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2015
British Phycological Society

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Secretary[1]

Dr Jane Pottas
Union Place
9 Upgang Lane
Whitby
North Yorkshire YO21 3DT
UK

secretary@brphycsoc.org
Tel: +44 (0)2079425271

Treasurer[2]

Dr Maeve Edwards
Carna 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@brphycsoc.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

This is a bumper spring edition containing the Bursary reports from students and the Manton Prize winner from the 2014 BPS Annual meeting, which was held in Galway. Inside you will also find all the abstracts from the meeting, including the minutes from the Annual General Meeting for your perusal.

We have reminiscences from our current President, Professor Christine Maggs, our President Elect, Dr Gill Malin, and our Vice President Overseas, Professor Charles Amsler – Happy Reading! We also have advertisements for algae courses, details of the new version of the coded list of freshwater algae of Britain and Ireland available, and articles relating to *Tetracyclus* and how not to confuse Phycology with Psychology….

We all hope the 2015 BPS Annual Meeting in London, hosted jointly with FEPS, will be a huge success and that you all enjoy it, with details no doubt appearing in the autumn edition. If you wish to have any of your photos included, and wish to submit any reviews from the meeting please contact the Editor! Otherwise the Editor will seek you oot!

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

Cover image: Desmid collage prepared as a birthday gift for the late Prof. Alan Brook by David Williamson. The desmids were hand-painted and arranged by David.

CONTENTS

Review of the 62nd BPS Annual Meeting

The Review of the 62nd Annual Meeting held at the National University of Ireland, Galway was detailed in the spring edition of *The Phycologist*, but all the abstracts are now available below, following the Manton Prize Winner's article.

Manton Prize Winner

Stress intensifies sexual dimorphism in a long-lived alga

Martyn Kurr, Bangor University
martynkurr@gmail.com

I was honoured and privileged to be able to present a talk at the annual BPS conference in Galway, summer 2014. I found the whole experience fantastically enjoyable, and although I didn't really know what to expect from my first conference, any doubts or worries I had melted within the first cup of coffee. Standing talking to so many people from different walks of life, commercial and scientific, all brought together over a topic as innocuous as seaweed I had one of those classic 'today it's a good day to be a scientist' epiphanies and settled in to a relaxed and informative few days.

Like most of us I had a passion for the natural world from a young age, and like most of us, I honestly wouldn't do anything else. Perhaps quite strangely for a winner of the Manton Prize, I don't consider myself a phycologist. My research interests have changed hugely over time, and if I were to send a message back to anything over 4 years ago explaining that one day I'd be doing a PhD in seaweed, my younger self would have laughed it off.

In the year I collected my GCSEs, my school was one of the lowest-performing in the country, resulting in only 27% of us walking away with more 5 or more A-C's… only just ever so slightly missing out on the 50% target. Despite claiming to be a maths and computing college, the school's strongest asset was its science department. Not because we had anything other than Bunsen-burners or meter-rulers to work with, but because the quality of the teachers was nothing short of phenomenal. Those same passionate, interesting, caring, and genuinely inspiring teachers wrangled me and a motley crew of misfits through A-levels and when I started looking for universities, I wanted the same environment.

This is how I came to be at Bangor. The university's been hit hard over the years because of money issues, lack of equipment, and lack of space. For 3 years I planned to do a masters project on cephalopod behaviour, "just give me some cuttlefish and a couple of Y-mazes!" I once said to my supervisor. But it was too much, and I ended up with the consolation prize of a bucket of mussels and sink full of dogwhelks. Perhaps I'd have ground my teeth away if the whole thing hadn't turned out to be one of the best things that ever happened to me. The project was a huge success. I enjoyed every minute, made it my baby, worked Christmas day, New year's day, my birthday, none of it mattered- I was doing Science.

