The Phycologist

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BPS Summer Meeting review

Winter meeting announcement

Student Reports

Hilda Canter-Lund photo prize

Brian Moss

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Editorial

A lot has happened since June. Firstly, we had our excellent Bournemouth meeting. Thanks to the organisers especially Chris Maggs and her Team. In this issue we therefore detail summaries from the meeting, as well as the abstracts of talks and posters. We also include the Manton Prize winner, and winner of the Hilda Canter-Lund photography prize, as well as the winner of the second prize. Details of these are outlined inside. There are a large number of student reports, highlighting the great work BPS does in helping fund the upcoming generation of phycologists.

Sara Marsham has stepped down as BPS Membership Secretary after serving 11 years on Council. Your new Membership Secretary is Hilary Redden who can be contacted on membership@brphycsoc.org. We wish to thank Sara for all her hard work and wish her all the best.

We had Brexit, and just as we now know that Brexit means Brexit, therefore autumn means autumn, and the autumn edition of *The Phycologist*. I won't be making any statements but you can read The Royal Society of Biology statement here https://www.rsb.org.uk/news/14-news/1528-uk-science-must-be-protected-in-wake-of-eu-referendum, and the Society for Experimental Biology statement here http://www.sebiology.org/news/article/2016/07/01/seb-statement-on-eu-referendum. There is also a good article from BrexEU (the Department for Exiting the European Union) and the impact on our domestic natural environment (http://www.endsreport.com/article/53767/brexeu-no-one-suggesting-scrapping-existing-environmental-law?DCMP=EMC-ENDSRPTLAWBULLETIN&utm_medium=EMAIL&utm_campaign=eNews%20Bulletin&utm_source=20160909&utm_content=). I won't of course mention anything about what could happen in Scotland….

And we have details of our next **BPS Winter Meeting, which will be held in… Bangor**, during the second week of January 2017. If you are interested in attending, full details are available on the Meeting Website at www.bps17.org.uk and you can contact us on bpsmeeting@gmail.com, as well as following the link from the BPS webpage.

Lastly we remember Professor Brian Moss, who sadly passed away on 27 May 2016. Many of us will have vivid recollections of Brian at BPS meetings and as President in 1997-1998. Brian was the first to contribute as a past BPS President to the collection of articles on the 60th anniversary of the BPS (see *The Phycologist* issue #79). It would have been interesting to hear Brian's opinion on Brexit….

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 : "Swell Life" by Tiffany Stephens - Hilda Canter-Lund prize winner

Review of the 64th Annual Meeting

Jane Pottas, BPS Secretary

The 64th BPS Annual Meeting was held at Bournemouth University 22nd – 24th June 2016. Chris Maggs and Dan Franklin put together an interesting programme of stimulating talks and also social events which allowed delegates to catch up with friends old and new.

The first event of the meeting was a visit to The Freshwater Biological Association River Laboratory in Wareham in Dorset. After lunch the first session was chaired by Gill Malin, BPS President. Talks in this session covered a wide range of topics including cyanobacterial taxonomy; possible sympatric speciation in Lake Baikal; chemical analysis of cyanobacterial mats from Captain Scott's Discovery expedition; the findings of a study of the life history of the red alga *Plagiospora gracilis*; and macroalgal microbiomes. After a break for tea and biscuits Matt Dring chaired the Manton Prize student presentations session. Five students presented details of their research and answered searching questions from an interested audience. All were thanked for their contributions but in time honoured fashion the winner was not announced until the conference dinner so the nail biting continued. Taylor and Francis sponsored the BPS welcome reception and members enjoyed a buffet meal and a chance to natter and network. This was followed by a pub quiz in the campus pub. Several teams of four or five wracked their brains over questions devised by Dan Franklin. Rounds about algae and science and general knowledge were tackled with some animated discussion but perhaps the round which was most challenging was the one with questions about Dorset. I've since googled the term "Dorset quiz" and found some of the questions (and answers) we were defeated by. What a pity I didn't do this **before** the meeting. Still, it was an enjoyable evening and certainly got people talking as well as scratching their heads. The following day there was a special session on Phytoplankton Ecology and Diversity which was chaired by Anne Jungblut. Gary Carvalho introduced the session and gave a tribute to Professor Brian Moss, a past President of the BPS, who died in May this year. A full day of talks was not yet over – there followed the AGM (quorate despite the low numbers attending the meeting) and a workshop with Taylor and Francis on how to get published. Over-stimulated brains were allowed to recover that evening at the Cottonwood Boutique Hotel where a barbecue awaited although this had to be changed to an inside buffet because in Britain no outside event can be arranged without also making contingency plans to have an alternative venue in case of inclement weather. Wet weather did not dampen our spirits and a very enjoyable time was had by all. The Manton Prize winner was announced as Flora Paterson for her presentation on the ecology of *Azadinium spinosum* and the other contributors were warmly congratulated for their presentations, too. As the evening drew to a close discussion turned to the EU referendum vote being held that day and as we returned to our various lodgings the general opinion was that the result would be close but that Britain would vote to remain. This turned out not to be the case and the next day the whole atmosphere of the conference changed and a gloomy air of dejection and disbelief clouded the last day of the meeting. It felt as though there had been a death in the family. Saul Purton had the job of convening the Phyconet session with fellow chairs Colin Robinson and Brenda Parker. At the end of the meeting Chris and Dan were presented with flowers, wine and chocolates as a small token of thanks for arranging the meeting and all contributors and delegates thanked for making the meeting a success.

The experiment to move the annual meeting to the summer has been repeated three times and following an analysis of the results it has been concluded that this has not been an unmitigated success so as from next year the annual meeting will revert to January. The next annual meeting will be held in Bangor in January 2017. Make a note in your diaries and check the BPS website for details. I look forward to seeing you there.

British Phycological Society

64th Annual Meeting

Bournemouth University

22–24 June 2016

We are grateful to our publishers, Taylor & Francis, who have generously sponsored the welcome reception

Contributed talks and posters

Widening changes in cyanobacterial taxonomy and nomenclature: implications for waterbody- and risk management

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The direct environmental determination of cyanotoxin types and concentrations is ultimately necessary to confirm and quantify health risks presented by these toxins in waterbodies containing mass populations of cyanobacteria. However in practice, intensive, structured environmental monitoring programmes, whether of multiple waterbodies, or of multiple sampling stations in a single waterbody, are typically based upon the identification and quantification of cyanobacterial taxa and their abundance. These data are still typically generated via traditional microscopy using cyanobacterial genus and species checklists. The rapid and reliable reporting of such environmental data can be used to provide a surrogate indication of health hazards with reference to threshold levels for cyanobacterial abundance, and of health risks arising from the usage of the waterbody. Based upon the impacts of electron microscopy, and especially of gene sequencing methods, aspects of cyanobacterial phylogeny are currently undergoing substantial change. This is resulting in changes in nomenclature and taxonomy, with the creation of "new" genera and species with proven or inferred potential to produce specific cyanotoxins. Several of the "traditional" assignations of genera and species, with established potential for the biosynthesis of specific cyanotoxins e.g. microcystins, anatoxins, saxitoxins, are being changed. For example, species of toxigenic Anabaena have been assigned to the genera *Dolichospermum*, *Sphaerospermopsis* and *Trichormus*. We discuss the significance of these research-led changes in cyanobacterial nomenclature and taxonomy for the risk communication and management of cyanobacterial mass populations, not least because the new names are being applied in primary research on cyanotoxin production in the laboratory and field.

The endemic Cladophorales (Chlorophyta) of ancient Lake Baikal – a case of sympatric speciation?

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The formation of new species is one of the fundamental topics of evolutionary biology. Sympatric speciation, the divergence of populations without geographical isolation, is a controversial issue and few cases have been confirmed. Sympatric speciation can take place in the presence of gene flow (ecological speciation) or through the interruption of gene flow (hybrid and polyploid speciation). We have discovered an ideal, novel system for studying sympatric speciation and

rapid diversification - a monophyletic group of endemic green algae (Cladophorales) from ancient Lake Baikal, Siberia, that displays exceptional morphological diversity. The endemic Cladophorales of Lake Baikal are classified by morphology as five different genera, but our molecular data show that these 17 taxa represent a monophyletic lineage, nested within the cosmopolitan, morphologically simple genus *Rhizoclonium*. While the morphological diversity in the endemic clade is high, the genetic diversity in ribosomal markers is very low, indicating a relatively recent radiation. Phylogenetic trees demonstrate the well supported monophyly of the endemic species, but fail to resolve the relationships between species. To understand the evolutionary history and to test whether the morphospecies are reproductively isolated, we generated microsatellite markers using next generation sequencing. In addition, some impressions of the fascinating underwater world of Lake Baikal from a recent expedition will be shown.

Macroalgal microbiomes: a new age of discovery

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Marine macroalgae are host to a wide range of prokaryotic and eukaryotic life, creating a dynamic and complex community of specialists or generalists that can be beneficial (mutualistic), neutral (commensal) or harmful (parasitic) organisms. Bacteria are the dominant active group that make up the microbiome, and macroalgal-bacterial studies suggest that there is a core microbiome at the phylum level consisting of the Gammaproteobacteria, Bacteroidetes, Alphaproteobacteria, Firmicutes and Actinobacteria. Next generation sequencing (NGS) is now revolutionising the subject and revealing the extent of bacterial diversity in these microbiomes. This talk will review what is known about microbiomes of marine macroalgae with a particular focus on the red algae. It will explore the notion of a core microbiome for different host groups and also the spatial and temporal ecological impact on host photosysnthesis of different types of epiphytes. Focussing in particular on the prokaryote component of the microbiome, the nature of the relationships between the bacteria and host and the implications for ecosystem function and environmental change including ocean acidification and increasing sea surface temperatures will be explored. Drawing upon our results of the microbiome of Corallina officinalis – the first for a geniculate coralline alga – differences in microbiome composition will be compared both within and between fleshy and calcified species. The nature of these relationships will be discussed including evidence that the epiphytic bacteria provide important services to hosts that are vital to their health, performance and resilience.

Plagiosporaceae, a new monotypic family for a crustose red alga on the road to extinction?

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Plagiospora gracilis, a mucilaginous crustose red alga growing on subtidal pebbles on both coasts of the North Atlantic Ocean, forms distinctive tetrasporangia (red algal meiotic structures that release haploid tetraspores) but gametophytes have never been reported. In the absence of gametangia, the taxonomic position of this monotypic genus has always been uncertain; it is currently placed provisionally in the Gloiosiphoniaceae (Gigartinales) by comparison with sporophytes of *Gloiosiphonia* obtained in culture.

Dioecious gametophytic crusts of *P. gracilis* are now reported for the first time, forming gametangia in inconspicuous superficial sori. There is no evidence that fertilization ever occurs in the field although fertile males and female were collected together. In culture, tetraspores grew into tetrasporophytes for three successive generations, by presumed apomictic sporophyte recycling. The life history of *P. gracilis* may represent a late stage in the loss of sexual reproduction leading to tetraspore-to-tetrasporophyte life histories such as that in *Hildenbrandia*. Phylogenetic analysis of sequences of the rbcL, LSU (28S) rDNA and coxI (COI-5P) genes for P. gracilis with other Gigartinales resolved P. gracilis as a distinct lineage in a well-supported clade of the families Sphaerococcaceae, Gloiosiphoniaceae, Endocladiaceae, Nizymeniaceae and Phacelocarpaceae. We are proposing the monotypic Plagiosporaceae fam. nov. to accommodate *P. gracilis*.

Cyanotoxins, microcystins and BMAA in 100-year old Antarctic cyanobacterial mats from Captain's Scott's Discovery Expedition

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The microcystin (MCN), β-N-methylamino-L-alanine (BMAA), two of its isomers 2,4-diaminobutyric acid (DAB) and N-(2-aminoethyl)-glycine (AEG), as well as the anatoxin-a content were investigated in Antarctic cyanobacterial mats collected during Captain Scott's "Discovery" National Antarctic Expedition in 1902-03. The samples were collected from Ross Island and McMurdo Ice Shelf, East Antarctica and have since been stored dry, in darkness, at room temperature in the UK Natural History Museum's Herbarium. Ultra

performance liquid chromatography-photodiode array detection (UPLC-PDA) and tandem mass spectrometry (MS/MS) analysis were used to detect and quantify cyanotoxins in seven cyanobacterial mat specimens. MCN, AEG and DAB were found five samples, whereas protein-bound BMAA was found in only one sample. No free BMAA or anatoxin-a were detected. The "Discovery" cyanobacterial mat samples represent the oldest polar cyanobacterial samples analysed and found to contain cyanotoxins to date, and the findings confirm that MCN and BMAA and its isomers are well preserved under dry herbarium conditions. The results also provide new baseline data for cyanotoxins in Antarctic freshwater cyanobacterial mats from prior to human-activity in Antarctica, the ozone hole, and currently experienced rapid climatic-driven environmental change.

POSTERS

Forty shades of green…red and brown? Understanding large macroalgal blooms in Irish estuaries

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Macroalgal blooms occur readily in many coastal waters, particularly estuarine areas, as a result of nutrient enrichment, changes in environmental conditions (e.g. climate change, hydrodynamic reduction), the arrival of non-native species or a combination of all these factors. The significant macroalgal biomass that develops and decomposes is an environmental risk to protected habitats, a risk to human health and a financial burden on local communities. The scientific knowledge about these macroalgal blooms is key for proper and effective management. In Ireland, four locations that consistently support significant green, brown or red blooms (Courtmacsherry Bay, Clonakilty Bay, Tolka Estuary and Killybegs Harbour) will be studied in the Sea-MAT project (2016-2018). The project aims are to develop and implement methods for a better understanding of these opportunistic blooms, the parameters that encourage their growth and why certain bays support particular types (e.g. the Ulvales or Ectocarpales). Traditional fieldwork will be complimented by use of molecular tools to identify cryptic species, as well as remote sensing surveys to quantify the blooms over their life span using a hyperspectral camera in conjunction with an unmanned aerial vehicle (UAV). PAM fluorometry, water sampling (macronutrients and physicochemical parameters), stable isotope analysis and metal content of the seaweeds will add to our knowledge of macroalgal bloom dynamics. Culture experiments in the laboratory and field will investigate resource efficiency (N and P) and competition between dominant species. We will describe our sampling methodologies for the field-based research and the main questions that we would like to answer.

Cyanobacterial sequestration by a phagotrophic unicellular eukaryote?

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Phagotrophic unicellular eukaryotes (i.e. ciliated protozoa) have been reported to ingest micro-algae as food, and retain their chloroplasts as 'active organelles' in the cytoplasm. The oxygenic photosynthetic activity of the sequestered plastids contributes to servicing the respiratory oxygen requirements of the aerobic ciliate in the anoxic habitats where they thrive (Esteban et al. 2009). Here we report the potential discovery of a microbial eukaryote with mitochondria that not only sequesters algal chloroplasts but also cyanobacteria, retaining them functional in the cytoplasm. Preliminary observations of Transmission Electron Microscopy ultrathin sections of the ciliate *Histiobalantium* natans show algal chloroplasts as well as cyanobacteria-like structures inside the ciliates. Throughout the course of evolution, chloroplasts may have arisen from cyanobacteria that were engulfed by eukaryotic cells containing mitochondria. Further investigations into the engulfed cyanobacteria by *Histiobalantium* are required but if confirmed correct, our discovery would be the first (and real) analogy to the initial stages in the origin of chloroplasts.

Esteban G.F., Finlay B.J., Clarke K.J. (2009) Sequestered organelles sustain aerobic microbial life in anoxic environments. Environmental Microbiology 11, 544–550.

