitment and consequently to the mosaic of fucoids within *Ascophyllum* beds. As dominant members of rocky intertidal communities and hence the focus of experimental ecologists worldwide, fucoids have played an important role in generating understanding regarding the role of biodiversity in ecosystem functioning, including productivity, stability and invasibility. Two separate studies across replicate sites within Europe have examined the extent to which fucoid canopies may enhance resistance to disturbance and promote stability within understorey assemblages. Both studies demonstrate complex outcomes but latitudinal patterns in structure, functioning and stability are evident. Finally, extending the theoretical nature of fucoid research to invasion biology, experimental work has demonstrated how, through modification of resource availability, canopy forming fucoids- Halidrys siliquosa and *Cystoseira* spp - may modify the invasibility of algal assemblages.

The use of natural infochemicals for sustainable and efficient harvesting of the microalgae *Scenedesmus* spp for biotechnology

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Microalgae offer a promising way to biofuels or animals feed. Open Ponds are regarded as the most economically viable option for large scale cultivation systems; however, many hurdles still exist, including reducing the energy inputs for harvesting cells. Also, they are open to invasion by grazers, which can potentially damage the cultivation. However, some invasive organisms have interactions with algae that are potentially beneficial to industry, which we aim to exploit. In this study, we focused on chemical cues (infochemicals) produced by the grazer *Daphnia*, reported to induce a defense mechanism of colony formation in microalgae, leading to sedimentation of algal cells and hence potentially providing a low energy and environmentally friendly harvesting method. In particular, we evaluated the role of Daphnia infochemicals on triggering flocculation of Scenedesmus spp, studying the combined impact of cues concentration and algal growth stage on flocculation efficiency, size distribution and composition of flocs. This was estimated by means of OD measurements, cell count and microscopy/image analysis. The highest removal efficiency was at ~80% for early exponential cultures exposed to concentrated cues. Image analysis of the aggregates, mainly composed by unicells, showed a high influence of algae growth stage and cues concentration on their size distribution. Further microscopy analysis of the flocs revealed a mucous material surrounding the algae cells, whose composition was analysed by FTIR spectroscopy, showing carbohydrates as main components. Furthermore, as the algae cell wall charge is one of the parameters affecting aggregation, we detected a Daphnia dependent variation in the isoelectric point of flocs vs planktonic algae. These results suggested an additional mechanism, other than colony formation, in response to predation risk and responsible for algal aggregation. These results show the potential advantages of using natural infochemicals over traditional coagulants, including lower costs and a more sustainable harvesting process

Diversity and genomics of cyanobacteria in the cryosphere

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In the extreme cold of Arctic, Antarctic and Alpine environments, cyanobacteria are of fundamental ecological importance as primary producers and ecosystem engineers. Yet while their role in biogeochemical cycles is well appreciated, the full extent of the diversity of cyanobacteria in the cryosphere is not yet known. Furthermore, the mechanisms that allow them to survive in such extreme conditions, and the means by which these mechanisms evolved, are not fully understood. In this project we used up to date genomic techniques to begin to answer some of these questions. First, by using a combination of traditional phylogenetics, phylogenomics and Bayesian ancestral state reconstruction we explored the diversity of cyanobacteria from polar and alpine environments and made predictions about which lineages of extant cyanobacteria are likely to have had cold-tolerant ancestors. The earth's cold environments are shown to support lineages of cyanobacteria from all across the cyanobacterial phylum. A total of 20 lineages have a putative cold tolerant ancestor and several of these lineages appear to be exclusive to the cryosphere. Second, we present the first sequenced draft genomes of cyanobacteria from the cryosphere; Phormidesmis priestleyi BC1401, isolated from cryoconite on the Greenland Ice Sheet, and *Leptolyngbya* sp. BC1307, isolated from the edge of Lake Hoare in the McMurdo Dry Valleys, Antarctica. Neither of these genomes exhibited the typical molecular hallmarks of psychrophily, corroborating the widely held assumption that polar cyanobacteria are cold tolerant rather than cold adapted. Instead, mechanisms for the production of extracellular polysaccharides and adaptation of the photosynthetic apparatus represent possible ways that these organisms deal with other pressures of the environment such as desiccation, freezing and high irradiance. Together the work presented here highlights the huge potential for investigating polar and alpine cyanobacteria at a molecular level and will serve as a springboard for future studies.

Seasonal distribution of sediment-dwelling protists (SDPs) in intertidal flats of Sligo Bay, West of Ireland

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Eutrophication in coastal waters has increased in the last decades worldwide owing to growing human populations and the development of industrial and agricultural activities. The EU - Water Framework Directive (WFD) introduced in 2000 set out measures to improve the quality of all water bodies by 2015. Phytoplankton diversity is considered a suitable biological indicator to determine the trophic state of coastal waters and its identification has traditionally been carried out by microscopy analysis. Intertidal sand-dwelling protists (protozoa and microalgae) have seldom been the focus of attention of ecological studies compared to planktonic organisms. This is partly due to the difficulty of carrying out microscopy analysis on samples containing high amounts of detrital organic and mineral materials. Yet benthic microorganisms are present in the sediments all year round and generally are not flushed out by tidal action in comparison to phytoplankton. Populations and communities at sites along the coastline may hence be viewed as sedentary and their structure a reflection of their local environment.

This study focuses on the seasonal distribution of sediment-dwelling protists (SDPs) in intertidal flats of Sligo Bay, Ireland. The well-established molecular method PCR-DGGE (Polymerase Chain Reaction – Denaturant Gradient Electrophoresis) and HPLC-based pigment analysis were used to investigate the community structure of SDPs. The molecular data generated will provide the foundations for the future ecological mapping of particular benthic protists species, population and/or communities of interest. It is anticipated that diversity results could contribute to the development of new environmental quality indices for incorporation to extent monitoring programmes.

Diatoms: From DMSP Synthesis to Global Significance

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Diatoms are a globally important group of microalgae, contributing as much as 40% of oceanic primary production, and playing key roles in the global biogeochemical cycling of carbon, nitrogen, phosphorus and other elements. The importance of diatoms in the global cycling of sulphur is becoming increasingly evident. Dimethylsulphoniopropionate (DMSP) is the cellular precursor of the volatile trace gas dimethylsulphide (DMS). Only a small portion of DMSP ends up as DMS but this oxidises in the atmosphere forming sulphate particles that can act as cloud condensation nuclei. Overall this increases global albedo resulting in climate cooling. Generally, increased DMSP concentrations will result in larger DMS emissions and increased cooling. DMSP is produced by various marine microalgae, a trait shared with diatoms albeit at lower concentrations than other phytoplankton taxa. A high global biomass and experimental evidence of cultures of diatom species upregulating DMSP production under common environmental stress conditions, e.g. decreased nutrient availability, changes in salinity and temperature, give the impetus for our detailed study of this group. Our experiments aim to quantify DMSP synthesis, half-life and exudation using stable isotope methods coupled with analysis by gas chromatography with mass spectrometry, with diatom cultures exposed to nitrate deficiency, decrea-

sed salinity and increased temperature. Ultimately, we will incorporate the synthesis and exudation rate data into the global biogeochemical model PlankTOM10. Improving our understanding of global DMSP and DMS budgets will help us towards understanding the climate of the future.

Transcriptomics analysis to investigate the host responses of brown algae (*Ectocarpus* spp.) during infection caused by the oomycete pathogen *Eurychasma dicksonii*

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The tiny filamentous brown microalga Ectocarpus, like any other living organism, is plagued by diseases caused by different types of micro-organism like fungi, oomycetes, bacteria or viruses. The fungal-like micro-organism oomycete *Eurychasma dicksonii*, which infects more than 40% of the tested algal species, is used as a model to investigate the molecular mechanism of these interactions. Importantly, not all algae are equal: some species are resistant (R) to the infection, whereas some are susceptible (S). To further investigate the algal responses to infection, we analyzed RNAseq data of three different species of *Ectocarpus*: i. *Ectocarpus siliculosus* (genome strain (S)) ii. *Ectocarpus* sp (R) iii. *Ectocarpus fasciculatus* (R) treated with two strains of *Eurychasma dicksonii*. Differentially expressed algal genes were identified between the mock and the infected samples for each of the above treatments. The orthologous genes in three different *Ectocarpus* species were identified through PicoPLAZA: 11.094, 1504 and 696 of the *Ectocarpus* genes were shared across all three species, across *E. fasciculatus* and *E. siliculosus* and across *E.* sp and *E. siliculosus* respectively. Using the available high quality genome annotation of *E. siliculosus*, we were able to functionally annotate more than 70% of the *E.* sp and *E. fasciculatus* transcriptomes. We then compared the expression levels of these orthologous genes across the *Ectocarpus* transcriptomes. With the integration of gene expression, functional annotation and orthologous gene data, a subset of genes that are highly induced during susceptible and resistant interactions across the three *Ectocarpus* species was obtained, and will be tested for in-situ functional validation using FISH. A similar approach is also carried out with the *Eurychasma* transcriptomes, in order to identify key genes involved in virulence and infection. Specific highlights of these analyses, such as their significance in the light of algal evolution and disease management in aquaculture, will be presented.

Investigating the role of calcification in coccolithophores

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Coccolithophores are globally distributed, unicellular marine algae belonging to the phylum *Haptophyta*. Characterised by their internally produced calcite coccoliths, bloom forming species in particular play a crucial role in ocean biogeochemistry through the transport of carbon from surface waters to the deep ocean. Despite their ecological significance, the role and process of calcification remains poorly understood. One of the reasons for this is that studies to date have predominantly focused on *Emiliania huxleyi*, the most globally abundant coccolithophore species, which can readily exist in a non-calcified state in laboratory culture without a significant impact on cell fitness. However, emerging evidence suggests that there are important physiological differences between species and that the mechanisms of calcification in *E. huxleyi* are not typical of all coccolithophores. *Coccolithus braarudii*, a significant contributor to global calcite production, has been highlighted by recent literature as a contrasting species to *E. huxleyi* in calcification mechanisms. We applied a multifaceted approach to examine the impact of disrupting calcification in *E. huxleyi* and *C. braarudii* in culture experiments. We find major physiological differences between these species and demonstrate that inhibition of calcification has a major impact on *C. braarudii* fitness. These findings suggest that calcification may have distinct cellular roles in these organisms, which may have important implications for our understanding of the evolution and ecology of coccolithophores and their response to our changing oceans.

Proliferation of the invasive kelp, *Undaria pinnatifida*, from marinas to rocky reef and the potential for its control

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The kelp *Undaria pinnatifida* is one of only two marine macroalgae included in the Invasive Species Specialist Group list of 100 most invasive species of the world. Despite its widespread distribution in the UK, *Undaria* has been found on natural substrates in only a few areas, with the majority of records from marina pontoons.

The distribution and abundance of *Undaria* in marinas and adjacent rocky-reef habitats was surveyed across 5 regions on the south coast of Devon and Cornwall. *Undaria* was recorded at all 13 surveyed marinas, however was found at only 17 of 35 reef sites, all within 2 regions (Plymouth Sound and Torbay). At reef sites, probability of occurrence

and abundance was greater at more wave-sheltered sites with lower coverage of canopy-forming macroalgae, particularly *Laminaria* spp. However, it was also significantly related to the level of propagule pressure from marina habitats, indicating potential proliferation from marinas to natural reef.

To investigate the potential for restricting its spread, a variety of exclusion methods were applied to experimental patches of marina pontoon at two sites, and maintained monthly. This included selective exclusion of *Undaria*, mechanical clearing of all fouling, and thinning of all macroalgae. Across all manipulations, *Undaria* was found to have an extended recruitment period allowing it to persist year round. Recruitment was diminished by clearing the gametophyte seed-bank and presence of competing macroalgae; however the temporal pattern of recruitment was seen to be highly plastic, altering based on exclusion method.

Excluding or limiting *Undaria* in marina habitats would be highly challenging, but could limit its spread to natural reef habitats. The results of this study should help advise on methods and priorities for the control of this highly invasive species. Further, ongoing work will examine the impacts of Undaria on native assemblages in natural and artificial habitats.

Thermal tolerance of range edge and range centre kelp populations: evidence for thermal ecotypes

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Climate change is causing the redistribution of marine species, which can have serious consequences for the functioning of entire ecosystems. If we are to understand and predict how distributions will change as climate change progresses we must first understand the physiological traits that explain existing distributions. Kelp forests are amongst the world's most ecologically important habitats, providing a range of goods and services important to human society. Unlike mobile biota they must utilise physiological and biochemical pathways in order to deal with a changing thermal environment. *Laminaria digitata*, an important canopy forming shallow-subtidal/ low-intertidal kelp, is distributed on both sides of the Atlantic with trailing edges at Cape Cod on the eastern US seaboard and the 17ºC summer isotherm in the English Channel. Southern populations in the NE Atlantic have seen recent declines with poleward contractions predicted over the next 100 years. In this study, we examine the heat shock response (upregulation of Hsp70 mRNA) to common garden temperature stress (8-32ºC) of central and trailing edge populations. Results indicate that populations are adapted to local temperature regimes with edge populations showing greater capacity to cope with higher temperatures. No difference in seasonal comparisons was observed indicating a limited plasticity in regional heat shock responses. If tolerances are genetically fixed and thermal ecotypes are present then it may not just be trailing populations that are susceptible to climate change. This would have serious implications for species response models and management strategies and warrants further investigation.

Freshwater Diatom Flora of Britain and Ireland – filling a gap and addressing difficult issues

Eileen J. Cox

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Diatoms are a key group for the ecological assessment of freshwaters under the Water Framework Directive, but no modern diatom flora covering Britain and Ireland exists. Although diatoms were originally to be included in the Freshwater Algal Flora of the British Isles, it became clear that this was impractical, given the number of diatom taxa and associated taxonomic problems. Approximately 2800 species of freshwater diatoms have been recorded from Britain and Ireland, and diatom taxonomy has been subjected to significant revision over the last 20 years.

A history of the British Diatomaceae by William Smith (1853, 1856) represents the only explicitly British diatom flora (marine, brackish and freshwater taxa). Hendey (1964) published an account of British marine diatoms, Hartley (1986) compiled a checklist of diatom species records, Sims (1996) edited an Atlas of diatom illustrations, Whitton et al. (1998) made a coded checklist of taxa, and most recently a CD-based interactive key to common river diatoms was produced (Environment Agency 2007). Only Krammer & Lange-Bertalot's four volume contribution to the Süßwasserflora von Mitteleuropa (1986, 1988, 1991a, b) attempted to cover freshwater diatoms in northern Europe, but this is now taxonomically out-dated. It was also written in German, which created problems for some users.

It is clear from the results of ring tests that there are recurring problems with the identification of some diatom species due to variable access to specialist literature, while inconsistent taxonomic treatments reduce the accuracy / comparability of ecological assessments. The new flora will greatly expand the species coverage (from the CD identification key), incorporate the most recent taxonomic revisions, and integrate ecological information from British and Irish sites. Its online format will also allow rapid content updates. This talk will present the background to the project, and some important aspects of its design and delivery.

Freshwater Diatom Flora of Britain and Ireland – an online identification tool

Ingrid Jüttner

Natural Sciences, Amgueddfa Cymru – National Museum

Wales

Diatoms are a key group for the ecological assessment of freshwaters under the Water Framework Directive, but no modern diatom flora covering Britain and Ireland exists. It is known that there are recurring problems with the identification of some diatom species, due to variable access to specialist literature, and differences in taxonomic opinion. These problems impact on the accuracy of ecological assessments. The new flora will incorporate the most recent taxonomic revisions, and the format will allow rapid update of contents.

The website 'Diatom Flora of Britain and Ireland' is an online identification tool for researchers, students, and professionals with an interest in diatom taxonomy, ecology and biogeography. It has been available online since December 2016 and provides a documentation of taxa found in the British Isles using light and scanning electron microscope images. Descriptions and literature references are currently available for 192 taxa with an emphasis on those frequently encountered during water quality assessments. The website will be updated continuously with a minimum of 80 taxa added annually.

The British Phycological Society has provided funding from 2014 – 2018 for the team of 10 editors (Martyn Kelly, Bowburn Consultancy; Eileen Cox, David Williams, The Natural History Museum, London; David Mann, Royal Botanic Garden Edinburgh; Helen Bennion, Roger Flower, Viv Jones, Carl Sayer, University College London, Environmental Change Research Centre; Chris Carter, Northampton) to meet for workshops and visit facilities and collections to compile data and images for the website.

The website is hosted by Amgueddfa Cymru – National Museum Wales and was designed by James Turner. This talk will introduce the features of the website and outline plans for its development in 2017/18.

Composition of microphytobenthic biofilms in coral reefs, and influence on coral recruitment

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Microphytobenthic biofilms play numerous roles in coral reefs, including potential roles on coral recruitment. However, their ability to play these roles is dependent on their composition, whose variations are currently poorly understood. As the coral cover decreases in coral reefs worldwide, while macroalgal cover is increasing, it is worth assessing if human influence or macroalgal development could modify the composition of biofilms in coral reefs, and through them prevent a successful recruitment by corals. In this study in Okinawa, Japan, we characterised the composition of microphytobenthic biofilms in two reefs submitted to different human impact, and at several sites with various biotic environments within each reef. We then tested how changes in compositions of these biofilms affected their ability to stimulate the recruitment of the larvae of the coral Acropora tenuis, a common species in these reefs. We hypothesised that the composition of biofilms will vary both between reefs, and depending on their biotic surroundings within each reef; and that biofilms grown in an impacted reef or near macroalgae will be less able to stimulate coral recruitment than biofilms grown in a pristine reef or near healthy corals. Our results showed that biofilms in the two reefs had different microbial composition, mostly due to changes in the photosynthetic community. Only slight differences between biofilms from various biotic environments were found within each reef. The composition of the biofilm matrix was also different between reefs, with an accumulation of glucose in exopolymers in the pristine reef which suggested higher photosynthetic rates than in the impacted reef. These changes in microbial and matrix compositions impacted the ability of biofilms to promote the recruitment of larvae of Acropora tenuis; microphytobenthic biofilms dominated by diatoms, with a high photosynthetic activity, seemed to be the most efficient in stimulating the recruitment of coral larvae.

Examining how kelp forest community dynamics differ along a latitudinal gradient in Great Britain

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Kelps in the United Kingdom have been relatively understudied compared with other marine groups, despite being widespread and ecologically important. Due to the location of the UK, astride an important biogeography boundary of cold arctic waters meeting warmer boreal waters, the seas around our coastline present a unique opportunity to study the implications of sea temperature rise on range shifts, especially for those species whose northern or southern distribution limit lies within this region. It is unclear how species in this area will respond to these changes. One of the most dramatic intertidal range shifts observed in recent years has been that for the cold water kelp *Alaria esculenta*, with its current southern limit at Seaton Sluice, Northumberland. This study serves to document the distribution and abundance of

kelp species across the infralittoral zone of the UK and record its associated flora and fauna. Quantitative surveys were carried out during Spring and Autumn in four regions: South West England, South Wales, West Scotland, and the North East of England, benefiting from the network of marine labs engaged in the Capturing our Coast programme. *Laminaria digitata* was widespread. Regional differences were found in the distribution and abundance of the kelp *Laminaria ochroleuca* and *Alaria esculenta*.

Towards a better understanding of ecological structure and functioning in UK kelp forests: An update on the Team Kelp (UK Division) fieldwork program and related outputs

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Kelp forests dominate shallow rocky habitats across much of the world's temperate coastline. As foundation species, kelps support high levels of primary productivity, magnified secondary productivity, and provide habitat for highly diverse associated assemblages. However, a recent lack of targeted research on subtidal kelp forests in the UK has led to pressing knowledge gaps, which current impede our ability to conserve and manage these critical habitats during a period of rapid environmental change. Over the past 3 years, a significant field-based research effort has focussed on examining the ecological structure and functioning of kelp forests dominated by *Laminaria hyperborea*. We have quantified a suite of ecological and environmental variables at 12 sites, nested within 4 regions, that span 9° in latitude (~3°C in mean sea temperature), from Orkney in north Scotland to Plymouth in southwest England. The population structure of *Laminaria hyperborea* is variable at multiple spatial scales, but sporophyte density and morphology is strongly influenced by site-level variability in wave exposure. Sporophyte biomass and standing crop of carbon varies at regional-scales, and tend to increase with increasing light availability and decreasing temperature. The broader structure of kelp forest habitat also varies between both sites (driven by variability in wave exposure and sedimentation rates) and regions, with the cold-water kelp Alaria esculenta prominent in the north and the warm-water kelp Laminaria ochroleuca present in the south. Crucially, growth rates, biomass accumulation and detritus production of *Laminaria hyperborea* also vary along the regional-scale temperature gradient. By using a space-for-time substitution approach, we predict that continued sea water warming will lead to a reduction in primary productivity and shifts in community composition and canopy structure in kelp forests dominated by *Laminaria hyperborea*, which could influence the wider functioning of nearshore coastal ecosystems.

Exploring the genomes of extremophilic red algae *Galdieria* with 2nd and 3rd-generation genomics to unlock Industrial Biotechnological applications

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Galdieria are red algae that exhibit wide metabolic versatility and display enormous capacity to thrive at highly acidic conditions (down to pH 0) and temperatures above 55 °C, which is the theoretical limit of eukaryotic life. Members in this genus display broad metabolic repertoires allowing vigorous chemoheterotrophic growth on virtually any sugar, sugar-alcohol or organic acid source and they are additionally capable of photoautotrophic growth aerobically and anaerobically. *Galdieria* are metabolic workhorses. They are known to detoxify contaminants under high concentrations of toxic metals and thus are targets for bespoke bio-mining applications for precious metal and rare-earth metal accumulation. The constellation of biochemical versatility in differing strains suggests a large repertoire of metabolic enzymes, which are potentially a rich source of thermo-stable proteins for biotechnology. We are tapping in to these resources by examining the phylogenomic space of dozens of our newly sequenced Galdieria genomes. We also will report the first-ever eukaryotic draft genome de novo assembled from the MinION nanopore 3rd-generation sequencing approach. The extremophile lifestyle of *Galdieria* makes them fascinating organisms to study from both a mechanistic viewpoint and to find those novel species with properties that have industrial biotechnological (IB) applications.

Use of FTIR spectrophotometry to monitor post-harvest treatments in seaweeds for enhancement of macromolecular composition

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The aim of this study was to test the utility of FTIR-spectroscopy to monitor macromolecules composition (proteins, lipids and carbohydrates) in two economic kelps species (*Laminaria digitata* and *Saccharina latissima*) and in the environmentally important green algae (*Ulva lactuca*) when they are exposed to post-harvest treatments of temperature, salinity, nitrate and light. An increase in carbohydrates content was found in kelps species when they were stressed using temperature (> 200% in *Saccharina* and > 125% in *Laminaria*). In *Ulva* an increase in macromolecules composition was found when they were subjected to nitrate depleted condi-

tions. Such changes simultaneously warn of the importance of rapidly processing material after harvesting, as well as the utility of controlled manipulations to enhance composition for commercial exploitation. FTIR spectroscopy was found to be a reliable and rapid tool to provide quasi-real time analysis for monitoring these changes.