So in summer 2011 when I first met the notorious Andy Davies, a man forged from the same red-bricked terraced background and dubious sensibilities as myself, I knew we could make it work. Right up until the point when he offered me seaweed. Seaweed? Suddenly a sink full of snails looked sexy, and I'm glad the offer came through email otherwise the look on my face might've been enough for him to turn-tail. I don't know why I took the offer. Maybe the same thing that made me shrug and take the snails, maybe the same thing that kept me going through seven years of badly funded secondary school education, or the thing that to this day makes me lift up big stones in the woods. What does it matter so long as its Science?

So now I'm writing this to take a breather from a postdoc proposal about seaweed… and snails… and bacteria. Not quite the future in cephalopod behaviour I'd imagined, but I could not be more excited about doing it. When I think about the atmosphere in Andy's office, or during my masters, or my old science lessons, or at the BPS conference in Galway, I realise now more than ever that you don't need money, or tons of equipment, or massive labs to do good research. The talk that won me the Manton Prize was built on data I collected with cable-ties and a bottle of nail-varnish remover, and talking to some of the other post-graduate researchers I think mine was well-funded. But the competition was so stiff, and the quality of the research so strong, you'd never have guessed. I couldn't be more happy to win the Manton Prize, and I couldn't have enjoyed my first conference any more. Thank you so much to the passionate, interesting, caring, and genuinely inspiring people at BPS.

Annual General Minutes
British Phycological Society
62nd Annual General Meeting

ÓTnuathail Lecture Theatre, Arts Millennium Building, NUI Galway
26th June 2014

Present

Chuck Amsler, Lorraine Archer, Eileen Bresnan, Juliet Brodie, Antonio Calado, Sandra Calado, Geoff Codd, John Day, Pilar Díaz, Matt Dring, Maeve Edwards, Michael Guiry, Svenja Heesch, Anne Jungblut, Chris Maggs, Gill Malin, Donal McGee, Linda Medlin, Leanne Melbourne, Karen Mooney, Alexandra Mystikou, Jeanine Olsen, Mariana Pandeirada, Brenda Parker, Jane Pottas, Marine Robuchon, Nestor Robinson, Kjersti Sjøtun, Wytze Stam, Christopher Williamson.

1. Apologies

Clare Gachon, Paul Hayes, Martyn Kelly, Jan Krokowski, Sara Marsham, Clare Scanlon, Elliot Shubert, Michelle Tobin, Martin Wilkinson

2. Minutes of the 61st AGM, July 2013

Accepted

3. Matters arising

No matters arising.

4. Reports from Officers

a) Secretary (Jane Pottas)

Normal secretarial duties have been carried out this year. Enquiries sent to the secretary have been either answered directly or forwarded to officers, committee chairs or BPS members for their attention. Documents from BPS meetings are in the process of being standardised in preparation for uploading to the BPS website as an electronic archive.

b) Treasurer (Michelle Tobin/Maeve Edwards)

Several delays and administrative errors have held up the transfer of the Treasurer role from Michelle Tobin to Maeve Edwards. Michelle apologised for not being able to attend the meeting in Galway. As a charity the BPS must publish and return accounts to the Charities Commission. 2013-2014 accounts summary: All card, cash and cheque membership payments received to date have been processed. Account Balance as of 24th June 2014 - Current Account: £11,257.83; BOS savings account: £57,082.35; NSI: £92,794.88. The use of the credit card terminal will be reconsidered before the current contract ends in 2016 with the recommendation that future payments will be made by PayPal. In the light of the current international economic climate a review of financial planning of the Society is to be undertaken, especially given the increase in applications for grants/sponsorship etc. The amount of money available for grants will be increased to £25,000 in 2015 to allow more participation by students in the EPC6 meeting. The Treasurer thanked all Council members for their support during this year and throughout her time as Treasurer and wished Maeve Edwards well as she takes on the role.

c) Membership Secretary (Sara Marsham)