Grazing of the ciliate *Blepharisma americanum* on one strain of *Chlorella* and three strains of *Microcystis*: grazing differences between strains linked to microcystin content

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Although the capacity for microcystin-production by cyanobacteria such as *Microcystis* predates the evolution of both unicellular and multicellular grazers, much work has investigated the possible role of microcystins, and other cya-

notoxins, as allelochemicals. In addition, recent modelling work suggests that due to their thermal sensitivity, protist grazers, such as the mixotrophic flagellate *Ochromonas*, will have a significant ability to control the cyanobacteria blooms predicted to increase in the future. However, relatively few heterotrophic protist grazers have been assessed for their ability to feed on cyanobacteria. Therefore, we investigated the capacity of a model protist grazer, the ciliate *Blepharisma americanum* (CCAP 1607/1), to graze on three non-colonial strains of *Microcystis* (PCC 7806, PCC 7806-mcy B and CCAP 1450/17) and one strain of the chlorophyte *Chlorella* (CCAP 211/11B). *B. americanum* ingested all strains but only proliferated in the presence of *Chlorella* and *Microcystis* PCC 7806-mcy B. *Blepharisma* died in the presence of *Microcystis* PCC 7806 and CCAP 1450/17 at a rate roughly equivalent to controls. The rate of cyst formation was low and was not significantly different between controls and strains. Of the 13 cyanotoxins detected by UPLC-MS/MS only two were present in strains PCC 7806 and CCAP 1450/17, namely MC-LR and Asp3 MC-LR at ~ 20 and 0.15 fg cell-1 respectively (PCC 7806) and a combined total content of ~ 2 fg cell-1 (CCAP 1450/17). The dataset indicates that *Microcystis* PCC 7806 and CCAP 1450/17 did not allow *Blepharisma* proliferation, but they were ingested, which may indicate that within a ciliate grazer capable of ingesting *Microcystis* cells, the production of microcystins by *Microcystis* may have an inhibitory function. These findings are in contrast to the situation found in a mixotrophic flagellate (*Ochromonas*) and a few heterotrophic protists, such as the flagellates *Collodictyon*, and *Diphylleia*, and some amoebae, which seem unperturbed by feeding on microcystin-rich cyanobacterial cells.

Manton Prize Student Abstracts

Phytoplankton distribution in relation to environmental drivers on the North West European shelf sea

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Phytoplankton in shelf seas play a crucial role in carbon cycling and food web dynamics. However, little is known about phytoplankton communities on the West Scottish Shelf, which is characterised by a steep continental slope alongside which the northwards flowing European Slope Current is steered. The continental slope and slope current were suggested to separate oceanic form shelf phytoplankton and increase northwards advection of phytoplankton along the coast. To improve our understanding of environmental drivers of phytoplankton communities on the shelf, shelf break and adjacent oceanic waters, biological and environmental data were collected on multiple cross-shelf transects across the Malin and Hebridean Shelves to the west of Scotland during autumn 2014. We found that phytoplankton communities on the shelf were significantly different to those found at the shelf break and at oceanic stations, suggesting that the continental slope and slope current limited cross-shelf phytoplankton exchange. Differences in phytoplankton communities between shelf and shelf break/oceanic stations were significantly related to different light availability and nutrient concentrations. There were no differences between northern and southern phytoplankton populations alongside the path of the slope current, suggesting a south to north connectivity provided by the current. This study gives a detailed assessment of phytoplankton communities on the shelf, shelf break and adjacent oceanic waters and hence provides a baseline for further studies on phytoplankton transport along the slope current, the role of changes in nutrient concentrations on phytoplankton communities and the ecological state of west Scottish shelf seas.

Living on the edge: is the structural integrity of rhodoliths (Corallinales, Rhodophyta) affected by climate change?

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Rhodoliths, free-living non-geniculate coralline red algae, are important habitat-formers (maerl). Due to their structural and functional complexity, they support a high level of biodiversity. Their susceptibility to climate change makes them ideal candidates to study the effects of ocean warming and acidification. However, little research has focussed on their structural integrity. Using Finite Element Modelling, we compared 3D geometric cubes representing various rhodolith features with biologically accurate models derived from computed tomography scanning. Results showed that these 3D cubes accurately represented the rhodolith skeleton within cultured *Lithothamnion glaciale* specimens. We can therefore make species-specific models to test specific hypotheses such as the effect of climate change on the structural integrity of rhodoliths. Historical material of *L. corallioides* and *Phymatolithon calcareum* collected up to 100 years ago from southwest England, was compared with contemporary material collected in 2014. Results showed that differences between mineral and structural properties for the two time periods were not large enough to be modelled suggesting responses to environmental change over the last 100 years was not large enough to affect the structural integrity of these organisms. Another example is assessing differences in the structural integrity between species. As different species have significant differences in their structural properties, we can model this and determine whether some species form weaker skeletons than others. With future predictions showing an increase in intensity and frequency of storm surges, our mo-

dels can be used to predict how individual species and hence the habitat will be affected in a more extreme environment.

Upgrading kelp to an omega three fatty acid rich feedstock using thraustochytrids

Joseph Penhaul Smith [1] and David Pond[1]
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Omega three fatty acids have been linked to human health benefits, with the current major source of omega three is the consumption of oily fish. Overfishing prevents the supply of omega threes from meeting demand and as a result alternative sources of omega threes are being sought.

Thraustochytrids are a group of heterokont microalgae which accumulate large of omega threes, principally docosahexaenoic acid (DHA). Currently industrial cultures of thraustochytrids use glucose as the major carbon source, however this is an inefficient process with approximately 5 tonnes of glucose being required to produce 1 tonne of omega three. Therefore research in the area has focussed on the transition away from glucose towards more sustainable, low cost alternatives.

Seaweeds have already been identified as potential aquaculture and bioethanol feedstocks with a number of advantages over agricultural crops. In this study a number of different seaweed species have been screened for their suitability to use in Thraustochytrid culture, with clear success at the laboratory scale. In addition we show that it is possible to reduce the requirement for complex nitrogen sources required for large scale culture by including by-products from whisky distillation. When combined in culture these seaweeds and distillery waste allow the reduction in the concentration of glucose used in cultures. This study is the first of its kind to show that macroalgae are a viable, sustainable, alternative to glucose when culturing thraustochytrids and has potential to meet demand for omega threes globally.

Understanding the ecology of the toxic dinoflagellate *Azadinium spinosum* in Scottish coastal regions

Ruth Flora Paterson[1], Keith Davidson[1], David Green[1], Eileen Bresnan[2], Jean-Pierre Lacaze[2]
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Azadinium spinosum, a recently described species of dinoflagellate, produces the neurotoxin azaspiracid (AZA). AZA accumulates in shellfish flesh which causes acute illness in humans when contaminated shellfish is ingested. The first global reporting of AZA poisonings was in 1998 from Irish shellfish, and AZAs have since closed shellfish production areas for many months each year damaging Irish aquaculture industry. Then during 2011, 2012 and 2013 AZA toxicity was detected in Scotland for the first time; in response to these events, this project conducted the first detailed Scottish survey of *A. spinosum* to determine distribution, seasonality and correlations with environmental parameters. The study was designed to provide basic information to inform the Scottish biotoxin-producing phytoplankton monitoring programme which protects people in Scotland, and abroad, from eating contaminated shellfish. Three coastal sites (Loch Creran, Loch Ewe and Scalloway Harbour) were monitored weekly for one year for *A. spinosum* abundance, phytoplankton community composition, dissolved toxins and other environmental parameters. *A. spinosum* is too small for enumeration confidently via microscope therefore an existing qPCR assay was developed and applied. Very little *A. spinosum* was detected however some trace levels of AZA 1, 2 and 3 were found in the water column. No toxins were detected in any Scottish shellfish during the sampling period. This finding demonstrates *A. spinosum* to be patchy in its distribution and suggests the species may have an interesting life cycle (i.e. hibernation) or be transported into Scottish waters through advective currents, and is not always present in Scottish local waters.

Structural polysaccharides and cell wall mechanics in *Ulva linza*: probing the effects of composition on rigidity

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Green macroalgae of the genus *Ulva* – sea lettuce – are found in marine habitats worldwide. Most species share a very similar, basic morphology – a thin and flexible thallus, only two cell layers thick, which is uniform in appearance and shows little cell differentiation.

Cell walls of *Ulva* species, as well as exhibiting cellulose and hemicelluloses, contain a fraction of sulfated, pectin-like polysaccharides, rich in rhamnose, glucuronic acid and xylose, which are known collectively as ulvan. Gas Chromatography-Mass Spectrometry was used to explore the relative proportions rhamnose, xylose and glucose in cell walls from replicate samples of *Ulva linza*, and cross-polarization magic angle spinning solid state NMR was used to explore both the molecular mobility and carboxylic acid content of these cell walls. Values obtained were used to estimate pectin content.

Atomic force microscopy was also used to probe the stiffness and elastic properties of cell walls, results of which showed a clear dichotomy in the stiffness and elasticity values obtained, with distinct 'patches' of lower rigidity on a two-cell scale seen in the thallus. The results obtained show a clear positive correlation between the ratio of 'stiff' to 'non-stiff' thallus region and the ratio of rhamnose and xylose compared to glucose found in sample cell walls.

Together, these data suggest a diffuse growth model for Ulva species, with dividing cells possessing less-rigid, pectin-rich cell walls, and non-growing cells exhibiting more rigid cell walls with a higher percentage of cellulose. NMR analysis

also suggests that *Ulva* cell walls may be extensively acetylated.

Special Session: Phytoplankton Ecology and Diversity

How does climate change affect the response of cyanobacteria to nutrients?

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It is widely believed that climate change acts synergistically with eutrophication to exacerbate the problems of algal blooms in lakes. However, changes in temperature and rainfall have many indirect effects on phytoplankton, making it difficult to predict what the effects of multiple stressors will be. One approach for unravelling this complexity is to examine responses in long-term lake monitoring datasets. Here we present results from 26 European lakes, sampled for at least 10 years between 1964 and 2014. In total 705 lake years of data were analysed to examine the effects of three stressors (total phosphorus (TP), temperature and rainfall) acting individually and their interactions

The most striking result was the large among-lake variability in responses to the three stressors. In the global model, spring TP had a significant positive effect on summer cyanobacteria biovolume. Weak negative relationships were observed in a few time series. Mean summer temperature showed weak relationships with cyanobacteria. Responses to summer rainfall were similarly weak in the global model and variable at the individual lake level, although significant negative relationships were observed in lakes with short residence times. In summary, the analysis highlights the dominant effect of TP in driving potentially harmful blooms of cyanobacteria but suggests that some individual lakes and lake types will also be sensitive to summer rainfall and temperature extremes, as both strong synergistic and antagonistic relationships are apparent in some lakes.

Progress in the use of satellite data for monitoring phytoplankton blooms in lakes at a national and global scale

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Phytoplankton blooms are a common occurrence in nutrient-enriched lakes, particularly during summer months. These blooms are not only a serious concern for biodiversity and the ecological structure and function of lakes but they can also pose serious risks to animal and human health if they are dominated by toxin-producing cyanobacteria. The reliable detection of phytoplankton blooms is challenging due to the fact that (i) phytoplankton blooms can develop rapidly; (ii) they are often distributed patchily within lakes; and (iii) the majority of lakes in the UK and elsewhere are not routinely monitored. The spatially synoptic and high-frequency observations provided by Earth-observing satellites have the potential to greatly improve our ability to detect phytoplankton blooms in lakes and provide near real-time information on water quality and potential health risks.

This presentation will provide an overview of recent progress in the use of satellite observations for the detection and mapping of phytoplankton blooms in lakes in the UK and globally as well as the key challenges that remain. Case studies will be used to illustrate the potential of using long-term, internally-consistent satellite time-series for investigating the spatial and temporal dynamics of phytoplankton blooms and their phenological responses to global change. Finally, the potential to closely integrate satellite observations with data from in situ sensors and citizen observatories will be discussed.

Exploring interactions between freshwater algae and bacteria

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Interactions between algae and bacteria are frequent in nature and can range from mutualism to parasitism. To further explore and understand these interactions, we have been characterizing the bacterial community associated with

the pennate diatom A*sterionella formosa*, a widespread freshwater microalgae.

A single colony of *A. formosa* was isolated from Esthwaite Water in the Lake District (UK) and was maintained in laboratory conditions. Physiological and microscopy approaches showed that *A. formosa* grows in the presence of multiple types of bacteria, some of which being essential to the diatom. To improve our understanding of *A. formosa* biology, identify associated bacteria and predict possible modes of interactions, we performed metagenomic sequencing of the *A. formosa*-bacteria community. A draft genome of *A. formosa* (total size ≈ 57 Mb) was obtained (Illumina technology) and is currently being improved by long-read PacBio sequencing. Furthermore, metagenomics sequencing revealed the presence of about 30 cohabiting bacterial species (mainly Proteobacteria and Bacteroidetes). Using 16S rRNA barcoding (Illumina technology), we found that relative abundance of these species varies depending on *A. formosa* growth stage, indicating complex dynamics within the microbial community. To characterize this community, cellular, physiological and molecular investigations on modified *A. formosa*-bacteria communities are in progress (addition/depletion of bacterial species).

The results obtained within this study will be compared to other described freshwater algae-bacteria communities and aspects such as the diversity of interactions modes, cohabiting bacterial species, and nutrients and signals exchanges will be discussed. Finally, applications emerging from the understanding of algae-bacteria interactions will be mentioned.

Genetic, morphological, and ecophysiological diversity in *Nitzschia inconspicua* (Bacillariophyta) and implications for ecological assessment of waterbodies

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The use of diatoms for ecological assessment of waterbodies depends on our ability to identify species and to describe their ecological preferences. Traditional identification of diatoms has been based on morphological features of their silica-based cell wall, i.e. the frustule. However, morphology-based identifications are not always straightforward and recent molecular studies have revealed a cryptic diversity in diatoms, suggesting that diatom biodiversity has been greatly underestimated.

Nitzschia inconspicua is a widespread small diatom species which has been described as being tolerant to salinity and organic or nutrient pollution. Consequently, *N. inconspicua* has been included in most diatom-based indices and suggested as a potential indicator of anthropogenic stress. However, the identification of *N. inconspicua* is not clear and it has been often combined with morphologically similar species such as *N. frustulum* and *N. soratensis*. We will present a multidisciplinary study combining morphological, molecular (rbcL and LSU D1–D3) and ecophysiological data (salinity preferences) from *N. inconspicua* clones isolated from the Ebro River basin in Catalonia, Spain. Molecular genetic data revealed seven rbcL+LSU genotypes grouped into three major clades, with a paraphyletic grouping containing other *Nitzschia* species. Morphological differences between clones and genotypes were small, inconsistent and often overlapped. However, two different ecophysiological responses among genotypes were observed, revealing a functional diversity that cannot be distinguished morphologically. Our findings support the need of combining traditional morphological studies with modern molecular approaches involving DNA barcoding in future ecological assessments.

The use of periphytic diatoms in the assessment of ecological status in grazing marsh ditch systems

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Extensive matrices of drainage channels called ditches, dykes or rhynes are located across Great Britain. These wetland areas have often been reclaimed for agricultural purposes in both river floodplains and in coastal regions. Coastal and floodplain grazing marsh areas are a priority habitat as defined by the UK Biodiversity Action Plan. Periphytic diatom assemblages were analysed to estimate their application in the assessment of the ecological and conservation status of selected grazing marsh ditches. Surveys were undertaken between 2007 and 2009 in locations across England and Wales. Periphyton were sampled from a variety of macrophyte species. A total of 135 samples were collected and 214 species of diatom were recorded, illustrating the importance of these sites for conserving diatom biodiversity. A number of metrics were determined, including the TDI, to examine spatial heterogeneity across sites. Key drivers affecting diatom species composition were highlighted. This database of diatoms serves as an important foundation on which changes in the status of these valuable water bodies can be measured.