Novel strategies for preventing diseases in cultivated seaweeds

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In any agricultural or aquaculture system, pests and pathogens typically reduce production yields by a fifth to a third; this also holds true for cultivated seaweeds. As seaweed cultivation develops and intensifies worldwide, the frequency and severity of disease outbreaks is increasing, for example on *Gracilaria*, *Pyropia*, eucheumatoids and kelps. Here, I will brush over different strategies developed in my group to describe and characterise hitherto unreported diseases of seaweeds and control pathogens in a cultivation context.

As a prerequisite for the implementation of meaningful breeding strategies in brown algae, I will introduce our work on the mechanisms and heritability of disease resistance in *Ectocarpus*; we find that disease resistance is a phenotypically stable, quantitative, and heritable trait. Its fundamental mechanism is not only conserved against several pathogens but also across the entire brown algal lineage, thus providing proof-of-concept to breed for disease resistance in commercially important species.

To address the need for fast cost-effective tools fit for the quantitative phenotyping of numerous individuals, nephelometry will be described as a novel, non-invasive method for medium-throughput biomass measurement of macroalgae; application examples will be presented not only for disease diagnostic, but also for fertility and in vivo growth measurement.

I will also briefly introduce our work on commensal or beneficial microbes naturally associated to seaweeds that may counteract pathogens and be used as biocontrol agents and the outcome of a collaborative initiative undertaken in the framework of GlobalSeaweed, leading to recommendations for policy-makers.

Growth, death and exopolymer particle production by diatoms

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Exopolymer particles play a significant role in the marine carbon cycle. They are a large pool of organic carbon and affect the aggregation of particles and the biological carbon pump. Exopolymer particles form from precursors produced by phytoplankton and are operationally defined by the dyes used to stain them. Transparent exopolymer particles (TEP) are composed of acid polysaccharides and Coomassie staining particles (CSP) contain proteins. Factors that affect the production and composition of exopolymer particles are poorly constrained. A limitation of current methods to quantify exopolymer particles is the lack of compositional information and the ability to express TEP and CSP concentrations in terms of carbon. To address this knowledge gap we are developing Raman spectroscopy methods to characterize the chemical composition of individual TEP particles. Observations of exopolymer particles in an upwelling region in the eastern Pacific Ocean and laboratory experiments with *Thalassiosira weissflogii* indicate that TEP and CSP are distinct populations of particles rather than polysaccharide and protein components of the same particles. We hypothesize that autocatalytic cell death plays a major role in the formation in the of exopolymer particles as an increase in cell permeability is associated with death. *Thalassiosira weissflogii* was exposed to hydrogen peroxide as a stressor, resulting in a reduced quantum yield of photosystem II, increased caspase-like activity, and an increase in the proportion of permeable cells. CSP concentrations were not affected by hydrogen peroxide concentration and did not correlate with indicators of stress and death. However, there was an increase in the TEP concentration in the cultures, indicating that TEP formation was associated with cell permeability and death. These data indicate that different environmental factors and physiological processes affect the production of different types of exopolymer particle.

The breakdown of bacterial "armour": feebleness of an invasive seaweed holobiont?

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Seaweeds represent up to 40 % of all introduced marine species, and some seaweeds can significantly affect the composition and functioning of marine benthic communities. Within ten years after its first discovery in the Kiel Fjord in 2005 the East Asian invasive red seaweed Gracilaria vermiculophylla has spread approximately 100 km eastward and 120 km northward along the German Baltic Sea coast, inhabiting now many lagoons and sheltered bays between the German-Danish border and Neustadt. During the first two years after its discovery *Gracilaria vermiculophylla* increased its biomass in the Kiel Fjord massively. However, this was followed by a sudden decline in late summer 2008, when the alga decayed in nearly all inhabited parts of the bay within few weeks. Co-cultivation of healthy *G. vermiculophylla* from unaffected environments with small amounts of decaying material from the Kiel Fjord in laboratory assays demonstrated that the decay was apparently caused by an infectious disease. Thus, 59 different species of epibacteria isolated from *Gracilaria* were tested for their capacity to induce decay in a bleaching assay. Out of these, 3 were found to induce the disease, while 19 others significantly reduced the risk of decay and were thus protective. When protectors and pathogens were tested together, the protective strains fully prevented the negative impact of the bleachers, hinting at the presence of an associational defense offered by *Gracilaria*'s epibacteria. Presence of such an associational resistance was also supported in a follow up bioassay where surface extract of *Gracilaria* and its associated microbiome attracted the beneficial strains, but deterred the detrimental ones. Thus, we suggest that the breakdown in 2008 was due to a collapse of such associational resistance provided by bacterial partners.

Carbon fluxes in ocean food webs: how phytoplankton community composition may (or may not) affect trophic dynamics and export

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Phytoplankton species vary greatly in size, shape, and chemical composition. This variation, in turn, influences trophic interactions and rates of biogeochemical cycling, and is thought to have considerable impacts on the rates and magnitude of organic material exported from the surface ocean to the deep sea. My presentation will focus on two aspects of phytoplankton community composition: cell size (small vs. large) and palatability to grazers ("yummy" vs. not). For each scenario, I will examine the pathways and ultimate fate of the phytoplankton primary productivity through marine food webs, and will address whether our conventional ideas of carbon flow – e.g., large phytoplankton are grazed by large grazers which results in high export fluxes - are supported by data from the field. I will use examples from my work in the Sargasso Sea, and from a recent collaboration with American and German scientists on models of carbon flow through food webs of the eastern Fram Strait.

Carbon fluxes in microalgal biofilms: the flows through dissolved organic matter and extracellular polymeric substances (EPS)

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Microalgal biofilms are physically-structured systems found widely in marine, freshwater and even terrestrial habitats. The physical juxtaposition of autotrophs and heterotrophs, along steep physico-chemical gradients, contribute to promoting the high rates of primary production and carbon flow that are observed. Dissolved organic matter, in a wide range of forms (from small organic molecules to massive extracellular polymeric substances, EPS) plays a significant role in the flux of carbon within these biofilm systems. Not taking account of the flow of carbon though the DOM pool underestimates the contribution of microalgal systems to overall carbon cycling. This paper will draw on examples from estuarine, marine, polar and terrestrial examples, illustrating the diversity, temporal and biological reactivity of different components of the DOM pool, and the evidence for specialised groups of heterotrophs that utilise this carbon source.

A new paradigm for marine planktonic primary production

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Traditionally the marine planktonic food web has been considered to be dominated by plant-like phytoplankton and animal-like microzooplankton. A review of the protists comprising these groups has led to a revised functional group description that in totality threatens, offers, to overturn this paradigm that supports marine biology. Other than the important exception of the diatoms, and ca. half the microzooplankton, it transpires that the bulk of the marine planktonic protists are mixotrophic, combining phototrophy and phagotrophy within the same cell. The basis of the new paradigm that sees mixotrophs at the heart of marine primary production will be explored, together with the various challenges and opportunities that become apparent with the revelation.

Phylogeny, physiology and environment: Is inorganic carbon an important ecological factor for freshwater microalgae?

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Phytoplankton are important primary producers in many freshwaters and in excess are symptoms of poor water quality. This talk is based on three strands. First, the phyto-

plankton come from a wide range of phylogenetic groups including prokaryotic cyanobacteria, and eukaryotic algae from the Plantae, Chromalveolates and Excavates. Secondly, the supply of dissolved inorganic carbon in freshwaters is very variable because of variable geology and productivity within their catchment. Thirdly, in productive systems rates of carbon-uptake by primary producers can exceed rates of supply from the catchment, the atmosphere and heterotrophic regions where CO_2 is produced such as the sediment, depleting the carbon-reserves. Together, these three facts raise the possibility that inorganic carbon is an ecologically important factor that might limit phytoplankton productivity in freshwaters and control the temporal and spatial distribution of species. I will briefly illustrate these three strands before tying them together to tackle the title of the talk using field data on inorganic carbon concentrations and phytoplankton composition and laboratory experiments characterizing the ecophysiological properties of different phytoplankton species or communities.

Gracilaria vermiculophylla: an invasive red seaweed has arrived in Britain

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Gracilaria vermiculophylla is native to the NW Pacific (Japan, Korea, China). It was first reported outside this range in the Eastern Pacific, and has been present in the Western North Atlantic (Virginia, North Carolina) since the 1970s. In Europe it was initially found in France in association with oyster aquaculture and spread rapidly around Atlantic coasts of Europe, becoming abundant in estuarine habitats. In the British Isles, it was first observed in N. Ireland in 2008 near an oyster farm, but had never been recorded in England. We surveyed its distribution and abundance in N. Ireland between 2008 and 2016. In England, in 2015 we discovered a single thallus near Kingsbridge, Devon, and found a large biomass of *G. vermiculophylla* in Christchurch Harbour, Dorset. We predicted that the Christchurch population could have originated from nearby Poole Harbour, a traditional site of oyster cultivation; in 2016 we found *G. vermiculophylla* in the lagoon at Brownsea Island, Poole Harbour, where it had been reported in 2010 as *Gracilariopsis longissima*. No reproductive structures were observed and the population appeared to be stable and reproducing vegetatively – the algal thalli were extensively coated with tubes of the lagoon amphipod *Corophium insidiosum*. We observed cystocarpic and tetrasporangial thalli in Carlingford Lough and Christchurch Harbour and showed by microsatellite genotyping that both populations were only partially clonal.

Tropical macroalgae under future conditions

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Coral reefs worldwide are exposed to increasing ocean acidification, climate change, nutrient enrichment and overfishing. But not only reef-building corals are affected by the changing conditions, other invertebrates, vertebrates and algae are also exposed to these changes. Tropical macroalgae have a variety of roles in these ecosystems, and while they are not the ecosystem engineers, they are an important part of this ecosystem, providing food, shelter and settling substrate for corals. On the other hand, algae are believed to thrive under conditions that are deleterious to coral health and, furthermore, are strong competitors for space. In order to gain insight into algal performance under future conditions, we conducted several studies. To this end, we exposed the algae to ocean acidification, elevated temperatures and increased nutrient loads as well as combinations of these factors. Several physiological parameters, such as growth, photosynthesis and respiration rates, nutrient uptake, pigment concentrations and reproduction rates were estimated to gain a comprehensive understanding. Overall, the data showed very little evidence for increased algal growth rates, with some algae showing decreases in growth and even mortality under future conditions. It seems that ocean acidification and potential energy savings achieved by the downregulation of carbon-concentrating mechanisms do not outweigh other negative effects, such as potential thermal effects and nutrient toxicity.

Measuring climate change effects in rocky shore communities

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Changes in the distribution and abundance of rocky intertidal macroalgae and animals have long been used to measure responses to changing climatic conditions. Most changes are reported on a species-by-species basis in terms of fluctuating abundance and shifts in geographical ranges. Responses are variable and often hard to ascribe directly to climate change. Here I use the Community Temperature Index (CTI) approach to show how rocky intertidal communities have changed over large geographical scales and long time periods with climate. CTI measures the relative proportions of cold-water and warm-water species by averaging range midpoint temperatures, termed the Species Temperature Index (STI), for each species in the community. Geographical

ranges for UK species were mapped from literature reports and matched to average sea surface temperatures to produce a thermal niche, described by percentiles of the resulting frequency distribution of coastal temperatures. Analysis of CTI values from surveys of Irish and UK rocky shores shows that, spatially, communities change in composition gradually from the warmer southwest to the colder east and north parts of the region. CTI measures based on macroalgae are less sensitive to changes in temperature than those based on animal species. This is because of the greater variability in STI values ('thermal diversity') for animal species compared with macroalgae, as expressed by the standard deviation of STI values, and a tendency towards wider species thermal ranges for macroalgae. A small decline in CTI values has occurred since 2002 at sites in the south and west of the UK, in line with changes in sea surface temperatures around the UK over the same period. In contrast, CTI values from annual surveys of 20-plus sites in Shetland have closely tracked changes in temperature since 1976. We recommend this approach as an extremely useful yet simple index of climate change response.

Brilliant and intense: structural colour in marine algae

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Structural colour is well-documented in nature where its function may include a means of visual communication, mate attraction or camouflage. It is widespread in the marine environment and the appearance of iridescent blue tips in the gametophyte phase of the red alga *Chondrus crispus*, for example, will be a familiar sight in rock pools in the intertidal in the North Atlantic. Structural colour is reported for red and brown algae, yet the phenomenon is largely unexplored. In the red algae two structural mechanisms are responsible for structural colour, either iridescent bodies or multi-layered cuticles, whereas in the brown algae, only iridescent bodies have been observed. The functional purpose of structural colour in these algae is unexplored experimentally, but studies from leaves of flowering plants have speculated that such colour may function as photoprotection or as predator deterrents. Here, we will explain how structural colour is produced in the algae and discuss possible evolutionary relationships with terrestrial plants. By reviewing their distribution and ecology we will also explore the functional relevance in the brown algae where structural colour is confined to species of the Fucales and Dictyotales. We will also explore the hypothesis that structural colour protects the seaweeds from radiation damage and discuss this in relation to climate change.

Epibacterial diversity and function in the physiology of polar coralline algae

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Primary colonizers of marine surfaces are often bacteria, especially on algae which produce exopolymeric substances that probably found these associations. Algae is an important habitat for bacteria and the association reciprocally influences the ecology, physiology, and biochemistry of each symbiont: while the epibacteria within the biofilm acquire resources and substrate from the host, they are also responsible for the physiochemical environment of the host alga, acting as a diffusive boundary layer (DBL) between the alga and its environment. This research project uses Miseq techniques to define epibacterial abundance and diversity and microsensors to define the role they may play in essential nutrient uptake in the Arctic coralline alga, *Lithothamnion glaciale*. *L. glaciale* is free-living coralline alga known to provide habitat and refuge for many marine species in the north-north eastern Atlantic. This species has a limited distribution along the southwestern coastline of Greenland and because biofilms play a role in the ecological functioning of corallines, we are curious to understand how they may function in this species distribution and physiology in this particular polar environment. We target nitrogen because green, red, and brown algae have no know nitrogen fixing mechanisms and nitrogen is a limiting resource for marine algae.

The effect of temperature on volatile organic compound production in coccolithophore species *Emiliania huxleyi*

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Some key volatile organic compounds (VOCs) such as dimethyl sulfide (DMS) and isoprene have been intensively studied. In contrast, disentangling the environmental volatile metabolome using signature peaks on gas chromatograms has received little attention. This study aims to develop novel tools for the detection of signature VOCs with the purpose of translating such information into an indicative database on the diversity of VOCs in phytoplankton and its application to assess phytoplankton health. Growth and

VOC production were quantified at temperatures of 16 and 26°C in the coccolithophore species *Emiliania huxleyi* (strain CCMP 373). Gas chromatography with flame ionisation detection (GC-FID) was used to monitor VOC production during exponential and stationary growth phases. Cultures grown at 16°C showed higher growth rates (0.194 ± 0.130 d-1) than those grown at 26 °C (0.095 ± 0.166 d-1). Most signature peaks were higher in exponentially growing cultures at 16°C compared to 26°C. Data suggests that significant changes in volatile metabolomes can be used to monitor the effects of temperature on algal physiology and could be applied as a diagnostic tool to monitor health and, since biological interactions can alter VOC signatures, food web functioning.

Advances in molecular tools for routine monitoring of toxic algae and pathogens in aquatic ecosystems

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Microarrays are oligonucleotides applied to the surface of a glass slide in an ordered array. When rRNA sequences are used, these are called phylochips, which can identify organisms and is a relatively new, innovative microarray application. Phylochips can facilitate monitoring for any microorganism in any environment and visualize its changes in abundance over time for long-term records. We developed in three EU projects: a phylochip for the detection of toxic algae in marine waters and for freshwater pathogens in freshwater and tested them with environmental samples in 5 countries for the toxic algae and 6 countries for the freshwater pathogens. Water samples were filtered until they clogged or concentrated into one litre using a kidney dialysis filter, of which free filters are being distributed upon request. Total RNA was extracted using TriReagent, fluorescently labelled and hybridised to the phylochip. The pattern captured via fluorescent excitation in the microarray scanner is exported as an excel file and analyzed based on presence/absence of probe signals in a hierarchical fashion. For a species to be present, probes for higher taxa, viz., genus to kingdom must also be present. Where calibration curves have been made, then the microarray signal can be converted into cell numbers. In a fourth EU project microarray probes were transferred to a SHA coupled to an electrochemical and a colorimeter detection. The electrochemical detection was 16 fold higher than that obtained in earlier applications and the colorimetric detection was automated for a real time in-situ assay in a buoy.

Taxonomic revision of Agaraceae (Laminariales, Phaeophyceae)

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We have reexamined the taxonomy of Agaraceae (Laminariales, Phaeophyceae) based on phylogenetic analyses of 6 mitochondrial and 6 chloroplast gene sequences from *Agarum*, *Costaria*, *Dictyoneurum* and *Thalassiophyllum* species as well as representative species from other laminarialean families. The genus *Agarum* was paraphyletic, comprising two independent clades, *A. clathratum*/*A. turneri* and *A. fimbriatum*/*A. oharaense*. The latter clade was genetically most closely related to *Dictyoneurum* spp., and morphologically the species shared a flattened stipe bearing fimbriae (secondary haptera) in the mid to upper portion. The phylogenetic position of *Thalassiophyllum* differed between the two datasets: in the chloroplast gene phylogeny *Thalassiophyllum* was included in the *A. clathratum*/*A. turneri* clade, but in the mitochondrial gene phylogeny, it formed an independent clade at the base of the Agaraceae, the same position it took in the phylogeny when the data from both genomes were combined despite a larger number of bp being contributed by the chloroplast gene sequences. Considering the remarkable morphological differences between *Thalassiophyllum* and other Agaraceae, and the molecular support, we conclude that *Thalassiophyllum* should be reinstated as an independent genus. *Dictyoneurum reticulatum* was genetically close to but independent of *D. californicum* and morphologically distinctive due to its midrib. In conclusion, we propose to treat *A. fimbriatum* and *A. oharaense* in a new genus, and the reinstatement of the genus *Thalassiophyllum*.

Evolutionary history of the hyperdiverse red algal family Rhodomelaceae

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The Rhodomelaceae, with about 1000 species growing worldwide in all benthic habitats in the photic zone, is by far the most diverse family of the red algae. It exhibits both high species diversity and a wide range of morphological architectures. The Rhodomelaceae is therefore a good candidate as a

model for testing evolutionary hypotheses, but to date there has been no attempt to construct a molecular phylogeny of the family. We used a phylogenomic approach with the aim of resolving relationships among the major lineages of the family. Subsequently, we constructed a time-calibrated phylogeny to unravel the timing and tempo of the diversification of the Rhodomelaceae, and analysed the evolutionary development of morphological traits. Finally, we propose an explanation for the observed patterns, as well as speculating why this family has achieved such high taxon diversity.

Temporal dynamics of the coastal Cercozoa; revealing hidden diversity in an understudied group

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Planktonic Cercozoa are abundant protists within the marine environment. However, their Rhizarian cousins, the Foraminifera, have received much greater attention. Assessment of global micro-eukaryotic diversity has shown the Cercozoa to be present in all oceans across the globe. Many in this group are bacterivores meaning they are the most numerous predators on earth. Members of the Chlorarachniophyceae contain chloroplasts and are mixtrophs meaning that they are important components of several functional groups. Knowledge of the diversity and dynamics of marine cercozoa is limited, in part due their lower abundance than other protists (i.e dinoflagellates) in the environment. This means they are often in low abundance in high-throughput sequencing (HTS) libraries that use general Eukaryotic primers. Targetted HTS has already been applied to the Cercozoa soil systems, here we apply Cercozoa specific primers combined with HTS to profile planktonic Cercozoa over a 13 month time series at a coastal sampling station. From >1 million high quality short read sequences we found >250 Cercozoa OTUs at the site. We detected OTUs from a range of orders and novel lineages with Chlorarachniophyta. Glissomonadida, Imbricatea, Thecofilsosea and Novel clade 2 dominating the libraries. Within these there are potential members of a variety of functional groups including predators, parasites and primary producers. There are clear temporal changes within Cercozoa communities across the time series with several OTUs correlating in abundance with environmental variables such as bacterial abundance and specific phytoplankton groups. This work shows the Cercozoa are both taxonomically and functionally diverse within coastal seas and their role within marine biogeochemical cycles should not be underestimated.

Taxon-specific volatile metabolomic signatures in three species of seaweed

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Every organism emits specific metabolomic signatures. The volatile metabolome represents the diffusive subset of this and has been applied for pest control and yield improvement in agricultural systems and to develop non-invasive biomarkers in the diagnosis and monitoring of human diseases. Aquatic environments are of particular relevance since the directional quality of volatiles is further enhanced by low diffusivity and microbial production/consumption processes. However, environmental volatile metabolomics is poorly explored for the assessment of structure and function in marine systems. We developed the first steps of an analytical pipeline based on gas chromatography (GC-FID) to quantify biogenic volatile organic compounds (BVOCs) from seawater, and a semi-automated routine for chromatogram alignment and averaging. Freshly collected phaeophyte, chlorophyte and rhodophyte seaweeds (*Fucus vesiculosus*, *Ulva lactuca*, *Ceramium* sp.) showed taxon-specific volatile metabolomes of increasing complexity. The sulfur gas dimethyl sulfide (DMS) was a significant feature in the chloro- and rhodophyte (111 ± 90.0 and 18 ± 21.7 nmol DMS g-1 FW h-1, respectively) whereas the phaeophyte showed lower production of 0.6 ± 0.25 nmol DMS g-1 FW h-1. Rates of isoprene production were about three magnitudes lower but similar across the different taxa (1.9 to 11.8 pmol DMS g-1 FW h-1). Principal Component Analysis (PCA) demonstrated clear separation of algal genera based on their volatile metabolome signatures. This suggests that volatile metabolomics could be adopted as a novel integrated approach to understand marine food web structure and function by focusing on marine BVOC signatures and their sensitivity to 'bottom-up' and 'top-down' controls. We currently explore the effect of temperature on volatile metabolomes and assess the role of BVOCs in the selective recruitment ('farming') of specific bacteria to the seaweed holobiont.

An algal-bacteria consortium for successful waste remediation and probiotic effect for aquaculture feeding

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Microalgae are an untapped resource with more than 30.000 species, of which fewer than 15 are in commercial production. Microalgal biomass is one of nature's richest raw materials in vitamins, proteins, and other nutrients. The potential application areas include waste remediation and production of feed for farmed fish and animals. The mass cultivation of microalgae is always associated with bacterial communities. Current knowledge of the composition and

role of the bacterial communities associated with microalgal mass cultures is not very well known (Biondi et al., 2016; Natrah et al., 2014; Ramanan et al., 2016). Several researches (Biondi et al., 2016; Fukami et al., 1997) shown the stabilising effect of mass culture, when microalgae symbiotically grown with the bacterial associations.