The active membership of the Society stands at 408 (304 fully paid up, 93 paid to end of 2013, and 11 Honorary Life Members). Thirty seven new members have joined the Society so far in 2014, including 18 student members. Three members have resigned their membership to date. Of the fully paid up members, 151 receive the EJP including 12 of the student members. The Membership Secretary thanked the Treasurer and Webmaster for their continued help with processing payments, also Pier Kuipers and especially Caoilte Guiry for making changes to and maintaining the database and PayPal, and also Council for their continued support.

d) Student Representative (Chris Williamson)

Chris drew attention to the career pathway posters which have been prepared by a number of BPS members and are displayed at the Annual Meeting. Student members at the meeting were encouraged to contact Chris to discuss what they want from the Society. CM thanked Chris for his work as Student Representative.

e) Editor of the *European Journal of Phycology* (Christine Maggs)

Christine Maggs has remained as Editor in Chief since David Mann stepped down in December 2013. Although it is disappointing that the May issue of EJP was not out in time for the AGM, the August issue is expected to be out on time following the appointment of two new Assistant Editors: Steve Dudgeon (CSUN) for Macroalgal Ecology and Giovanni Furnari (Sicily) as Nomenclatural Advisor. There is a big drive to reduce the time from submission to acceptance of papers. The changing nature of the BPS is reflected in the increasingly applied nature of research papers received. The acceptance rate is currently running at around 45%, the main reasons for rejection being linguistic problems or incorrect formatting. Overall, the status of the journal is very encouraging - the Impact Factor remains stable at around 1.9, it has remained at 68/197 in Plant Sciences, and the journal's five-year Impact Factor has grown to over 2. The importance of citing papers was

stressed and supervisors were reminded to encourage students and post docs to increase citations across the field.

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

Ms Agnès Marhadour was thanked for layout and typesetting, Monument Press in Stirling for printing, and Donna Farren and Gordon Nimbley, SEPA Admin staff, for their help in producing The Phycologist. No major issues have been reported this year. Total 2013 costs were £4,719.48, slightly down on the previous two years. Articles submitted include those by members about meetings or project reports following receipt of bursaries from the BPS. Recently a number of book reviews have also started to appear. The deadline for submission of articles for spring is March 1st, and for the autumn edition is September 1st. There continue to be a small number of returns and members are again advised to check and amend their address details.

g) Webmaster (Mike Guiry)

Recommendations to amend the website have been acted upon, e.g. inclusion of the word algae on the front page. Any comments regarding changes to the website should be made directly to the Webmaster. CM thanked Mike for all his work on the website and the prompt response to all comments and requests.

h) Awards and Training Committee (Paul Hayes)

Only one application was received for a Summer Undergraduate Research Project which was funded in full. Eight applications were received for Project Awards of which three were funded. 17 Student Bursaries were awarded to support attendance at conferences and workshops. All award recipients have been made aware of the need to provide a report of their activities for The Phycologist. Deadlines for applications have been posted on the BPW website: Summer Undergraduate Research Project deadline is December 1st; Project Awards deadline is May 1st; Student Bursaries deadlines are 1st February, 1st May, 1st September, 1st December. Details of the Summer Undergraduate Research Project award are drawn to the attention of members to encourage applications for funding. The budget for the A&T Committee has been raised to £25k for 2015 to support more applications to attend EPC6.

i) Biodiversity and Conservation Committee (Martin Wilkinson)

Freshwater Diatom Flora Project of Britain and Ireland Progress Report, June 2014 - report from Martyn Kelly - The Freshwater Diatom Flora Project group met in February 2014, and will meet again in October 2014. Members of the project group are Ingrid Jüttner, Eileen Cox, David Williams, David Mann, Martyn Kelly, Roger Flower, Viv Jones and Chris Carter and they will form the editorial board for the Flora. A website is under development by the National Museum of Wales. The project will focus on producing content for this website, the outcome of a series of workshops at which specialists will compare populations of diatom species from around the UK and Ireland and evaluate these in the light of the latest taxonomic developments. Details of at least 300 species will be documented on the website. The funding request to BPS will be in the order of £10K. There will also be a substantial 'in kind' contribution from the National Museum of Wales (equating to at least 25 days) as well as IT support and website hosting.