Temporal dynamics in aquatic ecosystem resilience

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Aquatic ecosystems are resilient to change and have continually adapted to anthropogenic pressures and changing climate dynamics. However, the limits to resilience are not well known and thresholds exist that determine their response to catastrophic events. Resilience in phytobenthic communities is particularly important for wider aquatic processes. Knowledge of winter disturbances and extreme events is limited. This introduces bias in communities used for ecological monitoring such as diatoms. Using long term monitoring in Defra's demonstration test catchment (DTC) programme

we assess the impact of multiple hydro-chemical stressors on phytobenthic community resilience and synthesize the impact of an extreme winter event. Monthly data from diatom communities collected in the Eden DTC show that river flow, strongly coupled to precipitation, is a key driver of these communities (Snell et al. 2014). Discharge has a direct effect on communities through scouring and is also tightly correlated to nutrient delivery, such that 80% of the TP load arrives in just 10% of the time under high flows (Ockenden et al. 2016). Trophic Diatom Index (TDI) values demonstrated considerable stability in inter-monthly TDI scores over 5 seasonal cycles against the highly variable hydrological regime. Winter disturbances are critical for understanding aquatic resilience which is of particular relevance for catchment management given the expected climate change induced increase in frequency and intensity of extreme winter events.

The impact of nutrient concentrations on algal growth rate and community composition in UK rivers

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Despite significant reductions in phosphorus concentration in UK rivers over recent decades, excessive algal growth still poses a serious risk to water quality and ecosystem structure and function. Developing a greater understanding of the physical and chemical controls on the timing, magnitude and duration of blooms is essential for effective catchment management. A series of nutrient limitation studies were conducted across a range of British rivers, using within-stream flumes. Soluble phosphorus concentrations in the incoming river water were both increased and decreased, and the impact on periphyton growth quantified. These studies have identified the P concentrations at which phosphorus becomes limiting for biofilm development. High-frequency physical, chemical and biological monitoring data have also been used to investigate the controls on the timing, magnitude and duration of phytoplankton blooms in the River Thames. This study has identified the complex multi-stressor interactions controlling bloom development. Nutrient concentrations appeared to have little impact on phytoplankton biomass, but severe depletion of dissolved phosphorus and silicon during bloom periods may have contributed to some bloom collapses through nutrient limitation. In combination, these two studies show the relative importance of nutrient concentrations on algal growth, compared to key physical factors such as light, temperature and residence time.

Applications of FlowCAM for phytoplankton enumeration, identification and estimation of chlorophyll content per cell

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The structural attributes of the planktonic community, such as abundance, size-structure or taxonomic diversity, are emergent properties of processes taking place at the cellular, individual level. The analysis of individual cells could be applied to the study of the ecosystem dynamics, both in structural and physiological terms. Techniques for the analysis of individual cells of the planktonic community have emerged in the last decades. The Flow Cytometer and Microscope (FlowCAM) is an automatic sampling device that allows the acquisition of information on a single cell basis. In the last years, standardized methodology for the use of FlowCAM has developed which allows to estimate abundance, biomass and size structure of phytoplankton community with reliability, compared to traditional techniques for plankton enumeration. Coupled with automatic classification of images, this methodology allows the identification of phytoplankton cells in broad groups, such as diatoms, dinoflagellates, ciliates and silicoflagellates. Recently, FlowCAM has been oriented to the estimation of intracellular content of different macromolecules, such as pigments or lipids. We explored the relationship between the emission of fluorescence of phytoplankton single cells measured by the FlowCAM and their chlorophyll content. Hence, from a routine analysis of natural samples it is possible to estimate quantitatively the chlorophyll content of single cells, which relates with the photosynthetic rates of the phytoplankton community and could help in the description of photoacclimation processes.

Marine phytoplankton international intercomparison exercises in the enumeration and identification of marine microalgae through the scheme "Biological Effects Quality Assurance in Monitoring Programmes (BEQUALM)"

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This study presents the results of a series of international intercomparison exercises between laboratories working in the area of phytoplankton taxonomy from across the world over a five year period (2011-2015). These intercomparison exercises are organised annually and have been running since 2005 by the Marine Institute in Ireland and since 2011 in collaboration with the IOC Science and Communication center on harmful algae in Denmark. These exercises are part of the community analysis component of the programme BEQUALM (Biological Effects Quality Assurance in Monitoring Programmes) until 2015 when the programme finished and it is now continued under the new name International Phytoplankton Intercomparison (IPI).

Here, we describe how a phytoplankton intercomparison is designed and organised, how samples are set up, materials are chosen and homogenised, results are collated and analysed statistically, how we arrive at robust consensus values and we used these values to calculate z-scores and other performance statistics. Also, we are presenting the combined results of the last five years and we are showing patterns of analysis performance behaviour through time. Tendencies to over- or underestimate scores over several rounds, what really lies behind these tendencies? How chosing a particular analytical methodology may influence your results. Are methods equivalent? How reliable are the analysts identification of marine microalgae?

Special Sessions: PHYCONET

Current algal biotechnology activities at PML

Mike Allen
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Microalgae offer great potential for commercial exploitation. Here I will provide a brief overview of some of the current activities involving microalgae that are currently being undertaken at PML. These activities range from the bioremediation of metal waste streams, downstream processing, the development of novel photobioreactors, scale up of industrially relevant strains, the generation of guidelines for GM risk assessment following industrial scale cultivation, through to graphic art inspired by microalgae and their structures.

Genome editing approaches to accelerate basic and applied research

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Synthetic biology is emerging as an important subarea of industrial biotechnology. This exciting field deals with the development of biocatalysts using an engineering approach to both improve productivity of natural compounds and design and construct novel biological parts, devices and systems to perform new functions. Synthetic biology requires the development of genome-engineering methodologies that will provide a panel of tools for the efficient and predictable manipulation of cells, which in turn will open the way to the construction of chassis strains.

Although significant advances in microalgal genomics have been achieved during the last decade, their use as industrial biofactories are still hampered by the paucity of genome engineering tools. Classical approaches to study gene function are based on random insertional mutagenesis followed by phenotypic selection, over-expression of transgenes via random integration, and silencing of target genes using RNA interference. However, several research groups contributed to cutting edge research by demonstrating that targeted and stable modifications of the genomes of some microalgae species can be achieved using specific nucleases, such as the Zinc Finger Nucleases, Meganucleases or TALE Nucleases and more recently the system CRISPR/Cas9. This system provides a simple, cost-effective and versatile approach to multiplex genome engineering, promising to be a key player for basic and applied research.

The development of these molecular scissors, able to perform multiple genes knock-out, genes knock-in and to introduce enzyme variants, will facilitate the study of gene function and the acquisition of new knowledge, a prerequisite for redesigning the metabolic potential of microalgae.

Making microalgae work - developing the right tools to dig into algal biology for industrial exploitation

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Microalgae represent the most biologically diverse group of organisms with species estimates ranging from hundreds of thousands to low millions globally. Commercial exploitation is, however, currently limited to less than 20 of these species with less than 10 species comprising the bulk of the global microalgal products market at present. The right tools are essential in order to dig into and develop microalgae for industrial exploitation. We have developed a suite of molecular tools and approaches in addition to controlled cultivation and modelling devices that are allowing us to develop specific microalgae strains as industrial platforms as well as to rapidly domesticate new strains suitable for industrial exploitation. These tools and approaches represent a common pipeline strategy that can be effectively applied to any new microalgae strain to progress effectively from discovery to an understanding of commercial potential. I will present an overview of our non-GMO and GMO-based strain optimisation approaches with examples of application, and provide insight into the future potential for harnessing microalgae within various industrial, biobased-manufacturing platforms.

New strategies for the production of high value chemicals and proteins in transgenic *Chlamydomonas reinhardtii*

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Microalgae have emerged as potentially powerful platforms for the production of recombinant proteins and high-value products, and *Chlamydomonas reinhardtii* is a commonly-used host strain because a range of genetic tools have been developed for this unicellular green alga. Transformation of the chloroplast genome offers advantages over nuclear transformation, and numerous proteins

have now been expressed in the *C. reinhardtii* chloroplast. However, only a single study has reported growth data for *C. reinhardtii* grown at pilot scale. This talk describes the first pilot scale growth study for transgenic, cell wall-deficient *C. reinhardtii*. Strains expressing a plant cytochrome P450 (normally located in the endoplasmic reticulum) or bifunctional diterpene synthase (cis-abienol synthase, TPS4) were grown for 7 days under mixotrophic conditions. The strains grew rapidly and expressed TPS4 and the membrane-bound P450 at high levels. The strains were robust, despite the cell wall-deficient phenotype, and growth characteristics will be presented. The study shows that cell wall-deficient strains may be suitable for commercial-scale operations under mixotrophic growth regimes, and the data provide proof of concept for expression of diterpenoid synthesis pathways in the algal chloroplast, where the cytochrome P450 is driven by photosynthetic electron transport.

Microalgae biotechnology – real world scale-up approaches for industrial development

L. Tiago Guerra, Diana Fonseca, Edgar Santos, Luis Costa, Vitor Verdelho, Manuel G. Antunes, and Nuno Coelho
A4F Algae for Future, S.A, Estrada do Paço do Lumiar, Campus do Lumiar, Ed E , R/C, Lisboa

Industrialization of the microalgae sector requires the integration of existing technologies, as well as the development of new technologies and operational procedures that allow for the maximization of microalgal biomass production in the shortest possible time with the lowest amount of consumables. For large scale industrial production facilities a scale-up strategy (a method to take an algae inoculum from a few millilitres to a culture of thousands of cubic metres) has to be developed. The choice of production systems to be used as well as the scale up strategy is complex and depends on many factors. Some of them are: i) the final product desired and its required specifications, ii) the strain to be used as its specific requirements, iii) proneness of the biological system to contamination, iv) the culture operation regime. Even though many engineering options are possible for the development of very large scale units, its implementation must be gradual with several evaluation points along the way in order to access and optimize performances at each point. A4F, is a bioengineering company that specializes in designing, building, operating and transferring tailor made industrial microalgae production units. This knowledge is supported by a number of biological and engineering research programs being carried out at A4F pilot and laboratorial facilities in Lisbon where different microalgae strains are applied to different production systems for evaluation and optimization. Here, strategies and systems for the scale up of microalgae production units will be described recurring to industrial and pilot scale examples.

Green mining – sustainable mine drainage remediation

Steve Skill and Mabrouk Zanain
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Prospecting and mining for copper ores in Wales was an active pursuit in the middle Bronze Age, almost 1,500 years before the Roman occupation. The mobilization of heavy metals by man through extraction from ores has led to the release of these elements into the environment and since heavy metals are non-biodegradable, they accumulate in the environment and subsequently contaminate the food chain. Certain heavy metals are carcinogenic, mutagenic, teratogenic and endocrine disruptors while others cause neurological and behavioural changes especially in children. There are 1311 abandoned metal mines across Wales that produce cadmium containing acid mine discharges (AMD) and cause nine percent of Welsh rivers fail to meet the European Water Framework Directive objectives.

Microalgae have a remarkable ability to take up and accumulate heavy metals from their surrounding environment, provided that there are adequate conditions for supporting microalgal growth, such as light and nutrients. We have developed a scalable, low cost, passive and sustainable technology solution for acid mine pollution that employs specially developed microalgal consortia. The system can be deployed in remote mine or spoil heap locations and does not require civil engineering constructions.

A Natural Resources Wales/Innovate UK funded demonstration project is currently underway at an abandoned Zn & Pb mine in Ceredigion, treating ~1m^3 /hour minewater with >90% removal of Pb with short hydraulic retention times. Over the next few months the system will be expanded and site-specific design modifications will be explored. The BPS conference presentation will highlight work to date and commercial roll-out both in the UK and overseas.

One cell at a time: droplet-based microfluidics for single algal cell study

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Droplet-based microfluidics has evolved as a standard high-throughput platform for single-cell experimentation and analysis. Monodispersed picoliter-sized microdroplets from microfluidic devices can be generated, merged, and sorted at kilohertz rates, where these microdroplets have been considered as 'microlabs' to compartmentalise single cells and to screen them in a high-throughput manner. Recently, we reported the quantitative tracking of the growth of individual green microalgal cells in microdroplets. Herein, we describe the cultivation, detection, and sorting of two species of marine microalgae *Phaeodactylum tricornutum* (Pt) and *Nannochloropsis gaditana* (Ng) in water-in-oil microdroplets. We show label-free screening and sorting of single Pt and Ng algal cells based on chlorophyll fluorescence. We also demonstrate the quantitative measurement of the expressed green fluorescent protein (GFP) from individual algal

cells in microdroplets, which can be used for screening Pt or Ng strains to identify those with the highest intracellular expression of signalling molecules. Furthermore, we also present a droplet-based microfluidic platform for the analysis of ethanol secreted from cyanobacteria, thereby overcoming one of the major limitations of traditional fluorescence-activated cell sorting by flow cytometry.

Implications of the Nagoya Protocol for algal biotechnology

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Traditionally, natural genetic resources have been considered commonly owned by mankind and so universally accessible, however, as biotechnology has progressed in recent decades so too has a will to develop a means for countries of origin to benefit equably from products derived from resources in their territory, hence, to avoid 'biopiracy'. To address this, the 1992 Convention on Biological Diversity (CBD) was signed at the Rio Summit with 3 main objectives: conservation of biological diversity; sustainable use of components; and fair and equitable sharing of benefits arising from the genetic resources. In order to develop a more transparent legal framework for upholding these aims, in 2014, The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation* entered into force and obliged national Governments to be responsible for setting up authorities to facilitate conforming to the Protocol. The Nagoya Protocol specifically covers 'utilisation of genetic resources', meaning conducting research and development into the biochemical or genetic resources technologies (or 'know how') related to the resources. The user must exercise due diligence to seek, keep and transfer to subsequent researchers, information concerning when, where and how a resource was obtained, and details of the benefit sharing arrangements. We explain the obligations and challenges faced by algal biotechnologists using natural products in their R&D.

Microalgal pigments: bioprospecting, biodiscovery & biorefinery

Dónal Mc Gee, Lorraine Archer, Eoin Gillespie and Nicolas Touzet
CERIS (Centre for Environmental Research, Sustainability and Innovation), School of Science, Department of Environmental Science, Institute of Technology Sligo, Sligo, Ireland.

The biodiversity of microalgae and their suitability for mass cultivation in closed-system photobioreactors has fostered the development in their biorefinery for high-value biological products such as carotenoids, polyunsaturated fatty acids, antioxidants or biopharmaceuticals. The antioxidant properties of carotenoids and phycobiliproteins warrant their applications as nutraceuticals and biopharmaceuticals for the treatment and prevention of chronic and age related diseases. The bioactive potential of microalgae derived pigments has led to a strong market demand for their application as natural colouring agents and functional foods.

Rapid chemotaxonomic and morphogenetic techniques are important components of the bioprospecting process in order to identify and characterise promising strains for physiology studies and subsequent up-scaling in photobioreactors. The total array of pigments present in phytoplankton species are typically taxon-specific, facilitating their application as chemotaxonomic biomarkers. These class-specific pigment signatures or pigment types constitute a useful tool for the characterisation of new microalgae isolates of uncertain taxonomical ascription. A key component to the successful operation of biorefinery plants is the selection of high-performing strains and the optimisation of culturing conditions for enhanced biomass and metabolite yields.

In this study, 120 microalgal strains isolated from the West of Ireland were successfully brought into culture. Rapid chemotaxonomic profiling of multiple strains was undertaken to aid in the identification of those with the potential for high-value pigment production. Six candidate strains, representing different pigment types, were cultured under different light regimes, nutrient stress and phytohormone concentrations in order to tailor the culture conditions and optimise the biorefinery of high-value metabolites.