An algal-bacterial consortium was isolated from an industrial site of steelwork production, at TATA Steel Strip Ltd in Port Talbot, UK and its bioremediation capacity tested. The mixed culture was "applied" to different waste-stream treatments from technological processes undertaken at the Steelwork and an anaerobic digestion plant at Dŵr Cymru Welsh Water. The research of algal mixed community applied for the waste waters and flue gas remediation was investigated in terms of presence pathogenic bacteria, after cultivation on waste nutrients. The predominant algal species in the consortium was Franceia amphitricha. Other algal taxa present in the consortium included: *Scenedesmus* sp., *Chlorella* sp., *Chlamydomonas* sp. and *Desmodesmus* sp. The bacterial community was composed by *Morganella morganii*, *Providencia rettgeri*, *Micrococcus luteus*, *Micrococcus radiodurans*, *Micrococcus lylae*. Different waste streams shown presences of different species in a bacterial composition, but less influenced on changes of microalgae consortium.

The physiological role of bacteria-algae consortium is studied. The biomass application was investigated as a feeding ingredient for aquaculture. It was find out that these algae-bacteria consortium provided probiotic activities and could be used in aquaculture for larvae and fish health.

POSTERS

Laboratory and field studies on the interaction between kelps and filamentous algal endophytes

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The marine brown macroalga *Saccharina latissima* is an important primary producer in temperate to cold northern hemisphere shores and an economically relevant seaweed with high industrial potential. Morphological changes - such as dark spots, twisted stipes and deformation of the blades - have been observed in wild populations and seaweed farms. The putative cause for the occurring symptoms is the filamentous endophytic brown alga *Laminarionema elsbetiae*, which is highly prevalent in European *Saccharina* populations but has also been found in its secondary host, the brown alga *Laminaria digitata*. *L. elsbetiae* is known to invade stipes and fronds of its hosts, however nothing is known about the molecular mechanisms of the interaction. To get further insight into the host-endophyte relationship and possible defence mechanisms, a co-cultivation bioassay was developed in order to monitor the impact of the endophyte on growth of laboratory-raised individuals of both kelp species and to test the pathogenicity of the endophyte according to Koch's postulates. First results revealed that co-cultivation of *L. elsbetiae* with *S. latissima* juveniles does not induce changes in growth or morphology of its primary host. On the contrary, growth of *L. digitata* significantly decreased within less than a week when co-cultured with the endophyte. A qPCR-based approach was set up to detect and quantify endophytic filaments within the host. Based on this method a field survey was designed to localize the endophyte within *S. latissima* sporophytes. It was shown that endophytic filaments are most abundant in the blade tip, i.e. the oldest part of the blade, suggesting that the endophyte either enters the host at an early stage or preferably infests old tissue. Ongoing experiments and field surveys aim to decipher and better understand the bases and mechanisms of the biotic interaction between the endophyte and its hosts.

Establishment of *Osmundea pinnatifida* mariculture

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Worldwide production of seaweed is a profitable sector, with an annual value of US $6.4 billion. Sustainable production of algae for human consumption/high value chemicals is of vital importance for the development of robust supply chains for algal products, especially in relation to the growing demand of seaweeds products. In Europe the focus has been on the use of seaweeds as gourmet food and low-volume-high-value raw materials for novel applications. UK coastal waters constitute an ideal environment for a variety of seaweeds that have played a role in the diet and culture of coastal communities for more than 4,000 years. Currently in Scotland, seaweeds are mainly harvested from intertidal macroalgal beds. In the future, natural harvesting will be insufficient to meet the rising demand, leading to significant environmental damages. The focus of this project is the supply of *Osmundea pinnatifida*, a red macroalga, collected from the wild and marketed in its dried form as a peppery seasoning. It is used both for food and nutraceutical applications. Currently a pack retails at £12 for approximately 5g dry weight. The establishment of pepper dulse mariculture, will provide a more consistent and sustainable product, reducing the environmental impact of harvesting wild material and ensuring future employment for coastal communities. Key aspects of the project will be: improving crop yield, optimizing the cultivation; tailoring the color/texture/taste of the product for the market; assessing the biochemical/chemical composition of seasonal collected samples, to identify the best nutrient profile for a commercial exploitation; developing a methodology for cultivation, with the establishment of tank

and/or outdoor cultivation systems at the industrial partner facilities, and the application of a reliable cryopreservation methods, in order to store and preserve the most promising strains ensuring a stock population. This challenging project represents the chance to translate research from academia to industry.

Characterisation of the elusive colonial haptophyte *Corymbellus aureus*

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Corymbellus aureus was first identified as a colonial haptophyte in British waters by J. C. Green in 1976. Alongside the colonial nature, *C. aureus* was characterised by the presence of two flagella, oval body scales and a short non-coiling haptonema arising from an apical groves. Although initially successfully isolated and cultured, the strain was soon lost. Since then there have been very few accounts of this elusive, yet distinctive, haptophyte. Here we identified the presence of the described *C. aureus* in L4 plankton samples, collected weekly off the coast of Plymouth. The strain was successfully isolated and examined using light microscopy. Subsequently, molecular methods were used to identify its position within the haptophytes. Here we present evidence from the sequenced 28S ribosomal DNA that '*C. aureus*' was found to be a haptophyte and is likely to be closely related, or belong, to the *Phaeocystis* genus. These observations also indicate that some haptophytes have an ability to form more complex colonies than previously thought.

Seasonal Silicon Cycling in the Severn Estuary

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Rivers are the main conduit of dissolved silicon to the oceans, providing an essential nutrient to marine diatoms that contribute to approximately half of all surface ocean productivity. Coastal silicon cycling has gained global attention with new insight into the importance of estuarine benthic-pelagic coupling as a potential source of silicon to the marine budget. As a hypertidal estuary, the Severn is a highly dynamic biogeochemical factory. However, despite being a key component in the estuarine benthic-pelagic coupling, the role of the diatom-dominated biofilms in their mediation of benthic dissolved silica (BDSi) and biogenic silica (BBSi) in these intertidal mudflats remains unclear. We provide a first assessment of the seasonal distribution of BDSi and BBSi standing stocks, relative to the ecological functioning of these biofilms. This was achieved through the assessment of biofilms biomass (chlorophyll pigments) and their photosynthetic activity measured using variable chlorophyll fluorescence, nutrient availability and external environmental pressures. We show that BDSi and BBSi standing stocks exhibited seasonal variations that are likely attributed to the biological uptake of silicon, with near complete consumption of BDSi during the spring, summer and autumn, corresponding to increased biomineralization resulting in peak standing stocks of BBSi. We compare our new results, from 2016, to previously published data from 2014 in order to address interannual variability of silicon cycling. Our findings highlight the relative importance of diatom-dominated biofilms, and how changes in their bioproductivity influence the BBSi flux in the Severn Estuary intertidal mudflats. These hitherto largely ignored processes have the potential to contribute to the Severn Estuary silicon export to the UK southwest pelagic zone.

Changes in total lipid and lipid class composition during the growth of three marine microalgae

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Addition of nutraceuticals (bioactive components) to food products shows promise as diet based prevention for many chronic diseases. These compounds are often hydrophobic and not easily incorporated into food products, (McClements 2012). Phospholipids, from microalgae are ideal candidates for the production of liposomes, not only allowing incorporation of the hydrophobic compound of interest, but also potentially providing omega-3. Studies have shown that phospholipids have the ability to modify uptake of dietary omega-3 fatty acids increasing adsorption of DHA in infants, (Carnielli et al. 1998), and reducing cholesterol and reducing hepatic fibrosis in mammalian models, (Wilson et al. 1998; Lieber et al. 1990). Three species were studied, (*Cylindrotheca fusiformis* CCAP 1017/2, *Nannochloropsis oceanica* CCAP 849/10, *Isochrysis galbana* CCAP 927/1). Lipid and pigments were extracted from samples taken throughout the growth phase. Percentage total lipid extract was determined and lipid classes were analysed by HPTLC and scanning densitometry. Results indicated that *C. fusiformis* phospholipid varied over the growth of the culture (3.11-14.51% of total lipid), no rapid increase in phospholipid was seen at the start of logarithmic growth phase. *N. oceanica* had overall high proportion of phospholipids, with the highest at day 5 (21.37% of TL), corresponding to the beginning of logarithmic growth, with the proportion of phospholipids remaining high throughout the log phase of the culture. *I. galbana* performed poorly in comparison, detectable phospholipid was only pre-

sent at day 10 and 13, (1.03-2.79% of TL). Photoautotrophic microalgae can be produced without carbon substrates and can grow on land or utilise water sources unsuitable for terrestrial plants, conferring advantages over terrestrial plants and bacteria. With careful selection of species, microalgae could be useful future sources of complex polar lipids and phytosterols potentially for use as additives or delivery systems for high value nutraceutical products.

Developmental and ecological response of *Fucus vesiculosus* to chronic environmental contamination in the northwest Atlantic

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Brown algae are important habitat-creating species in intertidal communities. *Fucus vesiculosus*, one member of this group, is prevalent in rocky intertidal habitats of the northeastern United States, where algal beds provide feeding and nursery habitats for commercially important fish and invertebrate species. Due to commercial and residential expansion along populous coastal waterways, organisms residing in these habitats are often subject to anthropogenic pollutant exposure. In the case of New Bedford Harbor on the southeast coast of Massachusetts, high levels of polychlorinated biphenyls and heavy metals have contaminated coastal ecosystems for decades. Although declared a priority cleanup site by the United States Environmental Protection Agency, these ecosystems remain loaded with dangerously high levels of contaminants. Despite the fact that Fucus vesiculosus has been historically abundant in and around the New Bedford Harbor, very little research has looked at how this contamination might affect primary productivity.

Our studies focused on the reproductive capacity of mature individuals, the ability of zygotes to meet critical developmental landmarks, and the ecological condition of populations of *Fucus vesiculosus* with varying historical exposure levels to the most common environmental contaminants. We found strong correlations between increased contaminant load and poor biological condition (delayed development, impaired or arrested ability to release gametes, and decreased biomass and density). These findings suggest a grim outlook for recovery of populations from heavily contaminated areas, but also provide insight into the ability of these fucoid algae to resist the damaging effects of chronic contamination; a quality which allows them to survive in these habitats. In an environment under increasing stress from climate change, it is important to understand the condition of these habitats and how human-induced habitat destruction has affected sessile macroalgae on a long term scale.

Seasonal observation of life history stages and population dynamics of the red alga *Porphyra dioica* in South Wales

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As a result of growing public and industrial interest in using natural and local products, red algae of the genus *Porphyra* are facing increasing harvesting pressure in South Wales. Yet there is little information on their autecology, leaving collection guidelines and management strategies poorly informed. We therefore investigated seasonal life history stages and population dynamics in a species exploited in South Wales, *P. dioica*. A permanent area (30 x 30 m) at Freshwater West was sampled monthly from April – November 2016. P. dioica density (individuals·m-2), cover (%), maximum length and width (cm) as well as environmental parameters (pH, water temperature) and benthic substrate type were recorded in the field. Reproduction status (% reproductive female and male thallus area, number of released zygotospores/agamospores per cm² reproductive thallus area and % zygotospore/agamospore germination) was assessed under controlled laboratory conditions. Results revealed highest *P. dioica* density, abundance, maximum length and width in May. With a high sand input into the sampling area during the end of May, the majority of the *P. dioica* population was buried. Following rising temperatures and day length resulted in decreasing condition of individuals - thalli appeared pale and were overgrown by epiphytes. *P. dioica* density and cover increased again from September onwards. Reproductive peaks occurred in spring and autumn. Zygotospores/agamospores that germinated into conchocelis were released throughout the studying period, but amount and percentage of germinating spores decreased during summer. Conchocelis development was followed in culture, but the completion of the life cycle was not successful. The filamentous conchocelis stage was not observed in the field. The study shows the strong seasonal variation of *P. dioica* in South Wales and advances the knowledge base for further resource management.

Morphological changes, cell damage and metal localization after long term stress by Cu(II) and Pb(II) ions over the green seaweed U. linza on batch cultures

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We present preliminary results to show how the green seaweed, *Ulva linza*, responds, at a cellular level, to heavy metal exposure to both Cu(II), as an essential metal, and Pb(II), as a non-essential toxin. Thalli were exposed for 7 days (long term stress), either to each ion in different concentrations, or to a mix containing both metals. Cell ultrastructure was then examined using Transmission Electron Microscopy

(TEM), with metal bioaccumulation quantified by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Moreover, as a first step to identifying how the cell deals with elevated metal concentrations, we looked at metal localisation within the cell using Transmission Electron Microscopy coupled with Energy-dispersive X-ray spectroscopy (TEM-EDS). We looked specifically at the relative extents to which cellular metal accumulation was localised to the cell wall and the cell interior. Our results will be used to direct future RNAseq studies that will differentiate the cell's responses to essential (Cu) and non-essential (Pb) metal elevations.

Climate-driven shifts in species dominance affect kelp forest functioning

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Changes in climatic conditions have shaped the distribution of life throughout Earth's history. Contemporary climate change is reorganizing the composition of ecological communities by inducing species migrations (range shifts), which can lead to the decline and substitution of established taxa in newfound habitats. There is a pressing interest to know how such shifts in species abundance –especially when climate migrants become dominant– will affect the properties of ecosystems and the services they deliver.

Kelps provide the foundation for habitat in many temperate reef systems, supporting abundant biodiversity and driving ecosystem function. We investigated how a shift in the distribution of *Laminaria ochroleuca*, a warm-temperate kelp, may have affected ecosystem processes associated with carbon and nutrient cycling, such as primary production, trophic dynamics, and detritus decomposition. We surveyed two mixed kelp forests at the poleward edge of *L. ochroleuca* distribution and compared the biomass dynamics of this kelp with that of the currently dominant cold-water kelps, *Laminaria hyperborea* and *Laminaria digitata*.

Laminaria ochroleuca was more productive than the cold-water kelps and exhibited a distinct growth strategy. A greater proportion of its production entered higher trophic levels, as this species was a preferred food and was subjected to higher grazing rates. Like the other kelps, most of primary production was lost via erosion of the lamina, which decomposed faster than that of its main subtidal competitor. Our results seem to be underpinned by differences in key functional traits such as blade surface area and nutritional quality.

Our study shows that climate change can indirectly affect ecosystem functioning by reorganizing community structure. The climate-mediated range extension of *Laminaria ochroleuca* has modified the dynamics of kelp forests, with notable ecological ramifications. The delivery of ecosystem services however, should not be critically impaired, as core ecological processes were maintained or enhanced.

Climate-driven substitution of habitat-forming species leads to reduced biodiversity within a temperate marine community

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1) Habitat forming species, such as reef-building corals and canopy-forming macroalgae, can alter environmental conditions and provide habitat for a vast array of marine life, from invertebrates to marine mammals.

2) This investigation examines the consequences of recent shifts in the relative abundances of two species of kelp, a warm water species, Laminaria ochroleuca, and a cool water species, Laminaria hyperborea, by defining their properties as habitat-formers and comparing their epibiotic assemblages. Algal and invertebrate assemblages associated with kelp stipes and holdfasts were compared between the two species, and from two sites with differing environmental conditions.

3) Significant differences were found in the structure of assemblages inhabiting both the stipe and holdfast between species, and between sites. The results suggest that local environmental conditions influence the structure of these assemblages.

4) This study shows that changes in the relative abundances of habitat forming species, as a consequence of rapid environmental change, alter local biodiversity patterns and potentially lead to impoverished assemblages. Crucially, while the structure of habitat-forming species may appear broadly similar, their functioning as biogenic habitats for associated biota may differ considerably.

A pan-Arctic assessment of biodiversity and ecosystems services provided by coralline algae reefs

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Non-geniculate coralline algae, both crustose and free-living forms (maerl), are some of the most prominent reef builders in the shallow marine environment. In the Arctic, corallines structure reef habitats in both crustose reef flats (Alaksan Arctic) and in large maerl beds (North Atlantic). Both communities are known to be biodiversity hotspots in this extreme environment, however very few geographic regions have been investigated in the Arctic. In Greenland kelp forests and maerl beds were surveyed using video transects, quadrats, and biodiversity grabs. The dominant species in these two habitats are not mutually exclusive, which is exemplified by kelp swaths and estimated percent cover

of coralline algae from transects. One kelp species, *Agarum clathratum*, can be particularly abundant in maerl beds and crustose coralline algae (CCA) is very common on the hard substrate, underneath invertebrates and algae, in kelp forests. Furthermore, habitats are alternatively more diverse depending on the scale of measurement (transect and quadrat vs. grab) indicating that kelp forests and maerl beds are important to specific species and life history stages. This is a preliminary report of this work, and we continue to investigate the vulnerable coralline habitats and their ecosystem services.

Studies of two interesting freshwater algae

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Two particularly interesting freshwater algae have been studied:

1 The Chlorophyte *Oedogonium idioandrosporum* (Nordstedt et Wittrock) Tiffany which has apparently not been recorded in the British Isles since G.S. West in 1899.

2 A Rhodophyte from the genus *Paralemanea* apparently new to the British Isles and closest to the taxa described as *Paralemania catenata* f. *nodosa* Knappe & Huth and Paralemanea catenata (Kützing) M.L.Vis & R.G.Sheath.

Images showing the key reproductive and taxonomic features (some as 3D anaglyphs) are presented together with a little historical background.

Living Architecture: A Modular and Programmable Synthetic Ecosystem for the Built Environment

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Living Architecture (LIAR) is a modular bioreactor-wall, which is based on the operational principles of microbial fuel cell technology and synthetic 'consortia' of microbes. LIAR is conceived as a next-generation selectively-programmable bioreactor and integral component of human dwelling, capable of extracting valuable resources from waste water and air, generation of oxygen and production of proteins and fibre by manipulating consortia performance. Its operational principles are grounded in distributed sensing, decentralised autonomous information processing, high-degree of fault-tolerance and distributed actuation and reconfiguration. Applications within urban systems are examined as a form of customizable microagriculture for installation in domestic, public (schools, hospitals) and office environments. Such a system has far reaching impacts on the building performance (resilience, resource recycling) manufacturing and design with ecosystems. The project will establish: foundational concepts through which 'designed' metabolisms can computationally process, recycle, remediate and synthesise valuable compounds from waste water; transferable principles by which synthetic ecosystems can shape the environmental performance of our living spaces to increase our health, productivity and ecosystems impact; and, new standards for synthetic 'ecosystems' through consortia design, engineering and optimization. http://livingarchitecture-h2020.eu/

Assessing spatial and temporal scales of variation in green tides: Tubular vs. Sheet-like morphologies

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In coastal lagoons and estuaries, one of the most evident signs of eutrophication is the proliferation of fast-growing opportunistic macroalgae, mainly Ulvoid species. Blooms and accumulations of Ulvoids have been called green tides. Although these blooms are not toxic to humans, these can cause relevant deleterious consequences for human activities and biodiversity. Anthropogenic nutrient enrichment of estuarine and coastal waters seems to be a key factor to explain the development of green tides. However, the extent, distribution, and species composition of blooms vary strongly among systems of similar nutrient loading, which compromises our ability to predict these events based on information about nutrient status alone. Therefore, additional factors may play a role in the control and development of macroalgal blooms. In order to elucidate these factors, the identification of relevant scales of variation is a necessary prerequisite before explanatory models can be proposed and tested. In this study spatial (perpendicular and parallel to the coast) patterns of biomass distribution were assessed for two *Ulva* morphologies in three Irish estuaries at three different occasions during bloom development. The obtained results revealed that sheet-like morphologies showed a more random pattern of spatial distribution than tubular ones. This should be related to the fact that sheet-like Ulva is commonly detached from the substrate, while tubular morphologies are generally attached to the substrate. For both morphologies a significant spatial variation was observed perpendicular to the coast, which suggest a role of the tide in the observed distribution. Temporal changes in

biomass can also be observed, with an increase in the biomass of laminar morphologies over the studied period, while the opposite trend was observed for tubular morphologies. These results suggest the existence of a temporal succession between different *Ulva* morphotypes, which should be considered when these blooms are modelled or management actions are proposed.

Addressing the future in a 21st century Culture Collection of Algae and Protozoa

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As time progresses, the needs of Biological Resource Centre (BRC) users evolve and technology advances. It is therefore imperative that culture collections review practices to keep abreast of this changing world. CCAP has addressed this in several ways: Diverse Taxonomy – the wide taxonomic breadth of our Collection continues to grow and we have adopted a policy of genetic bar coding and as well as morphological examination to strengthen our confidence in the identity of our strains; Purity – similarly we are reviewing our holdings to remove unwanted contaminants and will, in additional to conventional methods, utilise flow cytometric techniques to this end; Cryopreservation – we have the latest technology in liquid nitrogen generation and continue to develop methods for preserving recalcitrant strains; Quality Assurance – CCAP is currently refining practises and completing the documentation to gain ISO 9001:2015 accreditation; finally, Nagoya Protocol – our accession policy has been amended to ensure deposits are compliant and staff are trained in awareness and implementation. Through these developments we aim to provide our users with high quality, dependable strains for biotechnology, ecotoxicology, aquaculture and many other uses.

New Version of the AlgaeVision Website: A searchable photo catalogue of freshwater and subaerial algae

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A new and considerably expanded version of the AlgaeVision website was released in December 2016. This version is designed to be used with the second edition of The Freshwater Algal Flora of the British Isles (John, Whitton & Brook 2011), with each image entry accompanied by the page number for the taxonomic description and illustration(s) in the book. It contains more than twice the number of images in the earlier version and these cover 250 genera, 680 species and 80 intraspecific taxa; representing about 35% of the taxa recorded from the British Isles (excluding diatoms). Some brackish-water and marine Cyanobacteria are included and the only colourless representatives are dinoflagellates. The website is a searchable reference resource designed to assist algal identification and therefore contains mostly images of living algae showing diagnostic features essential for naming algae with a fair degree of confidence. A Scratchpads platform has been used to create the new version and is searched using a hierarchy of algal names. Unlike the earlier version each entry has a link to a page in AlgaeBase and the website will be regularly expanded by the addition of new/replacement images and taxonomy and nomenclature will be updated.

The Algal Collections at National Museums Liverpool (World Museum, LIV)

Geraldine Reid

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The herbarium (LIV) at National Museums Liverpool, World Museum, currently houses around 10,800 algal specimens (excluding diatoms). LIV houses historical material from the 18th, 19th and 20th centuries and is actively expanding its contemporary collections.

The collection has a number of early British collections such as the Thomas Velley herbarium consisting of eight volumes of marine algae from the south coast of England (1789-1802) and Hulme's 'The Scarborough Algae' (1842). The herbarium contains collections from Ross's voyage of the Erebus and Terror (1839-43), to the Southern and Antarctic Regions. It also includes notable collectors such as John Ralfs, James E. Smith, François Joseph Chauvin and John Boswarva.