Marine Field Meeting - Millport Marine Station now FSC Millport is being considered as the venue for a marine field meeting in summer 2015. The FSC are keen to develop a mutual relationship with the BPS. It is hoped that FSC staff will participate and that survey results will be used to look for long-term changes in the seaweed flora on Great Cumbrae A 5-day field meeting including lab facilities and full board would cost £116 per person. A field meeting at the end of August/early September to follow on directly from EPC6 is proposed which may attract some visiting phycologists.

Juliet Brodie reminded members to upload seaweed records on the BPS Seaweed Recording Website

http://www.bpsalgalrecords.com/

j) Outreach and Education Committee (Michelle Tobin)

The main focus of the committee is to promote marketing of the Society to enhance membership, develop links with external interest groups, and plan and promote the Hilda Canter Lund Photographic Competition (now under the remit of the O&E Committee) for 2014 and 2015. Revised rules for the HCL Photographic Competition have been placed on the BPS website. In 2015 the competition will run to coincide with EPC6 and there are plans to hold an exhibition of HCL photos during EPC. The current prize for the HCL competition is £150. In order to encourage a wider range of entrants and higher numbers the committee proposed an increase to £250 to match the prizes of other photography competitions. This was put to a vote and passed. A joint meeting with The Quekett Microscopical Club is proposed, e.g. a weekend field meeting in 2015 to coincide with their 150th anniversary. The Student Representative, Chris Williamson, is actively eliciting views of the student membership to find out what they want from the Society. A new BPS membership leaflet has been drafted. Closer links are to be forged between the BPS and the Society of Biology.

k) Algal Applications Committee (Gill Malin)

The Algal Applications Group (AAG) was one of 3 fixed-term working groups established at the BPS Council Meeting in July 2012. The group composition includes representatives from the academic teaching and research community, environmental consultancy and industry. In July 2013 Geoff Codd presented the AAG recommendations to

BPS Council and it was unanimously agreed that the AAG should go forward as a BPS committee with Gill Malin taking over as Chair. AAC members - Dr. Gill Malin (Chair) UEA, Prof. Geoffrey Codd University of Dundee, Dr. Sara Marsham (AAC Secretary) University of Newcastle, Craig Rose Seaweed Health Foundation, Dr. Andrew Spicer Algenuity. Dr Martyn Kelly resigned from the group and Dr Saul Purton UCL has been invited to join the committee to represent the views of the consultancy/algal monitoring and/or biotechnology side of algal applications. One of the first outcomes of the AAG has been the organisation of the special session on Applied Phycology at this the 62nd Annual BPS meeting. AAC activities will be stepped up in the autumn of 2014 and ideas are welcomed from BPS members.

Committee chairs and members were thanked for their work.

5. Federation Reports

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

The first issue of FEPS Journal, Perspectives in Phycology is to be published at the end of May and will be open to all. Editors-in-Chief are Professors Burkhard Becker (Cologne) and Mark Cock (Roscoff). Manuscripts for the second issue are currently with referees. Journal contents will consist of reviews, opinion articles, letters and occasional algal fact sheets. Professor Lubomira Burkhardt, University of Poznan and Council Member for the Polish Phycological Society, was succeeded on 21 May 2014 by Professor Waldemar Surosz of the University of Gdansk, the new President of the Polish Phycological Society. Preparations are progressing well for EPC6 in London, August 23-28, 2015. FEPS Council will be guests of the Phycological Group of the Italian Botanical Society and the FEPS Council Meeting and AGM will be held during the Society's Annual Conference in Padova (14-15 November 2014). Geoff was thanked for getting the journal off the ground.

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

BPS members are reminded that FEMS is a federation of microbiological societies in Europe, bringing together 50 member societies from 36 European countries, covering over thirty thousand microbiologists. Members can apply for fellowships, grants and/or support when organising a meeting. FEMS is supporting EPC6 with a grant of £7000.