The potential of the algal chloroplast as a low-cost platform for recombinant products

Saul Purton
Algal Research Group, Institute of Structural and Molecular Biology, University College London, Gower Street, London, WC1E 6BT, U.K.

There is a growing interest in the exploitation of several microalgal species as recombinant platforms for the synthesis of novel bio-products. These could be biofuel molecules, speciality enzymes, nutraceuticals or therapeutic proteins such as antibodies, hormones, vaccines and anti-microbials. DNA transformation methodology is most advanced for the model green alga *Chlamydomonas reinhardtii*, with routine methods for both the nuclear and chloroplast genomes. The chloroplast genome is particularly attractive as a site for insertion of foreign genes since: i) genes can be targeted to precise loci; ii) stable, high level expression can be achieved; iii) the organelle is the site of numerous biosynthetic pathways and therefore represents the obvious 'chassis' on which to bolt new metabolic pathways that divert the carbon fixed by photosynthesis into novel hydrocarbons, pigments, etc. I will present our recent progress on the development of new tools for the genetic engineering of the chloroplast of *C. reinhardtii*, and give several examples of applications in the field of therapeutic proteins. These include the production of anti-bacterial enzymes that target major human pathogens, and the synthesis of protein antigens to create bio-encapsulated vaccines that could be used for oral delivery in the aquaculture and poultry industries.

MANTON PRIZE WINNER

Ruth Paterson

Ruth.Paterson@sams.ac.uk

'A New Age of Discovery for Aquatic Microeukaryotes' was an exciting new meeting held at the EMBL in Heidelberg, Germany. I was fortunate enough to attend with the financial support of the British Phycological Society, enabling me to present my first conference poster 'Physiological differences in the requirement for calcification between *Coccolithus braarudii* and *Emiliania huxleyi*'.

I grew up on the Scottish west coast and spent a lot of time alone on the shore, turning over rocks at low tide and chasing the rockpool fish and crabs. I always felt like the sea was my home and being near water filled me with a deep sense of calm. During high school I was unsure what I wanted to do at university, and was hesitant about moving to a big city and leaving the coast behind. When I found out about the local Scottish Association for Marine Science (SAMS) offering BSc degrees I immediately called them to organise a tour.

Since then I've been studying at SAMS for nearly 7 years! I'm in my final year of a PhD programme which is part funded by Food Standards Scotland and Marine Scotland Science to work towards incorporating molecular techniques for harmful algal monitoring (in particular the recently described dinoflagellate *Azadinium spinosum*) throughout Scotland. The monitoring programme for biotoxin producing phytoplankton species is subcontracted to SAMS and helps to protect consumers of Scottish shellfish from naturally occurring biotoxins. I love the approach of my project because it's very applied. I can see the direct positive effects of my research both to supporting the economy of Scotland and protecting the people who love to eat our shellfish.

In my future career I would love to remain in the field of harmful algal blooms (HABs). The topic will only get more poignant as we rely more on our coastal waters for aquaculture production and as the climate changes. There is a great group of global scientists working on this issue, with people within and without of academic working closely to achieve similar aims. The more we know about HABs, the more we can do to protect the human population. This is a lovely example where science and government can work together to deliver real benefits and I want to be a part of that.

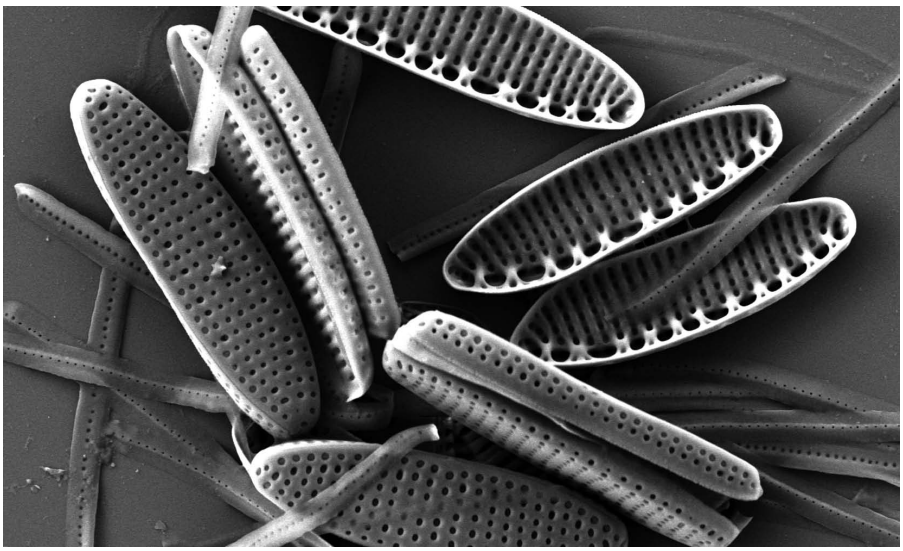
I thank my supervisors Prof. Keith Davidson, Dr David Green, Dr Eileen Bresnan and Dr Jean-Pierre Lacaze for their continued support and wealth of knowledge. I also thank the BPS 2016 organisers for a fantastic meeting in Bournemouth and for awarding me Best Student Presentation, I am very grateful and look forward to the next meeting in January 2017.

Attendance at the 2016 British Phycological Society Annual Meeting in Bournemouth

Laia Rovira-Torres, SEPA, laia.roviratorres@sepa.org.uk

The 64th British Phycological Society (BPS) Annual Meeting took place in Bournemouth in June 2016. The conference lasted 3 days in which experts not only from the UK but from all over the world shared their algal knowledge in a wide range of topics. This was the first time I have attended the BPS meeting and my first conference since I finished my PhD in 2013 and started working for the Scottish Environment Protection Agency (SEPA). It was a great opportunity not only to meet experts in the algal world, but also to present some of my research and to link it to the monitoring work we do in environmental agencies such as SEPA. My presentation was focused on the taxonomical challenges when using benthic diatoms as indicators of anthropogenic stress, and how molecular approaches such as DNA barcoding and metabarcoding can help to refine future ecological assessments.

The conference started with a visit to the Freshwater Biological Association River Laboratory, where we were shown several outdoor facilities including experimental channels, global warming ponds, a fluvarium and a fish counter. The afternoon talks were mostly focused on algal taxonomy with some fantastic footage and pictures of extreme and breath-taking habitats such as the Antarctic and Lake Baikal. The talks were followed by the Manton Prize student presentations, which covered a diverse range of topics, all of very high quality. The second day started with a heartfelt tribute to Prof. Brian Moss (who sadly passed away recently) by Dr Laurence Carvalho, followed by talks on phytoplankton ecology and diversity. There were also a few talks (including mine) on the use of phytobenthos for ecological assessment of waterbodies, and other topics such as using satellite data for monitoring algal blooms, analytical quality control and automated equipment designed for phytoplankton counting and identification. The day was followed by an (indoors) barbecue due to weather conditions, though it brightened up later and led to a very relaxed evening watching the sunset with plenty of interesting conversations. The last day was a PHYCONET special session, and included talks on algal biotechnology and industrial production. This session was particularly interesting since I have not been familiar with progress in algal biotechnology since finishing my degree a few years ago.



In addition to the talks and a few posters, another highlight of the conference was the Hilda Canter-Lund picture exhibition. As someone interested in art and photography, I enjoyed very much the quality and beauty of the pictures, which included both macro- and microalgae using microscopy and naked eye observations.

I am very grateful to the British Phycological Society for the opportunity to take part in such a welcoming and enriching conference. I believe environmental agencies can largely benefit from their scientists attending these meetings and being up-to-date with the latest algal developments, and I hope to repeat such a great experience in the future.

Leanne Melbourne (PhD Research Student), University of Bristol,l.melbourne@bristol.ac.uk

The British phycological society annual meeting is an excellent environment for general discussion, promotion and enhancement of algal research. This year it was held at the Bournemouth University, Talbot Campus between the 22nd and 24th of June 2016. This was a very small intimate meeting with two special sessions, one on Phytoplankton Ecology and Diversity and the second on Phyconet, a UK-network created to further develop the industrial biotechnological potential of microalgae. This small meeting enabled me to have discussions with a wide variety of phycologists and to hear about all the interesting research currently out there. Being a student, who did a chemistry degree, researching on the effects of ocean acidification on marine macroalgae, it was really informative to hear lots of talks on diatoms and freshwater algae, species I hardly know anything about. I found the research currently being done within the Phyconet network to manipulate algae to generate high-value products extremely fascinating.

I was lucky enough to present some of my PhD work in the Manton prize session titled 'Living on the edge: is the structural integrity of rhodoliths (Corallinales, Rhodophyta) affected by climate change?' An experience I thoroughly enjoyed, with members from the audience asking some really good questions which has enabled me to think about my own research in a different light. I also really love hearing what the other BPS students are doing. There are some really forward thinking, interesting research being done by students all over the UK. Overall I thoroughly enjoyed this meeting and have definitely taken a lot back to Bristol with me. For that, I would like to thank the BPS for the funding which enabled me to attend.

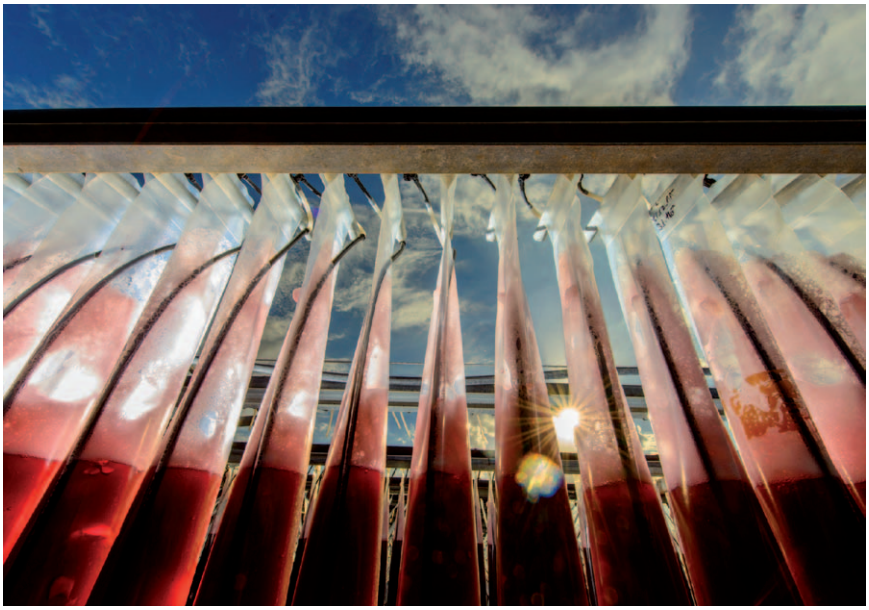


Image by Dani Machlis

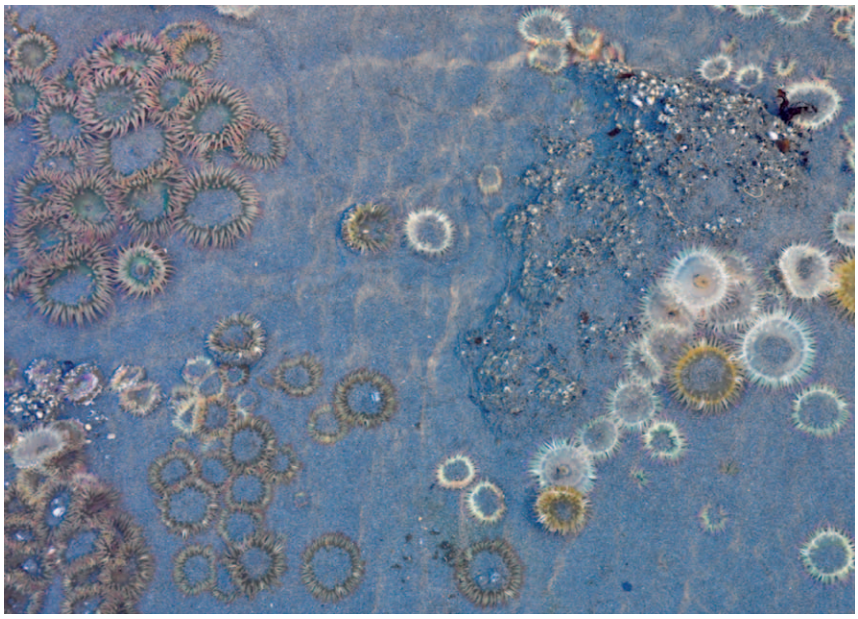


Image by Jamie Canepa

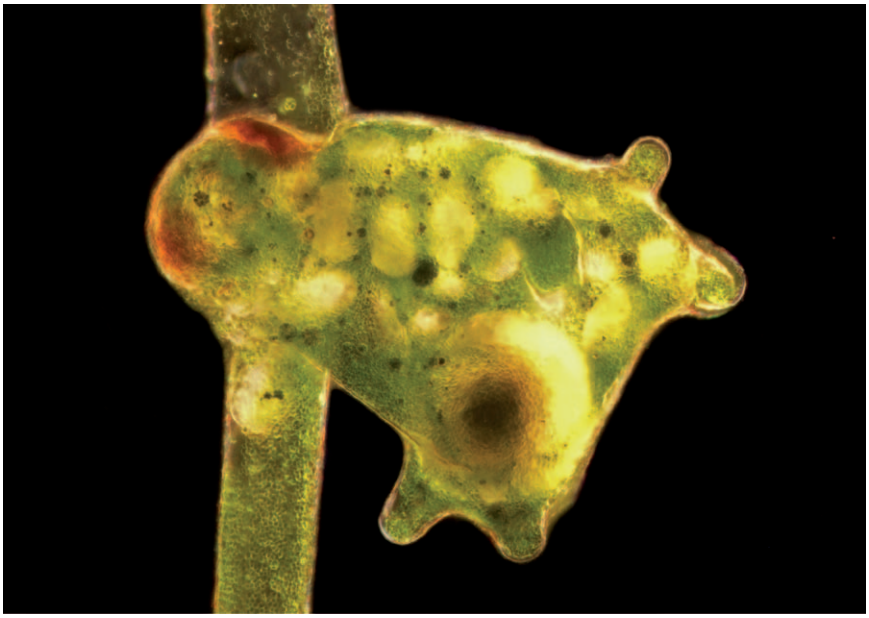


Image by John Huisman

COMPETITION ENTRIES

Image by Leah Reidenbach

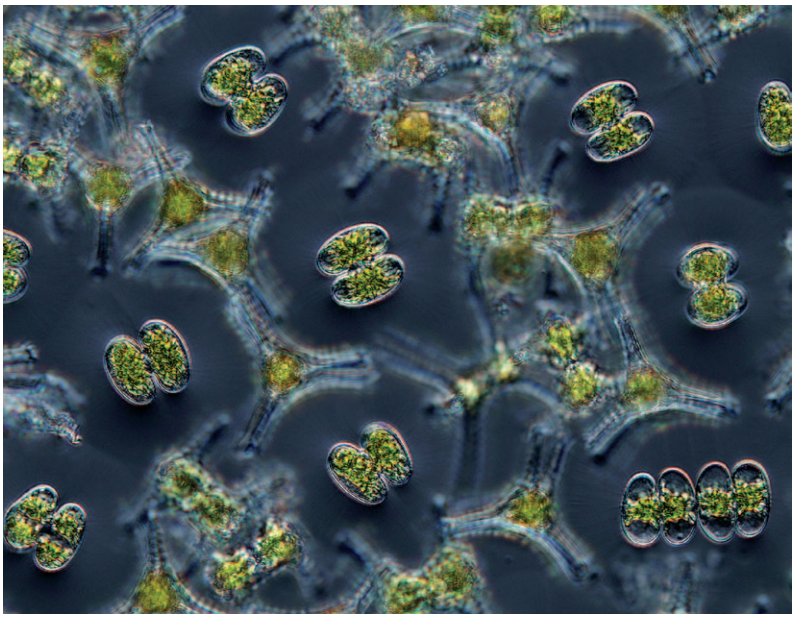


Image by Petr Znachor

Image by Tiffany Stephens

Minutes

British Phycological Society

64th Annual General Meeting

Inspire Lecture Theatre, Fusion 1 Building

Bournemouth University Talbot Campus

16.00 Thursday 23rd June 2016

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 and again in February 2016 to those members who were still in arrears. All future membership enquiries should be addressed to Hilary Redden via the email membership@brphycsoc.org. Sara thanked members for their support throughout her period in office.