The most significant collection in the algal herbarium is the University of Liverpool herbarium (LIVU), which comprises of around 4,000 specimens reflecting Liverpool's long involvement in phycology. This includes collections from Elsie Burrows, Mary Parke, Frederik C.E. Børgesen, Edward F. Linton, M. Díaz-Piferrer, S.R. Lenormand, George Russell, Elsie Conway, Peter Dixon, Robin South and N.L. Gardner. It also has a number of exsiccatae, including Hauck & Richter Phykotheka Universalis which includes specimens from Paul C. Hennings, Theodor Reinbold and Heinrich Heiden.

A recent addition to the herbarium is the Ann Archer Algal collection, consisting of about 800 specimens, representing the period 1958-65 collected for her taxonomic research on the branched members of the Cladophorales. It represents localities from around the North West of the United Kingdom; predominantly Anglesey. It also includes collections from the Isle of Mann, Shetland and Guernsey. The collection consists of herbarium sheets, microscope slides, drawings and notebooks from her research work. Ann was Elsie Burrows first PhD student.

Work is currently underway to identify the algal type specimens at LIV and to make them available online.

Impact of Climate Change on Communities of Scottish Rocky Shores since 2002

Gail Twigg and Michael T. Burrows

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Geographical distributions and abundance of species in the rocky intertidal in Scotland have been surveyed over the last 15 years to detect changes and allow interpretation in the context of climate change. Surveys between 2002-2010 were preceded by two decades of rapid temperature increases through 1980-1990 when average annual SST around Scotland rose by around 0.6°C. Since 2000, temperatures around Scotland have remained relatively stable, with no obvious upward trend. 154 surveys in 2014-2015 around the coast of Scotland revisited and extended the spatial coverage of surveys done between 2002-2010, with reference to earlier studies from 1950s to 1980s. Changes in species abundance showed disproportionate representation of macroalgae among those showing an increase. All species of macroalgae increased in abundance with the 8 most-increased species being macroalgae. The largest decline seen was in *Mytilus edulis* populations that decreased in abundance at 54% of sites by average of around one abundance category on the SACFOR scale. Sea surface temperature has not increased since 2002 across Scotland's coasts and, as expected, no northward range extensions were evident for those species that reach their poleward geographical range limits in Scotland. The pattern of change among species was not related to their thermal affinities, but was similar to patterns of responsiveness to ocean acidification shown in other parts of the world. Higher frequency observations of community change at sites near Oban show fluctuations often masked in long-term studies, particularly in terms of cover of intertidal fucoids. Monthly temperature readings and photographs were taken of the same area of rocky shore from 2005 to 2014. Photographs were used to score abundance using the SACFOR scale for macroalgae, and the mid-range percentages used to express cover numerically. The results show how a storm in 2011 dramatically changed species abundance.

How far can you trust your proteomics database?

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As DNA and RNA sequence data becomes available for more and more algal species, proteomics is being increasingly used as a tool to help characterise the metabolic capabilities of algae and to investigate how they respond to environment change. However in most proteomic pipelines, a proteins can only be identified if that protein is present in a database of predicted protein sequences. This database is most often derived from ab initio and homology based predictions from genomic sequence data, sometimes with RNAseq support. This method relies on prediction algorithms trained on well-studied species such as *Arabidopsis thaliana*, and so is not likely to perform well when applied to distantly related algal genomes. Prediction is likely to be especially poor for genes relating to functions specific to these algae, which are also likely to be some of the most interesting genes for the phycologist.

While endeavouring to use proteomic techniques to study the calcifying haptophyte *Emiliania huxleyi*, we suspected that poor gene models were limiting the quality and number of protein identifications. Thus we have developed a computational pipeline to: i) assess the extent of any database problems; ii) determine the best experimental or computational strategy to resolve the problems; iii) find unannotated regions of genomic DNA that are likely to encode proteins in a sample of interest; iV) provide a fully independent corroboration of database search methods. This pipeline should allow researchers to determine how much information they are failing to extract from their proteomic data, and provide them with the tools to plan strategies to improve the situation.

Can Differences in Minimum Areas Lead to Different Conclusions? A Case Study in Green Algal Tides

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The minimum sampling area is the smallest area wherein the species composition of a community is adequately represented. Different methodologies have been proposed to determine this area. Previous studies focused on green tides, blooms mainly consisting of Ulvoid species, have used fixed minimum areas ranging from 625 cm2 to 2500 cm2. This study investigates the effect of different minimum sampling area in our ability to assess the spatial scales of variation in green tides. In this case, spatial patterns (perpendicular and parallel to the coastline) of biomass distribution of Ulvoid species were assessed on one occasion in an Irish estuary located in Courtmacsherry, County Cork using two different sampling area sizes (650 cm^2 and 2500 cm^2). The obtained preliminary results showed that biomass distribution varied significantly in areas of biomass coverage less that 80% for both sampling area sizes. This was not the case for areas of biomass coverage 80% or above, where there was little variation of biomass distribution for both sampling area sizes.

Changes in total lipid and lipid class composition during the growth of three marine microalgae

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Geothermal sites are extreme environments spread throughout the world, although limited to volcanic areas, often characterized by low value of pH (< 3). A low species diversity usually characterize these acidic environments, mainly composed by bacteria, fungi and a few algal species. Microalgae belonging to the class of Cyanidiophyceae (Rhodophyta) (Ciniglia et al., 2014) are polyextremophilic both for pH (≤ 2) and for temperature (up to 55° C) and among them, *Galdieria maxima* (Sentsova et al. 1991) can also live heterotrophically (De Luca, et al., 1972). In this study, we report the first recovery of *G. maxima* in neutral or subneutral Turkish geothermal sites. A molecular and physiological characterization was made in order to compare these new strains with other acidophilic strains of *G. maxima* from Iceland, Russia and Turkey (Güçlükonak, Sirnak), contrasting the idea that these species cannot tolerate different ecological conditions (Gross, 1999). *G. maxima* cells were exposed in culture to higher pH conditions of 7.0, 6.5, 6.0, 5.0 and 1.5. All *G. maxima* strains acidified the medium as growth increased, with a direct correlation, thus giving a reliable mean that lowering pH to an optimal level would be a strategy to survive in some niches not ideal for them. All *G. maxima* strains were able to utilize ammonium as well as nitrate as nitrogen source, however, the growth performances were disturbed by nitrate at pH 5, since nitrate assimilation requires a net influx of hydrogen into the cell for reduction, thus providing a net effect of increasing of culture pH to 6,2.

A spotlight on algal RAD52 in Cyanidiophyceae (Rhodophyta): a relic in algal heritage

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Rad52, due to its capacity to join impaired DNA endings, is the main actor involved in double-strand break repair as well as in meiotic recombination, together with the RAD51 recombinase (Symington, 2002). The present paper displays the detection and characterization of RAD52 homologs in some Rhodophyta genomes. A broad correspondence of the homologs of the RAD52 proteins was provided, in order to perform phylogenetic analyses. Our data confirm the presence, the role and the functionality of RAD52 DNA-repair orthologue in Cyanidiophyceae, a group of polyextremophilic red microalgae (*Galdieria*, *Cyanidium* and *Cyanidioschyzon*) with a long evolutionary history (1.5 BYA, Yang et al., 2015); these microalgae are perfectly suited to the environmental extremes offered by the volcanic and post volcanic areas, where temperatures rise above 50°C, and high sulphuric acid concentrations, generated by the oxidation of sulphur gaseous emissions, greatly reduce the pH to values prohibitive for the majority of eukaryotic life forms (pH 0.5-3.0) (Ciniglia et al., 2014). These archean-like environments are considered as the scenario where eukaryogenesis and meiosis would have occurred concurrently (Gross and Bhattacharya, 2010). The deficiency of RAD52 in the vast majority of photosynthetic protists, sexuated or not, is intriguing, as well as its absence in plants, considering the role in homologous recombination process and its relatively high conservation across eukaryotes. Its presence in Cyanidiophycean genomes would give a reliable mean that RAD52 gene would have been inherited by a photosynthetic ancestor, and retained as a relic heritage in some photosynthetic eukaryotes still living in primordial-like environments, while lost in others, even in closely related Rhodophyta with intricate life cycles.

Major transitions in dinoflagellate evolution unveiled by phylotranscriptomics

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Dinoflagellates are key species in marine environments, but they remain poorly understood in part due to their large, complex genomes, unique molecular biology, and unresolved in-group relationships. We created a taxonomically representative dataset of dinoflagellate transcriptomes, and used this to infer a strongly supported phylogeny in order to map major morphological and molecular transitions in dinoflagellate evolution. Our results show an early-branching position of *Noctiluca*, monophyly of thecate dinoflagellates and paraphyly of athecate ones. This represents the first

unambiguous phylogenetic evidence for a single origin of the group's cellulosic theca, which we show coincided with a radiation of cellulases implicated in cell division. By integrating dinoflagellate molecular, fossil and biogeochemical evidence we propose a revised model for the evolution of thecal tabulations and suggest that the late acquisition of dinosterol in the group is inconsistent with dinoflagellates being the source of this biomarker in pre-Mesozoic strata. Three distantly related, fundamentally non-photosynthetic dinoflagellates, *Noctiluca*, *Oxyrrhis*, and *Dinophysis*, contain cryptic plastidial metabolisms and lack alternative cytosolic pathways, suggesting that all free-living dinoflagellates are metabolically dependent on plastids. This finding led us to propose general mechanisms of dependency on plastid organelles in eukaryotes that have lost photosynthesis; it also suggests that the evolutionary origin of bioluminescence in non-photosynthetic dinoflagellates may be linked to plastidic tetrapyrrole biosynthesis. Finally, we use our phylogenetic framework to show that dinoflagellate nuclei have recruited novel DNA-binding proteins in three distinct evolutionary waves, which included two independent acquisitions of bacterial histone-like proteins.

A review of the bladed Bangiales (Rhodophyta) in China: history, culture and taxonomy

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We review the cultural history, mariculture and taxonomic work to date of *Porphyra* sensu lato (bladed Bangiales) in China. The bladed Bangiales is a red seaweed group with high species biodiversity and economic value. In China, species occur along the length of the coast and are highly integrated into the country's culture. Chinese people have used species of the bladed Bangiales (*Porphyra* sensu lato) as foods and pharmaceuticals for about 1700 years with many references to these seaweeds in ancient books. The mariculture of bladed Bangiales in China also has a long history and an industry has been established based on some species, notably Pyropia yezoensis. Scientific taxonomic study of the bladed Bangiales in China began in the late 1920s. To date, twenty-five species and five varieties have been recorded for China, based on morphological identification, of which twelve species are considered to be endemic to the country. The majority of species have distribution data associated with them including evidence of possible change due to increasing water temperatures along the coast. Given that the extent of biodiversity of the bladed Bangiales in different parts of the world has been revealed using molecular approaches, there is a need for a molecular taxonomy to document species diversity in China. It is also important to document species distributions, as they include taxa of the wild stocks for seaweed cultivation and at the same time coastal habitats are increasingly impacted by the effects of an increasing human population and an expanding mariculture industry. There is a considerable body of literature on the bladed Bangiales, but much of it is Chinese and in obscure publications. Here, in addition to the above, it is our aim to make this information available to readers worldwide.

Bursary Reports

The 9th Asia-Pacific Conference for Algae Biotechnology APCAB 2016

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In November 2016 the 9th Asia-Pacific Conference for Algae Biotechnology (APCAB) took place in the vibrant and exotic city of Bangkok, Thailand. APCAB 2016 is held once every three years in a different country in the Asia-Pacific Region. This year's theme was "Algae for Food, Feed, Fuel and Beyond" attracting over 300 researchers from all over the world (mostly though from Asia) and encompassing a wide diversity of algal research ranging from ecology, taxonomy and physiology to bioprocesses, biotechnology and systems biology. I am currently in the final year of my PhD based at the Institute of Technology Sligo on the west coast of Ireland so it was very exciting to be invited to give an oral presentation on my research "METALGAE: Bioprospecting Irish Microalgae for the Biorefinery of High-value Pigments and Biopharmaceuticals" during the session Algal Biorefinery and Industrial Trends: Food, Feed, Nutraceutical and Pharmaceuticals. Being one of the very few EU researchers presenting at the conference, this was a brilliant opportunity to disseminate our research to an international audience and to fly the flag for Atlantic microalgal biotechnology.

One of the most insightful talks was the keynote presentation by Prof. Arthur Grossman (Carnegie Institution for Science, Stanford, USA) on "Discovering novel photosynthetic functions using the green algae *Chlamydomonas reinhardii*" in which he described the application of the GreenCut protein database to mine the function of photosynthetic proteins and the identification of novel proteins which may pave the way to engineering strains with enhanced photosynthetic yields and stress tolerances. The main highlight of the conference for me was the "Industrial case studies – successes and failures" which included invited speakers from the industry who shared with us their experiences in developing microalgae businesses for the commercialisation of biodiesel, food supplements, nutraceuticals and biopharmaceuticals.

In addition to the interesting talks and poster presentations, the conference was a great opportunity to discuss research and network with fellow students, post-docs and industry representatives from diverse cultural backgrounds and of course to indulge in exquisite Thai food.

I am grateful to the British Phycology Society for their financial support which made this trip possible. I would also like to thank the organisers of the conference for providing this valuable and enriching experience.

17th International Conference on Harmful Algae October 2016

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With the support of the BPS, I was fortunate enough to attend the 17th International Conference on Harmful Algae (ICHA) in October 2016 on the beautiful island of Florianopolis in Santa Catarina, Brazil. It was the fourth time this conference had been held in the southern hemisphere and the first time in South America. This biennial conference is the only international conference focusing specifically on Harmful Algal Blooms (HABs) and was well attended with 350 delegates from 35 countries.

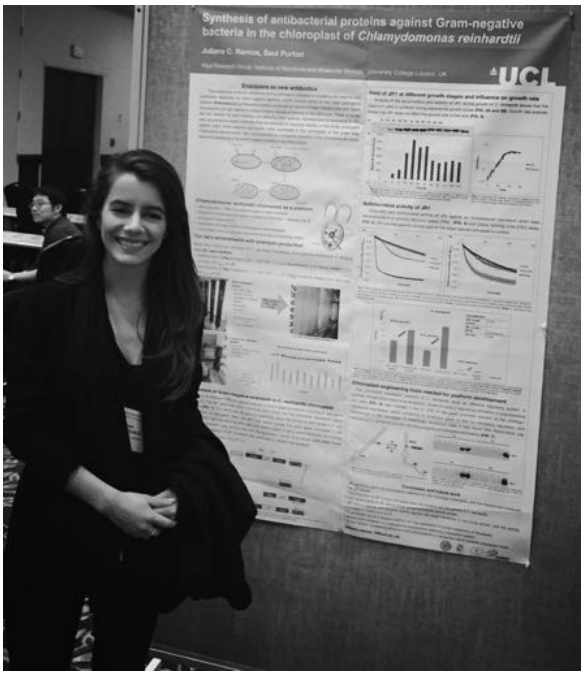
Professor Gustaaf Hallegraeff opened the conference with a stunning examination of fish killing microalgae, drawing attention to recent unprecedented HAB events in Chile, which devastated many aquaculture industries. Climate anomalies, global change and record blooms proved to be major themes of the conference with Professor Vera Trainer presenting research on a massive bloom of *Pseudo-nitzschia* on the west coast of America caused by an anomalous "blob" of warm surface water. Professor Silvia M. Mendez presented on the damage caused by an exceptional bloom of *Dinophysis* in

Uruguay and there were multiple presentations on extraordinary blooms of *Alexandrium* sp. in Tasmania, Australia. These presentations emphasised to me the importance of HAB monitoring programmes but also our need to be understand how to respond to early warning signs of bloom formation.

My research focuses on Benthic Harmful Algal Bloom (BHAB) species, an emerging area, so it was encouraging to see multiple sessions dedicated to BHABs at this year's conference. I am approaching the end of my PhD, so attending this meeting provided a great opportunity to present the findings and discuss my results with leading international HAB scientists and students. I gave an oral presentation titled "Mechanisms for Temperate Range Extension of *Gambierdiscus*, the Causative Organisms of the Human Illness Ciguatera Fish Poisoning", which was my first presentation at an international conference.

Attending the week-long congress gave me the opportunity to share my research, be inspired by fellow scientists and forge new collaborations and friendships. I am very grateful to have received a student bursary award from the British Phycological Society which gave me the opportunity to attend this conference.

Chloroplast Biotechnology, Gordon Research Conference



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The Gordon Research Conference on Chloroplast Biotechnology happens every two years, and at this year we were fortunate to attend this excellent meeting at Ventura, in sunny California, with the funding awarded by the British Phycological Society.

The five-day conference was focused on presenting innovative research in chloroplast genetic engineering and biotechnology in plants, algae, and cyanobacteria and it was extremely well organized. It had a full on schedule of talks, ranging from fundamental studies on chloroplast gene expression and regulation, photosynthesis and others, as well as synthetic biology talks on novel tools to engineer this organelle, such as metabolic pathway engineering, production of biopharmaceuticals and others. All talks were very informative and showing cutting edge research, with some of the highlights including the inspiring talks of young researches in the field.

We also had the opportunity to present our poster during the conference. The meeting provided students with two-hour slots every other day for poster presentation. This session was arranged in an informal environment, giving space for networking with all delegates, from PhD students to leaders on the field, and we both received great feedback and ideas to improve our research, and we also made contacts that could be important for our future career in the field.

As the meeting and accommodation were at the same site, coffee breaks, and the meals during the day were a great opportunity to meet people and network. Also, the Gordon Research Conference team organized excursions during a few free afternoons, were people could go whale watching, wine and beer tasting. We went to different activities and it definitely improved our experience in general, and we would like to thank the organization team for putting together such a fantastic meeting.

Attending the Chloroplast Biotechnology conference gave us both the chance to build a network with researches from around the world working in the field, and we are very grateful to BPS for funding us to participate and present our work in this prestigious international conference.

European Congress on Biotechnology

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The European Congress on Biotechnology (ECB), which brought together senior academics, industrial researchers and students, explored the current trends in research in the field of biotechnology and their applications. The 17th ECB was held in Krakow, Poland over the course of 3 days and included guest plenary lecturers from as far as USA and Korea. The schedule of the congress included 25 symposia each covering a specific topic related to the field of biotechnology, and provided the opportunity for more than 300 delegates to present 15 minute talks each. The diversity of the talks given was wide, ranging from microalgae applications for biofuels and high-value products, the state of recombinant protein expression at industrial level and the genetic modification of crops including discussions about their appropriate use in the 21st century.

I was fortunate enough to be able to present a talk entitled "Effect of organic carbon enrichment on the treatment efficiency of primary settled wastewater by *Chlorella vulgaris*". During the seminar I was also introduced to the varied breadth of work other research groups were doing which provided me with fresh ideas and guidance about experiments I wish to try. Throughout the ECB conference, most importantly in my view, I have come to appreciate the industrial constrains and hurdles that companies face in the hard task of ensuring the viability of research that is carried out in academia. Industrial partners from Total, Ingenza and Novozyme gave interesting talks on certain approaches the industry is using to overcome various problems related with production, the biochemistry of microorganisms and their fermentation. The ECB also ran small workshops throughout the conference which included a publications workshop and patent workshop. Having never truly considered the practical concerns of patent law in the field of biotechnology it was interesting to hear the talks organised on this subject given by respected patent lawyers from the Americas and Europe.

Overall, the ECB gave me the opportunity to have many informal talks with researchers and industrial representatives from a range of different fields, discussing new ideas that hopefully will lead to some interesting experiments. Given the broad umbrella that the field biotechnology covers, the inclusion of many subject areas which I had very little knowledge of was an appreciated approach of the ECB and its committee. My attendance was only possible because of the generous funding provided by the British Phycological Society and Heriot-Watt Alumni Fund, who I would like to thank very much. I can only recommend attending the upcoming ECB conference to any Ph.D. student or early career scientist.

1st International Symposium on Antimicrobial Hydrolytic Enzymes

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I'm a final year PhD student at UCL, working in Prof Saul Purton's Lab and travelled with my colleague and fellow PhD student Juliana de Costa Ramos. We arrived to beautiful clear skies, sunshine and 18C – no need for the hats, gloves and scarfs we had presumed necessary for November in New York City! Central Park was glowing with autumn colours and the view from the Empire State Building seemed to go on for ever. After a few days of exploring world class museums, wandering Central park and taking mandatory selfies outside Trump Tower, the time came to do some work!

We arrived at the spectacular conference centre at Rockefeller University for the first day of the "1st International Symposium on Antimicrobial Hydrolytic Enzymes", or just "The Lysin Meeting" for short, and immediately began to recognise familiar names and faces - some from past conferences, and some from key publications. As the first meeting of its kind, The Lysin Meeting had attracted all of the big names in the field.

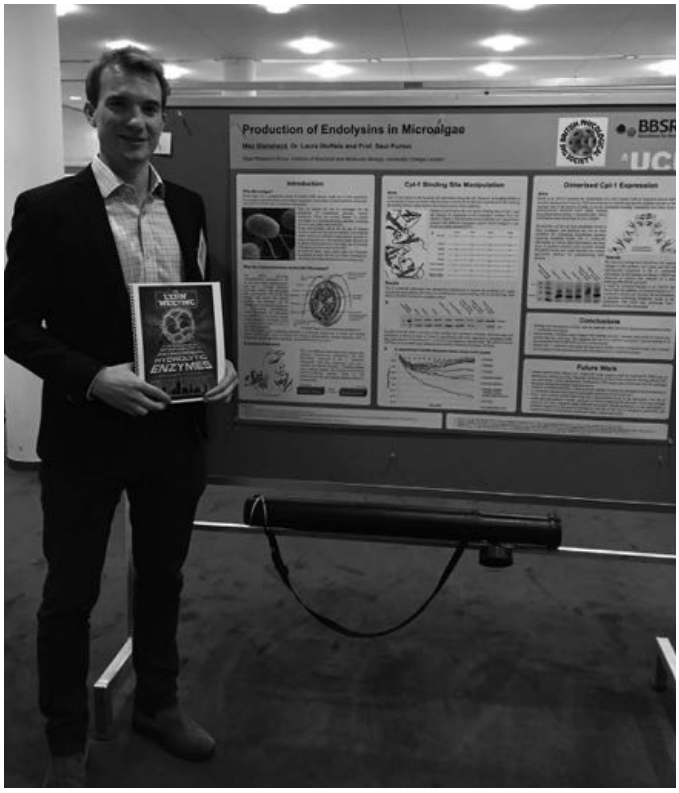
After the first morning of presentations, any day dreaming of sunny New York cafes and bagels in Central Park had been replaced with excited scientific discussion, idea sharing and collaboration planning. The introduction to the meeting by Prof Vince Fischetti, one of the founding pioneers of the field, and subsequent talks from Prof Daniel Nelson, Prof Martin Loessner and over 30 others, were all inspirational. The excitement in the room for the lysin technology was palpable.

