The Phycologist

Number 85
Autumn 2013

The Newsletter of the British Phycological Society

Editor: Dr Jan Krokowski

Homepage: http://www.brphycsoc.org/

The British Phycological Society is a registered Charity no. 246707 - *The Phycologist* is a registered publication - ISSN 0965-5301

2013
British Phycological Society

Council Officers (July to July)

President
Professor Christine Maggs (2013-2015)

President Elect
Dr Gill Malin (2013-2015)

Immediate Past President
Professor Paul Hayes (2013-2015)

Vice President Overseas
Professor Charles Amsler (2013-2015)

Secretary[1]
Dr Jane Pottas (2009-2015)

Treasurer[2]
Dr Maeve Edwards (2013-2016)

Membership Secretary[3]
Dr Sara Marsham (2007-2016)

Editor of the European Journal of Phycology
Professor David Mann

Editor of the Phycologist[4]
Dr Jan Krokowski

Ordinary Members of Councilh
(3-year term of office)

Dr John Bothwell (2011-2014)
Dr Martyn Kelly (2012-2015)
Dr Anne Jungblut (2013-2016)
Prof Elliot Shubert (2011-2014)
Dr Claire Gachon (2013-2016) (Co-opted Meetings Secretary)
Dr Clare Scanlon (2012-2015)

Webmaster[5]

Professor Mike D. Guiry

Student Representative[6]

Chris Williamson

Federation of European Phycological Societies (FEPS) Representative

Professor Geoffrey Codd

Secretary[1]

Dr Jane Pottas
Department of Life Sciences
The Natural History Museum
Cromwell Road
London SW7 5BD
UK

bpssecretary@hotmail.co.uk
Tel: +44 (0)2079425271

Treasurer[2]

Dr Maeve Edwards
Cama Research Station
Ryan Institute
National University of Ireland, Galway
Muigh Inis
Co. Galway, Ireland

maeve.edwards@nuigalway.ie
Tel: +353 (0)9532201

Membership Secretary[3]

Dr Sara Marsham
Dove Marine Laboratory, School of Marine Science and Technology
Newcastle University
Cullercoates, North Shields
Tyne and Wear
NE30 4PZ , UK

membership@prphycsoc.org
Tel: +44 (0)191 2223056

Editor of *The Phycologist*[4]

Dr Jan Krokowski
Scottish Environment Protection Agency (SEPA),
Angus Smith Building
Ecology
6 Parklands Avenue, Eurocentral
Holytown, North Lanarkshire
ML1 4WQ

jan.krokowski@sepa.org.uk
Tel: +44 (0)1698839000

Webmaster[5]

Professor Michael D. Guiry
Martin Ryan Institute
National University of Ireland
Galway
Ireland

michael.guiry@algaebase.org
Tel: +353 (0)91492339

Student Representative[6]

Chris Williamson
Department of Life Sciences
The National History Museum
Cromwell Road, London
SW7 5BD

c.williamson@nhm.ac.uk
Tel: +44 (0)2079425271

Editorial

We kick off our hot autumn edition with a review of the 62nd BPS Annual Meeting which was held in Belfast. There seem to have been lots of excellent talks, student talks in particular and many lively discussions, especially at the last morning in the special session which was open to the public. The accompanying photos perhaps don't do it justice and we could have done with some ones of the dancing! I guess we all hope for the same in Galway in 2014! Congratulations to Richard Dorrell, Manton prize winner and Néstor M. Robinson, Poster prize winner, who provide a summary of their work.

2013 is of course the centenary year for John W. G. Lund FRS and we are happy to celebrate this with a number of articles paying tribute to John. Many happy celebrations from everyone in the BPS!

There are many other interesting articles: enthusing the public and students about algae, details from students' work who received bursary awards from the BPS, details of new algal finds to the British Isles, summaries and adverts of algal courses, and details of the 2013 Hilda Canter-Lund photography award winner Chris Carter with his stunning image of *Chara virgata* – so read on!

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

CONTENTS

Review of the 61st BPS Annual Meeting

The View from the Secretary - an entirely biased perspective

In a departure from the norm the annual meeting this year was held in July not January. The decision to break with tradition was prompted by the prospect of better weather and therefore less likelihood of travel disruption by snow and wind. The weather was indeed better but organisational difficulties resulted in the late announcement of the meeting dates by which time some people had booked their summer holidays, others had field work planned and for some the summer is a busy period for work. This meant that there were fewer delegates, fewer posters and fewer talks than usual. On the plus side there were no parallel sessions to divide the audience so the macro and micro, freshwater and marine specialists were thrown together so we all had the opportunity to learn something new from people working outside our own discipline and there were some lively discussions following the talks and during tea and lunch breaks. There were a lot of student talks on the first afternoon. The programme looked pretty daunting. Would we be able to concentrate for three hours? This was not a problem as the talks were excellent. Richard Dorrell was the worthy winner of the Manton Prize and will also be in the Guinness Book of Records for delivering his talk with the most words per minute. Phew! Impressive. The poster session and wine reception which followed, sponsored by Taylor and Francis, gave delegates a chance to mingle and chat. Tuesday's programme of talks included one by Clare Gachon about a fungal pathogen of commercially produced red algae, a not altogether unexpected consequence of intensive farming in general and an interesting example of applied phycology. The last talk of the afternoon was the Presidential Address given by Paul Hayes who took the opportunity to reminisce about his career in phycology and the difficult question posed by his daughter when she asked him "Why do you do it" to which it seems there is no answer.

The conference dinner was held in the impressive Great Hall of Queen's University after pre dinner drinks on the lawn. The evening sunshine was lovely and the setting delightful. In keeping with BPS tradition dinner was followed by dancing. I say dancing but that is an inaccurate term and not a ceilidh this time but a chance to watch and learn some Irish dancing. I say "learn" but that barely describes what happened. Two very proficient dancers gave demonstrations of Irish dancing and then they attempted to teach us the steps. They skipped and twirled with breathtaking agility and looked to be dancing on air, their feet moving faster than the human eye can discern. The accompanying commentary which seemed to make sense at the time was suddenly incomprehensible when it was our turn to take to the floor and our efforts to execute the same movements descended into mayhem. It must have made those two women weep to see us stumbling about, feet in the wrong place, moving in the wrong direction, facing the wrong partner, a far cry from the nimble elegance of their fancy footwork and perfect posture. The macroalgae people looked as though they were losing their balance on slippery fucoids and the microalgae people could have been sliding about on diatom covered rocks. Whatever our phycological specialism we were all reduced to the same level of hapless ineptitude. And a great time was had by all!

The last morning of the meeting was the special session "Seaweeds and Health" which was open to the public and some came. I was dubious about this session when I saw it on the programme fearing that it would attract seaweed huggers (similar to tree huggers only wet) and members of AA – Algae Anonymous. The first three talks in the session described hypothesis driven research but I feel uneasy when commercial sponsorship is involved. For instance, the observation that alginate inhibits lipase activity is being investigated as a potential means of treating obesity. One of the project partners, a well-known baker, is making bread loaves containing 4% alginate which could be included as part of a weight control programme. Soft scoop ice cream also contains alginate. Could this also be eaten for the same reason? It just seems rather gimmicky. Eat less and exercise more would seem to be more effective and cheaper than spending a lot of money on this kind of research. Another speaker, who described himself as a forager of seaweed, prompted a heated discussion which had to be curtailed to be continued after the session when he suggested that foraging in general should not be the subject of legislation. Another speaker described his relationship with seaweed and the difference it made to his life and the research he was doing into the distribution of certain species. My discomfort alarm was practically off the scale at this point. The next invited speaker, Prannie Rhatigan, a medical doctor with an interest in the health properties of seaweed and author of a number of cookery books featuring seaweeds, talked about the evidence for including seaweed in the diet. She began by quoting Paracelsus (1493-1541). Interesting, but not exactly current. She then showed a table she had constructed summarising current knowledge about the properties of various seaweeds. Our attention was drawn to the many gaps as evidence that there is a lot we don't know. To a lay audience this reinforces the view that there are more things in heaven and earth, Horatio, than are dreamt of in your philosophy (Hamlet 1.5.166-7, Hamlet to Horatio) which whilst true does not mean that scientists are not trying to fill these gaps in our knowledge or indeed have already done so. The problem for Dr Rhatigan and others trying to research the properties of seaweeds (in fact anyone trying to find scientific information in any field) is that unless they have links to an academic institution they do not have access to scientific papers, their only

source of information being popular literature, magazines and books which are often written by non-scientists whose "research" amounts to little more than personal observation and "evidence" which is merely anecdotal. This may change with the move to open access publishing but as there is an increasing amount of material which is not peer reviewed even those of us who understand the importance of peer review may find ourselves similarly disadvantaged when it comes to knowing what to trust and what not.

The word "research" was used several times in this session – "I will do some research into that" which only meant "I'll have a look at this again when I'm out on the shore gathering seaweed". Whilst observation is a necessary starting point it is not research. Neither is a single observation statistically significant. Herein lies the problem as I see it – to find a common language between all the different groups whose common interest is algae whether it be academic, professional or commercial, whether their work be in the laboratory or in the field, theoretical or practical. Despite my prejudices and misgivings about this particular session maybe the answer is more contact not less so that those interested can learn more, for example, what is meant by the scientific method, thus ensuring that intellectual and academic integrity are maintained. The BPS should be the first point of contact for anyone interested in learning about, studying and using algae. We could learn a lot from the moss, fern and lichen societies where there are many amateur experts but if the BPS is only interested in welcoming academics I fear that membership numbers will dwindle to the point of extinction and to the detriment of phycology.

To round off the meeting lunch was a feast of seaweed foods, some of which were provided by the enthusiastic Rosaria Piseri who also spoke about her interest in seaweed which led to her founding a company selling seaweed-based food products and cosmetics. It was an appropriate way to end the meeting with a social activity based around seaweed. The smaller numbers this year did not detract from what was a varied and stimulating meeting drawing delegates from a wide range of backgrounds and it was thought provoking on many levels. Thanks go to Chris Maggs and her team for organising the meeting. Next year's meeting will be held in Galway, again in the summer. Over to you, Maeve.

Dr Jane Pottas
Research Assistant
Department of Life Sciences
The Natural History Museum
Cromwell Road,
London
SW7 5BD

British Phycological Society
Queen's University Belfast
7–10 July 2013

Abstracts

Special Session: Freshwater Ecology

Interactions between multiple stressors and the stability of algal communities

Ian Donohue, Deirdre M. McClean and Lindsay Hislop

School of Natural Sciences, Trinity College Dublin, Ireland

Trinity Centre for Biodiversity Research, Trinity College Dublin, Ireland

Ecological stability is touted as a complex and multifaceted concept, including components such as variability, resistance, resilience, persistence and robustness. Recent research has shown that perturbations can decouple relationships among these components of stability and even alter the nature of those relationships. We established a manipulative experiment in pond mesocosms to test the hypothesis that different types of perturbations can alter the relationships among components of stability in different ways. Specifically, we explore whether two globally important pressures on aquatic ecosystems, nutrient enrichment and amplified water level fluctuations, interact in their effects on the overall multidimensional stability of benthic algal assemblages. We show that simultaneous analysis of multiple dimensions of ecological stability gives a far richer understanding of how communities respond to perturbations.

Seasonal variation of phytoplankton $\delta^{13}C$ and $\delta^{15}N$ in a humic mesotrophic lake: The role of pelagic food web nutrient cycling

Chris Barry and Bob Foy

Agri-Food & Biosciences Institute, School of Biological Sciences, QUB

As with many Irish lakes Lough Melvin is peat stained due to high catchment inputs of coloured dissolved organic matter (DOM), but is also alkaline (pH 8) due to its carboniferous geology. The lake is deep and polymictic and these factors combine with the shallow photic depth to reduce chlorophyll *a* to that of oligotrophic lakes, despite lake phosphorus (P) of 30 µg l^{-1}. Buoyant cyanobacteria dominate the phytoplankton due to the light climate and pH while diatoms only attain comparable biovolumes during the spring bloom. Gross primary production is estimated at 43 g C m^{-2} yr^{-1}.

High nutrient and organic matter inputs but low chlorophyll suggests a high degree of allochthony in the lake, however changing catchment nutrient loads may be altering the C base of the food web. Since 1990 chlorophyll *a* declined by 44% to 2.7 µg l^{-1} but the photic depth declined by 30%, suggesting rising inputs of DOM. The altered nutrient loads have uncertain implications for the ecology of the lake, which has a high conservation value notably containing a unique post-glacial salmonid community and high quality macrophyte assemblage.

To determine seasonal reliance of zooplankton on autochthonous carbon (C) and so food web sensitivity to changing catchment inputs, stable isotope ratios of C and nitrogen (N) in dissolved inorganic C, phytoplankton, DOM and zooplankton were tracked over one year. Critically, density differences and filtration allowed near species-specific isotope ratios for the predominant phytoplankton and zooplankton taxa, including several coincident measurements for cyanobacteria and diatoms.

In this presentation we examine seasonal coupling between phytoplankton $\delta^{13}C$ and $\delta^{15}N$ and inorganic C and N sources, and present evidence to suggest pronounced seasonal linkages with heterotrophic production, that in turn are linked to the seasonality of catchment inputs to the lake.

Diversity and distribution of cyanobacteria and microbialites in the McMurdo Dry Valley lakes, Antarctica

Anne D. Jungblut[1], Ian Hawes[2], Dawn Sumner[3], Jenny Webster-Brown[2], Tyler Mackey[3], Kate Wall[3], and Dale T. Anderson

[1]Department of Life Sciences, The Natural History Museum, London

[2]Gateway Antarctica and Waterways Centre for Freshwater Management, University of Canterbury, Christchurch, New Zealand

[3]Department of Geology, University of California Davis, CA, USA; Carl Sagan Center for the Study of Life in the Universe, SETI Institute, CA, USA

Inland lentic ecosystems in the McMurdo Dry Valleys range from perennial ice-covered lakes, through meltwater ponds to supraglacial cryoconite holes. The biology of these systems is primarily microbial, and cyanobacteria and thick stratified cyanobacteria-based mats are a common feature of these unique Antarctic aquatic ecosystems. Filamentous cyanobacteria produce exopolymers and are the major structuring agents for the three-dimentional mats, and the complex structures provide diverse habitats that may be considered refugia for microbial eukaryotes, which survive and proliferate in the permanently cold habitats. However, little is still known about how environmental parameters influence cyanobacterial richness and community composition. We will describe Antarctic cyanobacterial assemblages from es-

pecially the McMurdo Dry Valley lakes, where microbialites can have discrete layer along vertical internal gradients using morphological descriptions, 16S rRNA gene surveys and PAM fluorometry. Although the impacts of environmental change have mostly been documented from maritime Antarctica, recent findings have confirmed overall warming of continental Antarctica and sensitivity of inland aquatic systems to such change. We will therefore also examine how cyanobacterial microbialite structures have responded to variable water dynamics and look at the implications of change for aquatic inland ecosystems.

Detection and role of Microcystins

Shauna Devlin, Julie P Meneely and Christopher T Elliott

Institute for Global Food Security, Queen's University Belfast

Cyanobacteria (Blue-Green algae) is one of the earliest forms of life and comprises of 150 genera, of which around 40 produce a wide range of potent toxins such as Anatoxin-α, Anatoxin α (S), Cylindrospermopsin and Microcystin. The most commonly occurring cyanotoxin is Microcystin, which are potent hepatotoxins as well as tumour promoters. The hepatotoxicity of Microcystins is due to their uptake route and they are fatal at high doses leading the World Health Organisation (WHO) to set a limit at 1 µg/L for drinking and recreational waters. The presence of Microcystins and other cyanotoxins in fresh water supplies is increasing due to climate change. Algal blooms are not only increasing in size, occurrence and duration, but are also spreading from their commonly found temperate regions to cooler waters.

Two methods were developed to detect microcystins, for both lab (SPR – Biacore Q) and field (Planar Waveguide – MBio SnapEsi Sensor) analysis, at and below the WHO limit. The methods employed novel lysis procedures to enable the rapid detection of intracellular toxin, acting as an early warning indicator of microcystins yet to be released. The methods were fully validated and showed high correlation with traditional Mass Spectrometry analysis.

Student Manton Talk Abstracts

A chloroplast transcript processing pathway copied and pasted through serial endosymbiosis

Richard G. Dorrell, Elisabeth Richardson and Christopher J. Howe

Department of Biochemistry, University of Cambridge

Chloroplasts have been acquired multiple times across the eukaryotes through the endosymbiotic integration of a non-photosynthetic host and a photosynthetic symbiont. In one variant of this model, termed serial endosymbiosis, a host that is already photosynthetic replaced its original chloroplast with one of new phylogenetic derivation. It is as yet not well understood whether the biology of the replacement chloroplast may be changed by pathways established during the predecessor symbiosis.

The fucoxanthin-containing dinoflagellates, typified by the genera *Karenia* and *Karlodinium*, have replaced their original chloroplasts, derived from red algae, with serial endosymbionts derived from haptophytes. We have demonstrated that in these species, two unusual transcript processing pathways- 3' terminal polyuridylylation, and extensive sequence editing- have been retained from the original dinoflagellate chloroplast symbiosis, and applied to the replacement haptophyte-derived chloroplasts. The replacement chloroplast lineage is now dependent on these pathways for complete expression of the chloroplast genome. Here, we profile the RNA processing of fucoxanthin dinoflagellates, and discuss the broader importance of the retention of biogenesis pathways through serial endosymbiosis for current models of chloroplast evolution.

Genetic transformation and transient expression of the GUS gene in *Chondrus crispus*

A. Ramessur, J.H. Bothwell, C.A. Maggs, S.Y. Gan and S.M Phang

Queen's University Belfast

It is important to develop reliable transgene delivery techniques for analysing the expression, function and regulation of red algal endogenous genes which will allow, in the future, the engineering of economically important traits in algae. However, the molecular manipulation of algal systems, compared to other organisms, is still in the initial stage and transformation methods have not yet been adapted to algae. To date, there is no published evidence of genetic transformation of the carrageenophyte, *Chondrus crispus*. In the present work, we tailored a *uid*A gene-bearing expression cassette adapted to the latter. Particle bombardment and *Agrobacterium*-mediated transformation methods were used to transfer the cassette into *Chondrus crispus* thalli and sporelings using previously optimised parameters. Successful delivery and transient expression were observed in cortical and medullary filaments using GUS histochemical assays which revealed clear colocalisation of the blue precipitate within cells. Sporelings seemed refractory to our transformation attempts with no transformants having been obtained so far. We present a working methodology for *Agrobacterium* transformation together with findings of certain parameters influencing transformation efficiency.

Metabolic profiling of the chemosphere of the macroalga *Ulva* sp.: Towards an understanding of chemical mediated interactions between *Ulva mutabilis* and its associated bacteria

T. Alsufyani[1], A. Engelen[2] and T. Wichard[1]

[1]Institute of Inorganic and Analytical Chemistry, Friedrich Schiller University Jena, Germany

[2]Centre of Marine Sciences, University of Algarve, Portugal

In the marine environment, the macroalga *Ulva* (Chlorophyta) is closely associated with marine bacteria to meet their physiological needs. In the absence of these bacteria (axenic conditions), *Ulva mutabilis Føyn forms callus-like colonies. However, the combination of the two bacterial strains, Roseobacter* sp. and *Cytophaga* sp., can completely restore the morphogenesis of *U. mutabilis* forming a symbiotic tripartite community.

We aim to decipher the dynamics of the chemosphere within this tripartite community. Therefore, we used a sensitive metabolic profiling approach to discover waterborne biomarkers which might indicate various phases in algal growth and enable us to understand the algal-bacterial relationship. The waterborne metabolites of *U. mutabilis* cultures were extracted by solid phase extraction. The samples were directly analyzed by ultra-high performance liquid chromatography (UHPLC) and/or by gas chromatography (after derivatization) coupled with a time-of-flight mass spectrometer (TOF-MS). A combined approach of chemometrics along with nutrient analyses and bioassays of reproductive behaviour reveals novel insights into the fluctuations of the waterborne biomarkers under different culture conditions over the growth phases of *U. mutabilis.* This approach was applied to laboratory bioreactors (20 L) and aquaculture vessels (250 L). Besides monitoring aquaculture, our study provides a promising contribution to the bacteria-dependent morphogenesis of *U. mutabilis*.

Anisolpidium; an enigmatic genus of marine brown algal pathogens

Kyle Fletcher[*1,2], Shar, AH[1], Gachon, CMM[3], van West, P[2] & Küpper, FC[1]

[1]Oceanlab, University of Aberdeen

[2]Aberdeen Oomycete Laboratory, Institute of Medical Sciences, University of Aberdeen

[3]Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll

The presumed hyphochytridiomycete genus *Anisolpidium* is morphologically defined as presenting anteriorly uniflagellate zoospores, with "monocentric, and holocarpic thalli". Currently three marine species (*Anisolpidium ectocarpii*, *Anisolpidium rosenvingei* and *Anisolpidium sphacellarum*) have been defined, all parasitic upon marine brown algae with a probable global distribution, but as yet no molecular work has been done on this genus. Recently, a sample of each species has been collected on CTAB and the identity confirmed through microscopic observation of permanent mounts. In this first molecular study of the genus it would appear that the species *A. ectocarpii* does not actually branch as expected within or in proximity to known hyphochytridiomycetes, but instead within the Pythiales (Oomycota). This group comprises economically and ecologically important pathogens such as the red algal pathogen *Pythium porphyrae*, responsible for the red rot disease of the widely consumed *Pyropia* spp. in Asia. Unlike hyphochtrids, all oomycetes present biflagellate zoospores (one anterior, one posterior). Indeed, preliminary scanning electron microscopy indicates evidence for the *A. ectocarpii* zoospores possessing two anterior flagella, a possible cause of this previous misidentification.