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

In the absence of Paul Hayes this report was presented by Gill Malin who attended the SB's dinner for Member Organisations on behalf of the BPS on 15th May 2014. The BPS is a Full Organisational Member of the SB which costs in the region of £600 per annum. Gill recommended maintaining membership, observing that closer links between the BPS (to be investigated and forged by the Outreach and Education Committee) could bring greater benefits to the Society. The SB accredits degrees in the biosciences and BPS members involved in higher education are asked for feedback on this. BPS members are also encouraged to write articles about phycology for *The Biologist.*

6. Council Membership

Ordinary Members of Council – end of term of office in 2014: John Bothwell and Elliot Shubert. John and Elliot were thanked for their contributions to Council. Following a call for nominations an election was held and Gary Caldwell and Saul Purton have been appointed to Council. Honorary Life Member – following the death of George Russell, Council were unanimous in agreeing that Linda Medlin should be invited to become an Honorary Life Member in recognition of her full and enthusiastic support of the Society. Linda graciously accepted this honour.

7. Future meetings

a) EPC6 London 2015

The European Phycological Congress is held every four years. Nearly 500 delegates attended EPC5 in Rhodes in 2011. EPC6 will be held in London in 2015. The BPS Annual Meeting will be enmeshed in this meeting in London. There will be the possibility of holding subsidiary meetings as there are rooms available at the venue.

http://www.epc6.org/

Arrangements for the Manton Prize at EPC6 - this is to be a two stage process – i) submission of an abstract either in written form or as a video – to be decided, and ii) a presentation by finalists at EPC6 – to be judged by the Manton Committee.

b) BPS 2016 – a venue was requested.

8. Archives

Juliet Brodie provided an update on plans to organise the BPS archive at the Natural History Museum, London with help from the museum archivist.

The meeting ended at 6.30pm.

British Phycological Society
62nd Annual Meeting
ABSTRACTS OF ORAL PRESENTATIONS

In first author alphabetical order.

Chemical mediation of Antarctic macroalgal-herbivore interactions

Charles D. Amsler

University of Alabama at Birmingham

Macroalgae dominate the hard benthos along the Western Antarctic Peninsula to depths of up to 40 m or more. Most of the macroalgae are chemically defended from a variety of macro- and mesograzers but harbor very high densities of amphipod mesograzers. The amphipods benefit from living on the large, chemically-defended macroalgae because they gain refuge from fish which are their primary predators. Most amphipod species do not consume most of the macroalgal species, but are of benefit to the macroalgae by keeping them relatively clean of epiphytic microalgae and filamentous macroalgae. Amphipods also appear to have selected for a relatively high incidence of filamentous algal endophytes in some of the larger macroalgae. These endophytes can be, but are not always, detrimental to the hosts. One amphipod species does consume some of the chemically defended red algal species and is able to sequester algal metabolites for its own use as defenses against fish. This is the first known incidence of defensive metabolite sequestration in marine arthropods.

Harmful algae in Scottish waters: diversity of the dinoflagellate *Alexandrium* (Halim) and interaction with zooplankton grazers

Eileen Bresnan, Kathryn Cook, Lyndsay Brown, Jean-Pierre Lacaze, Ana–Luisa Amorim, Jennifer Graham Elizabeth Turrell & Catherine Collins