d. Student Representative (Paul Cherry)

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

Feedback was initially sought from current BPS student members to inform future events/workshops and gauge interest in such events, however little feedback was received. Two student members expressed interest in writing articles for The Phycologist newsletter and guidance was provided. Student members have been regularly reminded of BPS and FEMS funding deadlines for education/training opportunities and the annual BPS meeting. Details of the 2016 Hilda Canter-Lund photography competition, Irene Manton Prize, and BPS Student Poster Prize were also provided well in advance of application/registration deadlines. The BPS twitter account, @bps_algae, was created in November 2015 and is managed by the student representative. Engagement was initially slow, but this has improved in recent months and is reaching a wider audience and promoting BPS/phycology.

e. Editor of the *European Journal of Phycology* (Chris Maggs)

Caroline Magill continues as Editorial Assistant. Two new Associate Editors have been appointed for Applied Phycology and Biotechnology, Dr. Wiebe Kooistra (Stazione Zoologica Anton

Dohrn) and Dr. Matthew Davey (University of Cambridge). Dr Fuquan Liu (Queen's University Belfast) began a trial term as additional Associate Editor for Molecular Biology. Papers are now available online when corrected proofs have been approved. All printed issues of EJP have come out on time or early over the last year, although there were some delays in distribution due to the membership list having to be newly generated for each issue. The EJP 2014 Impact Factor was 1.912, identical to the 2012 value which had been consistent for four years. The five-year impact factor has decreased slightly from 2.238 to 2.101. EJP ranking in Marine & Freshwater Biology dropped to 39/100 but the ranking in Plant Sciences has increased from 61 to 59. However, the Impact Factor is likely to increase. Journal downloads are maintaining a high value (over 30K per quarter), with a higher proportion being made on mobile devices. The situation remains healthy for manuscript submissions. In 2015 109 manuscripts were submitted to the journal and 27 papers accepted in 2015 will appear in print in 2016. Between January and May 2016 there were 45 original new submissions, including 2 reviews, and submissions from all parts of the world; countries with ≥ 3 submissions were China, Germany, India, Korea, Spain, UK, USA. The acceptance rate is just below 40%. The average number of days from submission to final decision is now < 40 days. EJP partnered the other FEMS society journals in a virtual FEMS Special Issue.

www.fems-microbiology.org/bestofnetworkjournals2016

The paper selected for EJP was the most-cited one – DNA-based species delimitation in algae by Frederik Leliaert, Heroen Verbruggen, Pieter Vanormelingen, Frederique Steen, Juan M. López-Bautista, Giuseppe C. Zuccarello & Olivier De Clerck (2014). The publishers, Taylor & Francis, continue to be very supportive, sponsoring BPS events and generally encouraging innovation in EJP. The Editors are very grateful for this important contribution to the BPS.

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 expressed to Agnès Marhadour for typesetting, Monument Press for printing, and Scottish Environment Protection Agency staff for packaging and posting all the newsletters. Over 400 hard copies of The Phycologist are produced and dispatched in spring and autumn. Members are asked to check and amend their address details as there are always a dozen or so 'returns'. A number of copies of the spring 2016 issue were returned due to the address labels peeling off. Members are asked to get in touch if they did not receive their copy so that a replacement can be sent. Details of how to opt to receive the pdf version only are on the BPS website (membership link).

Production costs continue to rise due to increased printing and postage. The introduction of the colour middle page spread has increased costs. Number 88 Spring 2015 issue was the most expensive to date because extra copies were produced for the BPS/EPC conference in London in August 2015. Contributors of content were thanked and members are encouraged to continue to send articles on phycology and associated topics including any phycological views, news, work events. The deadline for submission of articles for Spring is March 1st, and for Autumn edition is September 1st.

g. Webmaster (Mike Guiry)

No report.

Council has been informed that an annual report will be provided in future. Mike was thanked for his work as Webmaster.

h. Meetings Secretary (Claire Gachon)

No report

The 2016 annual meeting was organised by Chris Maggs with input from colleagues at Bournemouth University. It is anticipated that the role of Meetings Secretary will increase in future. The Society aims to keep costs down to make meetings accessible to as many people as possible. To this end an appeal was issued to BPS members to suggest suitable venues and to offer help in organising future meetings.

i. Awards and Training Committee (Chris Maggs)

Chris commented on the wide variety of conferences, meetings, symposia etc in many parts of the world that students are going to and which BPS is supporting by funding them. News of these activities can be read in *The Phycologist* since disbursement of monies is contingent upon receipt of a report from successful applicants. Students must have been a BPS member for three months prior to submitting an application for funding and it is likely that in future that there will be an expectation that supervisors must also be BPS members.

j. Biodiversity and Conservation Committee (Martin Wilkinson)

In the absence of the Chair of the B&C Committee an abbreviated version of this report was presented by Juliet Brodie. The full report will be published in *The Phycologist*.

k. Outreach and Education Committee (Michelle Tobin)

In the absence of the Chair of the O&E Committee this report was presented by Jane Pottas.

The Committee has been unable to meet so far in 2016 but hope to meet in late summer/autumn. The committee is keen to develop links with other societies and organisations and plans are underway to run a freshwater field weekend in conjunction with the Quekett Microscopical Club as an outreach event, dates to be confirmed. The Hilda Canter Lund competition has come under the remit of the Outreach and Education Committee. Council has agreed that as from 2016 two prizes each of £250 will be awarded, one of which will be for the best photomicrograph and the other for an image taken without a microscope. This year there were 41 entries. The winner in the without magnification category was Tiffany Stephens' image of *Durvillaea antarctica*. The winner of the microphotography prize was Petr Znachor's image of freshwater desmids. Images by finalists in the 2016 Hilda Canter Lund Competition and photographs by the previous seven winners were on display throughout the annual meeting and following the meeting they will be displayed at Poole Park in Plymouth.

l. Algal Applications Committee (Gill Malin)

The Algal Applications Committee met for a discussion meeting on 1st June. The overall aim of the AAC is to foster better connections between BPS and the academic and corporate communities that use algae in their work. In the short term we will a committee section will be developed on the BPS website. A collection of applied phycology photographs (free of copyright) will be for use on the BPS website, brochures etc. We are also compiling a list of commercial organisations with algal interests and major funded projects. This will be used for future meeting

invitations and to encourage corporate membership of BPS. If any BPS members can offer any photos or information please send to g.malin@uea.ac.uk.

Officers and committee members were thanked for their work. Special thanks were expressed to Sara Marsham for her work as Membership Secretary over three terms of office.

5. Federation Reports

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

The Federation includes, as full members, the national Phycological Societies/Algal Groups of Croatia, Czech, Germany, Greece, Ireland, Italy, Macedonia (FYROM), The Netherlands, Poland, Spain and the UK, representing more than 1000 scientists in these countries. The Belgian/Dutch Phycological Society has been disbanded and a new Belgian Phycological Society has been founded. A new Portuguese society for applied phycology is being formed and membership of FEPS is in discussion. The 1st issue of Volume 3 of the FEPS Journal: *Perspectives in Phycology* was published in April. It carried reviews of: dinoflagellate functional genetics; carbon metabolism in secondary endosymbiotic algae; parasite evolution in red algae; algal parasite life cycles; phenotypic plasticity and epigenetics in phytoplankton (www.schweizerbart.de/journals/pip/instructions?af=search). The next FEPS Council Meeting and AGM will be held in September 2016 at Charles University, Prague; hosted by the Czech Phycological Society, 57th Annual Meeting. Link: http://botany.natur.cuni.cz/algo/cas2016/. (FEPS website: www.feps-algae.org)

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

In the absence of the FEMS representative on Council this report was presented by Gill Malin.

FEMS continues to be a valuable source of funding for short-term Fellowships. Two BPS members have been successful in the Fellowship round that has recently been announced: Fatemeh Ghaderiardakani (€ 3800) and Kathryn Schoenrock (€ 1800). One member has applied for Fellowship support in the current round, and there are two meeting attendance grant applications pending. The Microbiology Society (formerly SGM) has submitted a pre-proposal to host the 2019 FEMS Symposium in the UK/Ireland and the BPS has provided a statement of support. (FEPS website http://www.fems-microbiology.org/

c. Royal Society of Biology (Gill Malin)

The BPS remains a member organisation of the Royal Society of Biology (RSB http://www.rsb.org.uk) at an annual cost of approx. £600 per annum, though billing has been somewhat erratic. RSB was set up as the unified voice for biology in the UK. The BPS Council will continue to explore how to increase the BPS profile and 'voice' within the RSB. The RSB monthly member bulletins are being emailed to BPS members by the Membership Secretary so that members can be informed about the work of the RSB and also the personal and professional development courses and meetings they offer.

6. Council Membership

As a consequence of moving the annual meeting to January as from 2017 the terms of office of positions on Council will be extended by six months.

7. Future meetings

BPS Annual Meeting January 2017 University of Bangor, local organiser Andy Davies.

BPS Seaweed identification course, MBA, 25th – 29th April 2017

BPS Field Meeting Orkney - dates and further details to be announced

EPC7 will be held in Zagreb, Croatia in 2019

8. AOB

None

The meeting ended at 17.15.

British Phycological Society Biodiversity & Conservation Committee Report to Annual General Meeting, Bournemouth, June 2016

This committee acts in the conservation of algae, both marine and freshwater, in a variety of ways. In addition to making an informed response to statutory requirements and ensuring that algae are taken into account in national and European conservation measures, the committee promotes interest in the field study of algae so that skills necessary to respond to conservation initiatives are not lost since there is very much less attention to them in universities compared with when the BPS was founded. There is the potential for overlap with the BPS Education and Outreach Committee so the two committees have agreed a division of effort as follows:

Biodiversity & Conservation (B&C) Committee functions are specific as follows:

- Reacting on behalf of BPS to external and legal initiatives concerning algal conservation (e.g. Important Plant Area designation) and liaison with statutory agencies (e.g. Natural England) for this.
- Promoting the framework for algal biodiversity recording, as a component of conservation, by means of:
- Promotion, initiation, support or publishing of algal identification works
- Promotion, initiation, support or organisation of courses on algal identification
- Encouraging biological recording by organisation of check-lists of British species
- Organisation of field meetings to collect records and induct recorders
- Development and management of an online portal for submitting and collating algal records

Some of these functions date back over 60 years to the establishment of the BPS of which some initial aims were the publication of a seaweed flora, and collection of records for a seaweed mapping scheme, supported by field meetings, leading to publication of a seaweed atlas. By a decision of Council in 2003 the B&C Committee took over functions of three previous committees: Conservation Committee; Freshwater Flora Committee and Marine Flora and Checklist Committee.

Education and Outreach Committee (E&O) has a much wider function than B&C. It is a direct successor to the Communication and Education Committee which was set up at the same time as B&C in 2003 with the following remit –

- To increase recruitment of members to the Society, particularly with regards to those living in countries other than UK and Ireland
- To increase recruitment and long-term membership of younger scientists in the Society
- To promote the teaching of algae at all educational levels from primary to adult
- To increase the public understanding of algae by intensifying the level of media attention given to the discipline.

In its short life the B&C Committee can list many achievements which it has either instigated or has supported such as the Freshwater Algal Flora, the SeaSearch Guide to Seaweeds, a new highly successful professional guide to green seaweeds, marine and freshwater check-lists, a website for algal records, responses to national and international consultations on rare species and a new series of marine field meetings.

This is a particularly active committee in which all members are active in various projects including:

- ***Freshwater diatom flora project*** – work is in progress with a BPS grant between Martyn Kelly and Ingrid Juttner and three workshops with interested contributors have been held in Cardiff and Edinburgh. The launch of the website for the public is planned for December 2016.
- ***Freshwater Algal Checklist*** – the NBN (National Biodiversity Network) Inventory is based on the Freshwater Algal Coded List from 2003 but will be updated soon by NBN to the 2014 revision, except for diatoms.
- ***AlgaeVision website*** second version is now live at http://www.nhm.ac.uk/our-science/data/algaevision.html. Some web searches are still leading to the earlier version so Dave John has publicised the new address through Algae-L.
- ***Natural England (NE) Aquatic Plant Taxonomic Group*** - mainly concerned with charophytes but also some seaweeds on the NE rare species list (several are maerl species).
- ***Seaweed Red Data List*** - in draft; is on BPS website.
- ***Seaweed check-list*** –new British check-list now available online at JMBA as proof copy.
- ***List of alien species in the north-east Atlantic*** – Juliet Brodie involved in compiling a list of existing and potential future alien species in the North-east Atlantic.
- ***BPS Algal recording website*** - Now extended to include freshwater (FW) algae as well as seaweeds. Paula Lightfoot (formerly NBN data officer) has been absolutely invaluable with this entire project.
- ***Other seaweed mapping schemes:***
  - *Capturing our Coast (CoCoast)* is a 3-yr Heritage Lottery funded project covering the whole of the UK supported by about 9 academic research institutions, coordinated from Newcastle University. Involves volunteers working on a range of projects including shore recording. Juliet Brodie is on the executive board;
  - *Big Seaweed Search* – existing Natural History Museum project involving public recording is being revised and could become a feeder for CoCoast.
- ***Meetings and courses*:**
  - *BPS Seaweed Field Training Course* - after great success last year run again in Plymouth March 8-12 2016 by Francis Bunker and Chris Maggs and was fully booked with waiting list. Provisional dates for 2017 are 25-29 April.
  - *BPS Seaweed Field Meetings* – not a training course but for recording in the mould of the original BPS field meetings run most years from 1952 to 1980. Second one in new series run at Millport at end of August 2015. 13 members attended. In total 147 taxa were recorded from 3 shores including new records and alien species. Durham Freshwater Algal ID course – run annually by DJ and Brian Whitton. In 2015 there were two courses at different levels attended by 20 people. In 2016 there will be one introductory course.

- *Freshwater Algae Course* at Durham, run by Dave John and Brian Whitton, is recruiting well with up to 16 participants next month.
- *NERC training course at NHM* in taxonomy and diversity, 7-11 March 2016, good support.
- *FBA macroalgae course* - there is to be one run by Alan Pentecost
- ***Publications***
  - *Freshwater Flora* continues to sell well.
  - *Desmid* posters some remaining.
  - *SeaSearch Seaweed Guide* (Francis Bunker, Juliet Brodie and Chris Maggs) second edition now at publishers with 50 additional species and revision of treatment of difficult genera such as Cladophora, and a new chapter on seashore habitats with lists of typical species. Publication expected at end of 2016.
  - *Green Seaweeds of Britain and Ireland* continues to sell.
- ***Wild seaweed harvesting***. Martin Wilkinson, Clare Scanlan and Juliet Brodie have participated in meetings of the Scottish Government's Project Advisory Group for a Strategic Environmental Assessment leading to formulation of Government policy for regulation of wild seaweed harvesting in Scotland. The proposals should go out to public consultation this summer.
- ***Porcupine presentation***. Martin Wilkinson gave a presentation at the Porcupine Marine Natural History Society conference in March at Millport Marine Station on the Island of Great Cumbrae, recently taken over by the Field Studies Council. The talk publicised the seaweed records collected at the BPS Field Meeting at Millport in September 2015, confirming the exceptional richness of the flora and publicising the BPS recording website and its potential use in tracking distributional change. The talk was well-received.
- ***Foraging of wild populations of plants*** has been causing concern and is now spreading to seaweeds. The B&C committee will address this in the near future.
- ***Harry Powell***'s (founding secretary of BPS who died earlier this year) papers and herbarium are being sorted at SAMS laboratory in Oban. These are likely to contain much of interest to seaweed distribution recording. Clare Scanlan has been engaged as a volunteer at the Royal Botanic Garden in Edinburgh to assist with Harry's herbarium specimens.
- ***Orkney field meeting proposal*** is now planned for 2017, either on the anniversary of the BPS 1973 Orkney meeting in August 2017 or at another time in the year when there might be collaboration with another group. A suggestion has been made of possibly joining with the Conchological Society in April which is currently being followed up. If a summer option is chosen this will take account of the IPC meeting dates.