Recent highlights from the exploration of seaweed biodiversity around the Antarctic Convergence

Alexandra Mystikou[1,2,3], Aldo O. Asensi[4,5], Paul Brickle[2], Pieter van West[3] & Frithjof C. Küpper[1]

[1] Oceanlab, University of Aberdeen, Scotland

[2] South Atlantic Environmental Research Institute, Falkland Islands

[3] Aberdeen Oomycete Laboratory, Institute of Medical Sciences, Foresterhill, Aberdeen, Scotland

[4] 18 rue de Moulinet, F-75014 Paris, France

[5] Muséum National d'Histoire Naturelle, Département Systématique et Evolution

UMR 7138 UPMC (Paris VI), MNHN, CNRS, IRD, Systématique adaptation évolution

Case postale 39 (bâtiment de Cryptogamie), 57, rue Cuvier 75231 Paris cedex 05, France

Significant gaps remain in the understanding of seaweed biogeography and biodiversity in the Antarctic and Subantarctic region. This contribution presents recent advances in the understanding of seaweed biodiversity around the Antarctic Convergence (in particular, the Falkland Islands and the southwestern Antarctic Peninsula), based upon 4 recent expeditions to the Falkland Islands and one to Adelaide Island (Antarctica). Unlike the tip of the Antarctic Peninsula, seaweeds of the Adelaide Island / Marguerite Bay region are very poorly studied. Records from the latter stemming from our 2010-2011 expedition were compared with the only other such survey from this region from the early 1970s, revealing a number of new records, previously known from more northerly parts of the Antarctic Peninsula and Subantarctic regions. Furthermore, numerical analysis of affinities of the brown algal flora composition of 7 Antarctic and Subantarctic areas (Antarctic Peninsula, South Georgia, Falkland Islands, Tierra del Fuego, Kerguelen, Patagonia and South Shetland) was conducted using the Sørensen similarity index. We will also present a number of new records from the Falkland Islands, alongside with new phylogenetic insight supported by molecular results of a number of taxa. Finally, a significant re-discovery of an enigmatic algal genus, *Cladochroa*, from the Falkland Islands, will be highlighted.

The skeletal mineralogy of *Corallina* (Rhodophyta, Corallinales): implications for climate change responses

C.J. Williamson, J. Najorka, R. Perkins, M. Yallop and J. Brodie

Natural History Museum, London

Marine species depositing high-Magnesium (Mg) calcite (> 8% $MgCO_3$) are especially vulnerable to ocean acidification (OA) given the increasing solubility of calcite in seawater with increasing Mg content. Temperature may drive Mg incorporation into the skeletons of calcifying macroalgae, therefore increases in sea surface temperature (SST) due to climate change may induce deposition of more soluble calcite, exacerbating OA responses. Assessment of the skeletal mineralogy of calcifying species of *Corallina* (Rhodophyta, Corallinales) in the UK intertidal, demonstrated the existence of seasonal cycles in Mg content for the present-day and, using herbarium collections of the Natural History Museum (BM), London, the recent-past (1850-2010). Regressions between SST and *Corallina* Mg content (r^2 = 0.45-0.76) demonstrated the dominant influence of temperature on *Corallina* skeletal mineralogy. *Corallina* may not be as susceptible to the

effects of OA as other temperate calcifying macroalgae, e.g. rhodoliths, given lower absolute values of Mg content (10-17 mol % $MgCO_3$), and smaller variation with change in SST (0.258-0.479 mol % $MgCO_3$ °C). No impact on skeletal mineralogy was detected in herbarium samples from 1850- 2010, however predicted increases in SST by 2100 could have substantial impact on *Corallina* skeletal mineralogy, and OA responses.

Phosphorus limitation and the effect of climate change on phytoplanktonic communities

Sarah Lee

Cardiff University

Current changes in climate are becoming increasingly significant, particularly the influence of temperature and rainfall fluctuations. Freshwater lakes are extremely sensitive to these changes and are regarded as important ecosystems, both ecologically and for human resources. The health of a freshwater lake and the organisms within it can be determined by the phytoplankton community. Cardiff Bay, South Wales is a relatively new freshwater lake which has experienced a decline in phosphorus levels due to restrictions made by Welsh Water on the five sewerage plants located on the Rivers Taff and Ely which feed into the lake. Chemical, biological and physical data recorded within Cardiff Bay since 2003 indicates that phosphorus is the primary control on phytoplankton growth and abundance. During this time there have been alterations in the climate of the lake, none of which have governed phytoplanktonic abundance. Due to phosphorus limitation causing low biomass and diversity in phytoplankton, there is less capability for biological responses to climate change through primary productivity. However, there are still questions to ask regarding the absence of biological oxygenation and whether an increase in water temperature can stimulate zebra mussel activity, decreasing dissolved oxygen concentrations within the lake.

Irish seaweed species inhibit alpha-glucosidase, stimulate secretion of glucagon-like peptide-1 (GLP-1) and inhibit dipeptidyl peptidase 4 (DPP4): potential for therapy of type 2 diabetes mellitus?"

Danielle Calderwood[1], Eamon Rafferty[1], Ciaràn Fitzgerald[2], Brian D.Green[1]

[1]Institute for Global Food Security, Queen's University, Belfast

[2]Food BioSciences Department, Teagasc Food Research Centre, Ireland

Type 2 diabetes mellitus affects ~300 million people worldwide. Here the anti-diabetic properties of ethanol and water extracts from green, red and brown seaweeds were screened for anti-diabetic potential. Both water and ethanol extracts from *Fucus vesiculosus, Ascophyllum nodosum* and *Alaria esculenta* had extremely potent inhibitory effects on alpha glucosidase (23-93%; p<0.001; n=3). Acute (3 h) and chronic (72 h) effects of extracts on secretion of GLP-1 from STC-1 cells as well as cellular GLP-1 synthesis were determined (n=3). A number of extracts positively affected GLP-1 secretion and synthesis, but an ethanol extract of *Ulva lactuca* increased acute (273.6±10.71 pM/million cells; p<0.01) and chronic (2329.7±38.31 pM/million cells; p<0.001) GLP-1 secretion and it also increased GLP-1 synthesis (384.24±23.97 pM/million cells; p<0.001). Several brown seaweed extracts potently inhibited dipeptidyl peptidase 4 (DPP4; an enzyme responsible for GLP-1 inactivation). Interestingly the ethanol extract of *Alaria esculenta* (91±0.1%; n=3) and water extract of *Laminaria digitata* (90.1±0.3%; n=3) strongly inhibited DPP4 to a similar extent as a known DPP4 inhibitor berberine (97.88±0.37%). These studies demonstrate that edible species of Irish seaweeds have potential as nutraceuticals for tackling type 2 diabetes by targeting GLP-1 secretion, DPP-4 activity and alpha-glucosidase activity.

Phycotoxin analysis of European water samples

Sara E. McNamee, Christopher T. Elliott and Katrina Campbell

Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast

During recent decades there has been an apparent increase in the occurrence of harmful algal blooms (HAB) in many marine, coastal and freshwater systems around the world. Diatoms, dinoflagellates and cyanobacteria (blue-green algae) are responsible for these HABs with some species producing toxic compounds that show adverse effects on other organisms as well as human consumers of contaminated seafood. Several of these toxins can be acutely lethal and some are the most potent natural substances known; additionally no antidote exists to any HAB toxin. The increasing concerns about algal toxins have necessitated the need for more rapid, robust and highly sensitive detection methods. Monitoring of these HABs is therefore of upmost importance and a portable early warning detection tool would be extremely beneficial to the aquaculture and fisheries industry.

The aim of this research is to develop a biosensor for use as an early warning detection tool capable of detecting algal toxins in algal and freshwater samples. Calibration curves for five toxin families have been produced and the sensitivity achieved to date is ng levels. Freshwater samples are currently being collected across Europe to evaluate the MBio biosensor as part of the FP7 European project µAqua.

Talk Abstracts

Will the real picobiliphyte please stand up?

Linda K. Medlin[1], Ramkumar Seenivasan[2], Michael Melkonian[2]

[1] Marine Biological Association of the UK, The Laboratory, The Citadel, Plymouth, UK

[2] Department of Botany, Cologne Biocenter, University of Cologne, Germany

Using vital mitochondrial staining and cell sorting by flow cytome-

try, a culture of a "picobiliphyte" has finally been established. This clonal culture, which has a 'picobiliphyte' 18S rDNA signature, is neither pico or pigmented. Its morphological and ultra-structural characters clearly show that it is slightly elongate and 2-5 µm in length with two unequal flagella not covered by hairs or scales. It exhibits unique cell movements (jump, drag, and skedaddle mode of locomotion) but often remains suspended in the water column for extended periods. Light and electron microscopic studies reveal that the cells are naked and that in this isolate, a plastid is lacking. A structure, presumably a feeding apparatus, suggests a rather unique mode of feeding on perhaps DOM is possible. The cells in this culture, thus, are heterotrophic, although their food source could not be determined, and food vacuoles containing bacteria were never observed. The cells harbour several other unique compartments that do not match those in any other known eukaryotes. This uniqueness is corroborated by phylogenetic analyses of the complete nuclear ribosomal operon, although the clade containing "picobiliphyte" sequences has some affinity with the Hacrobia. With their cell morphology now firmly established, we can now formally describe an important and abundant member of the eukaryotic pico/nanoplankton. This group/division is placed in a new phylum 'Picozoa' with *Picomonas judraskeda* gen. et sp. nov. as its type species.

Phenotypic and genetic characterization of *Thalassiosira pseudonana* (Bacillariophyceae) strains

Cecilia Rad-Menéndez[1,2] , Michele Stanley[2], David H. Green[2], Eileen J. Cox[3], John G. Day[1,2]

[1]Culture Collection of Algae and Protozoa and [2]Microbial & Molecular Biology Department, Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll,

[3]Department of Botany, The Natural History Museum, London

The study of phytoplankton populations continues to reveal cryptic variation at the intraspecific level, providing valuable information about phytoplankton diversity. In the present study, a polyphasic approach was employed to assess whether there were measurable intraspecific morphologic and/or genotypic variations among ten clonal isolates of the model diatom *Thalassiosira pseudonana*. Genetic variation was investigated using conventional DNA barcoding genes (*SSU* rDNA, ITS1 and ITS2 rDNA and *rbcL*), which revealed no nucleotide variation among the strains. Morphological analysis using scanning electron microscopy also concluded that the strains were virtually identical. However, on employing a whole genome fingerprinting technique, Amplified Fragment Length Polymorphism (AFLP), three apparent clusters were revealed, although the level of variation between the clusters was low. These findings indicate an unusual low level of diversity among the *Thalassiosira pseudonana* strains investigated, despite their wide distribution and the salinity range of their origins. This suggests that *Thalassiosira pseudonana* is a very conserved diatom, with no observable morphological or barcoding gene diversity, but an identifiable level of molecular diversity at the whole genome level.

***Pythium porphyrae* the agent of the red seaweed rot disease: a reformed plant pathogen?**

Claire M.M. Gachon[2]*, Jong Won Han[1], Antonios Zambounis[2], Tatyana A. Klochkova[1], Lisa Breithut[2], Gwang Hoon Kim[1]

[1]Department of Biology, Kongju National University, South Korea

[2]Scottish Association for Marine Science, Scottish Marine Institute, UK

The red alga *Pyropia* (formerly *Porphyra*) sp.is the most valuable seaweed worldwide, underpinning a global industry in excess of $ 1 billion. *Pythium porphyrae*, the agent of red rot disease is responsible for devastating outbreaks in seaweed farms. Here, we investigated the gene repertoire of *P. porphyrae* and its transcriptional regulation using next-generation sequencing EST libraries obtained during a time course of infection. We focussed our annotation on the genes potentially involved in pathogenicity such as secreted proteins, toxins, and homologues of known oomycete pathogenicity effectors. In agreement with the general view that *Pythium* pathogens are opportunistic, necrotrophic pathogens less specialised than other biotrophic oomycetes, *P. porphyrae* contains a gene repertoire very similar to the one described in other *Pythium* species. Strikingly however, we could not identify any enzyme specifically involved in the degradation of red algal-cell wall components. Instead, the presence of cellulases, CBEL proteins and of a cutinase hints to *P. porphyrae* tracing its roots to a pathogen of higher plants (Embryophyta).

Characterisation of sex chromosomes and patterns of nucleotide diversity for sex linked, pseudoautosomal, and autosomal genes in the model brown algae *Ectocarpus*

Sophia Ahmed

Marine Plants and Biomolecules, France

The genus *Ectocarpus* consists of marine brown algae with haploid-diploid life cycles. Species in this genus undergo genetic sex determination and the sexual phase is expressed in haploid gametophytes that form either male or female individuals. As gametophytes are independent of their diploid sporophyte counterparts, *Ectocarpus* provides a convenient model to study how sex chromosomes evolve when they function in distinct male and female haploid individuals. Using resources generated by the *Ectocarpus* genome project (Cock *et al*., *Nature* 2010), intron regions of genes from male and female field-collected gametophytes were sequenced in order to compare the level of neutral polymorphisms within and between different strains of this genus. Here I will present an overview of our recent work on characterisation of the sex chromosomes and nucleotide diversity.

Algal biotechnology – Is a new industrial sector being built on solid foundations?

John G. Day[1,2] and Michele S. Stanley[2]

[1]Culture Collection of Algae and Protozoa, [2]Scottish Association for Marine Science, Oban, Argyll

Over the past 5-10 years investment from public and commercial funders into algal biotechnology has been huge, conservatively running into hundreds of millions of dollars globally. Furthermore, media coverage highlighting the productivity, metabolic versatil-

ity and wide range of products obtainable from photoautotrophic and heterotrophic "algae" has changed public perception from - a sector providing niche products, towards it being a component of the industrial mainstream. This metamorphosis has been substantiated by scientific advances including an explosion of genetic information from next generation sequencing, the expansion of transformation protocols to commercially interesting algae, as well as the technical and commercial success of producing a variety of taxa at a large scale including: *Spirulina/Arthrospira, Dunaliella, Chlorella, Haematococcus, Schizochyrium*… We are now at a crucial point in the translation of R&D into future products and processes, but for many practitioners little thought has been spent on the conservation of master stock-cultures. Key questions remain unanswered:

Can the production strain be maintained long-term?

Is the trait of specific value stable?

Is there an evidence-base for genotypic and functional stability?

Without a guarantee of long-term stability of production strains irrespectively of whether they are: wild-type, generated through conventional strain selection/mutagenesis, or transgenic, algal biotechnology will not be economically sustainable. This paper discusses the issues involved and outlines strategies needed to ensure sustainability of the sector.

Without the solid foundations of guaranteed "fit for purpose" inocula algal biotechnology will fail!

Potential anticancer activity of Irish brown seaweed extracts in models of colon cancer"

E.M. Brown, P.J. Allsopp, P.J. Magee, C.I.R. Gill, J.J. Strain and E.M. McSorley

Northern Ireland Centre for Food and Health, University of Ulster

Chronic disease, including cancer, is a leading cause of death in Western countries and poses a huge and growing burden on public health care. Food and nutrition play a crucial role in colorectal cancer (CRC), the third most common cancer in Ireland with 46 – 60 people per 100,000 affected annually (Ferlay et al., 2010). Thus consumption of foods containing protective bioactive compounds may reduce the risk for development of CRC. Seaweed is a food source commonly consumed in Asian countries where CRC incidence is historically low. Fractioned extracts from edible brown seaweed, native to Irish waters, have demonstrated anticancer activity within in vitro models (HT29, Caco-2 and HT115 cells) of colorectal cancer using the well established MTT method to assess cell survival. Varying degrees of cell death were observed for the different fractions, with significant reduction in cell survival (by 36 and 38%) compared to control, for two fractions in HT115 metastatic cells with low doses of extract (250 µg dry weight/ml). The mechanisms responsible for this anticancer activity were further investigated using cell cycle and apoptosis analysis (Annexin-V and Propidium Iodide staining) and subsequent analysis of changes in gene expression of apoptosis genes in HT115 cells. These results demonstrate the potential of this brown seaweed extract as a source of novel anticancer agents requiring further investigation in a suitable animal model of CRC.

What is happening to the large brown seaweeds? An analysis of changing distribution patterns in the UK

Christopher Yesson[1], Juliet Brodie, Laura Bush, Andrew Davies and Chris A Maggs

[1]Natural History Museum, London

Over the last decade or so, there have been an increasing number of reports of changes, mostly reductions, in the distribution of large brown seaweeds, which constitute a significant UK habitat. Here, we report on a study undertaken to review the distributions of 15 kelp, fucoid and related species of commercially important large brown algae around the British Isles, with particular reference to changes in distribution over time. We have collated ca. 127,000 observations from the 19th-21st centuries from a wide range of sources, including NBN and NHM. These data are used to construct habitat suitability models and estimate the potential distribution of each species. UK distributions appear to be limited by topography and exposure rather than temperature. Excluding recent arrivals, these species are in the centre of their ranges, so the UK could be viewed as a stronghold for these species in a North Atlantic and global context. Additionally, we have compared abundance data from the 1980s and 2000s. There is a general decline in UK abundance for most species. The possible drivers of this decline are complex, but despite changes in temperature over the past decades, we do not find a direct link with climate change.

Waves and currents influence the growth of *Laminaria digitata*: Is it all about strength?

Louise Kregting[1], Andrew Blight[2], Björn Elsäßer[1], Graham Savidge[3]

[1]School of Planning, Architecture and Civil Engineering, Queen's University Belfast

[2]School of Biology, Scottish Oceans Institute, University of St Andrews

[3]School of Biological Sciences, Queen's University Belfast

The kelp *Laminaria digitata* forms luxuriant canopies from the lower intertidal to shallow sub-tidal zone throughout the north Atlantic. The range of hydrodynamics experienced by the kelps (waves and current) makes them ideal in assessing the role of water motion on growth rate. Here we quantify the growth and nutrient status of the kelp *L. digitata* at sites with different hydrodynamic conditions during a one year period in Strangford Lough. By utilizing an engineering modelling approach we numerically predicted both the temporal and spatial variability in the hydrodynamic environment. Seawater nutrients, temperature and irradiance were also measured in the field as well as internal nutrient status. Results suggest that the kelp populations growing in the highest flows and greatest wave action had the lowest growth rates. Differences observed in growth rate could not be attributed to seawater nutrient availability, temperature or light. The internal nutrient status also suggested no influence on the observed differences in growth rate. It may therefore be hypothesised that the growth rate differences observed were a function of water motion,

that as a response to forces imparted on the algal cells, plants were putting more energy into strengthening cell walls rather than blade elongation.

Is EU policy and governance up to the challenges of algal biomass production?

Gill Malin, Katherine Kerry and David Benson

School of Environmental Sciences, University of East Anglia

The international Future Earth initiative seeks to develop knowledge to allow adequate response to the risks and opportunities of global environmental change and the need for global sustainability. Likewise the IPCC encourages stronger partnerships between natural and social scientists, policy-makers, business and industry. Why should this be of interest to phycologists? One reason to be highlighted here is that recent years have witnessed significant worldwide growth in research into processes for algal biomass production for fuel, food and food supplements, nutrient recovery from waste and feedstocks for chemical and pharmaceutical industries. These expanding and new sectors will need the knowledge and expertise that the British Phycological Society nurtures. Algal biomass production could have excellent future sustainability benefits, perhaps especially so in terms of low carbon biofuels, but large scale algal production could also impose negative environmental impacts that must be fully considered. Pressing questions include the significance of these impacts and the adequacy of current governance arrangements in ensuring environmental protection. To examine these questions we combined our expertise in phycology, qualitative environmental impact assessment and EU governance to identify and compare the significance of potential impacts of several different production scenarios. Significant policy mismatches and gaps will be highlighted.

The EnAlgae macroalgal cultivation pilot site in Strangford Lough: initial growth estimates and stakeholder engagement methods.

K.M. Mooney[1], J.H. Bothwell[1,2], E. Gorman[1] and M.J. Dring[1]
[1] Queen's Marine Laboratory, Queen's University Belfast
[2] University of Durham

Macroalgal cultivation in North West (NW) Europe is increasing in both research effort and investment due to the production of biomass for algal bioenergy generation, as an alternative to microalgal and land-based biofuels. However, increased seabed usage has the potential to affect both environmental conditions and communities situated around the cultivation or processing sites, both positively and negatively. As the successful implementation of commercial scale seaweed farms relies on having minimal negative environmental impact and the acceptance and positive engagement of local stakeholders, these are two key issues to be addressed by initial pilot scale facilities. As part of the NW Europe Interreg IVB funded 'Energetic Algae' project (EnAlgae), macroalgal cultivation sites in Strangford Lough (Northern Ireland), Ventry Bay (Ireland) and Brittany (France) are conducting environmental monitoring and growth surveys of several kelp species. The effects on nutrients, water temperature and PAR of mass cultivation of *Laminaria digitata*, *Saccharina latissima* and *Alaria esculenta* will be examined, as well as hydrodynamic assessments (ADCP) in Strangford Lough. In conjunction with the environmental and growth analyses, an extensive stakeholder engagement and outreach programme has been implemented. We present initial environmental analyses and growth data from the Strangford Lough pilot site and the methods used to engage stakeholders, through formal information meetings, initial consultations and outreach within schools and community events.

Nutrient Induced Fluorescence Transients (NIFTS) provide a rapid a rapid measure of P and C (CO)-Limitation in a green alga

Elly Spijkerman[1], Slobodanka Stojkovic[2,3], Daryl Holland[2] and John Beardall[2]

[1] Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam, Germany.

[2] Monash University, School of Biological Sciences, Clayton, Victoria 3082, Melbourne, VIC, Australia.