Presentations that particularly stuck out were the work by Martin Loessner's group at ETH on rapid diagnostics, involving endolysins attached to magnetic beads – a fascinating use of endolysins, away from the traditional antimicrobial

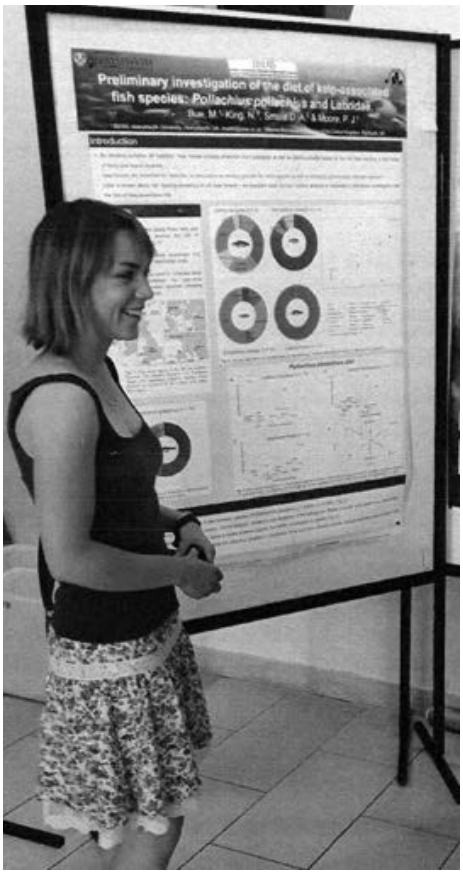
applications. Dr Assaf Raz, from The Rockefeller University, presented their work on "Lysibodies" – a fusion of antibodies and endolysins to produce an artificial antibody with a high-affinity to surface-exposed carbohydrate molecules – epitopes that generally have poor immunogenicity.

I must admit that never before have I been to a conference where my attention did not once slide for the entire two-day period. My pages and pages of notes, scribbles and email addresses, along with subsequent correspondence with new contacts are testament to the success of this conference. Nor was I alone in this view – at every poster session and coffee break I heard people talking about the joy of attending a conference wholly targeted at their particular field.

Thank you to the British Phycological Society for contributing so generously towards this trip – it was a fantastic chance to share the potential of *C. reinhardtii* as a recombinant protein production platform and to build relationships within this exciting field.



11th International Temperate Reef Symposium



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The 11th International Temperate Reef Symposium (ITRS) took place from 26th to 30th June 2016 in Pisa, Italy. The ITRS is the world's premier conference on coastal ecology and the use of temperate reefs as tractable systems for experimental ecology. This meeting occurs every three years and attracts participants from around the world, including those eminent in the field.

I was fortunate enough to be able to attend ITRS as a result of a successful funding application from the British Phycological Society. This was my first international conference and I felt quite privileged to be able to present a poster in such world class research meeting.

I am currently in the first year of my PhD at Aberystwyth University, Wales. The main focus of my research is to understand how living organisms interact within the kelp forest. I presented a poster on the preliminary results of stomach contents analysis of several fish species living in the kelp forest along the UK latitudinal gradient. This was a great opportunity to discuss my work with other delegates and to seek valuable feedback to take back to Aberystwyth with me.

The quality of the talks was excellent and it was very interesting to listen to the latest research in the field.

This symposium gave me the chance to meet a wide range of people at all stages of their careers from various institutes and universities around the world. As a first year PhD student, this was a great introduction to the marine scientists 'community and gave me inspiration for exciting new research questions for my PhD.

Overall, it was an enriching experience and I cannot wait to meet everyone again and to present my future work in the next ITRS!

I am truly grateful to the British Phycological Society for giving me the financial support to be able to attend ITRS and would like to thank the organisers for a great symposium.

24th International Diatom Symposium, Quebec City, Canada, August

Jennifer Adams, Environmental Change Research Centre, Department of Geography, University College London

The International Diatom Symposium (IDS) is an international meeting held every two years, which attracts international experts in the field of freshwater and marine diatom research. In 2016, IDS was held in Quebec City, Canada. Expertise represented at IDS 2016 encompassed both modern and fossil diatom research across many disciplines, including molecular, physiological, evolutionary, ecological, biogeographical, palaeoecological, biomonitoring, and systematic/ taxonomic fields. Further, plenary sessions were held twice every day of the conference: first thing in the morning and immediately following lunch. Each plenary session corresponded with a special session of the conference, and superb talks were given in the fields of biogeography, paleosciences, invasive diatom species, molecular studies, ecotoxicology, and monitoring. IDS 2016 also consisted of several specialized workshops on diatom systematics, the first Young Scientists Meeting, a mid-week excursion to Old Quebec City, and a conference banquet held at the Quebec City aquarium.

My PhD research involves using a multi-proxy approach to identify impacts of multiple anthropogenic stressors on shallow lake ecosystems in the Selenga River Delta, a floodplain wetland of Lake Baikal, in southeast Siberia. The Delta lakes have been subject to numerous stressors in the recent past including pollution, hydrological modifications, and climate change, and diatoms form a very important aspect of my doctoral research into the ecological response within shallow lakes to multiple stressors. At the time of the conference, I was at the very end of the third year of my PhD. At this point in my academic career, the ability to attend conferences, disseminate my research findings, and build my research networks is crucial. For these reasons I would like to very much thank the British Phycological Society, without whom I would not have been able to attend IDS 2016, and present, for the first time, the final diatom results from my PhD.

I presented in the session on diatoms in the paleosciences. My oral presentation was titled “Recent diatom assemblage changes in shallow lakes of the Selenga Delta, Siberia reveal drivers of environmental change”, and I presented diatom data from several sediment cores and surface sediments from the Selenga Delta, and discussed the relationship between diatom assemblage changes and various stressors. My talk was very well received by the diatomists in attendance. Currently I am in the final stages of writing up my doctoral dissertation, and anticipate a manuscript to come of the research I presented at IDS 2016.

How do you cope with extreme high light if you live on a glacier

Dr Rupert Perkins, Senior Lecturer in Marine Biosciences, Director Marine Geography, Cardiff University

On the 23rd August, 2015 I took a flight from the UK to Oslo and overnighted in a rather dull airport hotel that charged a monthly salary for a pint of beer. At stupid o’clock the next morning I then caught my domestic flight to Longyearbyen (Longyear Town), Svalbard, stopping briefly at TromsΦ, where the stunning scenery and clear crisp air were wonderful. A shortish domestic flight and I arrived at the small airport at Longyearbyen and walked out to catch the bus in to town. As a keen birdwatcher, the surrounding landscape didn’t look bleak, but excitedly ideal for Ptarmigan and Snow Buntings, whilst the Fjord to my left was teeming with Arctic Tern, chased by a few Arctic Skua. The bus pulled in to town and I disembarked outside the university buildings of UNIS. My first impressions of the town, were that the council could learn a lot from Tobermory (the multi-coloured village on Mull, not the Womble). A few blue or orangey buildings, but otherwise rather grey, surrounded by darker shades of grey, but excitingly for me, with a large white expanse in the distance that was my reason for being in Svalbard, curtesy

of the BPS small project grant, the Longyearbreen (Longyear glacier). I was met by Marian Yallop of Bristol University and after checking in carried my kit to my room (luxurious university accommodation that was super comfy for my weeks stay) and met up with Maggie Gamble (also from Bristol) and Liz Bagshaw and Lisa Mol from Cardiff University.

Previous work with Marian on Greenland ice sheet algae had led on to work with Liz comparing Arctic and Antarctic cryoconite phototroph communities. The Antarctic cryoconite holes in which the phototrophs form microbiomes with bacteria and small grazers, are usually capped with ice, whereas the Arctic ones are not, and we found interesting differences in their productivity and photophysiology using a combination of oximetry and fluorescence measurements. What I now wanted to do was to investigate this photophysiology further, but in situ using a more detailed fluorescence study. Cryoconite (cryo = ice, conite = dust) is an important component of glacier ecosystems, with the phototrophs, largely green algae and cyanobacteria, being important producers of organic carbon. However living on the surface of a glacier has its challenges, including exposure to extremely high light intensities. How do the phototrophs acclimate to this high light exposure, especially as the day length in summer is the full 24 hours? I investigated this using a Water-PAM variable chlorophyll flourometer. Broadly speaking I was exposing the cryoconite phototrophic community to a range of light intensities (rapid light response curves) starting low and going above saturating levels, or the reverse, to see how they differed in their ability to protect themselves from high light intensities. I followed this with induction-recovery curves to expose the cells to saturating light and then monitored their recovery in the dark. This combination provides a lot of information on photoprotection, such as down regulation through non-photochemical quenching (NPQ) in green algae and diatoms, and state transitions in cyanobacteria. Each day I walked up on to the glacier and spent about eight hours with Liz or Lisa, with one of them having the unenviable task of lugging the rifle and flare gun. I carried out the fluorescence measurements, cramming in as much as possible before the cold got to us. Eight hours sitting still on the ice is a long time! Meanwhile Marian poured over the microscope to identify what cells were in the cryoconite and Liz and Lisa helped with the field work and took water samples for geochemistry analysis. The walks to and from the glacier were long but fun; I'm not used to seeing Snow Bunting, Ptarmigan and Reindeer on my journeys to field sites! The scenery was strangely appealing, rather than just dramatic, and the pale yellow flowers of Svalbard Poppies were a pleasant addition of colour.

The results of our work have been really exciting, with similarities to ice algae, but also to soft-sediment microalgae inhabiting estuaries. This isn't surprising really, as the phototrophs inhabit the surface of the ice sheet, but are part of the sediment matrix that forms the cryoconite material. Our findings indicate that the phototrophs utilise a likely mixture of chloroplast shading (akin to ice sheet algae) along with likely cell motility to shade themselves within the cryoconite sediment. However, additionally we observed down regulation processes that were both light dependent (rapid) and light independent (slow), likely to be xanthophyll cycling in the green algae and state transitions in the cyanobacteria. This combination and plasticity of down regulation mechanisms enables the phototrophs to cope with the extremely high light intensities to which they are exposed in this harsh environment. For further details, see Perkins et al. (2017).

I'd like to thank the BPS for their support for this field work, through a small project grant. There are increasingly fewer sources of funding for opportunistic field work trips and small research projects, and the BPS should be congratulated for keeping this scheme going.

Perkins RG, Bagshaw E, Mol L, Williamson CJ, Fagan, D, Gamble M and Yallop ML. 2017. Photoacclimation by Arctic Cryoconite Phototrophs. FEMS Microbiology Ecology (in press).

10th International Conference on Toxic Cyanobacteria 23-28th October, Wuhan, China

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As I am currently in the third year of my PhD studying the incidence of cyanobacterial blooms due to climate change and eutrophication, the timing of 10ICTC could not have been better. Held every three years the conference draws the preeminent scientists in the field of toxic cyanobacterial research. I presented data and conclusions from my culturing experiments investigating the effects of light intensity on the growth, toxin profile and production in *Microcystis*, a common bloom forming cyanobacteria.

In recent years China, has suffered from an increase in freshwater cyanobacterial blooms, to almost epidemic levels. For instance, Lake Taihu has had a persistent *Microcystis* bloom since the 1990's and the lake provides drinking water for several cities including Shanghai. Wuhan is in the central province of Hubei, a conurbation of three cities on the confluence of the Yangtze and Hanshui rivers and is an industrial centre with a population of over 10 million. Wuhan is perhaps most famous as the location of the start of the popular uprising which led to the fall of the Qing dynasty and its last emperor in 1912. The conference venue was the East Lake International Conference Centre and Hotel, which provided excellent facilities and was close to the Institute of Hydrobiology, Chinese Academy of Sciences who organised the conference. East Lake and the lakes around Wuhan are not without their own cyanobacterial challenges and the institute has a reported 100 PhD students currently studying cyanobacteria.

Appropriately, the first invited speaker was Yongding Liu, who gave an overview of the past, present and future of cyanobacterial studies in China. Differences in optimum temperatures for cyanobacteria taxa were highlighted, along with the cyano-index; the poten-

tial for blooms to occur in eutrophic water when temperatures are above 25°C for one week. There was a summary of current remediation strategies, from 'bottom-up' nutrient control to 'top-down' bloom removal and use as a biotechnology stock. Phillip Orr presented work focusing on increasing the understanding of cell toxin quotas, his co-authored seminal paper is essential reading to my project and his presentation extended his work to *Cylindrospermopsis*, *Oscillatoria* and *Anabaena*. A theme throughout the talks was the consideration of cyanobacteria within the wider microbial community, Tim Davis presented evidence of heterotrophic bacteria protecting cyanobacteria from the effects of reactive oxidative stress. Jason Woodhouse continued this theme of research investigating the role of heterotrophic bacteria in nutrient cycling within cyanobacterial blooms. Shin-ichi Nakano's talk was on the impacts of grazing as a 'top-down' control from flagella, amoeba and rotifer on *Microcystis* blooms. Karina Yew-Hoong Gin presented computer modelling combining water quality and interaction models to predict the incidence of blooms in urban tropical reservoirs in response to increased water temperatures.

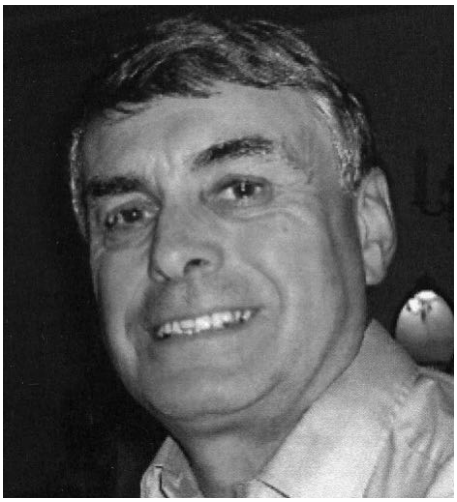
Cyanobacterial research from British institutions was well-represented at the conference. Julia Waack, from Robert Gordon University, presented her work on the accumulation and depuration of nodularin and microcystin toxins in blue mussels. In the UK cyanotoxins are currently unregulated and are of concern as cyanobacteria especially *Nodularia* increase in estuarine waters where most of our shellfisheries are located. Andrew Turner, from the Centre for Environment, Fisheries and Aquaculture Science (Cefas), presented cyanotoxin detection methods using liquid chromatography and tandem mass spectrometry. In collaboration with the Environment Agency he has been testing scum samples from their regular monitoring programme, the data indicated that many positive samples occurred in the late summer and throughout England. Daniel Franklin, from Bournemouth University, presented work on the fate of *Chlorella*, toxic and non-toxic *Microcystis* cells under grazing pressure from the ciliate *Blepharisma*. It has been suggested that the capacity of protist grazing to control cyanobacterial blooms may increase in the future, however, the data presented indicated that *Blepharisma* was unable to thrive on toxic strains of *Microcystis*. Lastly, an international conference on toxic cyanobacteria wouldn't be complete without a talk from the British Phycological Society's very own Geoffrey Codd. His presentation focused on the increasing numbers of cyanotoxins discovered and the potential synergistic toxicological effects, which should be considered when formulating toxicity risks and assessments.

I am very grateful to the BPS for the student bursary, which allowed me to attend 10ICTC, it was a wholly rewarding experience both professionally and personally. I would also like to thank the organisers of 10ICTC and the student volunteers (Teng Zhuoran especially) for whom no request was too difficult, they provided a programme of exceptional speakers, fine food, an educational excursion and an entertaining banquet. But, I would question their decision to serve the strong distilled spirit Baijiu, it was noted the scientific committee had smaller glasses that other delegates as they circulated sharing a toast, the reason became clear in the morning. Moreover, a high bar has now been set for the organisers of the 11th International Conference on Toxic Cyanobacteria in Krakow, Poland, 2019 to surpass.

BPS HONORARY LIFE MEMBER BIOGRAPHY

Martin Wilkinson

My Life with Seaweeds



I was astounded a few months ago when the BPS Council wanted offered me honorary life membership for services to phycology and asked me to write something for the *Phycologist* about my phycological career. I wondered what I had done that had served phycology so well. I still do! Here's my story and you can decide for yourselves.

At school I didn't have a career mapped out. I liked sciences although my best subjects were Latin and French! Of the sciences, I particularly liked biology and a sixth form field course in 1962 at Liverpool University's Marine Station at Port Erin, Isle of Man, whetted my appetite a little for marine work but didn't give rise to an ambition to make a life in marine biology, unlike many of the students I have taught since then. Probably more formative to an interest in coastal ecology was growing up in a house just metres away from one of the biggest sand-dune ranges in Europe on the Sefton coast of south-west Lancashire. The dunes and their plants fascinated me and I roamed on them almost daily. The same school biology teacher who took us to the Isle of Man, Josie Sheehan, helped us with field trips to these fascinating dunes.

I followed in Josie's footsteps by doing a degree at Liverpool University but opted to take botany rather than zoology because I was useless at dissecting animals, so important then even for school exams. It was the right choice. To a young impressionable student, botany at Liverpool looked like it was going places, with a mainly young, friendly staff in a modern building (actually an inter-war former chemistry building but so much more modern than the gloomy, Victorian zoology edifice peopled by a share of crusty staff).

Liverpool was a powerhouse of phycology. The botany staff included Elsie Burrows (one of the founders of the BPS) and Peter Dixon, joined later by George Russell (a former BPS President). So I certainly got a grounding in phycology from expert staff who were good at teaching.

My first contact with Elsie was 1963 while still at school. She was admissions sub-dean for science at Liverpool University and she had offered me direct entry to year 2 of a Scottish style 4 year botany degree but I wanted to do the full 4 years.

She won: I went direct into 2nd year Botany after she firmly told me to do so.

Later on when I wanted to be a teacher – she told me to do a Ph.D. – I did.

I wanted to do my Ph.D. on the ecology of fucoids – she told me to do it on microscopic, green, shell-boring algae – I did. "Told" is probably too strong a word but she could be insistent until she got her way. I suspect that was a hallmark of the formidable team of women who founded the BPS. Although it looks like she always won, it turned out each time that she was right!

My career path from 1969 to 2010 covered just three institutions. In 1969 I took up a one year lectureship in Botany at Royal Holloway College, London University with a very light teaching load, just covering a phycology course, deputising for John Evans, a freshwater phycologist who was on sabbatical. This let me finish writing my Ph.D.

Then from 1970 to 1974 I was Lecturer in Biology (specialising in plant biology) at Paisley College of Technology, near Glasgow. This was a real baptism by fire for learning to teach – going from the gentle Oxbridge style of 1960s Holloway to a Central Scottish polytechnic-style college filled with robust students. I learnt very quickly to handle a huge teaching load teaching many things to diverse audiences, sometimes at very short notice, and to get a much wider appreciation of biology than came from the specialisms of my Ph.D. My head of department, John Smyth, despite being a zoologist had done his Ph.D. on diatom communities in a Scottish sea loch, in preparation for it being a pioneer area for fish farming. John was a large figure in Scottish natural history and encouraged me to work on the Clyde estuary just a few km away. This evolved into a lifelong interest in algae of estuaries, an area where few worked, which was to prove so valuable 30 years later.

In 1974 I moved just 45 miles across Scotland to be the first specifically recruited lecturer for the new BSc in Marine Biology at Heriot-Watt University – one of UK's first marine biology degrees. I very quickly learnt to apply my algal knowledge to industrial environmental problems. I stayed there until retirement in 2010 becoming Senior Lecturer in Marine Biology, in charge of all marine and general biology teaching in 1980, and Professorial Fellow in Marine Biology in 2005.

I wanted to combine teaching with research. Unlike some academics who look on teaching as a curse I welcomed it and thoroughly enjoyed it. At Paisley and Heriot-Watt I profited from the emphasis on applied work. So I was

able to do lots of enjoyable consultancy and made a point of building the results into novel approaches to teaching which relied on good phycology but introduced students to role-playing and experimental investigations on simulated environmental problems with an algal involvement.

When I moved to Heriot-Watt the North Sea oil boom was taking off.

Allied to this Heriot-Watt became one of SERC's six Centres of Excellence in Marine Technology. Marine Biology played a part in this, collaborating in much interdisciplinary work with engineers. We had strong research groups which encompassed chemical, civil, mechanical, petroleum and offshore engineering all of which collaborated with marine biologists in the University. My research became very applied in use of seaweeds in environmental assessment and in management and ecology of estuaries. In addition we had the Institute of Offshore Engineering which engaged in marine consultancy and was directed by an exceptional botanist cum marine biologist, Cliff Johnston, who was also a member of BPS Council. Our aim was to produce graduates who were excellent at marine biology (including phycology) but at home with engineers and planners. This shaped the rest of my career with numerous environmental contracts concerning algae and continual integration of results of these into distinctly applied teaching.

I have had many inspiring consultancies that needed good seaweed knowledge but would particularly highlight the following. The Northern Ireland Littoral Survey was a four year study, 1984-88, of the entire littoral zone of the Northern Ireland coast with a view to selecting areas for conservation. Several of us in the Institute of Offshore Engineering formed a team that carried out the marine environmental assessment for the successful bid to construct and operate the Channel Tunnel and subsequently were consultants to the construction consortium. My Ph.D. experience was especially useful here since shell-boring algae and chalk-cliff boring algae have much in common and few people know them. I was involved in algal studies, both seaweed and microphytobenthos, for the feasibility study for the late 1980s proposal for a Severn Tidal Energy Barrage.

Perhaps the most rewarding consultancy was for the EC Water Framework Directive (WFD). I had got used to being the statutory botanist in a team of marine biologists of whom the rest were all zoologists. In some institutions (but not ours) such botanists were tolerated but maybe looked down on a little. The WFD changed all that. It has a legal requirement for marine plants (macroalgae, phytoplankton, seagrasses and salt-marsh plants) to be used in assessing ecological quality of coastal waters and estuaries. Years of work by myself and many of my students had inadvertently paved the way for this. Suddenly I felt valuable! For the last 10 years of my career I was part of the DEFRA Marine Plants Task Team for WFD which devised and tested macroalgal tools for ecological quality assessment. The rundown of classical phycology teaching in Britain in the last decades of the 20th century had meant that few people had the seaweed knowledge needed for tool development. One particularly valuable thing was the study of estuaries that I had started at Paisley. For over 30 years I had collected algae from over 100 estuaries, large and small, like a stamp collector collects stamps. During that time there were big successes for the water industry in reducing pollution. I was sitting on a goldmine of estuarine algal community data chronicling the pattern of algal recovery which proved very useful to the Task Team.

Involvement over the last 50 years with two contrasting learned societies which reflected the multidisciplinary nature of my research and teaching interests has been very valuable. I have been a member of BPS since 1966 and of ECSA (Estuarine & Coastal Sciences Association) since its foundation in 1972, and filled various posts in both societies. In the 1970s I was Field Meetings Secretary of the BPS organising annual seaweed field meetings, one of the founders' aims for the BPS, and followed this up for some years in the 1980s by editing the BPS Bulletin, predecessor of the *Phycologist* that you are reading now. It is sad that nowadays fewer students appreciate the value and role of learned societies.