Marine Scotland Science

Species within the dinoflagellate genus *Alexandrium* (Halim) are potent producers of the neurotoxins responsible for paralytic shellfish poisoning (PSP). Shellfish harvesting areas in Scottish waters experience harvesting closures as a result of PSP toxin concentrations exceeding the EU regulatory limit of 80 µg $100g^{-1}$ on an almost annual basis. A recent study into the diversity of *Alexandrium* in Scottish waters revealed four species to be present, *A. tamutum*, *A. minutum*, *A. ostenfeldii* and both the toxin-producing (Group I) and non-toxin producing (Group III) strains of *A. tamarense*. Molecular methods have allowed a regional assessment of the diversity of this genus to be performed. Laboratory studies examining competition between Group I and Group III strains of *A. tamarense* reveal that the Group III strain can outcompete the Group I strain at a number of different temperatures. Investigations into the impacts of *Alexandrium* on zooplankton have revealed little impact of dissolved PSP toxins on egg production or mortality. Feeding experiments reveal a mixed response between different copepod genera with some feeding on toxin producing cells and accumulating PSP toxins in their tissue. These results suggest that zooplankton can act as a vector for PSP toxins in Scottish waters suggesting that these toxins may pose a risk to higher trophic levels of the marine ecosystem.

The future of the northeastern benthic flora in a rapidly changing environment

Juliet Brodie[1], Chris Williamson[1,2], Chris Yesson[1,3] & Jason Hall-Spencer[4]

[1] Natural History Museum, Department of Life Sciences, [2] Institute of Zoology, Zoological Society of London, [3] School of Earth and Ocean Sciences, Cardiff University, [4] Marine Biology and Ecology Research Centre, School of Marine Sciences and Engineering, University of Plymouth.

Seaweeds, seagrasses and associated microphytobenthos have been profoundly affected by human impact in the northeastern Atlantic due to increasing warming and acidification of the environment. Based on available evidence we predict that over the next 100 years kelp forests will disappear from their southern ranges and maerl beds will dissolve in their

northern ranges. Invasive seaweeds will increase due to niches that become available as a result of loss. Conversely, seagrasses are predicted to thrive, provided they are protected from other human impacts such as dredging. It is anticipated that epiphytic coralline algae on seagrasses will be replaced with diatoms and filamentous algae. In this talk, we will present these predictions and the evidence upon which they are based, including a case study of large brown seaweeds between 1974 and 2010 in the UK which reveals a north-south divide of gain and loss of abundance and a mixed relationship with temperature. We will also address future research and the problem of making such predictions in relation to the lack or patchy nature of long term datasets through our work on using web map images to quantify coastal seaweed habitat.

Fine-structural organization and phylogenetic affinities of *Peridiniopsis polonica* (Dinophyceae): evidence for a new genus

Sandra C. Craveiro, Niels Daugbjerg, Øjvind Moestrup & António J. Calado

University of Aveiro, Portugal

The combined evaluation of cell morphology, internal organization and DNA-based phylogenetic analysis of freshwater species of *Peridinium* and *Peridiniopsis* resulted in the recent definition of several new genera. The species currently known as *Peridiniopsis polonica* (or *Peridinium polonicum*) crosses the artificial boundary between *Peridinium* and *Peridiniopsis*, viz. the number of intercalary plates, which in this species varies between one and two. However, in phylogenetic analyses based on different genes it always groups with species of *Scrippsiella* (within the clade that produces calcareous cysts) and distant from the type species of either *Peridinium* (*P. cinctum*) or *Peridiniopsis* (*P. borgei*). The internal cell structure of the types of *Peridinium*, *Peridiniopsis* and two splinter genera of peridinioids with affinities in the 'calcareous clade', *Chimonodinium* and *Theleodinium*, has been described in detail and is available for comparison. The fine structure of *Peridiniopsis polonica* includes the presence of up to six stalked pyrenoids surrounded by starch sheaths, a multilayered microtubular system clearly homologous with the microtubular basket of pfiesteriaceans, and an unusual pusular system, with a long tube that widens into a chamber from which a large number of pusular tubes emerge. Somewhat similar pusules were observed in distantly-related species like *Sphaerodinium cracoviense*, *Karlodinium veneficum* and *Gymnodinium fuscum*. A phylogenetic analysis based on ITS1, 5.8S and ITS2 sequences and including 26 species from the 'calcareous clade' grouped *P. polonica* with three '*Scrippsiella*' species in a statistically supported clade separate from the one containing *S. sweeneyae* and *S. trochoidea*, which represent the typical *Scrippsiella.*

Exploring the phylogenetic relationships of *Fernandosiphonia* (Rhodomelaceae, Rhodophyta) and its taxonomic implications.