[3] CSIRO, Marine and Atmospheric Research, Hobart, Tasmania 7001, Australia

Nutrient Induced Fluorescence Transients (NIFTs) have been shown to be a possible way of testing for the limiting nutrient in algae. In this contribution we show a co-limitation response for Pi and CO_2 via traditional nutrient enrichment experiments in natural phytoplankton populations inhabited by the green alga *Chlamydomonas acidophila*. In addition we show a similar response in unialgal cultures of *C. acidophila*. We attempted to link this response to the NIFT responses after a Pi- or a CO_2-spike to Pi/CO_2 (co)-limited cells of *C. acidophila*. A significant NIFT was observed in response to both nutrient spikes. The NIFT response to a Pi-spike showed an on/off response in relation to cellular P content, while the NIFT response to a CO_2-spike appeared to be inversely influenced by a high cellular P content. The NIFT responses were inversely related to the medium Pi and CO_2 concentration, but were not clearly related to the cellular nutrient content. A secondary response within the Pi-NIFT response related to the CO_2 concentration and possibly reflected co-limitation. In conclusion, NIFTs provided a quick and reliable method to detect the growth-limiting nutrient in an extremophile green alga, both under Pi, CO_2 and Pi/CO_2 (co-)limited growth conditions.

Long-term phytoplankton trends in Lough Neagh, Northern Ireland

Louise Vaughan, Yvonne McElarney, Hannah Cromie, Michelle Allen, Sally Dawson, Kevin Gallagher, Katrina Macintosh, Brian Rippey and Eugene O'Kane

QUB, Agriculture, Food and Environmental Science Division

Agri-Food & Biosciences Institute

Assessing the ecological consequences of environmental change on freshwater phytoplankton ecology is vital to ensure compliance with the European Water Framework Directive. Lough Neagh is the largest freshwater lake (total surface area = 383 km^2) in Britain and Ireland and an important multi-purpose water resource for Northern Ireland. Phytoplankton dominates the primary production in the Lough with cyanobacteria as the main algal group. The lake is dominated by low light and eutrophic tolerant cyanobacteria species *Planktothrix agardhii* and *Pseudanabaena* spp., forming a perpetual crop throughout the year. Other common species in the lough include the diatoms *Stephanodiscus* spp. and *Aulacoseira* spp. which form an annual spring bloom. Mann Kendall analyses showed a significant declining trend in chlorophyll *a* over a 40-year time period. This decline was attributed to

an observed decrease in the cyanobacteria *Planktothrix agardhii* particularly during the summer months. Phytoplankton changes were related to nutrient and physico-chemical changes within the lake and an increase in zooplankton grazer biomass.

Presidential Address

Phytoplankton – staying in the light and sharing genes

Professor Paul Hayes

Faculty of Science, University of Portsmouth, UK

In this lecture I will explore two aspects of the biology of planktonic cyanobacteria, the provision of buoyancy and population genetics. In particular I will focus on the structure and evolution of gas vesicles, structures that allow cells to float and thus remain in the illuminated upper layers of the water column, and on the transfer of genetic information between individuals in the absence of sexual reproduction.

Abstracts

Special Session: Seaweeds and Health

Characterising seaweed bioactives in an *in vitro* model gut system

Peter Chater and Jeffrey P. Pearson

Institute for Cell and Molecular Biosciences, Medical School, Newcastle University, UK

The digestion and absorption of macronutrients (fat, protein and carbohydrate) is a major factor in health and metabolic diseases such as obesity and diabetes. By 2015 it is projected that 2.3 billion people will be overweight and 700 million obese. This presents a huge global challenge in terms of health, cost and sustainability and obesity currently costs the NHS around £5 Billion annually.

A 3-step process has been developed at Newcastle University to identify bioactive properties of exogenous compounds towards the major digestive enzymes of macronutrient digestion; pepsin, trypsin, α-amylase and lipase. This consists of higher-throughput screening and selective enzyme kinetics to identify effective candidate bioactives, followed by physiologically relevant model gut analysis to study the effects of exogenous compounds on macrunutrient digestion in an artificial system. The model provides a robust, cost effective and ethical alternative to animal research and can be used to inform human studies.

This 3-step process has been employed on the 'Alginates and obesity' project at Newcastle University where it was shown that specific alginates can inhibit pancreatic lipase by over 70% in vitro. Human clinical trials have shown alginate to reduce fat digestion and absorption, therefore showing great potential anti-obesity agent.

Seagreens® harvests three brown seaweeds of the Fucaceae family from the Outer Hebrides for human consumption: *Ascophyllum nodosum, Fucus vesiculosus* and *Pelvetia canaliculata.* These seaweeds are rich sources of polyphenols and a range of biopolymers and their bioactive properties were analysed.

Potent inhibition by Seagreens Seaweeds of α-amylase and lipase activity has been demonstrated in high-throughput screening. These inhibitory effects were shown to persist in the physiologically relevant model gut system. The potential of Seagreens Seaweed as a tool to control Type II Diabetes and lower the GI value of foods is currently being investigated in humans.

UK consumers' perceptions of the nutrition and potential health benefits of seaweeds

Sophie Lewington, Iain Brownlee, Lynn Frewer and Sharron Kusnesof

School of Agriculture, Food and Rural Development, Newcastle University, UK

SWFresh seaweed received the most favourable responses during the informal taste testing in the focus groups.

The output of this study is a funcional, validated questionnaire which effectively captures consumer perception on teh risks and benefits associated with seaweed consumption, including its potention impact on health. By utilizing this questionnaire in future research, a strategy can be adopted to manage and communicate the perceived risks and benefits assocaited with seaweed, with a view to raising its profile within the UK diet.

Seaweed, iodine intake and thyroid health in women

Emilie Combe Aspray

Human Nutrition, University of Glasgow

Seaweeds are rich in iodine and represent a potential route for iodine provision in the diet of British women, a population shown to be mildly insufficient in the nutrient. This is a particular threat since iodine is essential for the synthesis of thyroid hormones. Maternal iodine deficiency, and the resulting changes in thyroid function, have been associated with adverse pregnancy outcomes including preterm delivery and impaired neuropsychological development, with significant impact on later life development and quality of life. Despite this, the UK has no iodine fortification programme and supplements are virtually non-existent.

Healthy females took encapsulated *Ascophyllum nosodum* (Seagreens®) daily for 15 days, and urinary iodine levels and thyroid function were measured. The bioavailability of the iodine from the seaweed was studied against potassium iodide in a separate experiment. The overall acceptability of seaweed was also measured.

The supplement was well accepted, and while participants indicate that they did not mind consuming capsules, there is a consensus that seaweed as a food ingredient (such as bread) would

be accepted. The iodine from seaweed was less bioavailable than potassium iodine over 24-hour, with a delayed peak excretion time, indicating potential for sustained release. Seaweed intake was effective in increasing the median urinary iodine concentration for the group above the 100 µg/L threshold for iodine sufficiency. There was no impact on thyroid hormones levels, however, TSH levels were mildly raised after supplementation. To generalise these results, further studies should be carried out for a longer time, with emphasis on dose, inclusion in staple foods (bearing in mind the impact of food matrix and processing on iodine bioavailability) and frequency of intake in relation to thyroid function.

Why won't people eat seaweeds?"

John Wright

Forager, author and presenter

John Wright, writer and broadcaster on all things forageable, asks why people in the UK ignore the edible potential of seaweeds. Perhaps it is good that they do as this leaves seaweed populations undisturbed. But maybe wild seaweeds are a large, untapped but nevertheless sustainable resource which could form a relatively substantial and healthy addition to our diet. If so then how do we encourage people to eat seaweeds beyond the odd bit of sushi?

How can we encourage people to accept seaweeds as part of their diet beyond its use as a food additive such as carrageenan? Cooking techniques need to be offered which produce "everyday" meals, rather than occasional exotic treats prepared in a restaurant.

The pleasures of foraging, the effect of foraging on people's perception of the natural world, a comparison between the use of seaweeds in the UK with the rest of the world, in particular between the UK and Japan and an assessment of how much wild seaweed is collected in the UK and for what purpose will be explored.

Should seaweeds suddenly become very popular/fashionable, consideration will need to be given to the amount of seaweed collecting possible before populations or the populations of their associated organism are seriously damaged. Should seaweed become a mainstay of the diet of the UK then what cultivation enterprises are possible or desirable?

Hand-harvesting sea vegetables on the lizard - a forager's healthful tale

Rory Macphee

Cornwall

I am a builder of boats and furniture, working the green woods in Cornwall and exploring the coastal zone. Intrigued by the presumed eating practices of my Celtic forebears, and concerned about my own physical and spiritual health, I began a quest some four years ago to acquaint myself with those curious, little understood *phyta*. My exposition will cover broad issues of health which can be referred to as Nature Deficit Disorder, together with a summary of historic and contemporary uses of macroscopic marine algae for human and animal health. It is hoped that I will encourage a debate on personal health within the context of national food security and coastal resilience. The components of the exposition will be contained within a matrix of Celtic spiritual practice.

Practical everyday use of seaweed for maximum health gain

Prannie Rhatigan

Irish Seaweed Kitchen, Streedagh House, Streedagh, Grange, Co Sligo

Seaweeds contain minerals, vitamins and trace elements in addition to components such as phyto-defensive compounds, specific polysaccharides and lipids but unless we actually consume them we are not going to gain much benefit. How many people can count a range of seaweeds as part of their daily 5 or more fruit and vegetables?

The cookbook "Irish Seaweed Kitchen" which is a comprehensive guide to healthy everyday cooking with seaweeds unveils what is under our feet and provides the information necessary to incorporate seaweed into sweet and savoury dishes to cater for breakfast, lunch and dinner. Misconceptions abound about taste, texture and aroma. The challenge is to help people change the way they think about seaweeds and to recognize that seaweeds are as diverse as any selection of vegetables available from the garden or a shop.

What are the health gains? While we have some good evidence around nutritional values, anti viral properties and expectorant properties of the various seaweeds there is less research available to support some of the other therapeutic claims. To enable the use of seaweeds in mainstream medicine more research is needed in the areas of cardiovascular health – anti-hypertensives and lipid lowering; bone health; gastrointestinal health; anti-cancer and anti-inflammatory activity.

Evidence quality is often presented in hierarchical terms with RCTs at the top and anecdotal evidence at the bottom. While we are unlikely to achieve many research results from the top of the pyramid, remaining with anecdotal work will not further the acceptance of seaweeds into the world of therapeutics. In examination of the research perhaps the term "evidence-informed" can be the umbrella under which all forms of evaluated findings are scrutinized.

The seaweed business

Rosaria Piseri

AlgAran Seaweed Products, Kilcar, Donegal, Ireland

That seaweed is good for you, everyone knows …. But that you could really enjoy eating it, up to the point of getting addicted, that was Algaran's Challenge!

After one year with a Belfast Food Technology graduate on board, Rosaria created some organic seaweed snacks to become very popular in Ireland and abroad: Carragheen Hazelnuts, Kelp Meringues, Carragheen and Herbal Blend Tea, Dulse Dukkah with Chilli and Cumin, Carragheen infused Extra Virgin Olive Oil, Puffed Spelt with Smoked Dulse. Among the ingredients: passion, folk traditions' wisdom and the best possible organic Ingredients from Donegal and from the rest of the world!

Rosaria is going to tell us her story and a brief story of the Company AlgAran, that she shares with Micheal McCloskey in Kilcar, Co. Donegal.

Poster Abstracts

RENEW: Restoration of eutrophic waters – a NERC catalyst grant for Academic/Government/Industry collaboration and proposal generation

Andrew Ferguson[1], J. Pandhal[2] , W. Zimmerman[3] , L.R. Carvalho[4]

[1]University of Sheffield, Chemical & Biological Engineering

[2]University of Sheffield, Chemical & Biological Engineering

[3]University of Sheffield, Chemical & Biological Engineering

[4]NERC Centre for Ecology and Hydrogeology

Eutrophication is the enrichment of nutrients in an ecosystem. Although a natural process, human activities associated with sewage discharge and agricultural practices have greatly enhanced this process. Excessive release of nutrients (nitrate and phosphate) causes algal blooms which following death lead to increases in oxygen-demanding bacteria which cause further detrimental effects to the ecosystem, including fish kills. Often perceived as a problem for developing countries, it is estimated that over 75% of England's surface freshwater are eutrophic with the annual costs for such management extend from £75-114m. Legislative measures to control eutrophication will take time to deliver benefits and existing control methods such as immobilization of nutrients within sediments and biomanipulation through trophic cascades have had limited success. A more immediate solution is algal harvesting, which traditionally has been an energy intensive process. As part of a NERC catalyst grant we propose to use a novel, energy efficient technology developed at The University of Sheffield in order to restore eutrophic waters and offset energy input costs via harvested biomass. This catalyst grant aims to collate existing data on eutrophic systems, develop partnerships by adding specific cross-disciplinary expertise and select sites for pilot-scale algal harvesting.

Reactive oxygen production and physiological changes in horned wrack, *Fucus ceranoides* due to silver toxicity

Kirti Ramesh and Murray Brown

School of Marine Science and Engineering, University of Plymouth

The effects of silver toxicity in different salinity regimes on reactive oxygen species (ROS) production has seldom been investigated in macro-algae. This study looks at ROS generation at different concentrations of silver (50 µg/L, 100 µg/L and 150 µg/L) at two salinities (10‰ and 28‰) in the intertidal alga *Fucus ceranoides* over a two week exposure. The chemically defined culture medium Aquil was used to conduct the study and silver speciation was calculated using Windermere Humic Aqueous Model (WHAM). Highly significant increases ($p<0.001$) in ROS were recorded at each salinity and for the interaction between salinity and silver concentration. Highly significant reductions ($p<0.001$) were observed in growth rates at each salinity and for the interaction between salinity and silver concentration. Accumulation of silver showed significant differences ($p<0.05$) at each salinity and for the interaction between salinity and silver concentration for Ag107 isotope. These results indicate that salinity affects the toxicity and bioaccumulation of silver by altering bioavailability. Silver toxicity is associated with ROS production. This study has important implications for biomonitoring of metals such as considerations of salinity stress and bio-available metal concentrations.

Towards a Red List for UK seaweeds

J. Brodie, J. Wilbraham and J. Pottas

Natural History Museum

Seaweeds are a diverse yet under-recorded group in the UK with very little supporting data available to inform conservation decisions. With environmental change, potential impact from harvesting, loss of habitats and increase in number of non-native species, there has never been a greater need to conserve seaweed diversity and to determine those species which are at risk of decline or loss. An initial assessment, applying IUCN criteria, of the UK seaweed flora (c. 650 species) using specimen collections at the Natural History Museum, London, Marine Recorder data and published literature, revealed that 1% were categorised as Critical, 5% Vulnerable and 55% Least Concern. A further 34% of species were assigned to the IUCN category of 'Data Deficient' which indicates that more work is needed to determine species distribution and status. The remaining 5% were non-native species. The provisional Red List provides a tool with which to assess and advance our knowledge of UK seaweeds. The next stage of the project will need to include targeted field work, including more recording, and reassessment. We will then be in a position to produce a 'finalised' Red Data List.

Development of RNA interference-mediated gene silencing in *Fucus serratus* embryos

G Farnham[1], M Strittmatter[2], S Coelho[2], MJ Cock[2] and C Brownlee[1]

[1] Marine Biological Association, The Laboratory, Citadel Hill, Plymouth PL1 2PB, UK

[2] CNRS, UMR 7139, and UPMC University Paris 06, The Marine Plants and Biomolecules

Laboratory, UMR 7139, Station Biologique de Roscoff, Place Georges Teissier, BP74, 29682, Roscoff Cedex, France

Phaeophyta in the orders of Fucales and Ectocapales have provided models for the study of multicellular evolution, reproductive biology and polarised development for a long time. The fucoid algae exhibit the unusual feature of inducible embryo polarisation, allowing many classical studies of polarity induction**.** However, further studies of brown algal models on these important aspects have widely been hindered by the absence of tools for manipulation of gene expression. In this study we present a method that allows gene function analysis through RNA interference-mediated gene knockdown. We show that microinjection of dsRNA corresponding to an alpha-tubulin gene into *Fucus serratus* zygotes induces the loss of a large proportion of the microtubule cytoskeleton, leading to growth arrest and disruption of cell division.

Injection of dsRNA targeting beta-actin leads to reduced rhizoid growth, enlarged cells and the failure to develop apical hair cells. The silencing effect on actin expression was maintained for up to three months. These results indicate that *Fucus* embryos possess a functional RNAi system that can be exploited to investigate gene function during embryogenesis.

Rock pools as refugia: photosynthetic communities negate ocean acidification

Williamson, C.,[1,2] Perkins, R.,[1] Goss, B.,[1] Yallop, M.,[3] Brodie, J.[2]

[1]School of Earth and Ocean Sciences, Cardiff University, Park Place, Cardiff

[2]The Natural History Museum, Department of Life Sciences, Cromwell Road, London

[3]School of Biological Sciences, University of Bristol

As atmospheric concentrations of carbon dioxide (CO_2) reach 400 ppm, there is urgent need to understand the impacts of associated ocean acidification (OA), i.e. increased seawater CO_2 partial pressure (pCO_2), bicarbonate (HCO_3^-) and proton (H^+) concentrations, and reduced carbonate (CO_3^{2-}) availability, on marine calcifying species. Numerous future-scenario OA studies have incubated species collected from near-shore environments in reduced, yet constant, pH conditions, neglecting potential natural fluctuations in carbonate chemistry experienced *in situ*. This is especially important as it has been suggested that exposure to natural pH variation confers increased resilience of calcifying species to future OA. Here we show that the irradiance-driven, photosynthetic activity of rock pool communities, dominated at our study sites by calcifying macroalgal species of the cosmopolitan genus *Corallina*, rapidly decreases rock pool pCO_2 and HCO_3^- concentrations over periods of summer and winter daytime tidal emersion, shifting the carbonate equilibrium to create more favorable conditions for calcification, i.e. super saturation of CO_3^{2-} ions. Photosynthesis, driven by irradiance, thus serves as a self-protecting mechanism for calcifying rock pool macroalgae, mitigating against the impacts of OA. It is thus imperative to incorporate natural fluctuations of carbonate chemistry into future-scenario incubations aiming to assess near-shore species and community responses to OA.

Genetic diversity in the brown algal genus *Cladostephus* (Sphacelariales)

Svenja Heesch

Irish Seaweed Research Group, Ryan Institute, National University of Ireland Galway, Ireland

The macroalgal genus *Cladostephus* (Sphacelariales, Phaeophyceae) is found world-wide along coasts in temperate regions. Most of its valid species are considered endemic in South America, whilst specimens from the rest of the world are currently attributed to a single, cosmopolitan species, *C. spongiosus* (Hudson) C. Agardh. However, comparisons of molecular markers from samples within the geographic range of *C. spongiosus*, including Europe, North America and the Southwest Pacific, suggest that at least three genetic entities are treated under this name, requiring the reinstatement of *Cladostephus* species which have been previously synonymised with *C. spongiosus* based on morphology.

Evaluating the anti-diabetic potential of several species of Malaysian seaweed

Chin Yao Xian[1,2 a], Lim Phaik Eem[1,2], Christine A Maggs[3], Phang Siew Moi[1,2], Yusrizam Sharifuddin[1,2] and Brian D Green[4]

[1]Institute of Ocean and Earth Sciences (IOES), C308 IPS Building, University of Malaya,

50603 Kuala Lumpur, Malaysia

[2]Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

[3]School of Biological Sciences, Medical Biology Centre, Queen's University Belfast

[4]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast

Type 2 Diabetes mellitus (T2DM) has been identified as a global epidemic of the 21st Century by the World Health Organisation (WHO). This study aimed to collect, identify and screen various Malaysian seaweed species and assess their potential to regulate postprandial hyperglycaemia which is a cardinal feature of T2DM. Seaweeds of various types were collected from various sites in Peninsular Malaysia and Semporna area of Sabah. Six genera of seaweeds were selected and subjected to evaluation of their anti-diabetic potential *in vitro* in terms of their inhibition towards α-glucosidase. Water extracts from three brown seaweeds *Padina*, *Sargassum*, *Turbinaria* and the green seaweed *Halimeda* were found to display inhibitory effects against α-glucosidase (23-81%; $p<0.001$; $n=4$). Amongst the four genera, *Turbinaria* and *Halimeda* were proven to be effective *in vitro* inhibitors of α-glucosidase with IC_{50} values of 24.3 mg/ml ($R^2=0.9971$; $p<0.001$) and 8.7 mg/ml ($R^2=0.9999$; $p<0.001$), respectively. Furthermore, *Turbinaria* displayed a modest inhibitory effect against amylase activity *in vitro* (6%; $p<0.05$), suggesting that it might have wider inhibitory activities. In conclusion, further investigation into the anti-diabetic potential of the genera *Turbinaria* and *Halimeda* is warranted.

Provision of access to biological materials – CCAP providing remote access and Transnational Access through the EU FP7 funded research infrastructure initiative: ASSEMBLE

Campbell C.N, Achilles-Day U.E.M, Clarke A, Field J, Gachon C.M.M, Kennedy F, Rad Menéndez C, Saxon R, and Day J.G

Culture Collection of Algae and Protozoa (CCAP), Scottish Association for Marine Science (SAMS), Oban, Argyll

Biological materials provide the fundamental building-blocks on which science is developed. ASSEMBLE is an EU FP7 research infrastructure initiative comprising a network of marine research stations. A key facet of the ASSEMBLE project has been the provision of access to marine biological materials. The Culture Collection of Algae and Protozoa (CCAP) at the ASSEMBLE partner institute of SAMS has to date provided 372 cultures of algal, cyanobacterial and protozoan strains for 15 remote access (RA) projects and transnational access (TA) projects. The

cultures provided encompassed a broad taxonomic diversity including: cyanobacteria, brown seaweeds, diatoms, dinoflagellates, green microalgae, fungal seaweed pathogens, and colourless heterotrophic flagellates. Additionally, CCAP has hosted, or been responsible for providing biological materials for, 22 out of the 44 transnational access (TA) proposals accepted for SAMS. The aims of these projects covered a wide spectrum of scientific topics including projects as diverse as: investigating effect of iron concentrations on cultures, cryopreserving algae, looking for biotech potential products in cyanobacteria, characterising polar cyanobacteria, feeding trials for cold water coral and more. During the lifetime of the project support protocols for visitors were developed and refined to provide a fit-for-purpose flexible system. The project has been extended until 31 October 2014.