Josie Sheehan, my school biology teacher who fostered so much of my coastal ecology interest, got one thing wrong. She told me that I would never make a teacher. In contrast, among my most valued achievements of recent years are a Lifetime Achievement Award at annual Learning and Teaching Oscars Ceremony at Heriot-Watt University and the Graduating Students' Prize for Best Lecturer, Heriot—Watt University,

Martin enjoying life on an effluent pipe surrounded by mud in the Forth estuary

In 2010 I retired from full-time work and capped it by organising a very successful European Marine Biology Symposium at Heriot-Watt in my last week of work. Being retired doesn't mean work has stopped. I still enjoy teaching, promoting the use of algae, but the difference is I don't get paid. I continue to serve the BPS as chair of the Biodiversity and Conservation Committee. In this committee we are trying to capitalise on the field meetings I organised for BPS in the 1970s by repeating some of them to see if floral change has occurred on the shores.

My Ph.D. training in seaweed ecology and taxonomy has always been useful. Although miles away from shell-boring algae it has helped enormously in moving to related areas. Estuarine macroalgae are a fascinating area to me of great use in environmental management, where no-one else seemed to do much. Similarly rocky seashore ecology has so often neglected the detailed and critical seaweed work, which is so important for recent developments in environmental management. Some colleagues have found it odd that rather than diving in coral seas I am at home walking on (or sinking into!) muddy, polluted, estuarine seashores. But that's where I find the algae that are so much part of my life.

BPS HONORARY LIFE MEMBER BIOGRAPHY

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Career of a Globe Trotting Phycologist

My interest in algae goes back to my upbringing in Llanelli, a small industrial town in South Wales, lying on the Lougher Estuary and opposite the Gower Peninsula. It was during long summer holidays spent in a caravan on Gower when I became interested in marine life and made my first seaweed herbarium. Little did I know then that collecting seaweeds would lead to a lifelong interest in them and also in freshwater algae. Unlike most of my fellow sixth formers at Llanelli Boys Grammar School I went to an English university rather than one in Wales through a chance meeting in a local pub between my father and a resident tutor at a Durham college.

In 1962 I began my undergraduate studies at Durham University and first encountered David Bellamy when he gave a talk at the fresher's week titled 'A Real Gone Don'. Dave, as he was always known to us students, was a dynamic junior lecturer in a still rather traditional Botany Department and not only inspired me as well as generations of botany students but greatly encouraged my interest in seaweeds. Dave even arranged for me to have tea with Professor Lily Newton and her companion when I was on a field trip to Aberystwyth. Lily was nothing like as formidable as I had been led to believe and listened patiently to my naïve ideas concerning applying the approach of terrestrial phytosociologists to seaweed communities. She offered me every encouragement to pursue my interest in seaweeds although I do rather wonder what she really thought of my ideas! Dave asked me to apply for a one of his Scientific Research Council studentships although said it was imperative for me to have a diving qualification. Summer 1995 was therefore spent working at a diving school on Giglio, an island off Tuscany, gaining experience that enabled me to obtain my British Sub-Aqua Club (BS-AC) qualification immediately on return to Durham. My PhD research initially involved describing and classifying seaweed communities but soon the focus changed to studying the productivity of laminarians growing in different parts of the British Isles. I spent September 1996 camping around the S-W Peninsula of England and surveying shallow water seaweed communities by swimming out from any convenient shore equipped with all my diving gear - well before the days of risk assessments! Occasionally I was fortunate to have a dive companion and boat support as happened when I visited the MBA at Plymouth. It was here I met Dr Mary Park who could not have been more helpful, giving me much advice on possible sites for L*aminaria ochroleuca* - she was the first to record it in the UK (1948). Fortunately I spent the previous month on the Durham Senior Scouts Expedition to N-W Spain with a team of divers from the Durham Branch of the BS-AC, who were on the expedition to assist me in measuring productivity of *Laminaria ochroleuca* and *Saccorhiza polyschides* growing around the Murazzo Peninsula. So on my visit to Cornwall I was able to readily recognize the occasional *L. ochroleuca* plant when swimming above dense beds of *Laminaria hyperborea*. Many of my survey sites were impacted by one of the world's first major oils spills that took place on the 18th March 1967 when the Torrey Canyon oil tanker struck rocks off the Cornish coast. As a result of this disaster, I returned with a team of divers in September 1967 to resurvey my sites to determine the impact on the seaweed communities of the oil-detergent emulsion formed when attempting to remove the crude oil. Much of my later fieldwork benefitted from the assistance of members of the Durham University Sub-Aqua Club which I founded soon after the start of my postgraduate studies.

In 1968 I applied for a lectureship at the University of Ghana because the advertisement mentioned that the successful candidate would work closely with Professor George Lawson, the head of the Botany Department and a leading authority on the seaweeds and shore ecology of tropical West Africa. The appointment provided me with a fantastic opportunity to research the seaweed flora of a still phycologically little-known region and to focus on subtidal seaweeds since the university possessed SCUBA-diving facilities and a research vessel. The years spent in West Africa were very productive ones and led to the discovery of many new taxa, especially when George and myself undertook a series of

UNESCO-sponsored expeditions to West African countries lying between Angola in the south and Western Sahara in the north. In some countries local botanists and SCUBA-divers hosted our stay, but more often there was little or no support and occasionally shore collecting could be a little stressful as when we were captured by the Polisario Front guerrillas in Western Sahara. Fortunately our guards allowed us to collect on the shore in front of the fort at La Guerra and released us to walk back through the desert to Mauritania after discovering we were not Spanish but not before we had saluted the raising of their flag at the fort! Most of my summer vacations and periods of study leave were spent working on West African material at the Natural History Museum (NHM) in London. It was here that I first met and began a long-term collaboration with Jim Price who was head of the Marine Algae Section. Jim accompanied George Lawson and myself on a 6-week expedition to Angola in 1974 and two years later Jim Price, Peter James (a NHM lichenologist) and myself went on a 6-week long expedition to the remote South Atlantic island of Ascension. An experience made all the more memorable when I broke my arm and some ribs in a car accident so curtailing diving in the later weeks of what otherwise was a very successful expedition. An unexpected delay when in transit enabled us to also investigate the seaweeds of Antigua.

A new phase in my career began when in March 1980 I returned to the UK to head the Freshwater Algae Section of the NHM, a positioned formerly held by Dr David Hibberd. Just a few years earlier I had become interested in freshwater algae when supervising MSc students working on Lake Volta, the second largest man-made lake in Africa. This new interest led me to write a review of the aquatic vegetation of the inland waters of tropical West Africa. When I arrived at the NHM Jenny Moore (now Bryant) was the only member of the Freshwater Algae Section and was writing an identification guide to British and Irish charophytes and undertaking a charophyte mapping project. We soon began a long-term investigation of the benthic algae of the River Thames, and a project with Irish collaborators to survey the charophytes of the Midland lakes of Ireland that were becoming increasingly eutrophicated. Later we undertook with assistance of vacation and sandwich students one of the earliest SEM investigations of the wall structure and ornamentation of charophyte oospores using the superb EM facilities and type-rich charophyte collection in the NHM. In 1982 Dr David Irvine and myself ran a symposium on green algae at North-East London Polytechnic that aimed to review the implications of recent ultrastructural findings on the phylogeny and classification of the group. We published the proceedings in the Special Volume series of the Systematics Association, a series for which I was editor-in-chief from 1986-1998. In the mid-1980s the Freshwater Algae Section was joined by Dr Leslie Johnson who ran the newly formed algal culture laboratory and now began a period when we collaborated on a programme of culture-based research on green algae. Later Dr Gill Stevens (nee Douglas) was appointed as a research assistant to carry out culture-based work on lichen algae. Later we collaborated on a multidisciplinary study of an unusual *Hydrodictyon* and *Microcystis*-dominated lake near Helston in Cornwall. By 1987 there were more staff working on algae in the NHM than at any other time - three in each algal section and two retired members of staff who were still actively engaged in research. I received a DSc from Durham University in 1988 for my contribution to research on freshwater and marine algae in West Africa and the British Isles. The Botany Department was reorganized in 1989 and I became head of the Division of Algae formed by the merger of the three algal sections. A year earlier George Lawson retired as head of the Biology Department at Bayero University in Nigeria and joined the NHM as a Scientific Associate.

The arrival of George provided fresh impetus to a project to taxonomically re-appraise the seaweeds of West Africa (Namibia to Western Sahara) and offshore islands. Jim Price and George had started this project in the mid-1960a and I joined it soon after my move to West Africa. Jim was incredibly meticulous when it came to checking literature and the work progressed well thanks to George's commitment and his ability to sensibly précis Jim's voluminous notes. The findings were published in 10 parts between1968-2004, with some of these parts co-authored by others including Professor Chris Maggs, Dr Bill Woelkerling and Dr Willem Prud'homme van Reine. In the late 1980s George Lawson and I wrote a review of plant-animal interactions in the marine environment, a topic we had independently researched in Ghana. It transpired that there was considerable interest in such interactions so I approached Dr Stephen Hawkins who agreed to jointly run a 4-day symposium on the topic. The Symposium on plant-animal interactions in the marine benthos was held in the late Professor Brian Moss's department at Liverpool University in September 1990, with the proceedings published as a Systematics Association Special Volume and in the Journal of the Marine Biological Association.

In 1992 the drive to generate external income led me to join the NHM diving team so putting to good use my SCUBA-diving experience and knowledge of tropical seaweeds and other marine plants since all other members of the team were zoologists. The team was expected to fly out to the Red Sea at short notice to assess damage caused to coral reefs when ships ran aground in Egyptian waters. Often I would take much work with me on trips to the Red Sea since weeks were sometimes spent waiting for sea conditions to abate sufficiently to enable us to dive on the outermost fringe of a reef where most boats struck. The leader of the very successful dive team was Dr David George and he asked me in 1996 to join a five-year investigation of the marine life of Abu Dhabi (UAE) which was oil-company sponsored. The very pronounced seasonality of the seaweed flora was totally unexpected and the study took on an added significance when it coincided with episodes of coral bleaching and death that led to the rapid colonization of the coral skeletons by season beds of seaweeds. I still retain an interest in the seaweeds of the Arabian Gulf and have revisit Abu Dhabi on several occasions since my official retirement to undertake contract work and attend conferences. A further reorganization of the Botany Department in the mid-1990s resulted in the creation of a Cryptogamic Division and five interdepartmental themes designed to encourage interdisciplinary research. As head of one of these themes, I began to collaborate with staff in other departments including those in mineralogy which led me to investigate the impact of heavy metals on freshwater algae and resulted in visits to Rumania, Malaysia, Sarawak, Parys Mountain on Anglesey and abandoned tin mines in Cornwall. Most of the larger multidisci-

plinary projects I have been associated with were funded by the Darwin Initiative for the Survival of Species, including a collaboration between the NHM, Raleigh International and organizations in Chile. My interest in the Patagonia region of Chile came about because having earlier studied seaweed biogeography in the Southern Oceans with George Lawson and Ian Tittley (NHM) and the seaweeds of South Georgia with Dr Phillip Pugh of the British Antarctic Survey. The project in Chile was particularly challenging since surveying the flora and fauna of shores in the remote Laguna San Rafael National Park in Patagonia meant month long camping trips and travelling around the fjord system in Avon inflatable dinghies. Nonetheless, it provided a wonderful opportunity to study a sub-Antarctic seaweed flora at first hand, including sampling massive *Macrocytis pyrifera* plants with just a single individual filling a large Avon inflatable dinghy! My seaweed collaborator was María Elíana Ramírez, Director of the Museo Nacional de Historia Natural in Santiago, whose considerable knowledge of the local seaweeds was indispensable and who participated in every fieldwork phase despite the extremely inhospitable nature of the environment in the Park. Another Darwin Initiative funded project aimed to enhance the skills of marine biologists working in the West Africa Sub-region and involved Newcastle University, the NHM and the University of Ghana. The project enabled me to meet former colleagues and students on visits to Ghana as well as to revisit seaweed-rich shores I had sampled over 20 years earlier. The closing advanced training workshop was held at the University of Ghana in January 2001. A Darwin Initiative appointed fellow, Dr Gabriel Ameka, continued working at the NHM and authored with George and myself the 3rd revision of an identification guide to the seaweeds of tropical West Africa.

I have always enjoy teaching and was therefore pleased to accept Professor Brian Whitton's offer in 1991 to join him in running algal identification courses that were initially intended to address the training needs of staff of the newly formed National Rivers Authority. These training courses have been running at Durham since 1992 and have been attended by several hundred people from many different organizations and countries. Meanwhile we approached the BPS with a request for financial support to enable us to produce a comprehensive, synoptic account and identification guide to British freshwater algae. Thanks to their support a Freshwater Algal Flora Committee was formed and potential contributors were invited to join the project in 1993. Over the next few years I very much enjoyed hosting many visits by overseas contributors, often accompanying them on extended collecting trips and remember spending many months editing manuscripts even during family holidays. Brian and myself were joined eventually by Professor Alan Brook and he introduced me to David Williamson who produced many wonderfully detailed line drawings of desmids for the Flora volume and meticulously checked all the illustrations submitted to us. To obtain colour images of living algae for the CD I was accompanied on several trips to different parts of the British Isles by Peter York (NHM) who brought with him all his photomicrography equipment.

We dedicated 'The Freshwater Algal Flora of the British Isles' to the late Dr John Lund who throughout its preparation gave us editors much valued advice and assistance. The official launch of the book and its accompanying CD took place in April 2002 at the Natural History Museum in London and was presided over by Dave Bellamy. It coincided with my official retirement although after a short break I was reemployed under contract to enable me to visit and complete research conducted in Abu Dhabi and Chile. In 2005 I successfully applied for a two-year Marie Curie Host Fellowship at the Martin Ryan Institute, National University of Ireland, Galway. During these very memorable and productive years I was fortunate to work closely with Dr Fabio Rindi and the Director of the Institute, Professor Mike Guiry, whom I had first met at the NHM in the early 1970s. Since my fellowship was 'for the transfer of knowledge' I ran four freshwater algal training courses at the Martin Ryan Institute modelled on those at Durham University and with Brian Whitton covering the cyanobacteria. My research focused on desmids, a group I had collected when in West Africa and published on with Dr Jo Gerrath. The group was a very obvious choice because lying to the west of Galway City is 'Connemara', a rather ill-defined region famous for its boglands and lakes that are considered some of the most desmid-rich in the British Isles. Thanks to considerable assistance from the desmid specialist David Williamson we published a book in 2008 titled 'A Practical Guide to the Desmids of the West of Ireland'. A year earlier we had published online a list of the most important areas in the UK for desmids based on an analysis of David's records extending back over 35 years. During my fellowship I collaborated with Mike Guiry and Fabio Rindi in writing and editing a multi-authored volume on Clare Island (Co. Mayo) in which our modern freshwater algal survey data were compared with surveys conducted by William West almost a century earlier. He was one of more than 80 scientists who carried out the first Clare Island Survey (1909-1911), one of the first geographically specific multidisciplinary studies in the world. My interest in carrying out the new survey of this fascinating island is thanks to Mike Guiry who arranged for me to visit it on several occasions, the first in June 1990 when accompanied by Mike along with Jenny Bryant and Pat Sims from the NHM. When in Galway I accepted an invitation from Professor Chris Maggs and Professor Juliet Brodie to co-edit and contribute to the 'Green Seaweeds of Britain and Ireland'. Therefore was able to study and photograph material from local shores when preparing my contribution. A year after return to the UK I was appointed an Adjunct Professor at the Martyn Ryan Institute. On my return to the UK in 2007 I became a Scientific Associate at the NHM and discussed with Brian Whitton the possibility of producing a new edition of 'The Freshwater Algal Flora of the British Isles', now almost out of print. We decided to go ahead with a 2nd edition and received financial support from the BPS, the Environment Agency and the Scottish Environment Protection Agency so was able to embark on a programme of fieldwork with Brian Whitton and host the visit of Professor Petro Tsarenko and his assistant from the Ukraine. On this occasion I revised the desmid chapter with David Williamson and Alan Brook and assisted Dr Chris Carter who produced many superb new colour images for the DVD that accompanied the new edition. Since publication of the 2nd edition in 2011 Brian Whitton and myself have continued to report on taxonomic/nomenclatural changes and new records for the British Isles in the BPS newsletter. In 2014 we revised the online version of the

'Coded List of British Freshwater Algae' with the assistance of Isabella Tindall who prepared it for publication on the Centre for Ecology and Hydrology website. Currently I am using the new version to update the 'Species Inventory for Freshwater Algae' for the UK's National Biodiversity Network, one of the standard lists that underpin national databases. I have been associated with the BPS for much of my Phycological career and am very grateful for their support over the years, most notably for the British Freshwater Algal Flora project and in 2016 for the redevelopment of the BPS algal recording portal to include freshwater. The first BPS meeting I attended was in 1967 at Royal Holloway College, Egham and was also the first occasion I gave a scientific presentation.

Thanks to Harry Powell I actually gave two presentations since immediately on discovering that I had an underwater film of my research in Spain he announced I would be presenting it just before the next afternoon session - rare in those days to have underwater footage of seaweeds. My regular attendance at BPS winter meetings did not begin until my return from Africa in 1980 and for the next 30 years I rarely missed a meeting. On at least three occasion I have been a member of the BPS Council, chaired the Conservation Committee from 1992-1996 and was secretary of the Freshwater Algae Flora Committee from 1992-2002. The role of the latter committee was taken over by the Biodiversity and Conservation Committee of which I am a member.

As I began writing this account of my career I soon came to appreciate just how diverse has been my research interests. On occasion I have been fortunate in given the freedom to pursue my own research interests, but more often the direction has been dictated by factors of which I have had little control over, with chance sometimes playing a part. Certainly I have been most fortunate in having had the opportunity to research algae in different parts of the world and enjoyed the rewarding experience of collaborating with scientists in other disciplines. What has become apparent to me is just how indispensable are well-researched identification guides. The founders of the BPS recognized the value of such floristic works and list among the original aims of the Society the production of a check-list of British marine algae and to work towards producing a new Flora of British Marine Algae. These original aims have been achieved for seaweeds and I am pleased to have been closely associated with projects that have ensured these aims have now been achieved for freshwater algae other than diatoms. One of my principal concerns today is the current decline in the number of algal taxonomists in the UK since will l be required to produce the next generation of floristic guides and revise existing ones, especially at a time when genomic investigations are leading to major taxonomic re-alignments, nomenclatural changes and to DNA-barcoding libraries that are used to assist identification.

Finally, I have been most fortunate in having had an amazingly diverse, interesting and exciting career researching and teaching algae and hope others will be likewise inspired to follow a career in algal taxonomy.

With John Lund in November 2011.

In 1967

Freshwater Algal Flora of the British Isles – Update 5

David M John and Brian A. Whitton, Life Sciences Department, Informatics and Diversity Division, The Natural History Mus eum, Cromwell Road, London SW75BD, UK (d.john@nhm.ac.uk) and School of Biological and Biomedical Sciences, Durham University, Durham DH1 3LE, UK (b.a.whitton@durham.ac.uk)

The current update to information published in the 2nd edition of *The Freshwater Algal Flora of the British Isles* (John et al., 2011) takes account of nomenclatural/taxonomic changes and new records for Britain and Ireland not mentioned in earlier updates. A list of all these changes and new records mentioned in our earlier updates along with links to the update articles are available on the AlgaeVision website (http://algaevision.myspecies.info/node/3505).

References to any taxonomic and nomenclatural changes are to be found in AlgaeBase (Guiry & Guiry, 2017). Code numbers for the new records are in parentheses and will be added to the next revision of the online 'Coded List of British Freshwater Algae' (Whitton & John, 2014).

Nomenclatural Change

p. 432. *Coelastrum verrucosum* (Reinsch) Reinsch is now regarded as a synonym of *Coelastrum sphaericum* Nageli

New Records

Paralemanea catenata (Kützing) Vis et Sheath (01340020): collected in the River Wye at Symonds Yat, Gloucester, England (SO56031562) on 13 May 2016 by Richard Lansdown. (Carter et al., 2017)

According to Chris Carter (pers. comm.), Prof. Johanna Knappe believes the material from the River Wye closely corresponds to *Lemanea nodosa* which she considers to be a form of *Paralemanea catenata* although Vis & Sheath (1992) had earlier reduced it to a synonym of this species. *Paralemanea catenata* f. *nodosa* Knappe et Huth has not been validly published (see comments in Guiry & Guiry, 2017).

Cosmarium didymochondrum Nordstedt var. *compressum* D.B Williamson et C. F. Carter (27052781): collected from small *Sphagnum* pools in old semi-permanent vehicle ruts lying a little north-east of Birkdale Tarn, North Yorkshire, England by Chris Carter, also collected from a lochan, near Durness, Northern Sutherland, Scotland on 18 November 2015 by Ian Evans (Williamson & Carter, 2016a).

Gloeochloris smithiana Pascher (10300010): collected from a drainage ditch in Northamptonshire, England (SP8653) from 2013 to 2015 by Chris Carter (Carter & John, 2015).

Saturnella saturnus (Steinecke) Fott (18250010): collected from bog pools at the Upper Teesdale National Nature Reserve in the North Pennines, England in March/ June 2014 and June 2015 by Jeannie Beadle (Beadle, 2015; Beadle et al. 2014; Carter et al. 2015).

Staurastrum spinolobatum D. B. Williamson et C. F. Carter (27381940): collected amongst *Sphagnum* floating in a shallow (<0.5 m deep), permanent peat pool from near the summit of Scrae Field, near Quarff, Shetland Islands, Scotland (HU416559) on 3 July 2016 by Chris Carter (Carter & Williamson, 2016)

Staurodesmus calyxoides var. *minus* D. B. Williamson et C. F. Carter (273900251): sampled in a *Sphagnum* squeezing collected from Glen Catachol, Arran, Scotland (NR915487) on 22 April 2015 by Chris Carter (Williamson & Carter, 2016b).

Acknowledgements

Many thanks go to Dr Chris Carter for additional information on his new records from the British Isles..