Martin Wilkinson

Seaweeds at Poole Park

Gill Malin, BPS President, with Ruth Paterson, Manton Prize Winner

WINTER BPS MEETING - Winter is Coming…. to Ocean Sciences

The Return of the Winter Meeting

The **School of Ocean Sciences at Bangor University** in Wales will host the 65th Annual British Phycological meeting during the second week of January 2017. Ocean Sciences has been based in the town of Menai Bridge on the Isle of Anglesey since the 1950s, and is truly part of the fabric of life on the largest island in Wales. It's a unique place, with magical beaches and dramatic coastlines, and hosts the village with the longest name in Europe (Llanfairpwllgwyngyllgogerychwyrndrobwllllantysiliogogogoch, aka Llanfair PG). To make the return to the Winter meetings even better, we have lined up some activities to suit all tastes, an amazing meeting dinner in one of Bangor University's most elegant halls and hopefully, we'll have a full schedule of talks and posters on cutting edge phycology.

Starting at 2pm on Wednesday 11th January 2017, the meeting will open with an option of two pre-meeting activities. For those of you who are thrill seekers, we've asked Ribride, a local adventure boating company to take you on a high speed tour of the Menai Strait (£20 per person). For those of you who are less inclined to experience high speed thrills, we've organised a trip to Beaumaris, often hailed as the Mayfair of Anglesey due to the many expensive apartments and houses. With a depth of history, quirky shops and one of the finest 13th century and early 14th century military architectures in Europe, Beaumaris is a lovely place to visit (£5 per person). Unfortunately, these events clash with a council meeting, so council members will not be able to attend (but we can work something out!). Ocean Sciences will formally welcome all attendees to an Ice Breaker in our iconic new building The Marine Centre Wales, starting at 6pm on Wednesday, sponsored by Taylor and Francis, with opportunities to socialise and taking in a display of Ernst Haeckel's Art Forms from the Abyss: Images from the Challenger Expedition. Following this, we've organised a Student Social and Buffet in a local bar (free for students), all other members can head into one of Menai Bridge's many restaurants.

Meeting sessions will start at 9am on both Thursday and Friday, with various sessions across two meeting rooms if needed. As usual the Society will be hosting the annual student competitions, the Manton Prize and the Student Poster Prize. Students should indicate whether they want to be considered for either when submitting your abstract. The talks and posters will be judged by members of the BPS from across the entire spectrum of phycology and there are cash prizes for the winners. The criteria for these awards can be found on the BPS website. In addition, student members can apply for financial support to attend before the 1st December 2016. The Annual General Meeting will be held at 5pm on Thursday, followed by a meeting dinner in Bangor University's Riechel Hall starting at 7pm, with entertainment from senior society members and prize giving. The meeting will close on Friday afternoon at 4pm.

If you are interested in attending, full details are available on the Meeting Website at www.bps17.org.uk and you can contact us on bpsmeeting@gmail.com. The website includes full registration information and abstract submission details. We've also provided full details of all venues that will be used during the meeting and a rough outline of the programme. Attendees can select accommodation in either Bangor or Menai Bridge (spaces are limited), we will be providing a minibus pick up from Bangor on each morning of the meeting (Thursday and Friday). Discounted Early Bird registration is open until the 4th November 2016 and registration will close on the 16th December 2016. Abstracts must be submitted by the 16th December 2016 to be considered for both oral and poster presentations.

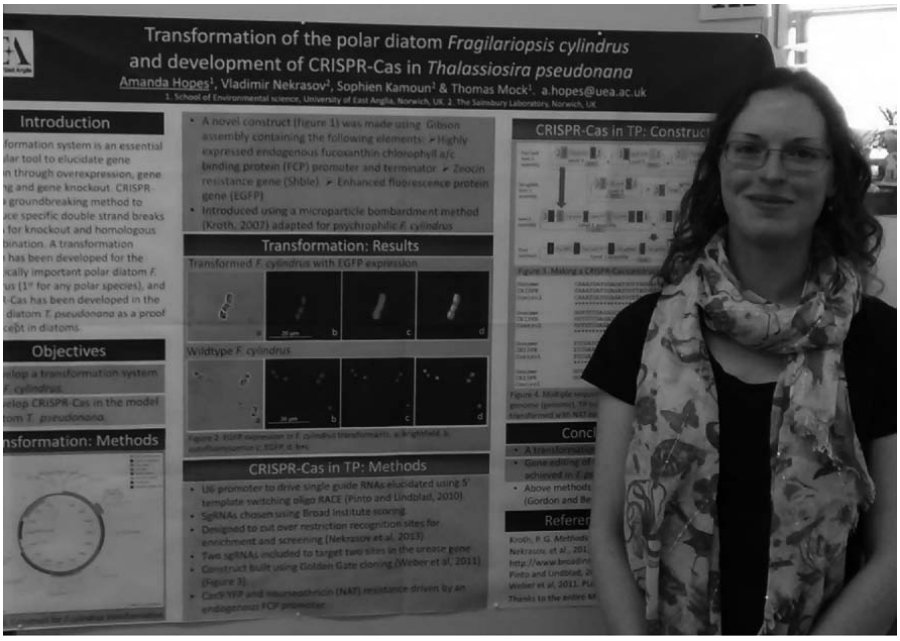
If you are interested in sponsoring the meeting, or wish to enquire about exhibit space, please do contact us on bpsmeeting@gmail.com.

We look forward to welcoming you to Ocean Sciences and Bangor University for the 65th Meeting of the British Phycological Society.

Andrew Davies and the Ocean Sciences coordinating team.

Student Bursary Reports

A New Age of Discovery for Aquatic Microeukaryotes, EMBL, Heidelberg



Amanda Hopes a.hopes@uea.ac.uk

The advanced training centre at the European Molecular Biology Laboratory (EMBL) in Heidelberg was the spectacular setting for the 'A New Age of Discovery for Aquatic Microeukaryotes' conference. The four day conference was split into eight sessions including topics on biological systematics, interactions, organelles and symbiosis, extracellular signalling, molecular and cell biology, ecophysiology and evolutionary ecology. The underlying emphasis of the conference was to enhance research, particularly within the protist community, by sharing methods and results from both established model systems and less widely studied species, bringing together groups working across many different fields. The conference was also a chance to see data from the Marine Microbial Eukaryote Transcriptome sequencing project (MMESTSP) and the Tara and Malaspina expeditions. Sponsored by the Gordon and Betty Moore foundation (GBMF), an important aspect of the meeting involved building on new methods within the community - the additional Experimental Model Systems (EMS) meeting for GBMF grantees was exceptionally useful as a sharing platform in this regard. There were plenty of chances to network with both leaders in the field and other young career scientists during breaks and during the evening. Tables were also set up for speakers during breaks to allow further questions past the presentations themselves. As a result I managed to speak to several people within the diatom and microalgae community, gaining a lot of useful feedback concerning my work on regulation of silicification in *Fragilariopsis cylindrus* and gene knockout in *Thalassiosira psuedonana*. Poster presentations were set up around the impressive double helix at the centre. I presented a poster on the successful development of two methods in diatoms: a transformation system in the polar diatom *F. cylindrus* and CRISPR-Cas in *T. psuedonana*. Both aspects of my poster generated a lot of interest, particularly from the microalgae community. Several other groups at the conference were working on CRISPR-Cas in *Phaeodactylum tricornutum*, a model pennate diatom. This led to some very useful discussions and ideas which are likely to be beneficial for this method across diatoms in general. The conference was very informative and a lot of fun, especially with the conference party and wonderful EMS dinner at the end. I would like to thank the British Phycological society for providing me with funds towards travel and attendance.

European Networks Conference on Algal and Plant Photosynthesis

Ana Luísa Gonçalves, LEPABE, Chemical Engineering Department, Faculty of Engineering, University of Porto, Portugal, pdeqb0707727@fe.up.pt

I am a third-year PhD student from the Faculty of Engineering of the University of Porto (FEUP). My PhD project, entitled "Carbon dioxide capture through microalgae and cyanobacteria", is being developed in the Laboratory for Process Engineering, Environment, Biotechnology and Energy (LEPABE), under the supervision of Professor Manuel Simões and Doctor José Carlos Pires. This project aims the optimization of culturing conditions of microalgae and cyanobacteria to improve CO2 sequestration and nutrient removal from wastewaters.

Thanks to the British Phycological Society student bursary, I was able to attend the European Networks Conference on Algal and Plant Photosynthesis (ENCAPP 2016) that took place in April 2016 in Qawra, Malta. The aim of this conference was to create a platform for knowledge exchange on the topics of photosynthesis and light-driven microbial communities and to disseminate the main results obtained in two EU-funded projects: "AccliPhot" and "PHOTO.COM". This was a very interesting conference because it covered different phycological aspects, being divided into ten sessions: (i) photosynthetic electron flow; (ii) modelling metabolism; (iii) light acclimation; (iv) CO2; (v) chloroplast structure/assembly; (vi) communities; (vii) omics; (viii) engineering; (ix) innovative algae research for a bio-based economy; and (x) industrial cultivation. Moreover, research fellows finishing their PhDs had the opportunity to present their works and main conclusions, which was very inspiring for me at this stage of my work. During this conference, I also presented my work through a poster entitled "Microalgal growth modelling and nutrients uptake in response to light and temperature". Therefore, this conference was very important for me to present my work and

to expand my knowledge on microalgal photosynthesis.

I would like to thank the British Phycological Society for the funding, which enabled my attendance at this conference. It was a very interesting and motivational conference, where I had the opportunity to meet fellow researchers from different research groups and to exchange ideas about future research studies, which was very challenging for me as a junior researcher.

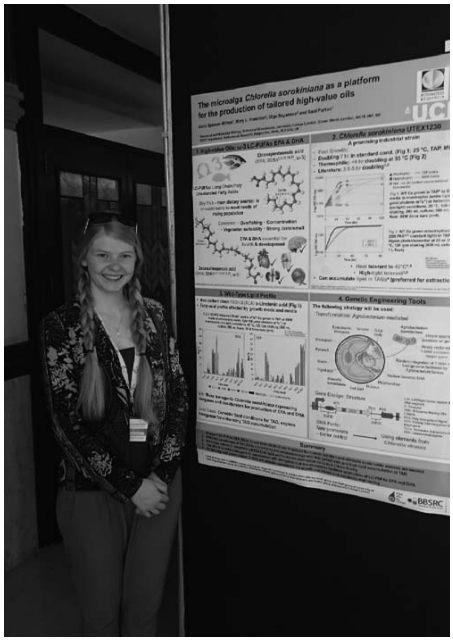
4th edition of the course "Microalgae process design: from cells to photobioreactors"

I am a third-year PhD student from the Faculty of Engineering of the University of Porto (FEUP). My PhD project, entitled "Carbon dioxide capture through microalgae and cyanobacteria", is being developed in the Laboratory for Process Engineering, Environment, Biotechnology and Energy (LEPABE), under the supervision of Professor Manuel Simões and Doctor José Carlos Pires. This project aims the optimization of culturing conditions of microalgae and cyanobacteria to improve CO_2 sequestration and nutrient removal from wastewaters.

Thanks to the British Phycological Society student bursary, I was able to attend the 4th edition of the course entitled "Microalgae process design: from cells to photobioreactors", organized by the Graduate School VLAG, in cooperation with Bioprocess Engineering - AlgaePARC (Wageningen University). The aim of this course was to provide a thorough understanding of microalgal metabolism and photobioreactor design to PhD candidates, postgraduate and postdoctoral researchers, as well as professionals. This intensive course was very interesting because it covered different topics about microalgae, such as: (i) fundamentals of photoautotrophic growth and light; (ii) quantifying light-limited microalgal growth; (iii) predicting productivity in photobioreactors and raceway ponds; (iv) microalgal metabolism and secondary product formation; (v) metabolic flux modeling; (vi) metabolic engineering strategies; (vii) mass transfer in photobioreactors; (viii) cultivation strategies in photobioreactors for optimal yield; and (ix) going large scale: experiences and challenges. Additionally, classes were divided in lectures, digital cases and a photobioreactor practical, where it was possible to learn how to describe microalgal metabolism quantitatively, how to apply basic design principles and setup mass/energy balances for photobioreactors, how to cultivate microalgae in fully controlled photobioreactors, and how to integrate all acquired knowledge into optimal production strategies for microalgal biomass or secondary metabolites.

I would like to thank the British Phycological Society for the funding, which enabled my attendance at this course. It was a very good opportunity to improve the techniques I am developing in my research studies and also to contact with the industrial point of view of microalgal production processes. Additionally, it allowed me to network with a variety of experts from the microalgal industry and colleagues from other academic groups, which was very useful for me as a junior researcher.

Young Algaeneers Symposium 23rd-25th April 2016



Xenia Spencer-Milnes,
University College London

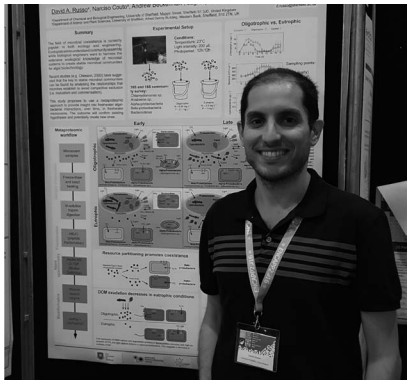
I am a second year PhD Student at University College London under the supervision of Professor Saul Purton. My research focuses on the production of high-value oils in the microalga *Chlorella sorokiniana*, including optimising and developing genetic engineering tools and DNA parts for this algae. In April this year, five members of our lab headed out to Malta to the Young Algaeneers Symposium 2016. This event focuses on algal researchers early on in their careers as PhDs or postdocs, and therefore provided a slightly more relaxed and less intimidating environment than some of the larger conferences: ideal for my first algae conference outside of the UK!

The conference took place at the Dolmen Resort Hotel in Qawra on the coast, which provided us with a lovely backdrop for lunch and outdoor discussion sessions. The first day consisted of a great get-to-know-each-other activity in the capital city of Valletta, where we were thrown together in teams of people we didn't know - a great way to break the ice! This was followed up by a 'speed-dating' event where we managed to have short but useful conversations with lots people in attendance – it also made me realise what a small world it can be as I discovered I knew a few other people already. It felt like these social events meant everyone was much more comfortable during the talks to ask questions and chat during the poster sessions.

The talks were grouped into three broad categories throughout the 3-day conference. The first session was based around cultivation of algae and the keynote talks covered topics of scaling up, improving strains with selection pressure, algal-bacterial interactions, and bioreactor design. Then short, 5-minute, poster 'teaser' talks concluded the session. This was the format of all the sessions, and the second focussed on algal engineering applications from a commercial point of view including high value products, whilst the third contained talks on wastewater treatment applications and bioremediation. The short teaser talks were a great way to appreciate the variety of research in algae and to communicate the research in a concise manner - I really enjoyed the format.

On the second day we also had a really interesting discussion session where we split into groups to talk about future challenges and prospects of algal research across different topics. On the third day ideas from this were presented to the whole group and some key issues such as communication in interdisciplinary teams were highlighted.