Molecular assisted identification of *Lithothamnion* Species (Corallinophycidae, Rhodophyta)

Néstor M. Robinson[1], Rafael Riosmena-Rodríguez[1], Viviana Peña Freire[2], Cindy Fernández-García[3], Jazmín Hernández-Kantún[4] and Line Le Gall[2]

[1]Programa de Investigación en Botánica Marina, Departamento de Biología Marina, Universidad Autónoma de Baja California Sur, Apartado postal 19-B, La Paz, 23080, Baja California Sur, México

[2]Muséum National d'Histoire Naturelle (MNHN), UMR 7138 Systématique, adaptation, évolution, Case postale N° 39, 57 rue Cuvier, 75231 cedex 05 Paris, France

[3]Escuela de Biología, Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), Universidad de Costa Rica, San Pedro, San José, 11501-2060, Costa Rica

[4]Irish Seaweed Research Group, Ryan Institute, National University of Ireland Galway

The wide biogeographical distribution of the genus *Lithothamnion* has been well documented worldwide; nowadays a total of 431 species and infraspecific names have been used for *Lithothamnion* species; from this huge number, 85 have been recognized as valid taxonomic names in Guiry & Guiry's Algaebase in 2013. However the great majority of these biological entities have been evaluated only with morphological and anatomical approaches which have been resulted in convoluted taxonomic histories, and the identification of a large amount of "dark taxa". From this taxonomic impediment has been derived the need to use a molecular approach which helps us to understand the species biodiversity in this genus. In our molecular approach we focus on delineating the boundaries between the intra and interspecific divergences that will be helpful to determine correctly the boundaries between the different taxonomic units of the genus *Lithothamnion* in the Eastern Pacific Ocean.

Manton Prize Winner

Richard Dorrell
Department of Biochemistry
University of Cambridge

Two formative experiences led me into research. A vaguely Good Life-style childhood, in which I was given my own flowerbed and actively encouraged to assist my parents in the garden, impressed on me the sheer beauty and complexity of photosynthetic life. As a teenager, a copy of Margulis instilled an interest in the extent of symbiosis and reticulation across the Tree of Life, and an appreciation for how many interesting eukaryotes do not appear in high school text books! From there, I completed my undergraduate degree in Plant Sciences at the University of Cambridge, and am currently conducting a PhD in Biochemistry at the same university, with Chris Howe. I have become extensively involved in teaching for my university, supervising undergraduates on the Cell Biology and Plant Sciences courses, and in this I try to emphasise that my students need to explore beyond the model organisms in their studies. Not only are other species fascinating in their own right, and are often of great humanitarian importance, but they may give us clues into the fundamental processes that underpin how cells function.

In my PhD, I principally investigate transcript processing in the chloroplasts of dinoflagellates, and their closest photosynthetic relatives. I am particularly interested in whether changes in chloroplast genome structure impact on the associated RNA metabolism- a rich area for investigation given the extraordinary plasticity in chloroplast genome content and organisation within the alveolates. Perhaps most significantly, there are several very well characterised examples of serial endosymbiosis within the dinoflagellates, in which the ancestral chloroplast lineage, derived from red algae and containing the pigment peridinin, has been lost and replaced by one of a new phylogenetic derivation, such as a haptophyte-derived chloroplast in the fucoxanthin dinoflagellates.

Presumably, any host that undergoes serial endosymbiosis possesses a diverse portfolio of pathways that it used to support the ancestral chloroplast lineage. We wished to test whether any of these pathways might be retained through serial endosymbiosis and applied to the incoming chloroplast- and if so, how might this affect its biology. The ancestral peridinin dinoflagellate chloroplast utilises highly unusual transcript processing pathways not found in other chloroplasts: transcripts receive a 3' poly(U) tail, and in addition undergo extensive and promiscuous sequence editing. Surprisingly, we found evidence that both poly(U) addition, and transcript editing, have been retained through serial endosymbiosis, and now function in the replacement chloroplasts of the fucoxanthin dinoflagellates *Karenia mikimotoi* and *Karlodinium veneficum*.

Both transcript processing pathways have now become essential for the function of the fucoxanthin chloroplast lineage: editing is involved in correcting for otherwise deleterious mutations in the chloroplast genomic sequence, and poly(U) addition has important roles in ORF recognition, and discriminating between functional and non-functional transcripts during processing. More broadly, our data shows that reticulation really does matter for eukaryotes: the biology of specific organelles may not only be supported, but actively altered by pathways retained from historical symbioses.

Currently, I am investigating how the chloroplast genomes and associated RNA metabolism of fucoxanthin dinoflagellates have evolved since the initial serial endosymbiosis event, and am also reconstructing early events in the evolution of poly(U) addition in the ancestral peridinin chloroplast lineage. Through this, I have been fortunate enough to work with a brilliant supervisor, and three highly talented undergraduates: James Drew, Beth Richardson, and George Hinksman, who has been supported via a British Phycological Society summer studentship. I am indebted to the Society not only for supporting this project, but enabling me to maintain contact with the next generation of scientists, and getting them enthused by non-textbook species. I look forward to continuing to work within the Society over the next few years, and sharing how this rather intricate, and potentially quite profound, story in eukaryotic cell biology unfolds.

Poster Prize

Néstor M. Robinson
University of Baja California Sur
La Paz, BCS Mexico

I am a young Mexican phycologist, the Great-grandson of James Alexander Robinson, a British citizen born in the early 1900s in Helen's Bay. For twist of fate, at the beginnings of the great economic depression in the 1930s, he moved out from Northern Ireland to Mexico, where my family grew up in the tropical lands of the Gulf of Mexico.

Interestingly, my passion for marine biology started during the final semesters of my bachelor´s degree, when I get the chance to be introduced to marine sciences and diving in Veracruz. Happily my passion for the seaweed world started in the earliest semesters of the undergraduate degree, after a course about marine plants given by one of the students of Laura Huerta Múzquiz, one of the first Mexican phycologists. My first experiences were on the identification of microalgae, particularly diatoms and dinoflagellates; however, I realized soon that my preferences were for the macroscopic ones, the macroalgae.

During my bachelor's degree I worked in a project to assess species diversity of marine macroalgae in the reefs of Veracruz. Coralline algae were surprisingly complex at any level. So, I decided to focus my master thesis on taxonomy of coralline algae, in the University of Baja California Sur (UABCS) under the supervision of Rafael Riosmena Rodríguez, well known for his expertise of coralline algae taxonomy, and Cindy Fernández García from the University of Costa Rica and well known for her contribution to the knowledge of the marine macroalgal flora from Central America. Fortunately I received funding from the Mexican government for developing a research project focused on taxonomy of coralline algae through research studentships in foreign countries. Thanks to the kind support of Line Le Gall and Viviana Peña, from the National Museum of Natural History in Paris, and Svenja Heesch and Jazmín Hernández Kantún from The National University of Ireland, Galway I had the opportunity to develop my research proposal and to attend for the first time the 61st Summer Meeting of the British Phycological Society that was held in Belfast last July 2013. During my first year as official member of the BPS I was awarded the Poster Prize of this meeting with the research project entitled "Molecular assisted identification of L*ithophyllum* and *Lithothamnion species* (Corallinophycidae, Rhodophyta) and verification of the "barcode gap".

After this series of fortunate events I sincerely want to thank the people involved in my work and especially to the British Phycological Society council, organizers and members; for this inspiring and unforgettable Summer Meeting.

British Phycological Society
Minutes of the 61st Annual General Meeting
Belfast, Tuesday 8th July 2013 4.30 pm

Present

John Bothwell, Juliet Brodie, Jenny Bryant, Christine Campbell, Geoff Codd, John Day, Richard Dorrell, Matt Dring, Claire Gachon, Paul Hayes, Anne Jungblut, Louise Kregting, Christine Maggs, Gill Malin, Linda Medlin, Karen Mooney, Matthew Pearce, Jane Pottas, Jo Wilbraham.

1. Apologies

Mike Guiry, Martyn Kelly, Jan Krokowski, David Mann, Rupert Perkins, Helen Rosenkranz, Clare Scanlon, Elliot Shubert, Martin Wilkinson

2. Minutes of the 60th AGM, January 2012

The minutes were accepted as an accurate record of the meeting.

3. Matters arising

None

4. Reports from Officers

i) Secretary (Jane Pottas)

In a change from previous arrangements it was decided to move the annual meeting to the summer. The transition was not as smooth as intended and thanks are due to Chris Maggs for stepping in to organise the meeting. The change to the timing of the meeting may well account for the smaller number of delegates this year but the effect on numbers will be reassessed after EPC6 in 2015. Until then the BPS is committed to holding the annual meeting in the summer. Proposed plans to establish a members only password protected area on the BPS website have had to be deferred because of problems with the website but it is hoped that these plans will come to fruition in the near future. Details of Council members and Officers will be updated on the website.

ii) Treasurer (Michelle Tobin)

The Society gave financial support to the 2012 annual meeting and AGM which were hosted by Newcastle University. Seven students received support to attend this meeting from the Scientific Meetings Fund. As part of the Society's Jubilee celebrations a one day scientific meeting was held at the Natural History Museum, London. Society funds were used to support attendance of students and invited speakers. The Society supported eleven students to attend courses, workshops and conferences. One summer studentship was awarded. The Hilda Canter Lund award for photography was presented to Gaysina Albertovna. The small grant/project award received a high number of applications and five awards were made. During 2012 honoraria were awarded to the Membership Secretary, Secretary and the Editor of *The Phycologist.* The Editor in Chief of *EJP* received editorial expenses. In addition Taylor and Francis provided monies to support the work of the editorial team. The *Journal* performed very well financially. The Scientific Meetings Fund was increased to allow the Society to support students with bursaries from the interest it receives. The Society's financial situation remains good and this has allowed the continued support of a wide range of projects and awards. However, the publications landscape is changing and this will affect the income the society receives from this source. A working group is to be set up to look at the future publications landscape, proposed by Gill Malin, seconded by Juliet Brodie, approved by all.

iii)Membership Secretary (Sara Marsham)

Problems encountered with the database following transfer to a different server meant that it was not possible to accept and process applications and renewals at the start of 2013. Following extensive work from Mike and Caoilte Guiry the database was returned to the original server and payments were accepted from March 2013. Membership is roughly stable at 380. Plans for a recruitment drive amongst phycologists across Europe are underway to encourage them to join the BPS to increase numbers.

iv) Student Representative (Helen Rosenkranz)

No report was received.

Claire Gachon commented that the financial support offered to students is much appreciated and it does bring in new members although there is a problem retaining them as members since so few continue to work in phycology because there are so few jobs in this field.

v) Editor of the *European Journal of Phycology* (David Mann)

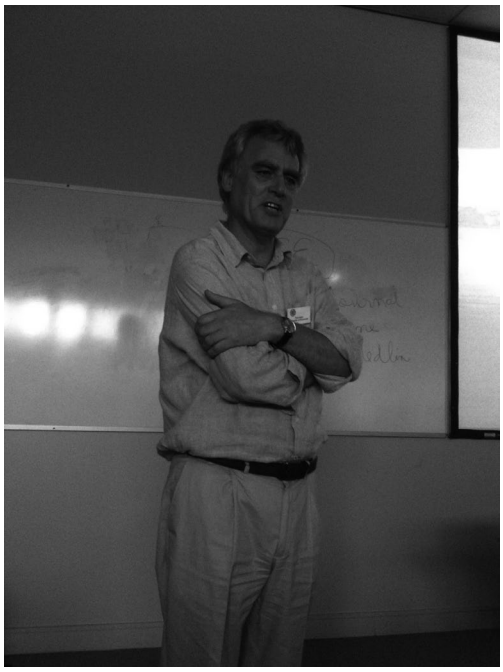
In the absence of David Mann Chris Maggs addressed this report.

The impact factor of the EJP is around 1.9 but submissions are dropping slightly. Open Access journals are a threat to subscription journals and the working group will consider the future shape of the EJP and work to improve the impact factor.

vi) Editor of *The Phycologist* (Jan Krokowski)

In his absence Paul Hayes thanked Jan for his continuing work as Editor of *The Phycologist* and encouraged all to write articles for the newsletter. Students and their supervisors are reminded that students in receipt of awards must write a report for *The Phycologist* as a condition of receiving their award.

Reports from Officers were accepted, proposed by Jenny Bryant, seconded by Claire Gachon.



vii)Student Awards and Training Committee (Juliet Brodie)

This year has seen a larger number of applications than in previous years and the majority of these were supported, either partially or fully. Juliet suggested that the Manton Session could be extended into a whole day for student participants at future BPS meetings. Juliet thanked the committee members Dr Michelle Tobin, Dr Michael Steinke and Dr Rupert Perkins for their hard work.

viii) Biodiversity and Conservation Committee (Martin Wilkinson)

Juliet Brodie spoke in Martin's absence.

A successful grant application to OPAL (Open Air Laboratories Network), which gives grants annually to increase biological recording activities, covered an online recording portal for seaweeds and a field meeting. OPAL only covers England but all British Isles records can be entered once the site is established. The online mapping and recording scheme has been set up with the help of Paula Lightfoot of the National Biodiversity Network and the website will be launched in time for the BPS Field Meeting in July at The Dove Marine Laboratory, Newcastle University, Cullercoats, Northumberland.

ix) Education and Outreach Committee (John Bothwell)

The BPS has been represented at various festivals in the past 6 months including the Scarborough Festival of Ecology. John announced that he will be stepping down from chairing this committee and Michelle Tobin has volunteered to take on the role.

Reports from Committees were accepted, proposed by Linda Medlin, seconded by John Day.

Paul thanked all Officers and Committees for their hard work.

5. Federation Reports

i) Federation of European Phycological Societies (FEPS) (Geoff Codd)

FEPS membership at national society level currently stands at 13 with several individual members from Turkey and Scandinavia neither of which has a national society. Successful negotiations have established a review journal to be published by Schweizerbart Scientific Publisher. The subject matter will range from cyanobacteria to brown algae, including aspects of biotechnology, cell biology, molecular biology, systematics and biogeography and evolution. The FEPS President is trying to organize a workshop "New molecular approaches in Phycology" for advanced PhD students and young Post-Docs.

EPC6 is to be held in London in July 2015 in conjunction with the BPS annual meeting. EPC6 planning is on schedule and a request for £10,000 for a deposit to secure the accommodation has been approved by BPS Council as a loan. Projected finances by the EPC6 Planning Committee are based on 200 delegates plus 100 student members. The BPS Meetings Secretary and BPS Council member, Anne Jungblut, are on the organising committee.

ii) Federation of European Microbiological Societies (FEMS) (Paul Hayes)

FEMS has funds to support work in European laboratories and in the current round of funding two BPS members have made successful applications. EPC6 can apply for funding to support the meeting.

Claire Gachon enquired why details about post doc funding opportunities had disappeared from the FEMS website. Paul will feed back on this after the FEMS Council meeting in September.

iii)Society of Biology (SB) (Paul Hayes)

The Society of Biology is becoming a much more effective body in lobbying government and it is to the advantage of the BPS to remain a member.

6. Council Membership

As a result of the decision to move the annual meeting and thus the annual general meeting to the summer roles were extended by six months.

1) President – Chris Maggs replacing Paul Hayes
2) President Elect – Gill Malin
3) Secretary – Jane Pottas to continue
4) Treasurer – Maeve Edwards replacing Michelle Tobin
5) Membership Secretary – Sara Marsham to continue
6) Student Representative – Chris Williamson replacing Helen Rosenkranz
7) Meetings Secretary – temporarily vacant
8) Overseas Vice President – Chuck Amsler
9) President Elect – Gill Malin
10) Ordinary Members of Council

Gill Malin, Linda Medlin, Eileen Bresnan will be stepping down at the end of their term of office. Claire Gachon and Anne Jungblut were elected to Council.

7. Report of Algal Applications Group (AAG) (Geoff Codd)

The AAG was established as a short term working group at the request of the BPS Council in July 2012. The aims of the AAG were to 1) survey existing relevant activities in applied phycology, of which the BPS should be aware, 2) identify ways in which the BPS may be effective in the promotion and support of algal applications, and 3) identify applied phycology links/potential links, including with academia, public agencies and regulatory bodies, private enterprises, companies and the general public. The AAG made a number of recommendations including: that the promotion and support of applied phycology within, and by the BPS should be more explicitly and actively pursued by a number of suggested means, e.g. holding joint meetings with other organisations; making greater use of social media (Facebook, Twitter, Linkedin); contributing to the professional development requirements of organisations; expanding the Awards and Training Committee Funding Guidelines to explicitly include the possibility of support for proposals for BPS members to engage with industrial partners to jointly supervise projects. Changes to the BPS website are proposed including the addition of the term "algae" to the Welcome page which would itself increase the total number of visits to the BPS website. The Editor of the *European Journal of Phycology* should be asked to commission more reviews in applied phycology.

A further recommendation of the group was that following the disbanding of the Algal Applications Group an Algal Applications Committee (AAC) should be established alongside the current working committees of the Council. The AAC should include representatives of the academic, commercial and public sectors drawn from the BPS membership. Council agreed to the formation of this committee - Chair: Dr Gill Malin; committee members: Dr Sara Marsham (AAC Secretary), Dr Martyn Kelly, Dr Craig Rose (Seaweed Health Foundation) Dr, Andrew Spicer (Algenuity).

Paul thanked Geoff and the members of the working group.

8. Future meetings

i) Galway 2014 – dates to be announced, local organiser Maeve Edwards.

ii) EPC6 2015 – dates to be announced.

9. Hilda Canter Lund Prize (Martyn Kelly)
This year's winner is Chris Carter for his image of *Chara virgata*.

10. AOB

Jenny Bryant was reassured that the BPS archives are an active issue and will be included in future agendas.

The meeting finished at 5.30pm.

The British Phycological Society
Registered Charity No. 246707

Annual Report for the year ended 30 September 2012

The Society is an unincorporated association governed by its constitution and administered by its Council (trustees). The addresses of the current office bearers are set out in the *European Journal of Phycology.*

Membership of the Council of the Society:

Executive Members

President:	Prof. P. Hayes
Treasurer:	Dr M. Tobin
Vice President:	Prof. C. Maggs
Ed. (EJP):	Prof. D. Mann
Overseas Vice President:	Prof. Phang Siew Moi
Ed. (*Phycologist*):	Dr J. Krokowski
Immediate Past President:	Prof. J. Brodie
Webmaster:	Prof. M.D. Guiry
Secretary:	Dr J. Pottas
Mem. Secretary:	Dr S. Marsham

Ordinary Members

Prof. M. Wilkinson
Dr J. Metcalfe
Dr Marian Yallop
Dr G. Malin
Dr J. Bothwell
Ms. H. Rosenkranz
Dr M. Edwards
Prof. E. Shubert

Meetings Secretary:	Dr R. Perkins
FEPS Representative:	Prof. G. Codd

Principal bankers:
Bank of Scotland, 39 Albyn Place, Aberdeen

Solicitors:
Wolferstans, 60/64 North Hill, Plymouth

Independent Examiner:
Flannigan, Edmonds and Bannon, 2 Donegal Square East, Belfast

This is the ninth Annual Report presented by the current Treasurer. It is made in this form to meet the requirements of the Statements of Recommended Practice (SORP), issued by the Charity Commission and serves as an annual record of the resources entrusted to the Society and the activities it has undertaken.

The Society gives financial support to activities that promote phycological research, disseminate phycological knowledge and assist young phycologists to present their findings at scientific meetings. The 2012 annual meeting and AGM were hosted by Newcastle University and thanks go to Dr Sara Marsham for organising a successful meeting. Congratulations to Alexander Jueterbock and Sabrina Heiser whose excellent presentations earned them the Manton Prize and Poster Prize respectively. Seven students received support to attend this meeting from the Scientific Meetings Fund (SMF) (twelve in 2011). As part of the Society's Jubilee celebrations, it part funded a one day scientific meeting at the Natural History Museum, London. Society funds were used to support attendance of students and invited speakers. Thanks go to Prof. Juliet Brodie for organising this event.

The Society supported eleven students to attend courses, workshops and conferences. One summer studentship was awarded (two in 2011). The Hilda Canter Lund award for photography was presented to Gaysina Albertovna. The Society continued to receive an encouraging number of applications for funding in this financial year and was able to support a good number of student members to develop and present their phycological knowledge both in the UK and abroad. The small grant/project award received a high number of applications and five awards were made.

During 2012 honoraria were awarded to the following council members: the Membership Secretary, Secretary and the Editor of The Phycologist each received £1000, the Treasurer received £1250. The Editor in Chief of EJP received £10,000 towards editorial expenses for this year. In addition Taylor and Francis provided £2695.37 to support the work of the editorial team.

The Journal performed very well financially and the final profit share from Volume 46 was £50,726.14(an increase of approximately £3000 from volume 45). In addition the Society received an advance of £30,000 guaranteed income for Volume 47. Production costs of the Journal remain low at £5,879.25 for Volume 46 (£6,108.75 for Volume 45).

The Society's financial situation remains good and this has allowed the continued support of a wider range of projects and awards. The Scientific Meetings Fund was topped up to a total of £25000 to allow the Society to support students with bursaries from the interest it receives. Finally, I would like to thank all Council and Society members for their co-operation and support during this financial year.