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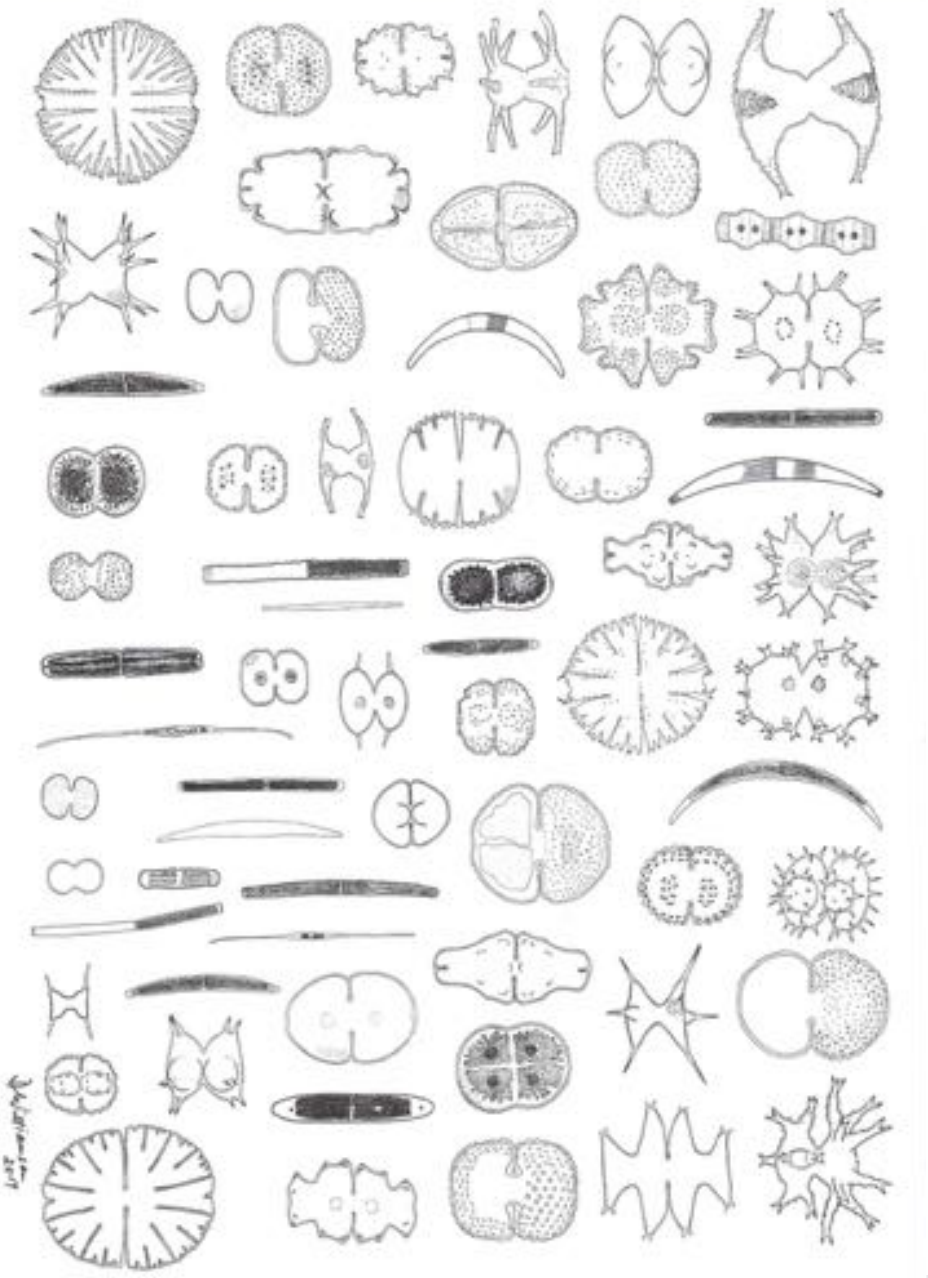
Hilda Canter Lund exhibition in Konstanz

A number of winning and short-listed images from past Hilda Canter-Lund competitions were on display in an exhibition entitled ALGEN: Faszination in Form und Vielfalt ("Algae: fascination in form and variety") at the Bodensee Naturmuseum at Konstanz in Germany between January and March . The exhibition was initiated by Claire Gachon, as an outreach activity for the EU-funded ALFF (Algal Microbiome, Friends and Foes) consortium, and organised by Martina Kroth. It attracted many positive comments and a request for the accompanying book!

The next stop on the Hilda Canter-Lund world tour is Seaweed Expo 2017 in Kongju, South Korea.

Martyn Kelly

Chris Carter's image of Coleochaete scutata *(shortlisted in 2010) comes under scrutiny during the ALGEN: Faszination in Form und Vielfalt exhibition at Bodensee Naturmuseum (photograph: Martina Kroth)*



Desmids are thriving in Dock Tarn, Cumbria

The picture shows an assortment of desmids (but not all!) found at the tarn in a single collection made by Dr Allan Pentecost of the FBA, Windermere in October 2016.

Dock Tarn (GR. NY274144) is a small, shallow and weedy body of water, lying on Borrowdale Volcanic rocks with a steep heather-covered catchment on the east side. The pH of the water is considered to be generally circum-neutral but it is clearly variable as it was measured by the writer at 5.8 in 1982 and 5.0 in 1988. The tarn often seems to reveal a rich desmid flora as about 80 taxa were recorded there by Lind and Williamson (unpublished) and now this latest sample has revealed approximately the same number.

David Williamson
davnar@btinternet.com

The illustration of the desmids was done by David Williamson. It is a pleasure to announce that David is to receive the Jill Smythies Award of the the Linnean Society of London in recognition of the excellence of his botanical illustrations. David will receive the silver medal and prize in due course at a meeting of the Linnean Society in London.

As we have all seen in the past, David is a superb botanical illustrator who has always specialized in producing accurate and very detailed line drawings of desmids.

David was nominated for the award by David John and seconded by Juliet Brodie. Congratulations!

Minutes

British Phycological Society

65th Annual General Meeting

Sarah Jones Seminar Room, School of Ocean Sciences, Bangor University

5 pm Thursday 12th January 2017

Present: Chuck Amsler, Juliet Brodie, Christine Campbell, Paul Carrier, Laurence Carvalho, Geoff Codd, Matt Dring, Maeve Edwards, Su Chern Foo, Daniel Franklin, Anne Jungblut, Jessica Knoop, Mila Kojadinovic-Sirinelli, Adam Lewis, Jane Lewis, Christine Maggs, Gill Malin, Leanne Melbourne, Alison Paskins, Ruth Paterson, Joe Penhall Smith, Jane Pottas, Saul Purton, Laia Rovira-Torres, Beatrix Siemering, Maria Snell, Natalia Torres, Jo Wilbraham, Marian Yallop.

1. Apologies

Francis Bunker, Gary Caldwell, Paul Cherry, John Day, Tim Entwisle, Claire Gachon, Mike Guiry, Paul Hayes, Martyn Kelly, John Kinross, Jan Krokowski, Carole Llewellyn, Sara Marsham, Matthew Pearce, Rupert Perkins, Hilary Redden, Saskiya Richards, Koen Sabbe, Beatrix Schlarb-Ridley, Michelle Tobin, Graham Underwood, Marine Vallet, Martin Wilkinson

2. Minutes of the 63rd AGM

Accepted

3. Matters arising

None

4. Reports from Officers

a. Secretary (Jane Pottas)

Members were welcomed to the Annual General Meeting and the organisers, Chris Maggs and Dan Franklin, were thanked for all their hard work in making the meeting a success. Taylor and Francis were thanked for sponsoring the welcome reception. Thanks were also expressed to the department for their generous support in accommodating the meeting and for the excellent facilities and catering. Normal secretarial duties have been carried out in the last 12 months. Enquiries about membership, funding, field courses, EJP have been forwarded to the relevant officers, committee or members of Council and all enquiries followed up.

b. Treasurer (Maeve Edwards)

The handover process from previous Treasurer (Michelle Tobin) is almost complete. Once details of the accounts for the period October 2014 – March 2015 are passed from Michelle to Maeve they will be submitted to the accountant for auditing and then they will be submitted to the Charities Commission.

c. Membership Secretary (Sara Marsham)

In the absence of the Membership Secretary this report was presented by Gill Malin.

It is with sadness that the Society received news of the deaths of two members – Mr Harry Powell an Honorary Member and the first Secretary of the BPS who died on 2nd January 2016, and Professor Brian Moss Past President (1997-1999) who passed away on 27th May 2016. This is the last Membership Secretary report by Sara Marsham who, after serving eleven consecutive years on Council, will be handing over the role to her successor, Dr Hilary Redden. Sara thanked all of the Presidents she has served under and Council Members she has served alongside. Special thanks were expressed to the previous Treasurer Dr Michelle Tobin, current Treasurer Dr Maeve Edwards and Webmaster Prof. Mike Guiry for all of their support during Sara's term in office. The active membership of the Society as of 13th June 2016 is 461 (328 fully paid up, 123 paid to end of 2015, and 10 Honorary Life Members - Dr G.T. Boalch, Dr Y. Chamberlain, Prof. J. Dodge, Prof. M.D. Guiry, Mrs L.M. Irvine, Dr J.M. Jones, Prof. L. Medlin, Prof. J. Raven, Sir W. Stewart and Dr J.F. Talling). Thirty eight new members have joined the Society to date in 2016 (including 29 student members). Of the fully paid up members, 144 (including 13 of the student members) receive the European Journal of Phycology. The distribution lists for volume 51 issues 1 and 2 were received by Taylor and Francis in February and March respectively so all members subscribing to the journal should have received these issues. Back issues and missing issues are to be sent to members as advised. The database is working well with few issues reported by the membership. Application and renewal notices for 2016 membership were initially circulated in December 2015 Present: Ricardo Bermese, Paul Brazier, Juliet Brodie, Francis Bunker, Gary Caldwell, Christine Campbell, Chris Carter, Geoffrey Codd, Eileen Cox, Andrew Davies, Matt Dring, Alexander Jueterbock, Ingrid Juttner, Paula Lightfoot, Stephen Maberly, Christine Maggs, Gill Malin, Jane Pottas, Tammi Richardson, Lasweta Saha, Kathryn Schoenrock, Alla Silkina, Joe Taylor, David Thomas, Daniel Thornton, Graham Underwood, Jo Wilbraham, Martin Wilkinson, Gabrielle Wyn

Apologies: Paul Cherry, Claire Gachon, Paul Hayes, Anne Jungblut, Martyn Kelly, Jan Krokowski, Rupert Perkins, Saul Purton, Hilary Redden

1. Election of Council members

Nominations were called for new members of Council. Three Society members were nominated – Francis Bunker (proposed Juliet Brodie, seconded Martin Wilkinson), Alla Silkina (proposed Geoff Codd, seconded Graham Underwood) and Jo Wilbraham (proposed Eileen Cox, seconded Jane Pottas). The nominees were asked to leave the room and following a vote Francis Bunker and Jo Wilbraham were elected to Council. All were thanked for their willingness to stand.

2. Constitution changes

Council proposed a change in the constitution whereby the wording of section 7.2. be changed from "Members not in full-time employment." to "Members retired and unwaged." Also the addition to section 9 of the positions of Federation of European Microbiological Societies (FEMS) Council Representative and BPS Natural History Museum Representative.

These proposed changes were agreed.

3. Minutes of the 64th AGM, 23rd June 2016

The minutes of the 64th BPS Annual General Meeting were accepted.

4. Matters arising

None.

5. Reports from Officers

a. Secretary (Jane Pottas)

Normal secretarial duties have been carried out. Emails to the secretary fell into a few categories - membership, funding, field courses, EJP. All enquiries were forwarded to the relevant officers, committee or members of Council and all enquiries followed up. There have again been a few emails from people wanting advice from the British Psychological Society. All such emails were responded to in a sensitive manner and correspondents directed to the British Psychological Society website.

b. Treasurer (Maeve Edwards)

In the absence of The Treasurer Graham Underwood presented a summary of the Treasurer's report.

The present finances of the BPS are in good health, with £28309 remaining in the current account on the 5/1/17 subsequent to the bulk of payments/awards being made in 2016. This represents the lowest funds held by the Society in the cycle of the financial year. It is just prior to the new incoming funds from 2017 memberships and payments from Taylor and Francis (2016 outstanding balance and 2017 royalty advances) to be paid in February 2017 (estimated ~£62000).

The most recent financial transactions (YE 2015) have been prepared by the treasurer and submitted to the Society accountants for preparation and verification of the financial accounts for that year. These accounts and the associated trustee's report were submitted to council and content discussed (see attachments). At this moment, a small amount of further editing work is required on the trustee's report to make it compliant as a Statement Of Recommended Practice (SORP) before final submission to the Charity Commission.

Charity Commission details have been updated so that Maeve Edwards is the contact name and Juliet Brodie is the Society's named trustee. Due to some final cross-over complications, the YE2015 accounts are somewhat overdue with the Charity Commission, so it is hoped that work will begin on YE 2016 accounts in February/March 2017 after the clearance of final few awards payments from 2016. Submission of these accounts are anticipated for the June 2017 council meeting.

Some of the delays in accounts preparation have been because of several banking issues. This has required a change of signatories for the National Savings and Investment account were agreed, signed and witnessed at the January 2017 council meeting to remove former treasurers Jackie Parry and Michelle Tobin from the list, and to include Juliet Brodie and Maeve Edwards as new signatories. Maeve to send the completed documents to NS&I after the council meeting. A similar action has been started with Bank of Scotland for the savings account that does not appear to be linked (as previously assumed) to the current account.

There are no other major concerns to report regarding Awards and Training payments and other financial transactions, with most running smoothly and only a few delays resulting from paperwork discrepancies or time constraints.

Paula Lightfoot offered to send details to the Treasurer of ethical investment opportunities from which more funds may be raised.

c. Membership Secretary (Hilary Redden)

In the absence of the Membership Secretary this report was presented by Gill Malin.

The active membership of the Society as of December 2016 is 365 (356 plus 9 Honorary Life Members). One member resigned their membership during 2016, due to retirement. Of the 356 paid up members 144 members receive the EJP including 15 of the student members. Application and renewal notices for 2017 membership were circulated at the beginning of December 2016 in conjunction with information about the AGM and Bangor meeting. There were some adverse comments from members that PayPal was forcing users to take out a PayPal account when they logged on to pay. It appears to be a condition of using PayPal that after a small number of guest logins an individual is asked to create an account before they can use the service further. Whether or not to continue with a PayPal payment at this stage is a decision only the member can make for themselves as BPS has no influence on the conditions of service for PayPal. Some members continue to pay by cheque. Membership fees are due on the 15th January each year. Members are reminded that payments made after this date up to October 31st are for the current year. Payments received after November 1st in any year will be for the following year.

d. Student Representative (Paul Cherry)

In the absence of the Student Representative this report was presented by Gill Malin.

The activity of the BPS twitter account, @bps_algae, has increased in the last 12 months and as a result the Society is reaching out to a wide audience of academics, students, and the general public. Frequent email reminders were sent to students regarding funding deadlines and to advertise the winter BPS meeting including details of the Irene Manton Prize, and BPS Student Poster Prize.

e. Joint Editors of the *European Journal of Phycology* (Christine Maggs and Juliet Brodie)

Christine Maggs and Juliet Brodie are joint *EJP* Editors in Chief and Caroline Magill continues as Editorial Assistant. The last 6 months have been busy with 53 submissions to the journal from 23 countries with an overall acceptance rate of approximately 40%. The time from submission to decision has fallen to around 23 days. In 2015 the *EJP* Impact Factor increased to 2.205 from its 2014 value of 1.912. By comparison, *Phycologia* dropped from 1.915 to 1.628, *Harmful Algae* dropped from 3.874 to 2.664, *Journal of Applied Phycology* from 2.559 to 2.372, and *Journal of Phycology* has dropped from 2.884 to 2.536. *EJP* five-year impact factor has also increased from 2.101 to 2.371, which is also an increase on 2013. Three algal journals with higher impact factors are *Harmful Algae* 2.664, *Journal of Phycology* 2.536 and *Journal of Applied Phycology* 2.372. The Scimago view (http://www.scimagojr.com/) of 21 December 2016 shows a very favourable position - total cites highest ever; uncited documents decreasing, and "SJR" rising meaning that *EJP* is back to Q1 in both categories, an important factor for attracting manuscripts. The Scimago widget will be added to the BPS website. Following discussions with Taylor & Francis and BPS a special issue of the journal devoted to Applied Phycology, which will consist of reviews only, will appear in October 2017. At present, the contributions look strong and it is anticipated that this will cement *EJP*'s presence in this area. T&F changed

to a new, more modern, appearance for the journal and EJP will look more like other, online, journals when viewed electronically. It is hoped that this will not detract from its appearance in hard copy. T&F were thanked for their support and sponsorship of the annual meeting.

f. Editor of *The Phycologist* (Jan Krokowski)

In the absence of the Editor of The Phycologist this report was presented by Gill Malin.

Thanks were again expressed to Agnès Marhadour for typesetting, to Monument Press for printing, and to the Scottish Environment Protection Agency Admin Department staff for posting all the newsletters. Spring and autumn editions were produced and dispatched on time. As there are always around a dozen returns BPS members were asked to check and amend their address details. Costs for the Spring issue (90) were £2869.45 and for the Autumn issue (91), £2420.34. Jan encouraged Society members to send in articles. Deadline March 1st for the Spring issue and September 1st for the Autumn issue. Jan commented that he has been editor of *The Phycologist* for a long time and is happy to continue unless there are any other volunteers.

It was noted that the costs of typesetting and layout have remained the same for several years and Council agreed that the sum paid to Agnès Marhadour should be increased from £400 to £500.

g. Webmaster (post vacant)

No report received from the retiring Webmaster.

Thanks were recorded to Mike Guiry for his many years of service to the BPS as Webmaster

h. Meetings Secretary (Claire Gachon)

No report received.

The Bangor meeting has been arranged by the local co-ordinator, Andy Davies, with input from Chris Maggs. It is envisaged that the Meetings Secretary will have greater input into the organisation of the 2018 annual meeting in Southend.

i. Awards and Training Committee (Chris Maggs)

During the calendar year 2016, there were four funding application deadlines for student support: 1 February, 1 May, 1 September and 1 December. For 1 February, there were 9 applications to attend the following conferences: Young Algaeneers Symposium (Malta); International Diatom Symposium (Canada); Temperate Reefs (Italy), requesting £8061. All were funded up to a maximum of £750 for international (non-European) conferences and the total BPS funding was £4961. For 1 May, there were 6 applications for conferences including BPS Bournemouth, ISS, and Harmful Algae (Brazil) and 4 applications for field courses and workshops in the UK and Europe (total £7917); all were funded to a maximum of £750 with the exception of a student based in Orkney (£200 additional); the total BPS funding was £5920. For 1 September, there were 3 conference applications, including Lytic Enzymes (NY), for a total of £2674, of which £2000 was funded; one of 3 project applications was funded, £2500 to study luciferin biosynthesis in UCL. For 1 December, there were 7 applications to attend BPS Bangor (all but one funded in full), and 5 applications for international conferences including Chloroplast Biotech Gordon Conference (California) and ASLO (Hawaii), of which the BPS funded £2855 vs £4024 requested, with total BPS support of £5153. One summer project was submitted (kelps for blue carbon at Aberystwyth) and funded for £1620.

In summary, during the year there were 30 applications for student support for conferences and 4 for workshops/field courses, which received a total of £18034; £2500 academic project; £1620 summer project, totalling £22154. Note that as payment by BPS is made when receipts are presented, this is a maximum cost.

In future more monies will be disbursed in the form of more generous grants.

Following a question from Linda Medlin it was established that applications for travel grants from retired members cannot be considered.

j. Biodiversity and Conservation Committee (Martin Wilkinson)

B&C Committee members have been assisting a Marine Scotland committee to formulate a policy recommendation to the Scottish Government to control seaweed and seagrass harvesting. A response will be made on behalf of BPS to the Sustainable Wild Seaweed Harvesting, Scottish Government Public Consultation. A number of meetings have been attended and presentations made by B&C Committee members on behalf of the BPS: Porcupine Meeting, Millport, March 2016 - publicising results of BPS 2015 field meeting; The Wildlife Information Centre (TWIC) conference on marine recording in Scotland, Nov 2016, Bo'ness; IUCN Freshwater Plants Specialist Group. Publications: SeaSearch seaweed guide by Bunker, Maggs and Brodie - an expanded 2nd edition will be published in 2017; the AlgaeVision website at the Natural History Museum, London is now fully operational to provide freshwater algal illustration; a revised checklist of British seaweeds published at beginning of 2016 by Brodie, Wilbraham, Pottas and Guiry; the diatom flora website funded by BPS with the National Museum of Wales, is now live and will be expanded in 2017. The B&C Committee has discussed many ways in which to improve the BPS species recording Website - www.bpsalgalrecords.com and to publicise and extend its use. A workshop on its use will be included at the BPS annual meeting in Southend January 2018. Help is being given to SAMS and Royal Botanic Garden Edinburgh in sorting an extensive collection of seaweeds and field data covering many decades which belonged to Harry Powell, the last surviving founder member of the BPS.

k. Outreach and Education Committee (post vacant)

Report written by Martyn Kelly.

Michelle Tobin has stepped down as Chair but is willing to remain a member of the committee. The Committee has not met since the annual meeting in Bournemouth in June 2016 but a number of activities have taken place. The Hilda Canter-Lund competition attracted over 40 entries in 2016 and two prizes of £250 were awarded, one for an image of a microalga and one for an image of a macroalga. A selection of HCL competition winners and shortlisted images will be exhibited at Bodensee-Naturmuseum for three months from January 2017, as part of an outreach event for the EU-funded AMFF (Algal Microbiome, Friends and Foes) consortium. The HCL images are available for display and members of the BPS are encouraged to seek opportunities with local galleries and science outreach events to mount a display. The images (mounted on foamboard) with captions along with posters with background information can be provided. In response to Council's encouragement to use

the HCL images to raise the profile of the society, two articles have been written for popular science magazines: for *The Biologist* and the NHM's *Evolve*. The HCL Photography Competition will be repeated in 2017. A placement student from Newcastle University's Marine Science Degree program will work with Bowburn Consultancy during the first part of 2017 to develop education materials around the theme "what have algae ever done for us?" A freshwater field weekend has been organised jointly with the Quekett Microscopical Society for 15-17 September 2017. This will be based at the Freshwater Biological Association in Ambleside and will focus on desmid communities associated with Important Plant Areas in the Lake District. This is the first freshwater field weekend that has been organised for about 25 years, and a donation of £500 is requested to subsidise costs (principally hire of FBA laboratories and meeting rooms) to ensure that freshwater field weekends get off to a good start. Council commented that the BPS provide financial support for students who apply to the Awards and Training Committee for funding to attend, and asked for information about what provision will be made by the FBA and the Quekett Microscopical Society.

Discussion ensued about the future of the Committee. A proposal to combine the work of outreach and education into the remit of the Biodiversity and Conservation Committee was rejected on the grounds that the B&C have a very full remit already. Martin presented details of the remits of the B&C, E&O (O&E), and AAC Committees. Council agreed that the O&E Committee should continue but that its remit should be clearly stated and that the Committee name might be changed to reflect its role which could in future include promotion of meetings and other BPS events. Martin suggested that one person should be on both committees to facilitate communication between them. Maeve asked for advice on the appropriate terminology to use in the accounts to describe support for committee activities.

l. Algal Applications Committee (Gill Malin)

The Algal Applications Committee (AAC) last met on 1st June. The AAC members continue to highlight the BPS when working on their various interests in applied phycology. The overall aim of this committee remains to foster better connections between BPS and the academic and corporate communities that use algae in their work. Ideas and suggestions from BPS Members and other interested parties are always welcome. In 2017 the aim is to have a committee section up on the BPS website. As notified in last years' report, applied phycology photos (free of copyright) are sought for use on the website, in brochures, emails etc. The committee would also like to establish more contacts in commercial organisations with algal interests and for major applied phycology projects. These would be used for future meeting invitations and to encourage corporate membership of BPS. Members are asked to contact g.malin@uea.ac.ukif they have any suitable photographs or can suggest contacts in commercial organizations with algal interests.

m. Natural History Museum Representative (Juliet Brodie)

The Natural History Museum, London is the official address of the British Phycological Society and Juliet is the nominated trustee at the NHM. Lucy Saint Smith has been working on the BPS archive and when this job is completed a list of what the archive contains will be added to the BPS website. The archives themselves will be incorporated at the NHM.