Overall it was very inspiring to see the variety of research around algae and microalgae, and it really helps to put the work you are doing into context with everyone else. The conference had a great atmosphere and I had a lot of fun as well. I would like to thank the British Phycological Society for the opportunity to attend this conference, which has left me very much enthused and invigorated about my research and algal research in general.



David Russo, d.russo@sheffield.ac.uk

The Young Algaeneers Symposium is an informal conference organised by young researchers aimed specifically at fellow young scientists in algal research. The previous two editions were held at the AlgaePARC (Wageningen, University) and in Montpellier/Narbonne. The third edition was organised by two Marie Curie ITN's (PHOTO.COMM and AccliPhot) and took place in Qawra, Malta in April 2016. The relaxed setting and being surrounded by young researchers created a comfortable environment to network, exchange ideas and showcase our research. Personally, this conference marked the end of my PhD. After 3 years and a half of hard work, I submitted my thesis just the week before travelling to Malta and I was lucky to be selected to share a part of my research in an oral presentation.

The conference started with a GPS challenge that lead us on a tour of Valetta. This was an excellent way to visit one of Malta's historic cities and at the same time to meet other attendees. Later in the day, a speed dating session and dinner were organised so we could quickly become acquainted with everyone at the meeting. Both these activities really set the tone of the fun meeting to come. The second day started with the first keynote and flash presentation session of the meeting entitled "Cooltivation, Bro". It was in this session that I had the privilege to present my work "Metaproteomics provide insight into algal-bacterial interactions". The audience asked extremely relevant questions and I was pleased to see that research into aquatic microbiomes is promoting an interesting debate.

After lunch the session entitled "Algaeneering: from bench to bank" introduced presentations that focused on translation laboratory approaches to industrial settings. Quite fittingly, this session also included an open debate "Algal gaps: Future challenges and prospects". The young researchers were

divided into four groups and each group was attributed a topic. I chose the group that discussed "Maintaining positive client-investor relationships" as this overlapped nicely with my current interest in industrial algal biotechnology. It was also interesting to see that many young algal researchers are application oriented and have a strong entrepreneurial spirit. Following this session was an excellent poster session and a dinner by the seaside for some well-deserved entertainment. The final morning of the conference was occupied by the session "Midas Touch: turning waste into green gold" which provided several open discussions regarding the best strategies for resource utilisation and the value of recycling waste products. The rest of the day had the final poster session, a wrap-up discussion of the open debates from the previous day.

Ultimately, this conference was an amazing experience and an opportunity to make friendships and expand my network amongst young people in algal research significantly. I'd like to thank the British Phycological Society for once again funding my presence at a conference that allowed me to disseminate my work while having a great time.

22nd International Seaweed Symposium (ISS) in Copenhagen, Denmark, June 19-24, 2016

Fatemeh Ghaderiardakani,
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I attended the 22nd International Seaweed Symposium (ISS) in Copenhagen, Denmark, June 19-24, 2016. The event was designed to present all aspects of modern and traditional seaweed research and applications in order to facilitate linkages between university and industry under the symposium title "Creating the scientific platform for sustainable and innovative industries for the future society".

The Symposium had a technical focus with about 40 technical sessions running throughout the 5-day conference covering issues including 'Cultivation - Landbased systems', 'Processing - Alginate', 'Biofuel', 'IMTA and Biomitigation', 'Seaweed for food and feed', 'Climate and Ecology' and 'Future of seaweed'. This conference was an ideal platform for both academia and industry to be present, allowing ideal networking opportunities.

The poster that I submitted in conference was entitled 'Comparing bacterial-induced morphogenesis between Ulva species'. Giving this presentation allowed me to have discussions with a number of researchers in this field and also to get valuable feedback and comments from other attendees. In addition, I made a number of international contacts particularly with some great companies who I may be able to collaborate with them in future.

I am very grateful to the British Phycological Society for their financial support in order to attend this great conference and would like to thank everyone involved for making this meeting such a unique experience.

Global Seaweed Workshop

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I am honored to be one of the recipients of the BPS student bursaries to attend the Global Seaweed Workshop in Scotland. I was thrilled to learn of my selection for this honor and I am deeply appreciative of your support.

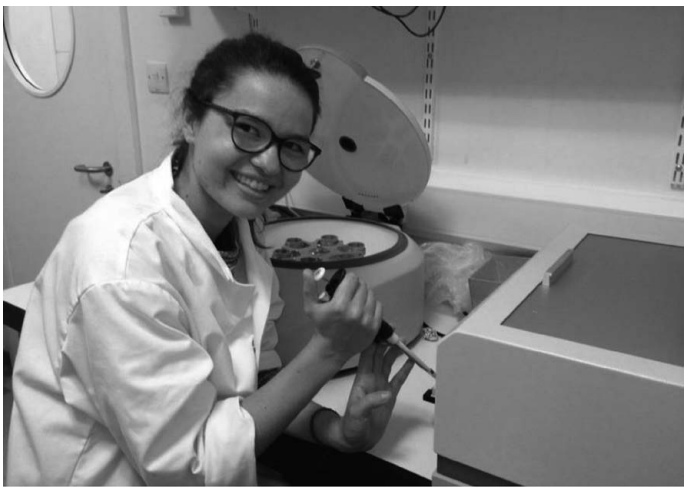
I am conducting a co-tutorship thesis between the University of Sfax-Tunisia, within the Doctorate Biological engineering, under the supervision of prof. Slim Abdelkafi, and the University of Messina-Italy, within the Doctorate Applied Biology and Experimental Medicine, under the supervision of Prof. Marina Morabito. My research focuses on "DNA barcoding identification of macroalgal flora of Tunisia". This project funded by EMMAG- Erasmus Mundus.

Last May I was fortunate enough to be able to attend the Global Seaweed Workshop 2: Potential and Challenges of Seaweed Cultivation, which was held in The Scottish Association for Marine Science (SAMS), Scottish Marine Institute Oban-UK. This second summer school run by the Global Seaweed Network, explored the potential and challenges of seaweed cultivation. Three-

day workshop blended lectures by experts, interactive round tables, field and laboratory sessions. By illustrating disease management and biosecurity challenges in established aquaculture industries, and with the support of specialists in the field (Salmon, Oyster, Shrimp), this second edition highlighted the lessons learnt from historic aquaculture sectors and provided a policy roadmap for sustainable development of the seaweed Industry. The first Day of the workshop focused on maximizing the benefit of seaweed cultivation by addressing ecological challenges. In second day, I learned about Seaweed Diseases, Deciphering algal-pathogenic interactions and future directions of seaweed breeding. The last day was learning lessons from established industries for the future of seaweed aquaculture.

This workshop was very interesting to improve my knowledge on possible economic applications especially I started to work on the diversity of macroalgae of Tunisia during my PhD project. As well as it was very helpful to meet famous scientists names and to deepen existing friendships and make new ones with students from around the world. I am very grateful to the BPS for receiving the travel award which gave me the opportunity to attend this excellent workshop.

Desperately seeking immunity: a summer's attempt to study Ectocarpus siliculosus



Helen Feord,
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I fell in love with algae during a field course in freshwater biology towards the end of my first year at university. Ten days of staring down a microscope at beautiful organisms that I had until then been relatively oblivious to changed my world. Ever since, I have been unwaveringly adamant that I want a career in phycology.

I am three quarters of the way through an undergraduate master's degree in plant science at the University of Manchester. This summer, BPS funding gave me the opportunity to spend a month and a half working in Dr Claire Gachon's lab, at the Scottish Association for Marine Science, just outside of Oban. The project I undertook related to the potential presence of membrane receptors involved in pathogen recognition in the model species of brown algae *Ectocarpus siliculosus*. We wanted to focus on a particular bacterial peptide which has been identified as a Pathogen Associated Molecular Pattern (or PAMP) called flg22. Indeed, flg22 is well known within plant sciences as it is recognised by membrane receptors present in different species. This recognition allows for the triggering of an immune response against these recognised invading pathogens. Flg22 is part of flagellin (the molecule making up bacterial flagella), which also contains another domain recognised by animal membrane receptors. Because of this highly conserved mechanism of innate immunity, it is likely that other (yet unidentified) organisms may have this immune response.

A previous study on the brown algae *Saccharina japonica* species had shown an immune response to flg22. As such, Claire's lab wanted to ask exactly the same question for *E. siliculosus*: could it recognise this peptide? And there were essentially two ways of answering this query. Either study how *E. siliculosus* reacted to flg22 by screening for known immune responses after incubating it with flg22, or by going to look for potential flg22 membrane receptors in silico. We focussed mainly on the former by looking for potential oxidative bursts in the brown algae when incubated with flg22, which we thought would be good initial indicator of an immune response. To do this we used a method called chemiluminescence, where reactive oxygen species (ROS), such as hydrogen peroxide reacts with a chemical called luminol in the presence of a catalyst, and produces light. The intensity of the light is a proxy for the amount of ROS in solution. In theory this would indicate if, when tested over time, flg22 induces an oxidative burst.

However, first we needed to familiarise ourselves with the machine as well as developing our own protocol for the use of chemiluminescence on *E. siliculosus* by adapting methods from previous studies on plants and other species of algae. Thus ensued hours of reviewing previous literature as well as pipetting, diluting and quantifying hydrogen peroxide to establish standard curves. By using hydrogen peroxide we were able to perform multiple tests to determine which catalyst and which machine settings were optimal for our experiments. Because it was a pilot study, I had been warned that it would not be straightforward and that the chance of it working was slim. I am still a newcomer to the world of research, and my (naïve!) optimism refused to believe in such rational foresight. However, while we did manage to develop a protocol that worked well for our experiment, our data suggests that *E. siliculous* does not produce an oxidative burst when incubated with flg22. This preliminary data leads us to believe that this alga does not recognise flg22 in a way which triggers an immune response.

Being at SAMS has been an incredible privilege. These seven weeks have been a chance to get to know the world of phycology better: I have read dozens of papers, talked to different scientists about their research and have really been taught to think about experimental design and to question

and interpret data. As well as this lab project, I have been introduced to the fundamentals of linux programing and gained some basics skills in microscopy. Additionally I got the amazing chance to help Susan Brawley, a visiting professor from the University of Maine, with fieldwork for a few days while she was here sampling macroalgae, as well as helping with the seaweed harvest at SAMS in my last week.

I have left SAMS more convinced than ever that phycology is what I am passionate about. I am about to start my masters project on extremophile algal genetics, and I am very motivated to continue postgraduate study in phycology. In particular, I would really like to thank Dr Yacine Badis and Dr Claire Gachon for offering me this placement and spending so much time teaching me, as well as the students and staff at SAMS who have been so welcoming. I am very grateful to BPS for making this placement possible.

8th Aquatic Virus Workshop

Sarah Heath, s.heath-2@sms.ed.ac.uk

In July 2016, I attended the 8th Aquatic Virus Workshop held in Plymouth, which attracted researchers from around the world. I was fortunate to receive funding from the BPS to attend and present a talk entitled "Environmental effects on growth and susceptibility to viral lysis in *Ostreococcus tauri*". Coming from a lab in which I am the only person studying algal viruses, this was the perfect opportunity to meet up with collaborators, find out what is at the forefront of aquatic virology and to receive feedback on my results from others. The small size of the conference, consisting of less than 100 delegates, meant that there was only one symposium and many people had the opportunity to speak. This allowed us to hear from a wide range of researchers, from professors to PhD students, without having to miss anything. The standard of talks and posters was excellent and I really found all of the results and ideas presented fascinating. Another great thing about being part of a small workshop was being able to talk to almost everyone and make useful contacts and friends. One afternoon of the workshop consisted of a discussion in which everyone could participate in a relaxed atmosphere. It was really encouraging to see that this field is being so proactive to move the research forward and form a close community. I am grateful to the organisers of AVW8 for providing such a great workshop, as well as the BPS for providing funding for me to attend. The meeting really made me excited about the field of aquatic viruses and I hope to be able to attend the next meeting!

European Congress on Biotechnology

Loris Fossier Marchan, lorisfossier@gmail.com

The European Congress on Biotechnology (ECB) is a world leading conference organized by European Federation of Biotechnology. Its aim is to bring academics and industrial biotechnology businesses together, and over the past years has developed a strong link with the Asian Federation of Biotechnology. The 17th ECB was held in Krakow (Poland) early July this year and involved a tight schedule over 3 days which included 4 plenary lectures, 25 symposia with associated 1 hour talks and more than 300 15 minutes - short talks and poster presentations mostly from early career researchers as well as satellite events and workshops.

This conference was an ideal hub to meet academics and industrial partners, and the best platform to talk about my research on the production of omega-3 fatty acids by a little known group of microorganisms, the thraustochytrids. The poster that I presented received a lot of attention from various researchers and industrial companies for its topics and the associated techniques used. I had the opportunity to compare and to discuss my work with other academics having either similar projects on the production of fatty acids but with other microorganisms (for instance, photosynthetic instead of heterotrophic) or having different end application using similar techniques (fermentation, gas chromatography, etc.).

The ECB was organized by 5 mains topics which were: Plant and Environment, Medical, Systems and Synthetic Biology, Industrial Bioprocessing, Tools and Products.

Hence this provided me with a diversity of talks and researchers with different backgrounds, and I soon realised that my research was relatable to the research of jet fuels or plant engineering. As a young career scientist, it was very helpful to see the different perspectives and aspects one's project can have.

In addition to these symposia, many satellite events were organised, three of which I attended on Publication, Intellectual Property Rights and Bio-economy and Bio-business. This was very new for me but extremely helpful for publishing effectively, protecting one's research and intellectual property and being aware of the future trends and vision from large funding bodies. Last, the poster section gave me the opportunity to have several informal conversations on different research projects presented as well as presenting my research, providing a good opportunity to network. This was made possible thanks to the British Phycological Society which I very much would like to thank for their financial contribution on travel and accommodation expenses and registration fees.

HILDA CANTER-LUND COMPETITION

Martyn Kelly

I'm pleased to announce that the winner of the 2016 Hilda Canter-Lund competition for algal photography is Tiffany Stephens, currently at the University of British Columbia, Canada, for her image "Swell Life", showing *Durvillaea antarctica* on Snares Island, 200 km south of New Zealand. The winner was decided by a vote by BPS Council Members for their favourite image from the shortlist (www.brphycsoc.org/Canter_Lund_2016/index.lasso).

Thanks to all those who entered the competition this year, and especially to the other five shortlisted photographers, for making this competition a success. Tiffany's image is a fine example of a phycologist "seizing the moment" during fieldwork, so don't forget your camera when heading out over the next few months, in case you miss the opportunity to catch next year's prize-winning image.

The Council of the BPS have agreed to introduce a second prize for the Hilda Canter-Lund competition. Over the seven years of the competition the prize has gone to five "macro" photographs but only two photomicrographs. The "macro" winners are all extremely good photographs, but Hilda Canter-Lund is best known for her microscopic images and we wanted to make sure that this was recognised in the competition. In future years one prize will go to the image that wins the most votes from BPS Council members, whilst the other prize will be to an image in contrasting style, at the discretion of the judges.

Council also decided that the award of this prize should start with the 2016 competition. The second award this year therefore has been awarded to Petr Znachor for his image of freshwater phytoplankton dominated by desmids, an image which is very much in Hilda Canter-Lund's style.

Congratulations to Petr. The competition will run again in 2017 so go to http://www.brphycsoc.org/canter-lund/index.lasso to seek inspiration for next year's winning entries ...