The British Phycological Society
Statement of Financial Activities for the Year ended 30th September 2012

	Note	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2012 £	Total 2011 £
Income and Expenditure						
Incoming Resources						
Subscriptions 2010		0.00	0.00	0.00	0.00	2,785.50
Subscriptions 2011		185.00	0.00	0.00	185.00	9121.73
Subscriptions 2012		6,088.00	0.00	0.00	6,088.00	0.00
Journal profit share 2010		0.00	0.00	0.00	0.00	17,930
Journal profit share 2011		20,726.14	0.00	0.00	20,726.14	30,000.00
Journal profit share 2012		30,000.00	0.00	0.00	30,000.00	0.00
Auction/quiz/sales proceeds		0.00	0.00	0.00	0.00	322.00
FW Atlas		0.00	0.00	0.00	0.00	0.00
Winter meeting 2010		0.00	0.00	0.00	0.00	11,450.00
Winter Meeting 2012		12,435.00	0.00	0.00	12,435.00	0.00
EJPMC		2,695.37	0.00	0.00	2,695.37	2,604.22
Jubilee Meeting 2012		975.00	0.00	0.00	975.00	0.00
MISC		127.00	0.00	0.00	127.00	0.00
Total Incoming Resources		**73,231.51**	**0.00**	**0.00**	**73.231.51**	**74,213.58**
Resources Expended						
Grants, studentships & awards	**2**	17.761.90	1,657.70	250.00	19,669.60	24,005.60
Publications expenditure	**3**	21,752.03	0.00	0.00	21,752.03	21,393.48
Meetings & Committee Expenses	**4**	20,548.21	0.00	0.00	20,548.21	23,532.64
Administration Costs	**5**	9,144.93	0.00	0.00	9,144.93	9,091.51
		69,207.07	**1,657.70**	**250.00**	**71,114.77**	**78,023.23**
Net Incoming (Outgoing) Resources for the Year		**4,024.44**	**(1,657.70)**	**(250.00)**	**2,116.74**	**(3,321.29)**
Fund at 1st October 2011		104,450.08	25,000.00	3,944.09	133,394.17	136,715.46
Transfer (General to SMF)		(1,657.70)	1,657.70	0.00	0.00	0.00
Fund at 30th September 2012		**106,816.82**	**25,000.00**	**3,694.09**	**135,510.91**	

Balance Sheet as at 30th September 2012

	Note	2012 £	2011 £
Current Assets			
Debtors	**7**		1,777.34
Short term deposits			138,251.99
Cash at bank			8,710.86
Liabilities: amounts falling due within one year	**8**		15,346.02
Net Assets			**133,394.17**
Funds	**9**		
Unrestricted			104,450.08
Restricted			3,944.09
Designated			25,000.00
			133,394.17

Signed on behalf of the British Phycological Society
Dr Michelle Tobin, Treasurer

The British Phycological Society
Notes to the Accounts for the Year ended 30th September 2012

1 Accounting Policies

The accounts have been prepared in accordance with applicable Accounting Standards and the SORP - Accounting and Reporting by Charities issued in March 2005. A summary of the more important policies, which have been applied consistently, is set out below:

Basis of Accounting

The Accounts are prepared in accordance with the historic cost basis of accounting.

Subscriptions

Subscriptions include amounts received from members during the year. No amount is included in respect of subscriptions outstanding at the year end. Subscriptions received in advance for future years are included in deferred income.h

Funds

Restricted funds comprise unexpended balances of donations and interest to be applied for specific purposes. At 30th September 2012, the Society's only restricted fund was the Manton Fund.

Designated funds are those set aside out of unrestricted funds for specific purposes. At 30th September 2012, the designated fund of the Society was the Scientific Meetings Fund ("S.M.F.").

Cash Flow Statement

The Society has taken advantage of the exemptions provided in FRS 1 "Cash Flow Statements" for small entities and has not prepared a cash flow statement.

	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2012 £	Total 2011 £
2 Grants, Studentships & Awards					
Travel awards for Winter Meeting	0.00	4,095.60	0.00		4,095.60
Awards for courses, travel, Summer Bursary	6,480.00	0.00	0.00		6,480.00
Manton Prize	0.00	0.00	250.00		250.00
Poster prize at Winter Meeting	150.00	0.00	0.00		150.00
Special Project Grants	12,880.00	0.00	0.00		12,880.00
Hilda Canter-Lund award	150.00	0.00	0.00		150.00
Hilda Canter-Lund exhibition	462.50	0.00	0.00	462.50	0.00
Jubilee Meeting student bursaries	95.00	0.00	0.00	95.00	0.00
Suumer studentships	1,800.00	0.00	0.00	1,800.00	0.00
	17,761.90	**1,657.70**	**250.00**	**19,669.60**	**24,005.60**
3 Publications expenditure					
Journal	5,879.25	0.00	0.00	5,879.25	6,108.75
Editor's Stipend	10,000.00	0.00	0.00	10,000.00	10,000.00
E.J.P.Management Committee	999.37	0.00	0.00	999.37	0.00
The Phycologist	4,128.47	0.00	0.00	4,128.47	4,884.83
EJP Editorial Assistant Expenses	149.94	0.00	0.00	149.94	249.90
BPS Brochure promotion	595.00	0.00	0.00	595.00	150.00
	21,752.03	**0.00**	**0.00**	**21,752.03**	**21,393.48**
4 Meetings & Committee Expenses					
Council Meeting 2011	553.95	0.00	0.00	553.95	3,591.30
Council Meeting 2012	3,129.71	0.00	0.00	3,129.71	3,406.08
Biodiversity Committee Expenses	918.24	0.00	0.00	918.24	1,491.71
Awards & Training Committee Expenses	0.00	0.00	0.00	0.00	0.00
Winter Meeting 2011	180.00	0.00	0.00	180.00	3,492.19
Winter meeting 2012	13,861.08	0.00	0.00	13,861.08	0.00
Federation of European Phycologists	541.38	0.00	0.00	541.38	945.64
FEMS Meetings	398.77	0.00	0.00	398.77	0.00
Jubilee Meeting 2012	**965.08**	**0.00**	**0.00**	**965.08**	**0.00**
	20,548.21	**0.00**	**0.00**	**20,548.21**	**23,532.64**

The British Phycological Society
Notes to the Accounts for the Year ended 30th September 2012 (cont.)

	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2012 £	Total 2011 £
5 Administration Costs					
Public liability insurance	460 .90	0.00	0.00	460 .90	435.56
Independent Examiner's Fee	1,440.00	0.00	0.00	1,440.00	1,380.00
Credit Card Charges	625.06	0.00	0.00	625.06	740.87
Bank charges	257.06	0.00	0.00	257.06	436.28
Executive Honoraria (2011)	0.00	0.00	0.00	0.00	3,250.00
Executive Honoraria (2012)	4,250.00	0.00	0.00	4,250.00	0.00
Society of Biology Subscription	595.00	0.00	0.00	595.00	594.860
General Expenses (Sec/Treas/mem sec)	113.21	0.00	0.00	113.21	32.99
FEMS subscription	436.34	0.00	0.00	436.34	453.53
FEPS subscription	430.86	0.00	0.00	430.86	273.33
Website Maintenance	500.00	0.00	0.00	500.00	1,457.59
Miscellaneous	36.50	0.00	0.00	36.50	36.5
	9,144.93	**0.00**	**0.00**	**9,144.93**	**9,091.51**
	69,207.07	**1,657.70**	**250.00**	**71,114.77**	**78,023.23**

6 Reimbursment of Council members' expenses

Sixteen (2010: Sixteen) Council members received £4,162.96 (2010: £4,700.45) as reimbursment of travel and overnight accommodation for expenditures incurred during the year on Society business. No monies were paid to any Council member in respect of subsistence.

7 Debtors	2012 £	2011 £
Interest receivable		275.14
Prepayments & accrued income		1,502.20
	0.00	**1,777.34**

8 Liabilities: Amounts falling due within one year		
Accruals & deferred income		4,846.02
Provisions for the *Journal* and the *Phycologist*		10,500.00
	0.00	**15,346.02**

9 Analysis of Net Assets between Funds

	Unrestricted Funds £	Designated Funds £	Restricted Funds £	Total Funds £
Fund balances as at 30th September 2012 are represented by				
Current assets	147,157.32	4,444.09		151,601.41
Current liabilities	(14,635.95)	(250.00)	0.00	(14,885.95)
Total Net Assets	**132,521.37**	**4,194.09**	**0.00**	**136,715.46**

Report of the Independent Examiner to the Members of the British Phycological Society
We report on the accounts of the Society for the year ended 30th September 2012, which are set out on pages 23 to 26.

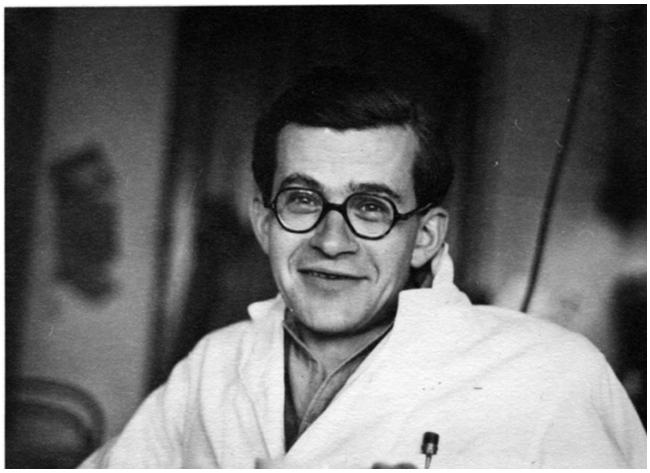
Respective responsiblities of trustees and examiner:
The Council Members are responsible for the preparation of the accounts. The Council Members consider that an audit is not required for this year (under section 43 (2) of the Charities Act 1993 (the 1993 Act)) and that an independent examination is needed. It is our responsibiliy to:
* examine the accounts (under section 43 (3) (a) of the 1993 Act):
* to follow the procedures laid down in the General Directions given by the Charity Commissioners (under section 43 (7) (b) of the 1993 Act); and
* to state whether particular matters have come to our attention.

Basis of independent examiner's report:
Our examination was carried out in accordance with the General Directions given by the Charity Commissioners. An examination includes a review of the accounting records kept by the charity and a comparison of the accounts presented with those records. It also includes consideration of any unsual items or disclosures in the accounts, and seeking explanations from the Council Members concerning any such matters. The procedures undertaken do not provide all the evidence that would be required in an audit, and consquently we do not express an audit opinion on the view given by the accounts.

Independent examiner's statement:
In connection with our examination no matter has come to our attention which gives us reasonable cause to believe that in any material respect the requirement:
* to keep accounting records in accordance with section 41 of the 1993 Act and;
* to prepare accounts which accord with the accounting records and comply with the accounting requirements of the 1993 Act;
have not been met.

Flannigan Edmonds Bannon
Chartered Accountants and Registered Auditors
Belfast, Northern Ireland

John Lund Celebration



Ed. In 2012 we reported on two of the editors of the second edition of '*The British Freshwater Algal Flora of the British Isles*' (David John and Brian Whitton) presenting signed copy of the book to John W. G. Lund FRS, just before his 99th birthday. This being the centenary celebratory year, the following articles pay tribute to John Lund.

Images of John Lund courtesy and with permission from FBA.

The epilithic diatoms of certain Welsh streams, with special reference to the effects of bracken: a tribute to John Lund

Brian Moss

School of Environmental Sciences, University of Liverpool, Liverpool, UK

Inspiration

Many of us, in the generation that worked on algae in the last half of the twentieth century, value connections with John Lund and are delighted at his centenary. He was the supervisor of my PhD supervisor, Frank Round, and I'm told he also had the gift of non-interfering light supervision that promotes independent thought. John Lund had an admirably cavalier attitude to authority, telling me, on one occasion when some funding body told him he could not publish without permission, that he replied they could go ahead and sue. He wrote well and his Baldi lecture to the International Society of Limnology (Lund, 1964) is a model of clarity, straightforwardness and lack of pomposity that is a lesson in writing. His open-mindedness and curiosity ran, and still does, to learning Russian to have access to papers on green algal taxonomy.

John Lund began his career not with the phytoplankton that made his name, but with the tricky sampling of algae on pond sediments (Lund, 1942), under the guidance of F.E. Fritsch in London, and with the even more intractable soil algae, when he was employed by the forensic service during the Second World War. His interests in these areas passed to his students, like Frank Round and grandstudents like myself; from his base at the Freshwater Biological Association, directly and indirectly, John Lund has fostered a wide coverage of the ecology of the algae.

He always showed an interest in practical problems, as well as fundamental taxonomy and ecology, and it is that connection that underlies this essay on the ecology of attached diatoms in upland streams. There is also a happy linkage embodied in a Russian graduate student, who took the samples of diatoms, the counting of which, some ten years ago, kept me broadly sane as university authorities in the UK moved into their present regime of bureaucratic dirigisme, something which I believe John Lund, himself taking pleasure in counting samples, would have equally deplored.

The hills are alive..

..with the growth of bracken. The Lake District Fells, the Pennines, the Welsh hills, Dartmoor, Exmoor, many lowland heaths and great swathes of Scotland and Ireland are plagued with bracken (*Pteridium aquilinum*), a fern that my colleague in this project, Prof. Robert Marrs describes as a thuggish plant. Given rein by the overgrazing of the moorlands by sheep, its aggressive rhizomes take over the hillsides, suppressing other species, reducing the available grazing and producing a set of toxins, notably ptaquiloside. These toxins have a reputation for causing a variety of diseases in stock, stomach cancer in North Wales, and mouth cancers in the Japanese people who relish the young crozier shoots that emerge in spring. (I quite liked the taste of them too on my youthful hikes across the moors, but have so far survived). Ptaquiloside is water soluble and may contaminate milk, and naturally there have been concerns about its possible contamination of water supplies.

When the days arrived for the research councils to demand that applications for research studentships should say exactly what the project would be, and that it should

preferably expand the economy, Rob Marrs and I came up with the idea that bracken might have effects on stream ecosystems in the uplands. We engaged a young and very athletic Anglo-Russian, Pavel Toropov, who had completed his first degree at Queen Mary, London, in the descendant of F.E. Fritsch's and John Lund's old department. He was avid to work on invertebrates in streams and content to walk, laden with equipment, up and down miles of hillsides, with a speed that led to his successive companions in the field regarding a sampling occasion as literally a once-in-a-lifetime experience. The hypothesis was that bracken in the catchment would reduce the functioning and diversity of invertebrate and diatom communities in a series of streams in North Wales, where there was variable bracken coverage, a lack of conifer afforestation, and absence of dams or sources of pollution to complicate the issue. We would also carry out some experiments in which water was sprayed over fresh bracken, and then allowed to trickle through artificial laboratory streams, to investigate its effects on freshwater shrimps.

The investigation

Bracken covers about 5.7% of Wales and may grow very vigorously (Fig. 1). We chose two areas in the Berwyn Mountains and Clwydian Hills, close enough to Liverpool for sampling, and with many comparable headwater streams. The areas were typical of uplands between 200 and 500 metres above sea level, with mosaics of acid or neutral grassland, stands of bracken, and heather moorland. The Berwyns lie on Ordovician and Silurian shales, mudstones and sandstones, the Clwydians have slightly younger shales with some limestone. The thirteen streams finally selected provided a gradient of water chemistry as well as potential influences of bracken. Ten were in the catchment of the Afron Dyfrdwy, the Welsh Dee, and three in that of the River Clwyd, itself a main tributary of the Dyfrdwy. The streams were 1 to 2 km in length with catchments of 1-2 km^2. They were in open land, were sometimes overhung with bracken, and less than a metre wide or 30 cm deep, with riffles and pools, runs and cascades over a largely rocky bottom. Conductivities were between 40 and 60 $\mu S\ cm^{-1}$ in the Berwyns, and 80 to 140 in the Clwydians and nutrient levels were low, with ammonium usually lower than 20 $\mu g\ N\ L^{-1}$ and nitrate undetectable, or less than 0.1 $mg\ N\ L^{-1}$, except in two Clwydian streams where it reached around 0.8 mg N per litre. pH ranged from 3.95 to 5.81 in the most acid stream, to 6.5 to 7.24 in the most alkaline.

Environmental variables were sampled monthly for a year. They included catchment features (altitude, stream length and catchment area), stream features (depth, width, moss cover, areas of riffle, run, and pool habitats, cascade length, chlorophyll *a* density on the rocks in the stream, and degree of shading), water chemistry (pH, Ca, Mg, Cl, Fe, Na, NO_3, NH_4, conductivity, alkalinity and suspended solids) and features of the bracken in the catchment (frond density, frond height, area covered and total biomass). Invertebrates were also taken monthly, with two-minute kick samples (covering 2 metres of channel) in each of two pools and two riffles in a 100-m section. Epilithic diatoms were scraped from measured areas of three randomly determined embedded rocks in each stream using a piece of Velcro and brought back as suspensions in water, in May, July and September. Chlorophyll *a* on the rocks was also determined from these suspensions. Pavel sorted, identified and counted the invertebrates, whilst I made permanent slides, mounted in naphthrax, of the diatoms, after digestion of the samples with nitric acid, and counted frustules identified using Hustedt (1930) and Krammer & Lange- Bertalot (1986 et seq). This I recall as a pleasure because the frustules were clear and intact, in contrast to those fractured and vanishing fragments that I was more used to, in sediment cores.

The diatom communities of the study streams were very similar, with almost every one of the 78 recorded taxa found in all study streams. *Achnanthes minutissima*, *Gomphonema gracile*, *Eunotia praeerupta* and *Fragilaria capucina* were the most common species. In the Clwydians these were joined by *Cocconeis placentula*. Both alkaliphilious and acidophilous taxa were present. The former included *Fragilaria virescens, Cymbella gracilis*, and *Epithemia sp*, the latter *Tabellaria flocculosa*, *Frustulia rhomboides*, and nine species of *Eunotia*.

Fig 1. Bracken often dominates the hillslopes of streams in the Berwyn Mountains, sometimes overhanging the headwater streams (left) and growing to head height (right). Photographs from Toropov (2002).

The streams differed in overall diatom densities with fewer diatoms in the apparently more fertile streams of the Clwydians than in most of the Berwyn sites, where densities could reach over half a million per cm^2. Insight was gained from multivariate redundancy analysis (RDA), following detrended correspondence analysis to decide on the most appropriate of redundancy or canonical correspondence analysis to deal with an inevitably complex body of information. Data for the spring diatom communities (which were seasonally most abundant) are shown in Fig. 2.

The arrangement of the arrows of the significant variables falls within two axes. The first axis is an altitude/chemistry gradient. Conditions associated with lower altitude are on the top left, with greater grazer density and higher pH. Grazer species included: *Baetis, Rhithrogena semicolorata* and *Siphlonurus lacustris* among the Ephemeroptera; several elminthid beetles; the trichopterans *Silo pallipes*, *Odontocerum albicorne*, and *Agapetus fuscipes*; the plecopteran *Brachyptera risi*; and in the Clwydian streams, molluscs, *Ancylus fluviatilis*, *Limnaea peregra* and *Valvata spp*. Moving diagonally across to the bottom right of the ordination, the conditions change to those of higher altitude: lower pH, larger substratum particles and greater amount of periphyton chlorophyll. The second axis is of lesser importance than the first, and reflects hydrological differences between streams. Fast-flow conditions, where riffles are common (bottom left of the ordination), change to slower flow, as the percentage of runs increases. Variation explained by the first two RDA axes was 39%, with 23.4% explained by axis 1 and 15.6% by axis 2. None of the variables relating to bracken had significant effects.

Diatoms were less abundant in summer and autumn and the communities were significantly related to fewer of the variables measured. In summer there was a link with an axis determined by chlorophyll and bracken frond height, which acted in opposing directions and this was best explained by a shading effect that gave lesser numbers of diatoms where the stream was overhung. In autumn, the water chemistry again became important with a separation dependent on alkalinity and magnesium and some effect of chlorophyll, such that most species were associated with both low base status and low chlorophyll. Again there were no significant effects of bracken.

This lack of relevance of bracken in the multivariate analyses extended also to the invertebrates, though the numbers of litter-shredding invertebrates were inversely related to the frond height of bracken. This was most likely related to the nature of the supply of detritus to the stream and the toughness of dead bracken as a food source than to any toxicity. It has been noted that bracken decomposes slowly, and some cynics have said that the rich brown tones of the still-standing bracken on autumn hillsides are the only positive things that can be said about it. Nor did our experiments using water sprayed through fresh bracken have any effects on the growth of survival of *Gammarus pulex*. We also failed to detect ptaquiloside or its pterosin derivatives in analyses by UV spectroscopy and thin layer chromatography of the stream water, but made, because of the expense, on only one occasion.

Overall bracken was largely neutral to the communities of either diatoms or invertebrates in these Welsh streams, despite the reputation bracken has for toxicity and the

widely demonstrated poisoning of stock that eat it. Only when bracken is damaged is ptaquiloside readily released and there may be the possibility of some short-term effects during the periods when it is controlled, usually by an application of a herbicide, asulam, coupled with cutting.

Thus we were not able to provide the University press office with a headline that '*Killer fern wrecks hillside streams'*, and we may all continue to drink the water from our upland reservoirs with impunity. And it struck me that had I asked the wise John Lund about this project before we started, he might well have pointed out that bracken has been around for a long time and so have the invertebrates and diatoms, and that there has therefore been ample opportunity for natural selection to have sorted out any potential problems.

References

Hustedt, F. (1930) *Die Susswasser-flora Mitteleuropas. 10 Bacillariophyceae (Diatomeae)*. Verlag von Gustav Fischer, Jena.

Krammer, K. & Lange-Bertalot, H. (1986 *et seq*). *Sußwasserflora von Mitteleuropa. 2/1, 2/2, 2/3 Bacillariophyceae*. Gustav Fischer Verlag, Stuttgart.

Lund, J.W.G. (1942) The marginal algae of certain ponds, with special reference to the bottom deposits. *Journal of Ecology*, 30, 245-283.

Lund, J.W.G. (1964) Primary production and periodicity of phytoplankton. *Verhandlungen internationale der Vereinigung theoretische und angewande Limnologie*, 15, 37-56.