6. Federation Reports

a. Federation of European Phycological Societies (FEPS) (Geoff Codd)

The annual meeting of FEPS Council and AGM were held in Prague, September 19-21, 2016, with the FEPS Council as guests of the Czech Phycological Society during their annual conference. About 80 attended the conference. FEPS Council changes and appointments: President: Prof. Christos Katsaros, University of Athens, retired upon completing his term as FEPS President. His successor is Prof. Olivier De Clerck, University of Gent and Belgian Phycological Society Representative; President Elect: Prof. Cecilia Totti, University of Ancona and Phycological Branch of the Italian Botanical Society Representative; Secretary: Dr. Dagmar Stengel, University of Galway and Phycological Branch of the German Botanical Society, reappointed; Treasurer: Prof. Elliot Shubert retired and is succeeded by Dr. Yvonne Nemcova, Charles University Prague and Czech Phycological Society Representative; Hellenic Phycological Society Representative: Prof. Satiris Orfanidis, Fisheries Research Institute, Kavala and President of the Hellenic Phycological Society, was appointed following the retirement of Prof. Katsaros. The FEPS Journal: Perspectives in Phycology has now completed its third year of publication with 2 issues of Volume 3. Discussions are underway to expand to 4 issues per year and to facilitate access via Web of Science and the Thompson Reuters Citation Index. Citation information for the journal can now be accessed via Google Scholar. An unofficial impact factor of 1.2 for year 1 of publication (2014) was welcomed as good for a new journal and the Editors are optimistic that an impact factor of 2.5 is achievable. See: www.schweizerbart.de/journals/pip/instructions?af=search. The FEPS Website is under new management and domain transfer is underway. Proposals for a new structure are under discussion with features of the PSA and FEMS being considered. GAC made a request at the FEPS Council Meeting in Prague, on behalf of the BPS Council, for information on FEPS activities (in addition to the FEPS journal and EPC series) which may more accurately reflect the subscriptions of the national member societies. GAC provided an example of a possible new action (Europe-wide database of museum materials for molecular biology) which could involve member societies across Europe. The request was received in a positive spirit and has resulted in a potentially useful outcome. The new FEPS President has responded by asking all member societies to submit at least 2 ideas for new FEPS projects. BPS Council members were asked for suggestions for new actions following the

Prague meeting and three suggestions have emerged: (i) Geoff Codd: Europe-wide database of museum and archive historic holdings of algae and cyanobacteria for phylogeny, expansion of exotic and invasive species using molecular methods: (ii) Gill Malin: establishment of a European network and database of (coastal) monitoring stations for marine phycology; (iii) Jan Krokowski: establishment of a European network and database for freshwater phytoplankton and water quality. Submissions are being received by the FEPS President from throughout the Federation and it is expected that selection and prioritisation for actions will follow. The next FEPS Council Meeting and AGM will be held in Crete September 14-17, 2017; c/o the Hellenic Phycological Society.

b. Federation of European Microbiological Societies (FEMS) (Paul Hayes)

Members of the BPS continue to benefit from membership

of FEMS through access to FEMS funding schemes and several members have been successful in applying for Fellowships and Meeting Attendance Grants. FEMS is in the process of updating its Memorandum of Association. The FEMS representative recommends that the BPS endorses the new Memorandum, subject to minor drafting changes. FEMS now requires an annual report from member societies giving information about their membership and activities delivered in support of their charitable purpose. This report will be submitted to FEMS by January 26th. FEMS are seeking nominations for three Director roles (Director of Science and Publications; Director of Education and Public Understanding of Science; Director of Events and Internationalisation) by the end of April. Given the current representation of U.K. based societies within the FEMS directorate, the chances of success for any but the first of the roles is likely to be low.

c. Royal Society of Biology (Gill Malin)

The BPS is a member organisation of the Royal Society of Biology (RSB http://www.rsb.org.uk) through payment of an annual fee of approximately £600. BPS members may wish to explore a number of opportunities offered by the RSB including the personal and professional development courses and meetings that the RSB organises. The Membership Secretary passes on the RSB monthly bulletins to the BPS Membership to enable members to keep up to date with what they are offering. Council continues to explore ways to increase the profile of the BPS with the RSB and it is hoped that an article featuring an aspect of phycology will be published in *The Biologist* in 2017. Members are encouraged to promote phycology wherever and whenever possible.

All reports were accepted en bloc proposed Graham Underwood, seconded Gill Malin.

7. Future meetings

a. BPS Annual Meeting 2018 – Southend, Essex Tuesday 9th – Thursday 11th January. Graham Underwood is the local organiser. He outlined the location and facilities of the venue. Detailed information will be added to the BPS website and circulated by email.

b. BPS Annual Meeting 2019 - Oban

The meeting ended at 6.30 pm.

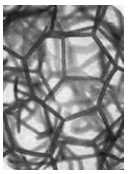
Advertisements

British Phycological Society Seaweed Field Meeting

Orkney 25-29 July 2017

The Society is holding a field meeting to investigate seaweeds from rocky shores on the Orkney Isles off the north coast of Scotland. Orkney is a phycologically remarkable area with species-rich shores with a mixture of northern and southern species and a range of wave exposure from extreme shelter to full Atlantic swell. Particularly exciting are shores with meadows of the arctic fucoid, Fucus distichus. We can revisit shores studied in the BPS field meeting in 1973 to assess change. The meeting will be suitable both for experienced professional seaweed specialists and for those less experienced wishing to learn including amateur naturalists. The meeting will be based at the ferry port of Stromness on the Orkney mainland with laboratory facilities at the International Centre for Island Technology of Heriot-Watt University. Orkney abounds with historical interest as well as fantastic coastal scenery. Stromness is on the edge of the Heart of Neolithic Orkney World Heritage Site. One of our sampling sites will be at Bay of Skaill which also has the remains of the Neolithic village of Skara Brae. Participants might like to build the meeting into a holiday in this fascinating area. For more information about the meeting or to register interest please contact the organiser

Martin Wilkinson at
martin.wilkinson8@btopenworld.com

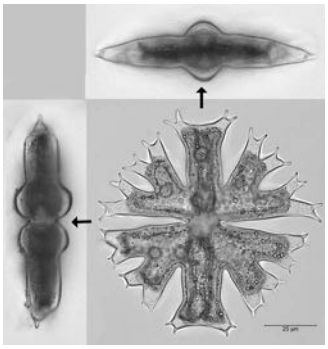


Joint BPS / Quekett field meeting in Windermere

If you are interested in the variety and fascination of freshwater algae, particularly desmids, keep the weekend of free in your diary. This weekend will see the first joint meeting between the British Phycological Society and the Quekett Microscopical Society and will combine field visits, laboratory time and talks. We plan to focus our attention on desmid-rich "Important Plant Areas" (IPAs) in the Lake District, but will be watching out for interesting specimens of all algal groups.

Detailed plans are not yet complete, but we have booked the laboratory at the Freshwater Biological Association for the weekend, and will also organise a meeting room in Windermere or Bowness for evenings. Participants will need to arrange their own accommodation, but there is a wide range in the vicinity, catering for all tastes. Several expert phycologists will be on hand to answer queries about the identity of any algae you find and Quekett members are an invaluable fund of information on all aspects of the microscopic world and on microscopy in general.

If you want to join us, send an email to MGKelly@bowburn-consultancy.co.uk and I will send more information as it becomes available. Students will be able to apply for BPS bursaries via the usual routes



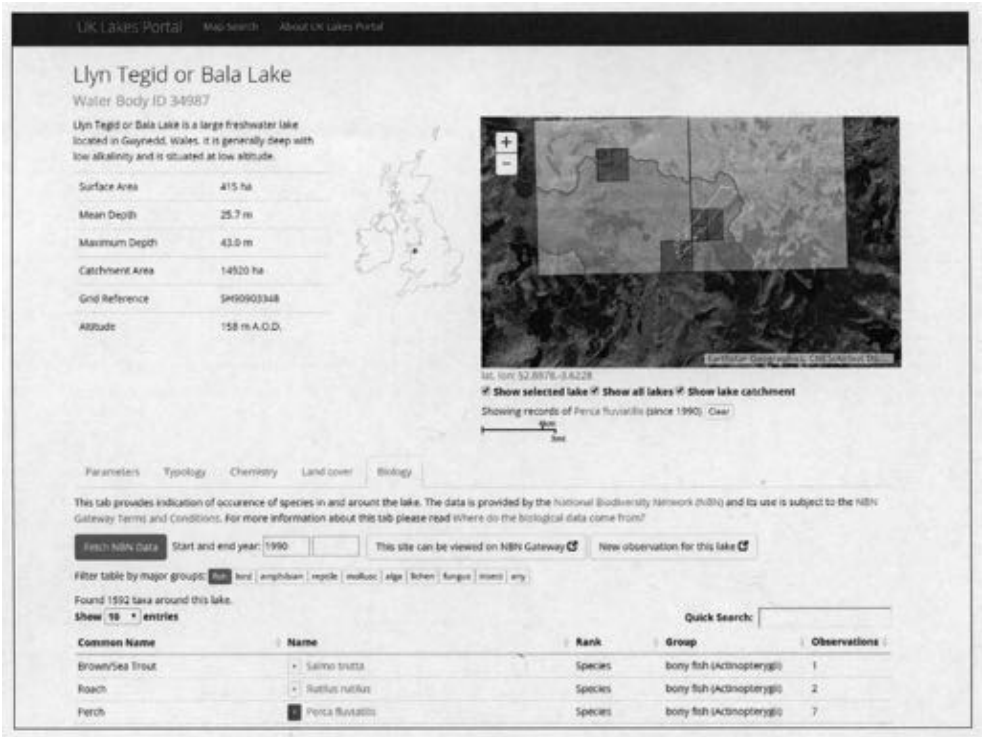
THE UK LAKES PORTAL –
A NEW ONLINE PLATFORM FOR RECORDING FRESHWATER ALGAE

Laurence Carvalho, Freshwater Ecology Group, NERC Centre for Ecology & Hydrology (Edinburgh)

The UK Lakes Portal (www.eip.ceh.ac.uk/apps/lakes/) is a new online gateway to discovering the lakes of the United Kingdom, linking data from many institutions into one central hub, hosted by the Centre for Ecology & Hydrology. The underlying database of UK standing waters has been in continual development since 2004 and includes chemical, environmental, physical and typographic data from an extensive set of sources (Hughes et al., 2004)[1]. This vast dataset, with more than 40,000 lakes represented (including a third with detailed information on their catchments), is now freely-accessible via this newly-developed online portal. The portal provides a national inventory of standing waters in the UK and their surrounding environment (e.g. land cover). Recently the portal has been developed to integrate with data from the National Biodiversity Network (www.nbn.org.uk/), creating an innovative platform for freshwater science recording and knowledge exchange, with each UK lake having a dedicated page with integrated biodiversity data. Freshwater algal species can be queried to filter NBN records and the portal also allows members of the public to record new species observations at any site using the iRecord system developed by the Biological Records Centre, either in the field using the app (http://www.brc.ac.uk/irecord/) or back at home using the dedicated lake records page (www.brc.ac.uk/irecord/enter-uklakes-records). It is hoped that this new online platform will help generate new data on lake biological communities, which are often poorly represented in species records from citizen science projects, to support freshwater research into questions such as how well-connected biodiversity is across UK lakes and how fast invasive algal species are spreading across UK fresh waters. To conclude, the UK Lakes Portal is a fantastic new resource for both professionals and amateur citizen scientists interested in finding out more about their local lakes and the biodiversity within them.

Iain Gunn, Phil Taylor and Laurence Carvalho (Centre for Ecology & Hydrology, Edinburgh)

[1]Hughes M. et al. (2004). The development of a GIS-based inventory of standing waters in Great Britain together with a risk-based prioritisation protocol, Water Air & Soil Pollution 4: 73–84.



INTRODUCTORY COURSE ON FRESHWATER ALGAL IDENTIFICATION

VAN MILDERT COLLEGE and DEPARTMENT OF BIOSCIENCES, DURHAM UNIVERSITY, UK

Organizers BRIAN WHITTON (DURHAM) and DAVID JOHN (LONDON)

Sunday 9 July - Saturday 15 July 2017

AIM To train staff from Environment Agency, SEPA, water plcs, consultancies, museums, research students and overseas visitors in the identification of the more widespread and environmentally important microscopic and macroscopic freshwater algae. Topics introduced include monitoring, field sampling, preservation, harmful and nuisance algae and implications of the EU Water Framework Directive.

COURSE LEADERS Prof. David John and Prof. Brian Whitton. Dr Gordon Beakes (University of Newcastle), Dr Alan Donaldson (consultant) and Dr Martyn Kelly (Bowburn Consultancy) also contribute.

WHERE Accommodation in Van Mildert College and the course in the School of Biological and Biomedical Sciences (about 600 m away). All meals and evening lectures are in the College. Parking near the College will be available for anyone bringing a car, but it is essential to reserve this in advance.

LECTURES and/or practicals run until 2120 each evening, including the Sunday. The formal part of the course ends at 1300 on the Friday, with most study during this period is in the laboratory or seminar room, but there is a short field excursion on the Tuesday afternoon. Following the end of the formal course there is an optional half-day field visit to river sites and to streams influenced by former lead-zinc mining. This concludes with a meal in an Alston pub.

COSTS The inclusive cost for all members other than full-time research students is £920 (no VAT charge) for those making a firm reservation by 1 April. Overseas memberss may stay one further night in advance of the course free of charge. The cost is the same whether leaving after lunch on Friday or breakfast on Saturday.

The discounted price for full-time students is £800. Students who have been members of the British Phycological Society for at least three months (essential!) may apply directly to the Society for some support, but any decision rests with the Society. Details will be posted on the BPS website (http://www.brphycsoc.org/funding.lasso), but it is recommended that an application is submitted as early as possible.

Van Mildert College can provide accommodation for anyone wanting to stay one extra night at the beginning and as many as required at end of the course (about £37 for B & B, with, if wanted, lunch £11 and/or dinner £13 - exact sums announced in early 2017). Payment can be included in the main invoice, provided organizers know well in advance, but otherwise it can be paid to the college after arrival.

BOOKING Provisional and firm reservations for one of 16 places should be made by email (b.a.whitton@durham.ac.uk) to B.A.Whitton Algal Training, 74 Archery Rise, Durham DH1 4LA, UK. A full refund will be made to anyone paying in advance, but then cancelling before 1 June, while 50% refund will be made to anyone cancelling between then and 1 July.

WHAT TO BRING Members should bring boots for field visits and (preferably) fresh samples from their local waters. There is no need to bring a laboratory coat, as these will be loaned. Everything else is provided, including access to The Freshwater Algal Flora of the British Isles and associated DVD. Some people may find it useful to bring their own portable computer, but the risk of loss for this and other equipment such a camera must be covered by their own insurance. A digital version of he training manual will be emailed in advance; if you have booked, but not received a copy by 1 June, please inform the organisers. Hard copies will be distributed on arrival. Overseas members need not bring clothes for the field visit(s) - these will be loaned. The College has facilities for accessing the internet.

TRAVEL Durham is on the main rail line between London King's Cross and Edinburgh. Trains are at least once an hour and the journey from London (400 km) takes three hours (sometimes longer on a Sunday). Overseas members should contact the organizers for advice on buying their ticket. (Advance booking is essential to get the cheapest.) A taxi from the station to Van Mildert College (about 2 km, but a moderate hill for walkers) costs about £5.00 The nearest airport is Newcastle-upon-Tyne. **Avoid Teesside and Durham airport, unless this provides the only suitable flight**. There is a rail route from Newcastle airport to Durham, though this involves changing at Newcastle main rail station and the overall journey can take anything from 1.5 to 2 hours, depending on the connection at Newcastle. A taxi from Newcastle airport to Durham (40 km) takes 35-45 minutes and costs just under £70 on Saturday or Sunday. The organizers almost always collect members at the airport, but it may not be possible to help with the return journey.

PROGRAMME The course (run since 1992) is a mixture of lectures and practicals, together with a short field visit and an optional slightly longer one at the end. Members should arrive by 1700 on the Sunday (though they can take their room earlier in the day), while the daily programme runs from 0900 to 2120. The main course ends after lunch on Friday, but most people join the visit to field sites later that day and leave after breakfast on the Saturday. There is no formal test, but the course ends with a slide-show quiz and a prize for the winner.

Brian Whitton and David John give the majority of lectures. Gordon Beakes helps on the Tuesday; Alan Donaldson (special expertise blue-green algae/cyanobacteria) helps on several days; Martyn Kelly (diatoms) gives lectures and practicals on Wednesday morning and afternoon.

All participants are expected to have read the Manual before joining the course !

FURTHER INFORMATION

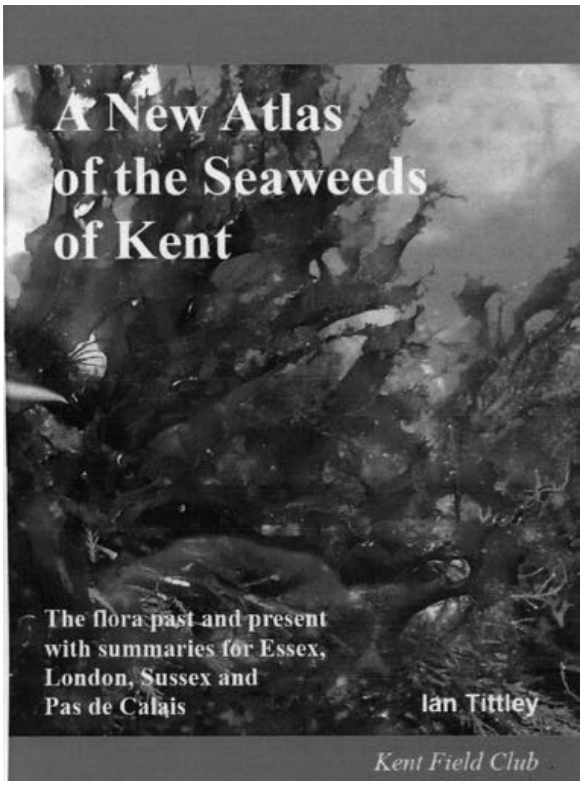
Anyone wanting more details should contact

Brian Whitton b.a.whitton@durham.ac.uk phone +44(0)191-3867504 or

David John d.john@nhm.ac.uk or d_m_john@ntlworld.com phone +44(0)208- 4646367 or 07920124825 or Department of Life Sciences, Division of Diversity and Informatics, Natural History Museum, Cromwell Road, London SW7 5BD, UK

BOOK REVIEW

A New Atlas of the Seaweeds of Kent



by Ian Tittley published 2016 by the Kent Field Club. pp. 158 with CD.

ISBN 978-0-956 1926-6-0

Can be purchased online from www.kentfieldclub.org.uk at £24.00 including post and packing.

This is a remarkable publication setting a new standard for atlases of this type. The author has been associated with the flora of Kent for about 50 years and his knowledge shows through in this work. Ian Tittley has also been in the forefront of championing amateur involvement with seaweeds and this is served by this work which is, on the one hand, academically rigorous for professional phycologists but, on the other hand, takes care to set the scene and give help to those who are less experienced.

The atlas is in the second half of the book which has 84 pages of distribution maps for 281 species. This updates the earlier atlas of 1977 compiled by the Ian Tittley with Jim Price which contained just 184 species. That former work had just one black and white map for each species based on 5km squares of the National Grid but the present one under review not only has almost 100 additional species but very much more detail with the maps. For most species several coloured maps are supplied separately showing, where possible, distribution records prior to the 19th century, and fo the 19th, 20th and 21st centuries, more finely mapped using 2km squares. Most species also have a map based on 10km squares comparing the distribution of species found in Kent with adjacent counties both north and south of the Thames estuary and across the Channel in the Pas de Calais. The maps are accompanied by a brief description of each species often accompanied by habit photographs and/or line drawings of microscopic or macroscopic identification features. The map section of the atlas is a tremendous advance in clarity and information content on the atlas of 40 years ago as well as containing analysis and identification hints. A CD enclosed with the book has the species distribution maps presented on a finer scale of 1km squares of the National Grid than in the printed versions in the book. An important feature of the Atlas is that all parts of the Kent coast are covered including the Thames estuary upstream to Deptford as well as the open coast.

The first half of the book is a veritable mine of information on the shores of Kent, which sets the scene for the atlas. About 55 pages, lavishly illustrated with colour pictures of shores and habitat types contain the following sections. There is a description of the whole Kent coast which does justice to estuarine shores as well as the open coast. Physical environmental conditions that affect the flora are summarised. There is an excellent colour photographic diagram showing seaweed zonation patterns on four principal types of shore found in Kent – chalk, greensand, estuarine river walls and man-made sea walls. Habitat and community types are described with the aid of 29 coloured illustrations. Analysis of the information presented by the maps includes summaries of species totals for Kent by colour groups compared with adjacent counties and the Pas de Calais, with photographs from these areas to compare with the shores of Kent. Species totals within Kent are compared for eight areas within the county with different predominant shore types.

A checklist of seaweeds of Kent is presented updated to the most recent 2016 British checklist of Brodie et al. with a table showing nomenclatural changes since the previous atlas. The reference list covers 122 sources from 1567 to the present. An important feature is the use of grey literature which can be a useful source of data provided that the surveys are thorough and done by competent identifiers. The author has paid attention to this and used data from the many competent, commissioned surveys of Kent locations which have abounded in the last 30 years.

The Kent Field Club is to be congratulated for backing such a superb publication which deserves to be enjoyed by amateur naturalists who may want to know all sorts of information on Kentish shores as well as by professional phycologists interested in deeper analysis of the seaweed distribution patterns. Even if one is not a regular worker on the Kent coast the analysis and descriptive sections are fascinating and valuable.

Martin Wilkinson

INSTRUCTIONS FOR CONTRIBUTORS

Copy which is submitted for publication in *The Phycologist* should be concise and informative. Articles should be scientifically sound, as jargon free as possible and written in a readable scientific magazine style. Unless absolutely essential references should not be included. All types of relevant material will be considered, these include job advertisements, scientific reports, book reviews, news items of topical interest, meeting announcements, grant awards, promotions, appointments, profiles of eminent phycologists and obituaries. If you are interested in submitting material that does not fall within any of these broad categories, or you are unsure of the appropriateness of a potential article, then contact the editor. Suggestions for future articles or a series of articles are welcomed.

Copy should be submitted, preferably as attachments to email or on disc (MS Word for Windows or Rich Text Format). **Illustrations and photos to accompany copy are welcomed and should be supplied as JPEG or TIFF file-format no less than 600 dpi resolution**. The editor reserves the right to edit the material before final publication.

Submission of Copy and Deadlines

Copy should be submitted to:

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Scottish Environment Protection Agency (SEPA),
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Holytown, North Lanarkshire
ML1 4WQ

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