Tiffany Stephens

Petr Znachor

Image by Tiffany Stephens

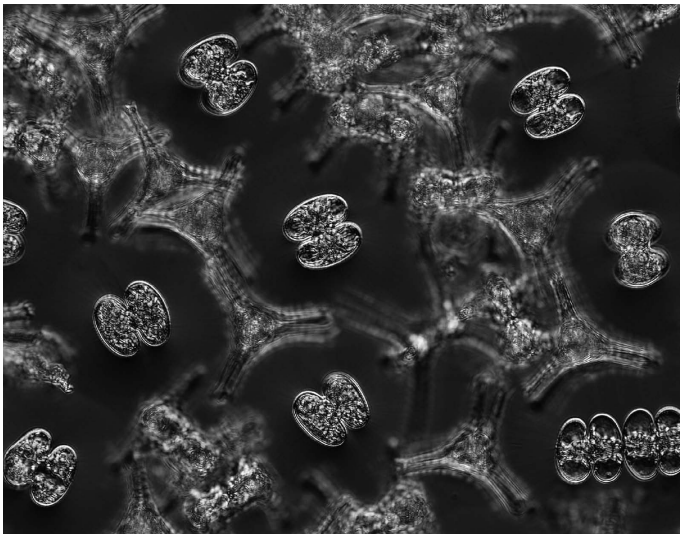

Image by Petr Znachor

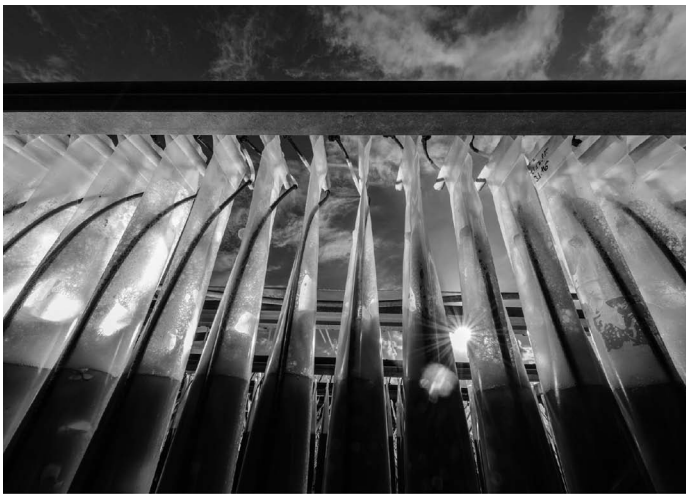

Image by Dani Machlis

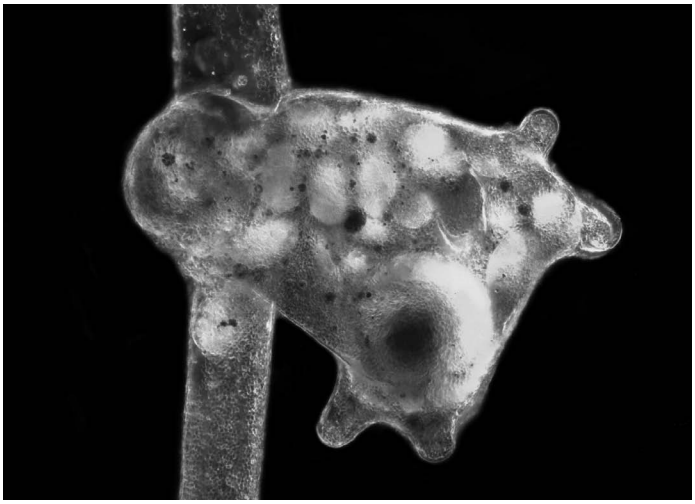

Image by John Huisman

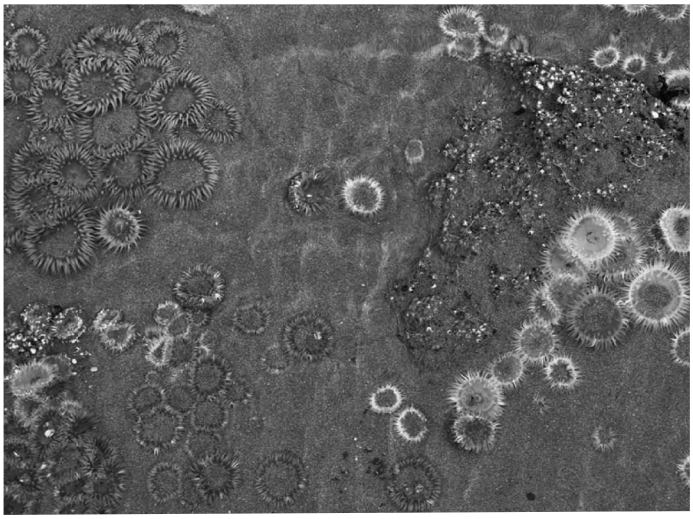

Image by Jamie Canepa

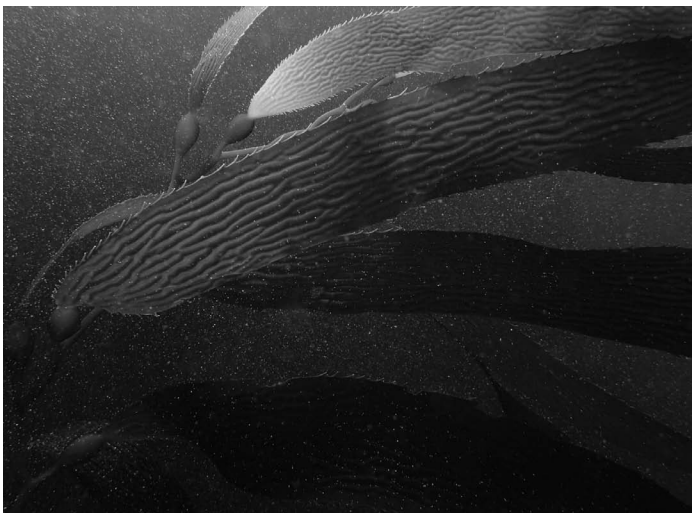

Image by Leah Reidenbach

Obituary

Brian Moss

Professor Rob Marrs DSc FCiEEM CEcol,
University of Liverpool
Dr Laurence Carvalho, CEH

It was with great sadness that we learned of the death of Emeritus Professor Brian Moss on Friday 27th May. He informed his close friends that he was terminally ill just after New Year and since then he has provided a very upbeat, indeed somewhat humorous, series of emails with respect to his condition.

Brian was a polymath, a true "Renaissance Man", but was best known as perhaps the most influential freshwater ecologist in Europe over the past three decades, and without doubt the world's leading scientist on shallow-lake ecology. Much of his research extended well beyond lakes – for example his identification of alternative stable states, studies on trophic dynamics, and his work on climatic effects on lake ecology. He was an inspirational teacher –not only to University students but to many fellow professionals in a wide range of disciplines.

Born in 1943 in Stockport, his school days were spent identifying plants in the Peak District before undergraduate studies and a PhD in Botany supervised by Frank Round at the University of Bristol. He then spent time abroad, studying tropical limnology at Lake Chilwa in Malawi, and thereafter the impacts of nutrients and fish predation on the structure of a deep, eutrophic lake in Michigan using large-scale experiments. His next move, to the University of East Anglia (UEA), saw him blossom further in the interdisciplinary School of Environmental Sciences, beginning his world-renowned work on the eutrophication of the Norfolk Broads. At this point, he also entered the field of restoration ecology, making a first attempt at restoring the conservation value of such systems through bio-manipulation – innovatively engineering fish communities and zooplankton grazers to affect algal stocks. He was involved in projects that led to removal of phosphate from several Broadland wastewater treatment works. He has maintained an active research interest in the Broads ever since and his popular "New Naturalist" account (The Broads) summarised their history and ecology, all interwoven with Brian's radical ecological thinking.

Some seventeen years after joining UEA, Brian succeeded Professor Tony Bradshaw FRS as Holbrook Gaskell Professor of Botany at the University of Liverpool. Here he continued his research on shallow lake systems in the North West of England. He also developed an extensive experimental pond system at Ness Botanic Gardens where he assessed ecological function in relation to nutrient and climate manipulation – in other words pond-warming. This was yet another groundbreaking step with which others are still trying to keep pace.

Brian has published an impressive number of publications,

and the fifth edition of his standard textbook on freshwater ecology is now at proof stage. Also at the proof stage is a guide (Ponds) in the Naturalists' handbooks series. Brian was a superb communicator and a very popular plenary speaker. He has been President of the British Phycological Society, Vice-president of the British Ecological Society, and both Vice-president and President of the International Society for Limnology, and for seven years (from 1981) edited the *Journal of Ecology* for the British Ecological Society. In 2007 he was awarded the August Thienemann–Einar Naumann Medal – the highest international honour for outstanding contributions to scientific limnology, in 2009 the Excellence in Ecology Prize awarded by the International Institute of Ecology, and in 2010 the Institute of Ecology and Environmental Management's Medal. Part of the former prize was the freedom to write a book on "anything of his choosing". The outcome was a *tour de force*: *Liberation Ecology*" a scientific textbook written for the general public, using parallels in religion, art, music, and his mother–in-law's washing line to get over complex issues of ecology and environment. Liberation Ecology was, in turn, awarded a prize: the Marsh Christian Trust Ecology Book Award by the British Ecological Society. Brian's eighth book *Lakes, Loughs and Lochs*, also in the "New Naturalist" series (he wanted to get the Welsh Llyn into the title also, but it didn't scan), moved his radical ideas on environmentalism forward. Brian was awarded a DSc by the University of Bristol in 1981, and in 2014 an Honorary Degree (Fellowship) at the IHE, Delft. Also in that year he became Acting Director of the Ecology Institute (Kinne Foundation) in Germany.

Beyond this very impressive curriculum vitae, Brian had three important qualities that were altogether more human.

The first was an uncompromising approach to "doing the right thing" environmentally and in his relations with others. He was always prepared to argue his corner, quietly and effectively. He did this always with the politeness and elegance of a true gentleman, and without causing upset. However, he had no truck with bureaucracy for its own sake, seeing it as an unnecessary intrusion, preferring to trust students, staff and colleagues to take responsibility for their own actions. His poetic blasts at bureaucrats were legendary and extremely witty, particularly for anyone able to follow insults that issue sometimes in spontaneous Latin prose. Lately, he has been a thorn in the flesh of Natural England over the management of a local nature reserve near his home. The discussion got as far as the Ombudsman, and Brian was very disappointed at the overall verdict (thought himself fobbed off). However, not to be outdone, he had recently complained to the Fraud Dep't of the Rural Payments Agency. They, too, tried to fob him off (twice) and argued that 'must' in a legal document (e.g. X 'must' be done for the payments to be made) did not actually mean X had to be done: it was optional. A week before he died he mentioned that the only course of action was taking them to court.

Second, Brian was a superb, boundlessly enthusiastic and inspirational speaker. His taught courses often attracted an audience from those who were not enrolled, particularly for sessions in which he conducted second year students in Flanders and Swann's immortal song, "The Hippopotamus". Brian's rendering is now so famous that it can be viewed on YouTube, where it has scored thousands of hits. He was a brilliant field teacher. Latterly, the honours field courses were smattered with substantive arguments between Brian and Rob Marrs (RHM), a close colleague; the students would often say, "they argue like a married couple"; it was brilliant to watch in practice, even though well-rehearsed. They also were extremely effective at dealing with University bureaucracy when their "Mr Nice" and "Mr Nasty" (swapped between the two of them as appropriate) pincer strategy was as effective at getting the correct outcome as it was cynically implemented.

Third, Brian had an utterly compelling sense of humour. In the last ten years or so at Liverpool he took up playing the double bass, recording faithfully his progression through each musical grade on all annual reports to the University. Even his research grant applications were graced by knowledge of his current musical level. He eventually joined the Southport Orchestra, eventually becoming its chairman. Professionally, he was very keen that the University of Liverpool develop a School of Environmental Sciences; indeed he believed every student should be taught about the environment. This was a major difficulty in such a traditional establishment. Nevertheless, he relished the role of "Big X", in the "Escape Committee" of applied ecologists plotting to move from Biological Sciences into Environmental Sciences at the University of Liverpool. He enjoyed the final email when the School of Environmental Sciences was formed and staff had transferred "RHM (the last committee member still active) has made a home run". He was also a great impressionist. On mock public inquiries he convincingly played the parts of a Welsh biochemistry professor, an old man from Lancashire whose 11 siblings had died from dirty water, and a posh chairwoman of the local parish council complaining about the lack of public toilets "Excuse me I am a lady and I have a 48 inch bust to prove it!"

All of these idiosyncrasies made Brian an enigmatic but truly inspirational leader in environmental science. However, none of his quirks have ever diminished his influence as an individual moved by his unfailing commitment to the environment, and by the conservation ethos of one his great heroes, Aldo Leopold. It is impossible to capture Brian's true scientific contribution, huge character and sense of fun in these few lines. Perhaps the most apposite distinction is to borrow from Brian's great hero Leopold himself, to say that: "There are some who can live without wild things and some who cannot". Brian Moss, clearly, was in the latter group. But hugely more important is that, through his work and actions, he has made it far more likely that so many of the rest of us sit there too, and for this all of us who knew him owe him a huge debt of gratitude. In his introductory lecture to incoming science students he always finished by advising them with the lines from Hamlet, "to thine own self be true"; Brian certainly lived up to this maxim.

He is survived by his wife Joyce and daughter Angharad. Our thoughts are with them.

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

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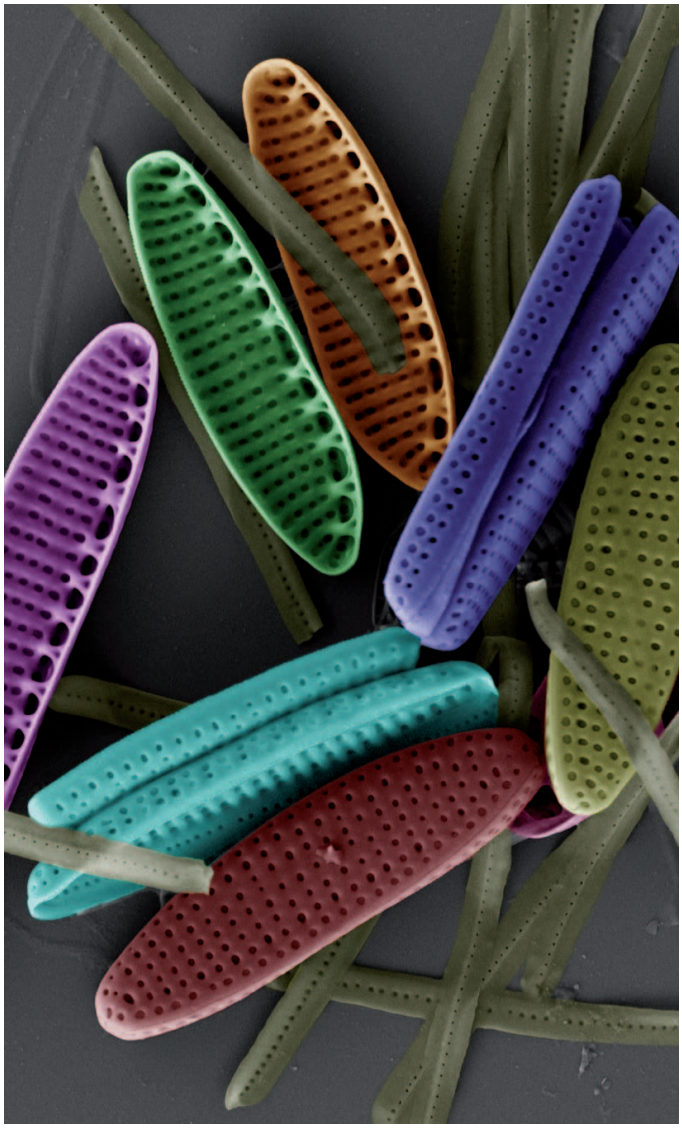

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