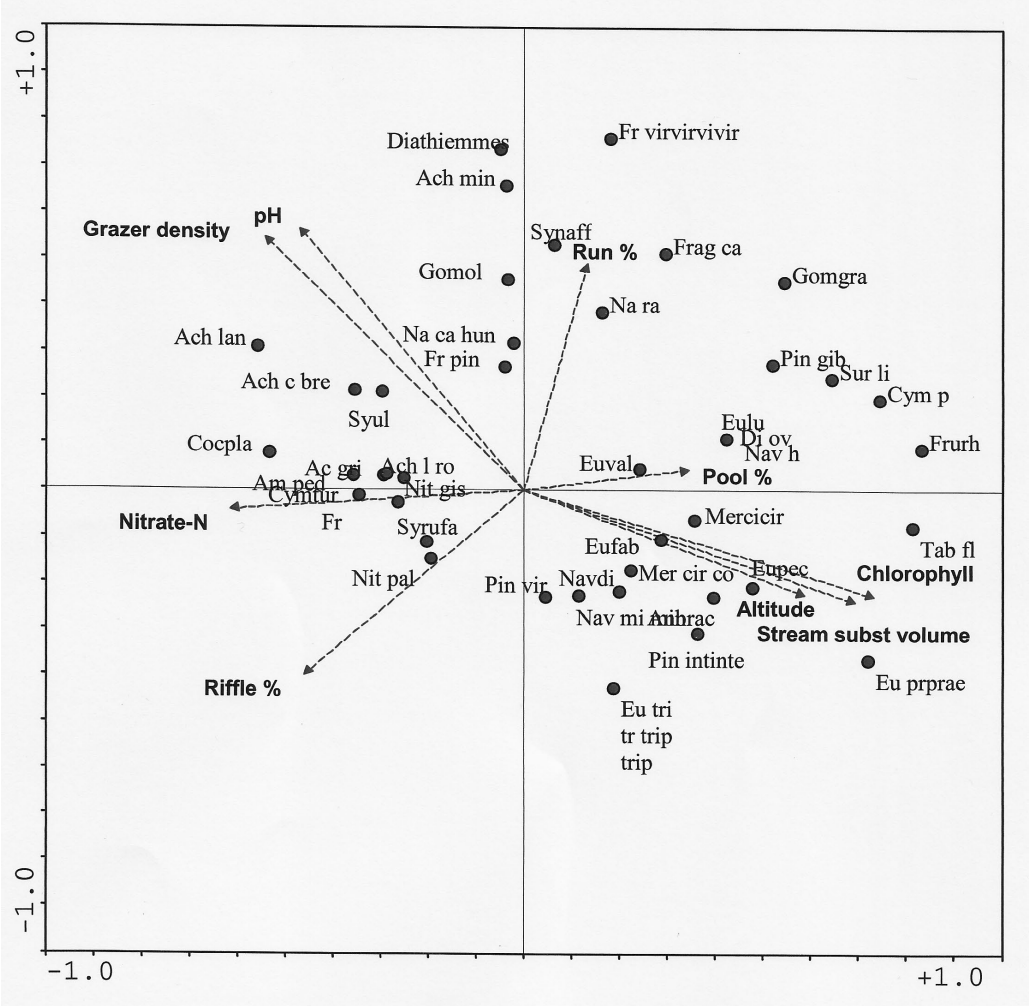


Fig.2

Redundancy analysis plot of diatom incidence in relation to significant environmental variables. Abbreviations: subst, substratum; Ach c bre, *Achnanthes conspicua* var *brevistriata*; Ach l ro, *Achnathes lanceolata* var *rostrata*; Ach gri, *Achnanthes grimmei*; Ach lan, *Achnanthes lanceolata*; Ach min, *Achnanthes minutissima*; Am ped, *Amphora pediculus*; An brac, *Anomoeoneis brachysira*;Coccpla, *Cocconeis placentua;* Cymtur, *Cymbella turgida*; Cym p, *Cymbella parva*; Diathiem, *Diatoma hiemale* var *mesodon*; Di ov, *Diploneis ovalis*; Eu tri, *Eunotia tridentula* var *perminuta*; Eupec, *Eunotia pectinalis*; Eufab, *Eunotia faba*; Eulu, *Eunotia lunaris*; Euval, *Eunotia valida*; Eu pr, *Eunotia parallela*; Frag vi, *Fragilaria virescens*; Frag ca, *Fragilaria capucina*; Fr pin, *Fragilaria pinnata*; Fr har, *Fragilaria harrissonii*; Frurh, *Frustulia rhomboides*; Gomgra, *Gomphonema gracile*; Go ol, *Gomphonema olivaceum*; Mer cir, *Meridion circulare*; Mer cir co, *Meridion circulare* var *constricta*; Na ra, *Navicula radiosa*; Nav h, *Navicula hasta*; Na ca hun, *Navicula capitata* var *hungarica*; Nav mi, *Navicula minima*; Navdi, *Navicula disjuncta*; Nit pal, *Nitzschia palea*; Nit gis, *Nitzschia gisela*; Pin int, *Pinnularia interrupta*; Pin gib, *Pinnularia gibba*; *Pinnularia viridis*; Sur li, *Surirella linearis*; Synaff, *Synedra affinis*; Syul, *Synedra ulna*; Syrufa, *Synedra rumpens* var *familiaris*; Tab fl, *Tabellaria flocculosa.* Modified from Toropov (2002).

Freshwater *Rivularia* in the British Isles

Brian A. Whitton[1] and Allan Pentecost[2]

[1] School of Biological and Biomedical Sciences, University of Durham.

[2] Freshwater Biological Association, Ferry Landing, Cumbria

Some forty-five years ago, when ICI was preparing to flood some of the flowering plant rarities of Upper Teesdale to form the Cow Green Reservoir, one of us (BAW) was given research money to survey algae in the streams flowing into the reservoir. When the committee passed the proposal to John Lund for comment, the suggestion came to study the abundant *Rivularia* colonies.in these streams. A few years after this the late Dr Edith Kann came from Austria to look at blue-green algae in flowing waters in north-east England and during the first couple of days it became evident that she thought none grew here as well as in Austria. However, all changed with a visit to Slapestone Sike and Red Sike in Upper Teesdale, where she stated firmly that nowhere in Austria did *Rivularia* form such abundant growths as in these streams. The need to understand why *Rivularia* was so successful there became increasingly obvious.

In the British Isles *Rivularia* in streams almost always occurs in catchments which combine peat or peaty soils and limestone. Just one record is known from waters rising in catchments with no obvious limestone - Haweswater Reservoir in Cumbria . It was interest in limestone regions that led the other author (AP) to start studying *Rivularia*. Since then we have jointly measured C and N_2 fixation by *Rivularia* at two sites, but otherwise made separate studies. This article is both a brief summary of what we have found and a thanks to John Lund for encouraging the study of this organism. The literature and arguments to support many of the general comments here can be found in a recent review (Whitton & Mateo, 2012).

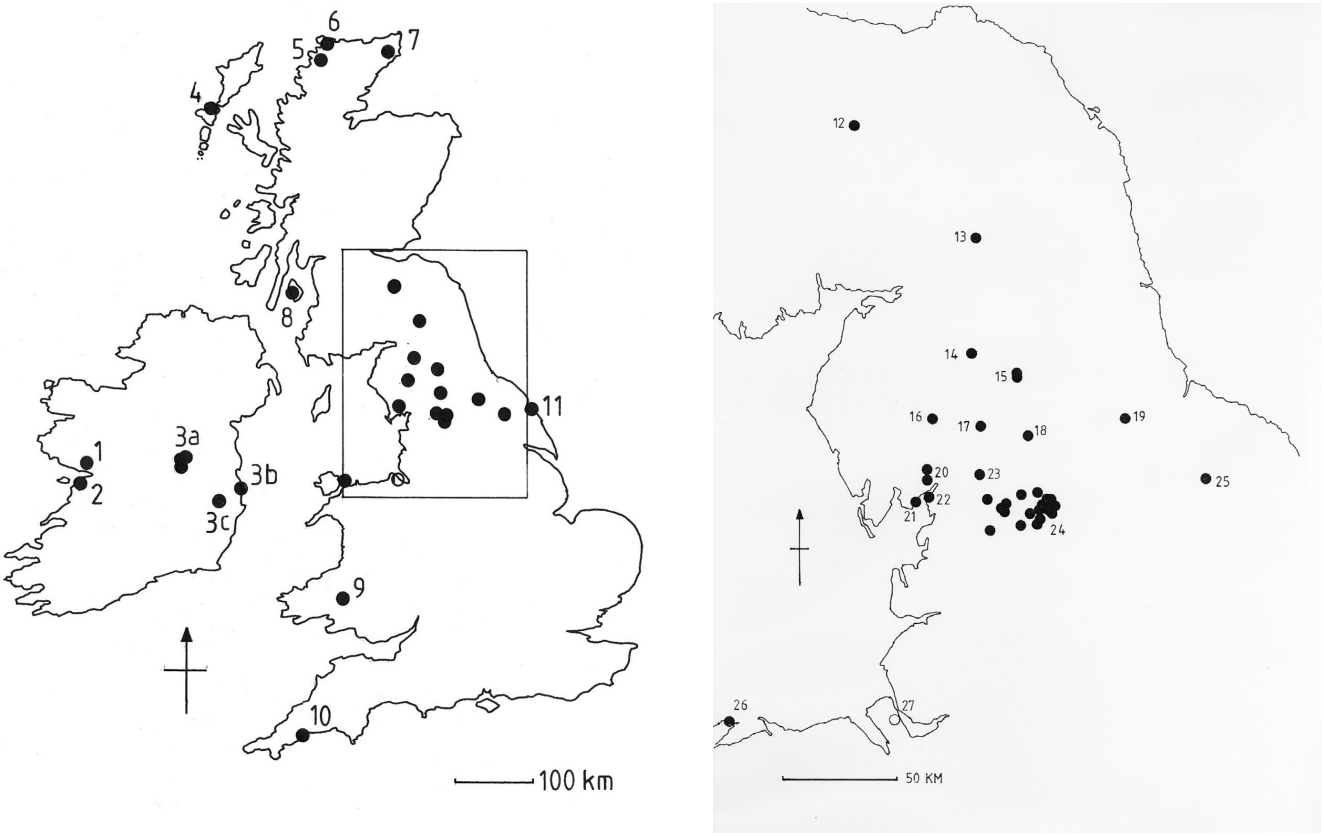
The hemispherical slightly calcified colonies of *Rivularia* abundant in the upper stretches of some of the small streams in Upper Teesdale fit *R. biasolettiana* and this is the name most frequently reported in the British Isles. Larger colonies with distinct and heavily calcified layers are referred to *R. haematites* and were described from the Malham Tarn district by John Lund in 1961. These are characteristic of highly calcareous streams in regions with marked winters and in Europe reach their largest size in countries with a strongly continental climate, such as Austria. However, at some sites in the British Isles colonies of one type appear to be merge with colonies approaching the other type. At the other climatic extreme, the coastal region of the far west of Ireland and especially Clare Island, where the distinction between summer and winter is less marked and there may be heavy rainfall at any time of year, *R. beccariana* is frequent. This has very small colonies with only moderate calcification and no hint of layers.

Field surveys require names, but there is a problem. When clonal cultures were established from colonies taken from three different regions (including Spain), they were all found to contain at least two distinctly different types of filament; molecular sequencing was used in two cases to confirm this. Colonies are formed by recently released filaments aggregating together, so it easy to understand how genetically heterogeneous colonies occur, but it means that the 'species' name refers to a genetic mixture. It is not surprizing that at some sites the It is best to consider the widely used names as form-species. Much the same applies at the generic level with *Rivularia* and other Rivulariaceae such as *Dichothrix* and *Gloeotrichia*, which are all known to be phylogenetically heterogeneous. In fact the form-genera *Rivularia* and *Dichothrix* merge into each other, but it is useful to retain both genera, because species at the extremes look very different.

The typical filament of a *Rivularia* colony has a heterocyst at the base and a long multicellular hair at the other end. The heterocyst fixes nitrogen and this is probably the main N source for the filament, while the apical part of the filament and especially the hair are probably the main site for P uptake. The latter is aided by the surface of the hair being the site of intense phosphatase activity, permitting the organism to make effective use of organic phosphates in their environment. N_2-fixing activity is highest when the filament is P-rich. After a few weeks of P-rich status, the hair becomes detached and each filament starts to form motile hormogonia at the apex, which glide away and aggregate with others. As the filament becomes P-limited once more, the multicellular hair redevelops.

The seasonal cycle of *Rivularia* growth at a site reflects the seasonal cycle of nutrients. In Upper Teesdale this is determined by pulses of mostly organic phosphate released from peat in late winter and early spring combined with long periods in the summer with very low phosphate in the water. Much the same happens at other streams sites, though differences in the local catchment and climate, together with differences in rainfall events from year to year influence the characteristic morphology of colonies in the stream. *Rivularia* also used to grow in one of the Hell Kettles near Darlington, a 5.5-m deep pond fed by Magnesian Limestone water from the base and here the hormogonia were often formed in autumn, apparently as a result of P released from silt. Sadly the colonies can no longer be found there, almost certainly as a result of P draining from sediments at the side of the pond as a result of the water level being raised slightly to help maintain surrounding wetland vegetation.

Colonies is shallow streams sometimes calcify sufficiently to form structures known as oncoliths. These occur, for instance, in a series of very small streams on the moor near Sunbiggin Tarn and rather similar streams near the small reservoir upstream of the main one at Kielder. Several of the streams at Sunbiggin in the 1970s had colonies which were almost spherical, but now they all appear less



distinctive. The spherical structure developed when the flow was sufficient to permit the colonies to roll over at times with plenty of water. Apart from these examples, in streams *Rivularia* grows attached to firm substrata and the majority of records come from the Carboniferous Limestone and the associated travertine (a re-deposited limestone).

In the hopes of encouraging others to look for more sites, observe colony growth over the years and then report their observations, we have provided two maps of sites where *Rivularia* has been found over the past half century in Britain and Ireland. It is possible a few have been lost due to nutrient enrichment. Fortunately they are still in Upper Teesdale, but there are now much larger growths of *Mougeotia*, *Spirogyra* and *Zygnema* in summer, suggesting N enrichment and a worry for the future.

Acknowledgements This story was aided by the research of many people over the years, but especially Christine Sinclair, Susan Knight (formerly Kirkby), David Livingstone and Julia Yelloly. Melinda Lyons is also acknowledged for her Irish records.

References

Lund J.W.G. (1961). The Algae of the Malham Tarn District. Field Studies 1: 1-35.

Pentecost A. (1992). Carbonate chemistry of surface waters in a temperate karst region: the southern Yorkshire Dales. J. Hydrol. 139: 211-232.

Pentecost A. & Franke U. (2010). Photosynthesis and calcification of the stromatolitic cyanobacterium *Rivularia*. Eur. J. Phycol. 45: 345-353.

Whitton BA, Mateo P (2012) Rivulariaceae. In: Whitton BA (ed.) Ecology of Cyanobacteria II Their Diversity in Space and Time. Springer, Dordrecht, 561-591.

Legends for the Figure:

Distribution of freshwater *Rivularia* in Britain and Ireland.

1 Lough Corrib, Galway; 2 Caher River and Glenamanagh, Co. Clare; 3a Owel marl lakes, Westmeath; 3b Magherabeg, Wicklow; 3c Louisa Bridge, Kildare; 4 Seilebost, S. Harris; 5 Inchnadamph; 6 Borallie Lochs; 7 Loch Stempster; 8 Machrie, Arran; 9 Clydach, Dyfed; 10 Little Perhaver; 11 Cloughton Wyke. **Inset** 12 Pentland Hills; 13 Bakethin Dam, Kielder; 14 White Beck; 15 Red & Slapestone Sikes; 16 Haweswater Reservoir; 17 Tarn Moor; 18 Boggle Hole Gorge; 19 Hell Kettles; 20 Whitbarrow; 21 Humphrey Head; 22 Arnside; 23 Barbon Marl Spring; 24 Craven sites: Attermire, Austwick Beck, Kettlewell crons, Brayshaw Beck, Burn Moor, Cam Gill, Clapham Beck, Cote Gill, Cosh Beck, Cow Gill, Cowside Beck, Dowbergill Beck, Fountains Fell spring, Gordale Beck, Hagg Beck, Howgill Beck, Lower Beck, Malham Tarn, Norber Beck, Scoska Beck, Sleets Gill, Thieves Moss, Thoragill Beck, Thornton Force, Waterfall Beck; 25 Helmesley; 26 Penrhyn Glas; 27 Merseyside

Seasonal changes in the abundance of freshwater algae in a small humic pool in southern England

Allan Pentecost

The Freshwater Biological Association, Ferry Landing, Cumbria LA22 0LP

Summary

The seasonal distribution of the free-floating algae in a small oligotrophic bog pool is discussed. Cell numbers for all species were low with occasional small and apparently erratic peaks. The algae were mostly small acidophile flagellates whose absolute numbers may have been controlled by surface growth of *Potamogeton* reducing light levels in summer.

Introduction

Small waterbodies have received little attention from algologists, most of whom obtain grants and/or employment to examine larger, more significant expanses such as reservoirs and lakes. For other organisms, Oertli et al. (2002) found that as pond area declines, the conservation value increased and this is likely to be the case with algae, many of which inhabit pond margins and more investigation of small ponds is desirable. There have been algological investigations of British ponds and other small waterbodies, though most of them appear in the older literature (e.g. Griffiths, 1912, 1936; Fritsch & Rich, 1913; Smith, 1942; Lind, 1951). The majority either deal with eutrophic waters and provide lists of the species encountered on one or two occasions. Seasonal studies of oligotrophic and dystrophic ponds have been few. Early work by Smith (1942) and Hayward (1957) noted some seasonal variation and nutrient levels respectively in *Sphagnum* bogs but the most detailed study to date was undertaken by Duthie (1965). He investigated the seasonality and microdistribution of green algae (mostly desmids) and diatoms in a North Wales bog but failed to observe any strong correlations with nutrient levels or seasonality. In none of these studies was detailed attention played to the planktonic forms.

This present study was planned as a small contribution to our knowledge of the occurrence and seasonal distribution of planktonic algae in bog pools. The pool is located in Southern England where oligotrophic waters are rare. The location was chosen on convenience- the sampling incorporating the healthy activity of dog-walking - the latter playing no further part in the proceedings.

Methods

The site is a small bog pool located in Marlpits Valley below Duddleswell (NGR: 51/458294; alt. 115 m). The pool was shaded by a few young (c. 4 m high) pine trees on the western side (Fig.1). Geology is Ashdown Sand covered by a thin mor soil and vegetated with *Calluna* and *Molinia*. The depression in which the water collected was probably artificial but not of recent origin and measured approximately 5m in diameter with marginal *Sphagnum cuspidatum* and *S. papillosum*. During summer much of the open water was covered with the floating leaves of *Potamogeton*. Water samples were collected at approximately monthly intervals. A 50 mL aliquot was centrifuged at c. 200 g and the sediment taken up in 0.5 mL water for cell counting in a haemocytometer at a magnification of x250.

Surface water samples were returned to the laboratory for the measurement of pH and specific conductivity, then a few samples were filtered using 0.45 um Millipore and analysed for total dissolved and particulate phosphorus (Menzel & Corwin, 1965) and dissolved nitrate using the hydrazine reduction method (Strickland & Parsons, 1965).

Results and discussion

Physical and chemical characters of the pool.

The data are presented in Figure 2 where the expected seasonal change in water temperature is apparent (a). Water conductivity (b) shows a significant increase during winter perhaps due to the decay of organic matter releasing HCO_3^- and other ions although this is not apparent in the pH (c) which does not appear to be influenced by season

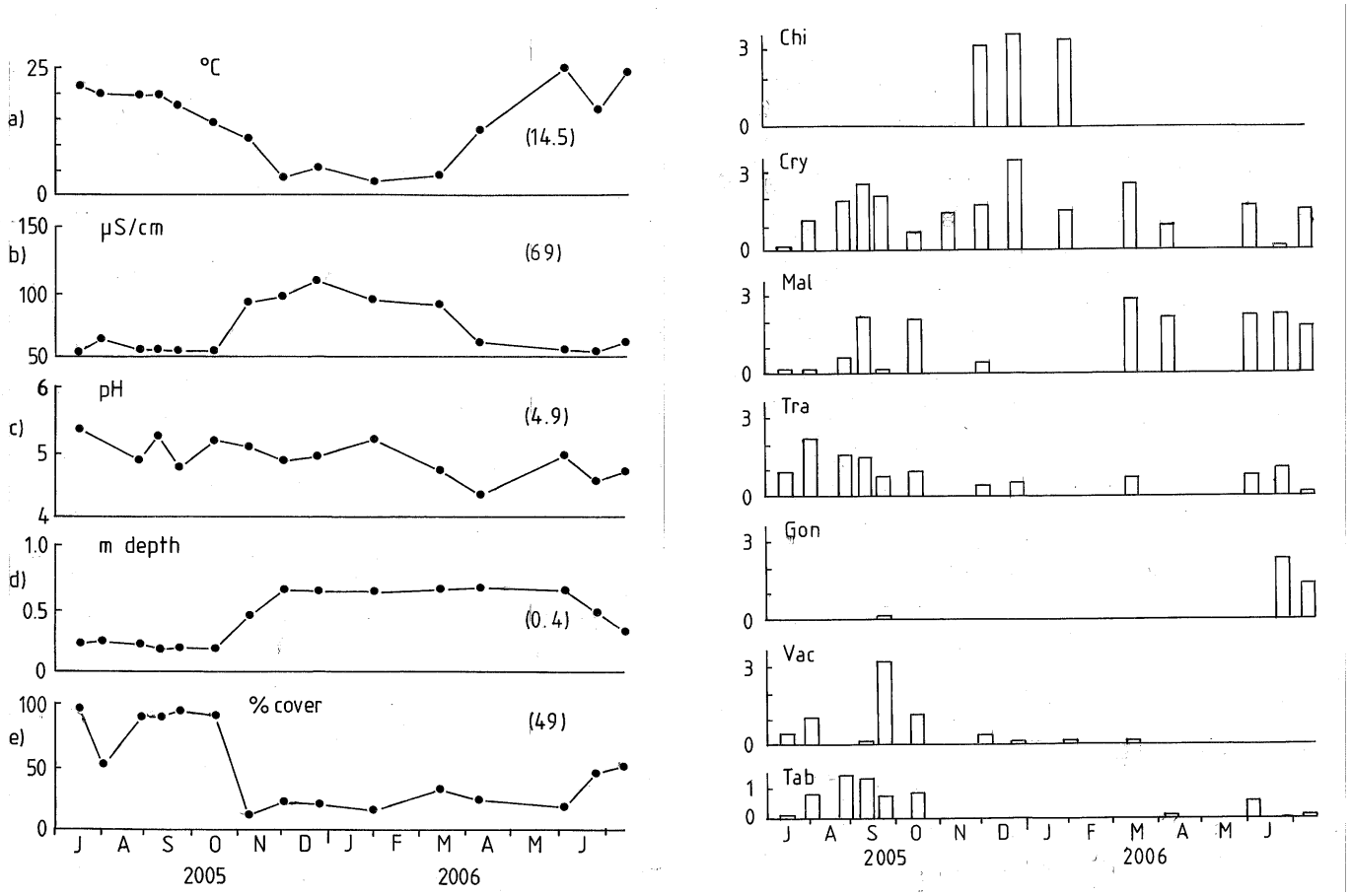


Figure legends

Fig. 1. The site photographed in September showing extensive growth of *Potamogeton* covering most of the water surface.

Fig. 2. Seasonal changes in some physical and chemical variables. Mean values are shown in brackets.

a) Mid-day water temperature

b) Specific conductivity

c) pH

d) Maximum water depth

e) Percentage cover by floating macrophyte (*Potamogeton*)

Fig. 3. Seasonal changes in numbers of free-floating algae. Ordinate in $\log_{10}$ numbers per ml.

Chi *Chilomonas*; Cry *Cryptomonas*; Mal *Mallomonas*; Tra *Trachelomonas*; Gon *Gonyostomum*; Vac *Vacuolaria*; Tab *Tabellaria*.

---

but remains between 4-6 throughout. Marked changes in water depth (d) were apparent reflecting the small size of this waterbody, prone to evaporation and transpiration. Cover of *Potamogeton* (e) is correlated to water depth and temperature. There was virtually no open water during late summer owing to *Potamogeton* growth.

Nitrate-nitrogen and phosphate phosphorus data are presented in Table 1. Levels are low for both nutrients, particularly during mid-summer probably indicating uptake by aquatic plants. The nutrient data suggest the water is oligotrophic since much of the dissolved P probably exists in an unavailable colloidal form or as organic complexes.

Table 1

Date	Nitrate nitrogen µg/L	Total dissolved P µg/L	Total particulate P µg/L
2 Feb 06	45	35	28
4 June 06	10	5	20
November 06	10	36	-
12 December 06	83	35	63

The free-floating algae

The common algae, plotted in Figure 3 were cryptophytes *Chilomonas paramaecium* (Chi) and *Cryptomonas marssonii* (Cry), the chrysophyte *Mallomonas* cf *caudata* (Mal), the euglenophytes *Trachelomonas cervicula* and *T. volvocina* (Tra, combined in the figure), raphidophytes *Gonyostomum semen* (Gon) and *Vacuolaria virescens* (Vac) and the diatom *Tabellaria flocculosa* (Tab). Occasional species included the desmids *Closterium cornu*, *Cylindrocystis brebissonii* and *Micrasterias denticulata* which were probably derived from the marginal *Sphagnum*, plus the dinophyte *Gymnodinium hiemale* and an unidentified species of *Dinobryon*.

Counts were generally low for all taxa, with occasional peaks. This pattern has been observed on many previous occasions indicating the apparently erratic abundance of many algal flagellates over time (cf. Fritsch & Rich, 1913; Hickman, 1974). As part of his PhD, John Lund investigated the algae of some small ponds in south east England and found that the cryptomonads were most numerous in late winter and spring (Lund, 1942). At the Ashdown site, *Chilomonas* was also a winter form but there is no seasonal trend for *Cryptomonas*. In contrast, the chrysophyte *Mallomonas* was not found in the winter samples, in agreement with the observations of Griffiths (1936). Euglenoid flagellates such as *Trachelomonas* are often associated with sediments (Hickman, 1974) and this may explain their frequent occurrence in shallow water bodies. At Ashdown, no seasonal trend in *Trachelomonas* was apparent although both Fritsch & Rich (1913) and Lund (1942) noted a greater prevalence in the autumn. *T. volvocina* appears to be a species particularly suited to pH values of 5-6 (Smith, 1942; Duthie, 1965). The abundance of the surface-floating leaves of *Potamogeton* probably had a considerable influence on algal growth in this pond. Light levels in the water would be significantly reduced. In addition, Duthie (1965) suggested that the decaying plants inhibited the growth of desmids and perhaps other algae.

Gonyostomum was first recorded from Britain in 1929 by Smith (1933) where it was found in several consecutive years in *Sphagnum* bog-pools at Austwick Moss in North Yorkshire and it is known from similar habitats on the continent. The author has also found it in *Sphagnum* pools near Tarn Hows in Cumbria with a water pH of 5.6. *Vacuolaria virescens* was reported from Britain by West & Fritsch (1927) without location. They suggested that its apparent rarity may be caused by its tendency to be found in small numbers in shallow pools. It was also found in pools from North Wales by Woodhead & Tweed (1954) with a pH range of 4.4-8.4. The apparently more frequent occurrence of these algae in recent years may be linked to rainwater acidification with *Gonyostomum* increasing greatly in abundance in the humic lakes of Scandinavia over the past 25 years (Cronberg et al., 1988).

Acknowledgement

Thanks are extended to Dr. E. Haworth, curator of the Fritsch Collection of Algae for her assistance and the Ashdown Forest Park Centre for permission to collect water samples from the site.

References

Cronberg, G., Lindmark, G. & Bjork, S. (1988). Mass development of the flagellate *Gonyostomum semen* (Raphidophyta) in Swedish forest lakes- an effect of acidification? Hydrobiologia 161: 217-236.

Duthie, H.C. (1965). A study of the distribution and periodicity of some algae in a bog pool. J. Ecol. 53: 343-359.

Fritsch, F.E. & Rich, F. (1913). Studies in the occurrence and reproduction of British freshwater algae in nature. III. A four year's investigation of a freshwater pond. Ann. De Biologie Lacustre 6: 1-83.

Griffiths, B. M. (1916). The August heleoplankton of some North Worcestershire pools. J. linn. Soc. Bot. 43:423-432.

Griffiths, B. M. (1936). The limnology of Long Pool, Butterby Marsh, Durham. J. Linn. Soc. Bot. 50: 393-416.

Hickman, M. (1974). The seasonal succession and vertical distribution of the phytoplankton of Abbot's Pond, North Somerset, UK. Hydrobiologia 44: 127-147.

Lind, E. M. (1951). The plankton of some lakes and pools in the neighbourhood of the Moor of Rannoch. Trans. Proc. Bot. Soc. Edinb. 35:326-369.

Lund, J.W. G. (1942). The marginal algae of certain ponds, with special reference to the bottom deposits. J. Ecol. 30: 245-83.

Menzel, D.W. & Corwin, N. (1965). The measurement of total phosphorus in sea water based on the liberation of organically bound phosphorus by persulfate oxidation. Limnol. Oceanogr. 10: 280-282.

Oertli, B., Auderset Joye, D., Castella, E., Juge, R., Cambin, D. & Lachavanne, J. B. (2002). Does size matter? The relationship between pond area and biodiversity. Biol. Conservation 104: 59-70.

Smith, A.M. (1942). The algae of Miles Rough Bog, Bradford. J. Ecol. 30:341-356.

Smith, A.M. (1933). *Gonyostomum semen* Diesing. A flagellate now first recorded for the British Isles. Naturalist London for 1933; 49-50.

Strickland, J.D.H. & Parsons, T.R. (1965). A Manual of Sea Water Analysis. Fisheries Research Board of Canada, Ottawa.

West, G. S. & Fritsch, F. E. (1927). A Treatise on the British Freshwater Algae. Cambridge University Press.

Woodhead, N. & Tweed, R.D. (1954). The freshwater algae of Anglesey and Caernarvonshire. The North Western Naturalist 1954: 85-122.

Isn't algae great?

Jane Fisher

I read Martyn Kelly's article on his algae blog in the last issue and it reminded me of my attempts to enthuse the public, and undergraduates, about algae. I am told that I come across as an enthusiastic person but this, combined with spouting on about algae, can give the audience an impression of a 'mad scientist' rather than someone to be taken seriously. During my time as a professional I have done my bit to spread the word, and have found all attempts to do this rewarding and surprising. During my time at the Centre for Ecology and Hydrology we used to open our doors to the public during Science Week. Each year, one of the attractions was simply a projected real-time image of a droplet of water from our work pond, as seen at X400. Visitors used to come in to sit and watch, memorised by the wheeling Trachelomonas and gyrating dinoflagellates. One year we even had a gentleman video it for watching again at home! I didn't attempt to tell them much about algae or the study of phycology, I simply explained what they were seeing on the screen and they went home enthused and interested. I have since been teaching undergraduates on a module in 'Plant Science' and in this module I have about 3 hours of lecture time dedicated to algae. I know what the students are thinking as they sit in the lecture theatre waiting for me to start…something along the lines of, 'oh God, have you seen the topic today…yawn.. I'd much rather be….(fill in space)'. But, like Martyn's blog, my lecture is structured around natural history and big glamorous topics, peppered with the odd example from a scientific paper, which I sneak in. I cover the diversity of 'algae' including the origins of photosynthesis (using cyanobacteria), the influence of marine phytoplankton in glacial-interglacial cycles, the formation of diatomite, through to the support of the oceanic and freshwater food webs and the role of algae in producing medicines and foods. Overall, I keep to the large scale, sexy stuff in a manner not unlike a shiny wildlife documentary, but it works. This year we had comments from students that they 'wanted more' and I even had students asking to conduct their final year projects on algae. This might not be cutting-edge science as we know it, but to enthuse is the start.

Undergraduate student collecting attached algae from stones in the River Bollin, near Wilmslow, for her dissertation

113th general meeting of the American Society for Microbiology

My trip to the ASM 2013, the 113th general meeting of the American Society for Microbiology, began as a surprise and ended as a profound source of inspiration. I'm a first year PhD student from Chemical and Biological Engineering in the University of Sheffield and I wasn't expecting to be able to attend an international conference in the first year.

By the time the abstracts for ASM 2013 were due, mid-January, I was only 3 months into the PhD program and had accomplished a pair of humble experiments, albeit with interesting results. I managed to write up a short overview of my work and, with the title "A Metaproteomic Assessment of the Microbial Loop During Algal Bloom Formation", submitted a confident abstract but with the knowledge that my presence at the conference was far from guaranteed. A month later, it was with great surprise that I received an invitation to present my work in poster form and saw my effort awarded with a Student Travel Grant by the organization. Still in awe with this opportunity, I started to plan my trip and look for sources that would help me fund the expensive trip to the city hosting the meeting - Denver, Colorado.

In November of 2012 I decided to join the BPS not only due to the topic of my PhD but also due to my love for everything algae. So when the time came to procure funding I decided to contact the BPS and apply for the opportunity to receive one of its generous student bursaries. I am delighted to state that, in the end, the BPS student bursary funded 50% of my trip and guaranteed that I could comfortably attend the meeting.

The meeting kicked off on a Saturday night under the banner "Breadth. Vision. Impact.". The opening session entitled "Microbes: Nature's Mighty Engineers" presented speakers Nathan Wolfe, PhD. (director of Global Viral and Professor at Stanford University), Christine Jacobs-Wagner, PhD. (Professor at Yale University), and Frances Arnold, PhD (Professor at the California Institute of Technology). These three speakers traversed the field of microbiology and demonstrated how the current state of research is pushing the boundaries of our understanding of nature. This session was truly inspirational and set the scene for the meeting. The night ended with a dinner reception doubling as a networking session where researchers engaged in scientific discussion while enjoying some of the finer things in life.

The next three days were mentally and physically challenging and the numbers were impressive: more than 200 speakers, 2500 posters and 6500 attendees. My personal highlight of the first day was my two hour poster presentation. This presentation allowed me to discuss my work with international specialists and gain confidence in my ability to communicate my research. The rest of the meeting was a back and forth between oral and poster presentations and many hours of scientific discussion. This meeting was an incredible experience and overall I would recommend it to any PhD student, not only for the benefits in personal development but also for showcasing the ground breaking research in every field of microbiology.

David Russo, University of Sheffield

9th European Congress of Chemical Engineering and 2nd European Congress of Applied Biotechnology, The Hague, 21-25 April 2013

The beautiful city of The Hague was chosen to hold the 9th European Congress of Chemical Engineering and 2nd European Congress of Applied Biotechnology (ECCE9-ECAB2). This conference brought together 1900 academics, industrial delegates, young researchers and students from 65 countries covering the widest range of subjects relevant to process technology, such as process intensification, renewable feed stocks, sustainable value chains, product design and biotechnology. It was very interesting to see how nicely different disciplines such as various engineerings, biology, chemistry, computer science and others blend together towards a shared purpose.

Within the themes covered in this extensive 5-day meeting, the area of Renewable Energy & Feedstock was the more relevant to me, which included the subareas of Bioenergy, Biorefineries, Renewables, Biofuels, Bio-Feedstock, Algae, Marine Biotechnology, Photobiotechnology, Bio-based Products, Biopharmaceuticals and Biomass Process Technology.

I was kindly invited to open the Microalgae I session with a talk on my current research on the recombinant protein expression in the chloroplast of *Chlamydomonas reinhardtii*, which was an excellent opportunity not only to present my work but to get valuable feedback and comments from the audience. Furthermore, I had the chance to interact with other researchers working in algae (Wageningen group in particular) and with Prof. Dr. Bernhard Sonnleitner, expert in flow cytometry, one of the technologies I use profusely in my research.

There were so many interesting talks that it is difficult to summarise, but just to mention a few I would highlight the work of Dr. Sharon Glotzer on materials design, Prof. Hermann Hofbauer on an example of a fully sustainable city and Dr. René Wijffels on various applications of algae in biorefinery.

I'd like to express my gratitude to the British Phycological Society for supporting my attendance to such an important and relevant conference and in general for supporting young researchers in participating of these events.

Stephanie Braun Galleani
University College London

Freshwater Algae Identification Course: Kindrogan Field Studies Centre, Scotland

I joined Bournemouth University at the start of this academic year, undertaking a PhD program with the aim to develop novel methods in detecting and controlling the cyanobacteria Microcystis in freshwater closed systems. Alongside laboratory experiments, in situ analysis is also a focus of my studies. Working with such dynamic ecosystem I sort to develop my understanding of other freshwater microbial species and how they interact with Microcystis. Thankfully with support from the BPS I was able to attend the 2013 freshwater algae identification course in Kindrogan to increase my understanding of aquatic organism.

After crossing the UK by train, I was met by the Kindrogan staff who took us all to the field centre. Set in the scenic area of Highland Perthshire, the facilities and diverse habitats provided a great platform to learn about the identification of freshwater algal species. The course was tutored by Dr Eileen Cox and Professor Elliot Shubert with their wealth of experience in diatomic and green alga research, guiding us into the world of these ecologically important organisms.

Through field trips to many of the beautiful surrounding Lochs, algal samples were collected and analysed using taxonomic keys, morphology and structure from generic to species level, under the guidance of Eileen and Elliot. The practical work was also underpinned by a number of fascinating lectures covering broader aspects of identification such as classification, reproduction and molecular techniques.

The course was attended by a very international group, coming from across Europe, Asia and North and South America, as well as a number of UK based individuals. With such a cosmopolitan range of interests from the industrial and academic sectors, I was able to create networks amongst institutions which have already benefited my studies.

In addition, the guest lecturers also contributed immensely to the understanding of my project. Dr Laurence Carvalho from the Centre for Ecology and Hydrology gave a presentation on the EU Water Framework Directive, focusing on counting methods in lakes. Professor Geoffrey Codd an expert on cyanotoxins spoke about current and future detection methods, where I was able to discuss potential methodologies for my experiments.

I would highly recommend this course to anyone involved with identifying freshwater phycological species as part of their academic or professional development. It was a pleasure to work with both renowned experts Eileen and Elliot, especially with the plenary of the famous algal charades.

.

Ian Chapman
Bournemouth University

BPS Macroalgae Identification Course

Soon after the Christmas holidays, myself and a colleague registered for the macroalgae ID course, organised by the British Phycological Society. Not long after that we received the program for the 3 day course and a list of materials to bring. We hurried to loan a pile of relevant books from the National Marine Biological Library (NMBL) and got some white card and nappy fillers ready for the seaweed pressing. We were both looking forward to enhancing our repertoire of seaweeds we could identify, and I in particular was keen on knowing more on seaweed ecology, as I was due to start an experiment in the lab on kelps.

On a Wednesday, the 13th of March we came down to the Marine Biological Association (MBA), equipped with all of the above, plus wellies and several layers of clothes. After a brief introduction from the leaders Francis Bunker, Christine Maggs and Juliet Brodie and the group of about 23 of us, it was great to realise this course had attracted people from all sorts of backgrounds, from Natural England to the Natural History Museum.

On our first day, following a classroom session on seaweed groups and their evolution, we went down to the shore just by the MBA. We split into two groups and busied ourselves taking notes of latin names and diagnostic features and collecting dozens of specimens into ziplock bags and buckets. As the hours went on and as the tide was coming in, we decided to start making our way back, not before Francis managed to give Christine a piggyback and rescue her from the progressively deeper rock pools.

Back at the lab we had several guides and keys to aid our ID and with Christine, Francis and Juliet's guidance we slowly set up a growing 'reference collection' of specimens found that day. We had lots of different genera to become familiar with, ranging from the quite common *Ulva*, *Fucus*, *Chondrus*, to the ones new for many of us, *Gelidium*, *Dilsea*, *Gracilaria*, *Porphyra*. We still had time that afternoon for a classroom session on coralline algae by Dr. Jason-Hall Spencer from the University of Plymouth.

At six that evening we were directed to the MBA's common room, where a delicious meal awaited us. I had heard fantastic things about the cooks at the MBA, and they certainly lived up to it! I loved the chocolate sea shells scattered over the tables!

Following our very filling meal, we had the day's final talk, by the course's guest, Dr. Paulo Horta from the University of Santa Catarina in Brazil, who introduced us to South American seaweeds and the several monitoring sites off the coast of Brazil.

On the next day we started bright and early with a lecture on life histories. We went through the single-phase of Fucus, the biphase of *Laminaria* and the triphase of *Polysiphonia*. It was quite a bit to take in, but we had lots of resources available to go through this again in our own time. We also discussed environmental controls; which seasonal factors macroalgae exploit and which they avoid. This was followed by a great field trip to Salcombe! We scrambled the rocks for a good couple

of hours (in the sun!), looking for all the seaweeds we could now quite confidently identify and looking also for ones we hadn't come across before. We compared *Cantanella* with *Caulacanthus okamurae*, the latter being an invasive species. We came across *Bifucaria bifurcaria*, a mostly southern species, whose presence in the UK might indicate a shift of this species range as a result from climate change.

Back at the MBA, we had the pleasure to meet Dr. Gerald Boalch, MBA's seaweed curator, who introduced us to what was like to collect and ID macroalgae in the 1900's.Dr.Boalch kindly took us through the herbarium collection where we could see pressed seaweeds from the mid-nineteenth century!

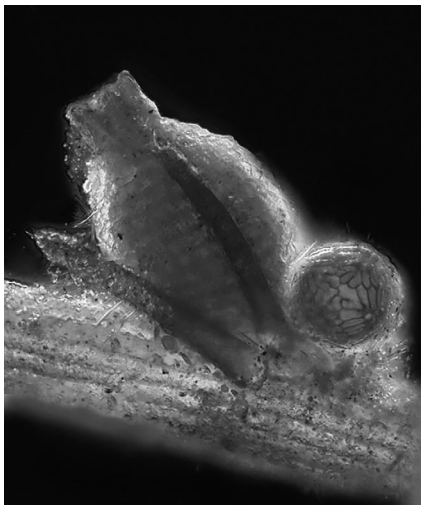
Juliet Brodie also explained us the stages of seaweed pressing and gave us a few handy tips on it. We were able to press as many individuals as we wished and take them all home at the end of the course.

The next and last day was only a morning session, as most people had a fairly long way to travel. We had a lecture on alien species and the several possible vectors. Finally, we still had time for a tour of the MBA seawater hall by the aquarist John Rundle. It was incredible to see all the cuttlefish and the tiny, tiny jellyfish!

The end of the course came way too soon. It was fantastic to be able to dedicate two and a half days fully to seaweeds only and it was a great opportunity to clarify any doubts with the extremely helpful experts. The course attendants had very different levels of experience, but I am confident to say that everyone thoroughly enjoyed this course from the British Phycological Society and seriously improved their identification skills. I do hope this course is available again next year!

Joana Nunes
Plymouth Marine Laboratory

2013 Hilda Canter-Lund photography award



Congratulations to Chris Carter for winning the Hilda Canter-Lund photography award 2013 with his photograph of Chara virgata. This image was selected from the shortlist of six images by the Council of the British Phycological Society and is richly deserved, as Chris has also made the shortlist twice in the past.

You can see the winning image, along with all the other shortlisted images at http://www.brphycsoc.org/canter-lund/Winner_2013.lasso. You can also find the shortlists for 2009, 2010 and 2011 at http://www.brphycsoc.org/canter-lund/index.lasso. I hope that you find inspiration in these images to go and take some great photographs in anticipation of the 2014 competition.

Thanks to everyone who took part and, especially, to the five others who made the shortlist.

Martyn Kelly

Seasearch Guide to Seaweeds, 2nd Edition

The 1st edition of the Seasearch guide to seaweeds has been a great success with over 2,000 copies sold since 2010. Maybe this is not the same scale of success enjoyed by J K Rowling but for a seaweed identification book, 2000 copies is good going.

In the initial planning phases, the 1st edition of the Seasearch Guide to Seaweeds was limited in scope compared to the guide which eventually emerged. Publication costs were a limiting factor and expansion of the guide was enabled by BPS who provided helped pay for extra printing costs.

Since publication of the 1st edition, feedback from phycologists both profession and amateur has revealed the need for the inclusion of more species, better photographs and photographs of which illustrate the great intraspecific variation shown by some species. (For example Irish moss, *Chondrus crispus*).

We are in an era where genetic studies have given us a new understanding of relationships between species. This has resulted in a plethora of new species being described and existing species changing their name.

The authors, Francis Bunker, Juliet Brodie, Christine Maggs and Anne Bunker were keen to produce a second edition of the Seasearch Guide to Seaweeds to address some of the issues raised above. Following an application to BPS for funding, the Council agreed to help finance the production of a new expanded second edition of the guide and the authors would like to thank the council for their award.

Included in the new volume will be:

- descriptions and photographs 40 more species
- the updating of species names
- correction of errors which were printed in the 1st edition
- inclusion of information on seaweed habitats
- provision of a glossary of terms

The 2nd edition of the Seasearch Guide to Seaweeds should be available towards the end the beginning of 2014. The publishers are waiting for current stocks to dwindle before printing a new edition.

As with the previous edition of the guide, contributions of photographs are welcomed. If you think you have a better picture than any of those already printed, then please do get in touch!

Francis Bunker

Identifying Freshwater Macroalgae

The Freshwater Biological Association,

Windermere, Cumbria

Two day course: April 2014 (dates to be confirmed)

Martyn Kelly & Allan Pentecost

Cost: £285; early bird rate £270*; FBA member £260

A two day course on how to recognise and identify the larger freshwater algae. Field and laboratory-based exercises will introduce participants to the biology and identification of those freshwater algae most likely to be encountered during freshwater surveys. Martyn Kelly is a freelance consultant, specialising in the use of algae for environmental monitoring. Allan Pentecost of the FBA has studied algae for 40 years and has published many research papers and a book on algal ecology and taxonomy.

For further information and to book a place on the course, please contact the Freshwater Biological Association: events@fba.org.uk; +44 (1539) 442468

Website: www.fba.org.uk/fba-training-courses

**Early bird rates apply to fees paid at least eight weeks before the start of the course.*

Freshwater phytoplankton species new to the British Isles

Pauline Lang
Scottish Environment Protection Agency

Recently, a number of exciting algal discoveries emerged from routine analysis conducted on phytoplankton samples collected as part of the Scottish Environment Protection Agency's ongoing assessment of the ecological status of freshwater lochs in Scotland.

Of the five phytoplankton taxa documented so far (see Figs 1 – 5), all are not only completely new to Scottish lochs but have never previously been recorded from freshwater habitats in the British Isles, until now. Furthermore, *Pediastrum privum* has since been incorporated into the second edition of The Freshwater Algal Flora of the British Isles.

These fascinating phycological finds comprise valuable contributions that enhance knowledge of algal diversity in UK freshwaters. Hence these data not only provide a means of monitoring water quality across Scotland, but also provide information on species distributions, including rare or previously unrecorded species, at the local to national level. Above all, our everyday work demonstrates that even in relatively well studied freshwater habitats of the British Isles...there are still marvels to be found amongst the algae!

References

Lang, P., Krokowski, J. & Ross, N. (2012) The rare green alga *Pediastrum privum* (Chlorophyta, Sphaeropleales) in a Scottish kettle loch: new to British freshwaters. *The Glasgow Naturalist* 25, 139 – 142.

Lang, P., Procházková, L., Krokowski, J., Meis, S., Spears, B.M., Milne, I. & Pottie, J. (2013). The bizarre Eustigmatacean alga, *Pseudostaurastrum limneticum* (Borge) Chodat, in a shallow, nutrient-enriched Scottish loch: new to the British Isles. *The Glasgow Naturalist* (In press).

Lang, P. & Krokowski, J. (2013a) The fusiform green alga *Desmatractum spryii* (Chlorophyta, Chlorococcales): noteworthy discovery made in a peninsula loch, SW Scotland. *The Glasgow Naturalist* (In press).

Lang, P. & Krokowski, J. (2013b) The solitary planktonic chrysophyte *Dinobryon faculiferum*: an alga species typically restricted to brackish environments, found inhabiting a freshwater loch in northern Scotland. *The Glasgow Naturalist* (In press).

Lang, P. & Krokowski, J. (2013c) *Ollicola vangoorii* (Chrysophyceae, Chromulinales): an unfamiliar loricate protist newly documented in UK freshwaters from a southern upland loch, Scotland. *Glasgow Naturalist* (In press).

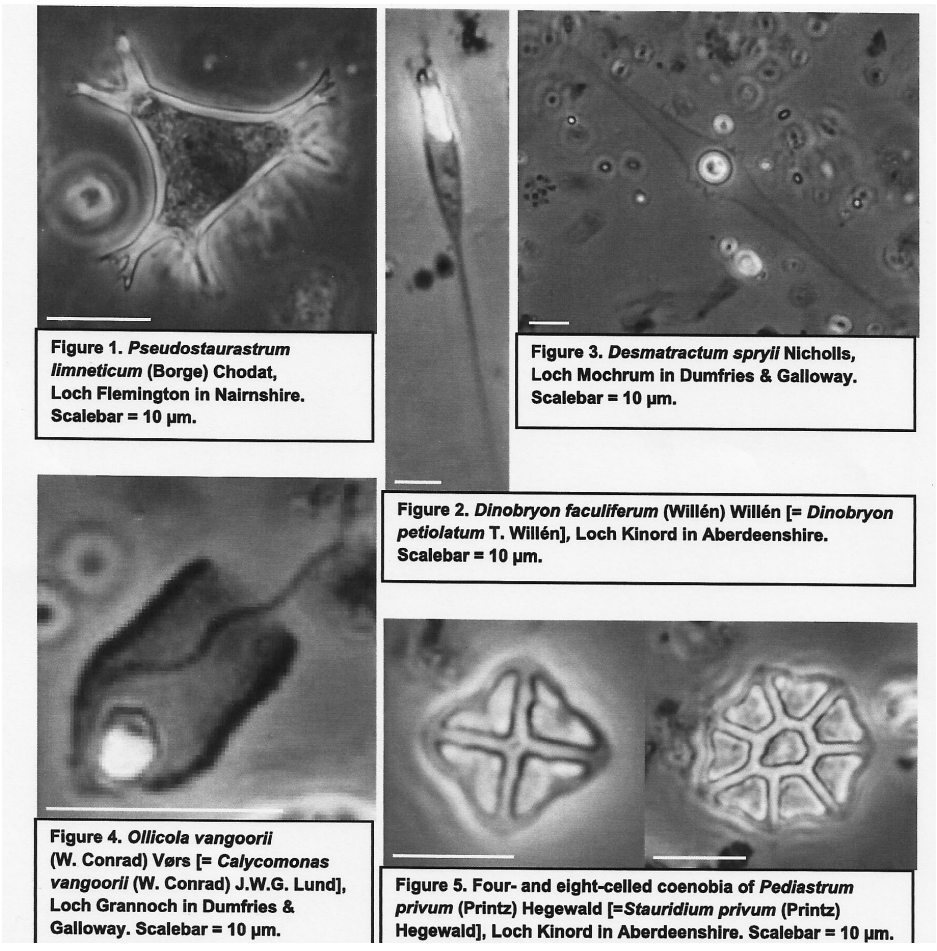


Figure 1. ***Pseudostaurastrum limneticum*** **(Borge) Chodat, Loch Flemington in Nairnshire. Scalebar = 10 µm.**

Figure 3. ***Desmatractum spryii*** **Nicholls, Loch Mochrum in Dumfries & Galloway. Scalebar = 10 µm.**

Figure 2. ***Dinobryon faculiferum*** **(Willén) Willén [=** ***Dinobryon petiolatum*** **T. Willén], Loch Kinord in Aberdeenshire. Scalebar = 10 µm.**

Figure 4. ***Ollicola vangoorii*** **(W. Conrad) Vørs [=** ***Calycomonas vangoorii*** **(W. Conrad) J.W.G. Lund], Loch Grannoch in Dumfries & Galloway. Scalebar = 10 µm.**

Figure 5. Four- and eight-celled coenobia of ***Pediastrum privum*** **(Printz) Hegewald [=***Stauridium privum* **(Printz) Hegewald], Loch Kinord in Aberdeenshire. Scalebar = 10 µm.**

An *Aegagropila linnaei* wreck at the Loch of Harray, Orkney

Clare Scanlan
Scottish Environment Protection Agency

Orkney is a great place for a holiday for many reasons. A relaxing week there at the end of May was book-ended by fine, sunny weather. The middle of the week, however, was less summery, culminating in an extremely windy night on Wednesday 22nd; this was rumoured to be Force 10. Fortunately the storm died down the next day. Before leaving on Saturday afternoon (25th), we visited the Neolithic site at Barnhouse, close to the standing stones of Stenness (HY 305 127). This site sits at the south-west edge of the Loch of Harray. Interesting as the Neolithic house remains were, I was even more taken by the large quantities of small algal balls washed up around the water's edge nearby. These were mostly about 1cm in diameter, with a small proportion up to 2cm across. These were *Aegagropila linnaei* (confirmed later by microscopic examination). This form of *Aegagropila* is known from the Loch of Harray, so it wasn't surprising to find it, just not the quantities seen.

The main wreck was fairly fresh, with only the superficial layer being dried out, and those beneath still green. The location of the densest accumulations seen was in the southern part of the loch, driven there by the northerly wind. There was no time to walk right round the loch, but given the wind direction of Wednesday, this was a logical place. A colleague from Scottish Natural Heritage (Angus, *pers. comm.)* had told me of a similar wreck he saw in March 2011, so this is presumably a periodic occurrence. This was borne out by much drier balls forming "tide lines" up to several metres from the water line, these being clearly from earlier events.

Larger *Aegagropila* balls have been found recently in Lake Windermere for the first time (van Rijn, 2013), but Boedeker & Immer (2009) believed that the number of sites in the Netherlands with this form of *Aegagropila* has decreased, possibly due mainly to eutrophication. Presence of this form is dependent primarily on various physico-chemical factors.

On our way home we checked Loch Watten in Caithness, another site for *A.linnaei* balls (Scanlan, 2009). There were some washed up, but not on the same scale as in Orkney. Possibly the wind was less strong there, or there is less biomass in L.Watten.

It's good to note that this interesting alga is still extant in the Loch of Harray, and also in the neighbouring brackish Loch of Stenness. In the time available, it wasn't possible to check the south and west sides of L.Stenness, and only a few scattered balls were washed ashore on the south-east side. However, large numbers were visible in shallow water either side of the sluice which links the two lochs.

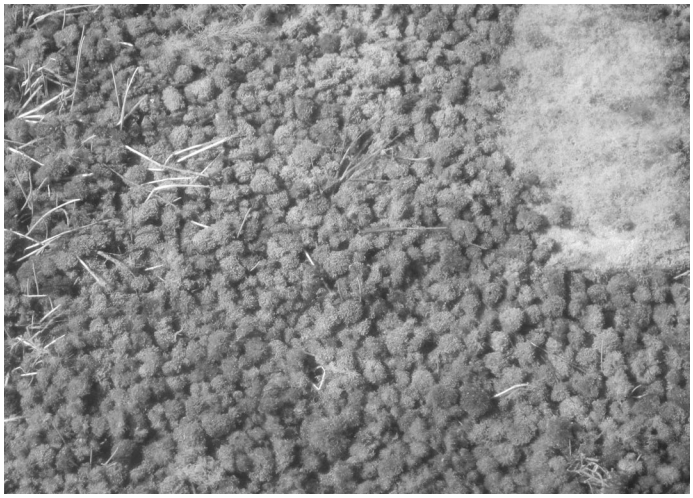
References

Angus,S. *Pers.comm.*

Boedeker,C. & A.Immers 2009. No more lake balls (*Aegagropila linnaei* Kützing, Cladophoraceae, Chlorophyta) in the Netherlands. *Aquatic Ecology*, DOI 10.1007/s10452-009-9231-1

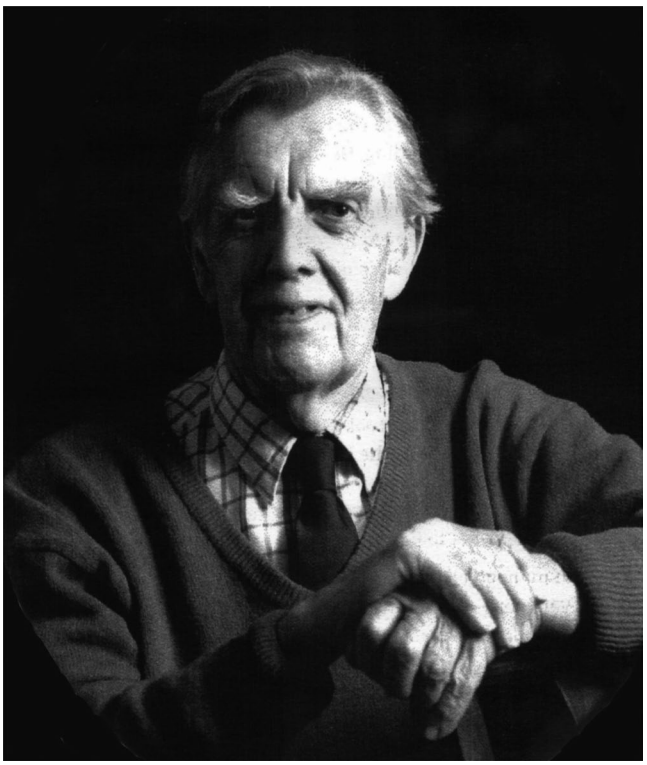
Scanlan,C. 2009. *Aegagropila linnaei* Kützing at Loch Watten, Caithness, Scotland *The Phycologist*, No.77, p.10

Van Rijn, 2013. Lake balls (*Aegagropila linnaei)* discovered in Windermere, UK. FBA News, No.60, p.6



Obituary

Professor Alan J. Brook 1923-2013



Alan Brook, emeritus professor at the University of Buckingham School of Science and Medicine, passed away peacefully on 5 March 2013 and was just 10 minutes into his 90th birthday. The last visit by one of us (DMJ) to Alan and his wife Patricia was a few months after publication of the 2nd edition of 'The Freshwater Algal Flora of the British Isles', the last major work with which he was associated. Although frail, Alan still possessed his usual wit, charm and good humour and freely admitted that his main interest was now in music rather than desmids, the freshwater algae to which he had devoted much of his research career. Alan not only made a significant contribution to our understanding of desmids, but was a very talented amateur musician and played a leading role in organizing concerts and lectures at the University of Buckingham, co-founding the Buckingham Summer Festival, co-chairing the Buckingham Festival of Music and Drama for the past 20 years and president of the Buckingham branch of the University of the Third Age. His contribution to the musical life of Buckinghamshire led to a MBE in the Queen's Birthday Honours List for 2003.

Alan was born on 5 March 1923 in Newcastle upon Tyne and educated at Dame Allan's School before becoming a Kitchener Scholar at Kings College, Newcastle (then part of the University of Durham), where he obtained a BSc degree in Botany. After war service in operational research with the Royal Air Force in India and Ceylon (Sri Lanka), he returned to Newcastle and gained a DPhil in 1949 for his thesis on the algae associated with the slow sand filter beds of waterworks. John Lund was his external examiner and later became a close friend. After Newcastle he spent three years at the University of Khartoum in the Sudan, where his lectureship gave him the opportunity to carry out research on the ecology of the river Nile phytoplankton. He returned to Scotland in 1952 and was appointed botanist at the Freshwater Fisheries Laboratory at Pitlochry (formerly the Brown Trout Research Laboratory) where he studied the impact on algae of the artificial nutrient enrichment of Scottish hill lochs. Desmids first captured his attention during this period and several papers on the group were published before he left to take up a lectureship in botany at the University of Edinburgh. According to Barry Woodward (W.B.Woodward), one of Alan's colleagues at Pitlochry, they were among the first to draw attention to the impact of inflow and outflow on the plankton of small lakes in Scotland and the two co-authored a paper on this topic in 1955.

Perhaps it was observations he had made in Khartoum that aroused his interest in 1957 to write about blue-green algae as well. This was a chapter on "Water-blooms" in the excellent Penguin "New Biology" series. It was a semi-popular article influenced by a topic in an academic review in 1955 on the physiology and biochemistry of blue-green algae by G.E.Fogg (Tony Fogg), one of the three editors of the "New Biology" volumes. Alan Brook's article was one of the earliest attempts to bring together the scattered information about the ecology of blooms formed by blue-green algae in lakes and reservoirs. It was probably also the first time one of the present authors (BAW) ever heard about these organisms and so had quite an impact on his own career.

In 1962 Alan was awarded a DSc by Edinburgh University for his work on desmids and in the following year was elected as a Fellow of the Royal Society of Edinburgh. In 1964 he moved to the USA to become a Professor of Botany at the University of Minnesota, later becoming Professor and Chairman of the newly-established Department of Ecology and Behavioural Biology. During nine years at the University of Minnesota he maintained his interest in blue-green algae (cyanobacteria), especially their occurrence and seasonal distribution in meromictic lakes. On return to the UK in 1973 he became Reader in Freshwater Biology at the University of Reading, where he wrote the *Biology of Desmids* for the Blackwell Botanical Monograph series. While at Reading he also helped to establish the Independent University College of Buckingham (now the University of Buckingham) and moved there himself in 1978 as Professor of Life Sciences, later becoming Dean of Science and having a spell as Pro-Vice-Chancellor. Alan retired in1989, but kept a small laboratory at the University and established research links with the Nuclear Physics Department at Oxford University and, in collaboration with their Scanning Proton Microscope Unit, studied aspects of the accumulation of strontium and particularly barium by desmids.

During his long career Alan did much to share his interest in freshwater algae, particularly in desmids. John Lund remembers him bringing students from Buckingham to the Freshwater Biological Association's laboratory at Windermere on many occasions. He also encouraged members of the Quekett Microscopical Club to take an interest in desmids and organized week-end meetings for them at the University of Buckingham. Thanks to Alan there was for a period a small group of desmid enthusiasts, among them David Williamson, with whom Alan wrote several papers and eventually co-authored a major work on desmids, a 350-page/1500-illustration monograph on three desmid families, which was published in 2010 by the Ray Society. This monograph contains an enormous amount of very detailed ecological information extracted from Alan's field notebooks and represents a life time spent collecting and studying desmids.

We owe a great debt of gratitude to Alan, who co-edited 'The Freshwater Algal Flora of the British Isles' (the Flora) and contributed a chapter on the desmids (with David Williamson in the 2nd edition). DMJ has fond memories of staying with Alan and Patricia when editing manuscripts and illustrations before an evening meal of typically a Malaysian dish and always followed by an excellent single malt whisky! Alan's ideas and tremendous knowledge all contributed to ensuring the Flora remains an important work on British freshwater algae. On one occasion Alan arranged for us to use a laboratory at Buckingham to lay out the Flora plates and a long day was spent together with David Williamson examining each plate for errors and seeking ways to improve them. Some of the plates were of the wonderfully detailed drawings of desmids by Alan himself along with those by David Williamson, another accomplished illustrator, who first became involved with the Flora thanks to Alan's appreciation of David's talent for illustrating desmids.

Alan's contribution to science will live on amongst those who study desmids, with many new species and infraspecific taxa named by him, including the genus *Tortitaenia* published in 1998. Over the course of his career Alan wrote or co-authored almost 100 papers on the ecology, taxonomy and physiology of freshwater algae with the majority on desmids.

Alan is survived by his wife Patricia, his first wife Rosemarie, two daughters and a son.

Selected Publications

Lind EM, Brook AJ (1980) Desmids of the English Lake District. Scientific Publications No. 42. Freshwater Biological Association, Ambleside. 123 pp.

Brook AJ (1957) Water-blooms. New Biology 23: 86-101. Penguin Books, Harmondsworth.

Brook AJ (1964) The Living Plant: an Introduction to Botany, with illustrations by the author. Edinburgh University Press, Edinburgh. 529 pp.

Brook AJ (1981) The Biology of Desmids. Botanical Monographs 16.1–267. Blackwell, Oxford.

Brook, AJ (1998). *Tortitaenia* nom. nov.pro *Polytaenia* Brook, a name of a genus of saccoderm desmids. The Quekett Journal of Microscopy 38: 146.

Brook AJ, Williamson DB (2010) A Monograph on British Desmids: Families Mesotaeniaceae, Peniaceae, Closteriaceae. Ray Society, London. 350 pp.

Brook AJ, Woodward WB (1965) Some observations on the effects of water inflow and outflow on the plankton of small lakes. Journal of Animal Ecology 25: 22-35.

John DM, Whitton BA, Brook AJ (eds) (2002) The Freshwater Algal Flora of the British Isles. Cambridge University Press, Cambridge. 702 pp.

John DM, Whitton BA, Brook AJ (eds) (2011) The Freshwater Algal Flora of the British Isles. Second Edition. Cambridge University Press, Cambridge. 878 pp.

Thanks go to the following for providing us with information: Barry Woodward, John Lund, David Williamson and Patricia Brook. Photo by Mike Kirby

David M. John and Brian A. Whitton

Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD, UK d.john@nhm.ac.uk; School of Biological and Biomedical Sciences, Durham University, Durham DH1 3LE, UK b.a.whitton@durham.ac.uk

INSTRUCTIONS FOR CONTRIBUTORS

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

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

Submission of Copy and Deadlines

Copy should be submitted to:

Dr Jan Krokowski,
Scottish Environment Protection Agency (SEPA),
Angus Smith Building
Ecology
6 Parklands Avenue, Eurocentral
Holytown, North Lanarkshire
ML1 4WQ

Tel. +44 (0)1698839000
E-mail: jan.krokowski@sepa.org.uk

Deadlines are **March 1st** for the April issue, **September 1st** for the October issue.