Pilar Díaz-Tapia[12], Lynne McIvor[1]& Christine Maggs[1]

[1]Queen´s University Belfast, [2]University of A Coruña

Polysiphonia sensu lato, with more than 200 species, is the largest red alga genus. Since its establishment, numerous genera have been segregated from *Polysiphonia* based on morphological characteristics. One of them is *Fernandosiphonia* which was described by Levring in 1941 based on *F. unilateralis* from the Juan Fernández Islands (Chile). This genus was characterized by having primary dorsiventrality and it currently contains three species. Here, we analyse its phylogenetic relationships to other members of *Polysiphonia sensu lato* and the taxonomic implications. Using specific primers designed to amplify a 100-bp region of the *rbc*L gene, a sequence of the type material of *Fernandosiphonia unilateralis* was obtained and phylogenetic trees show that it is placed in the same clade as the well-resolved segregate genus *Neosiphonia*, established in 1999 by Kim & Lee based on a combination of morphological features and that currently includes 35 species. Our results show that the species of *Neosiphonia* must be transferred to *Fernandosiphonia*, which has taxonomic priority. Consequently, the morphological concept of *Fernandosiphonia* needs to be reviewed. In this regard, it is distinctively characterized by its particular arrangement of the plastids, which are absent from the outer walls of pericentral cells.

Examining the causes of cell death in cyanobacteria and its possible ecological significance

Daniel J. Franklin

Bournemouth University

Cyanobacteria contribute a significant fraction of global primary production and are therefore of great ecological significance. Individual cyanobacteria have four potential fates: to divide, perhaps after a dormant period, to be eaten, to undergo viral lysis or to undergo cell death. Cyanobacteria cell death has been classified as programmed cell death (PCD), a concept more widely known in metazoan cells, and there are various biochemical parallels to support this categorization. Here I review the evidence for the existence of PCD in cyanobacteria and examine a number of hypotheses to explain the evolutionary and ecological causes of cyanobacteria cell death. One idea of recent prominence is that bacterial cell death is driven by a process of asymmetric division whereby cell division results in daughter cells of unequal fitness. If cells start out with a variable fitness then they would have a differing capacity to respond to changes in the abiotic and biotic environment, and this might contribute to patterns of cell mortality observed in nature. A complementary idea is that differences in fitness between cells arise by random processes, basically: the cell experience, and this can lead to the accumulation of dead cells in natural populations. Testing hypotheses on the ultimate causes of cell death in cyanobacteria will require the use of flow cytometry and multi-stain physiological assessment which fully encompasses dormancy, known to be significant in some cyanobacteria. In this talk I reflect on what is known, and what could be usefully learnt, about the patterns of cell death in natural and cultured cyanobacteria populations.

Advanced textiles for open sea biomass cultivation (AT~SEA)

Bert Groenendaal[1] & Declan Hanniffy[2]

[1]Sioen Coating, [2]OceanFuels Ltd.

The project AT~SEA targets the development of advanced textiles in order to demonstrate the technical and economic feasibility of open sea cultivation of macroalgae (seaweeds) in Europe, the latter being an important source for our future supply of sustainable chemicals and energy. This paper will discuss the development of advanced textile materials for 3 different elements of such an aquatic biomass cultivation system:

- Advanced textile substrates as seaweed cultivation platforms
- Advanced textile based cables and connections for positioning and anchoring of the textile cultivation system
- Advanced coated textiles for flexible and lightweight flotation tubes, as well as for storage and transportation tanks

During the presentation we will give a general overview about the project (technical objectives, partners, etc.), discuss the technological concepts for each of the 3 elements, and discuss the results from laboratory tests as well as from tests at sea. The AT~SEA project has received funding from the European Union's Seventh Framework Programme (FP7/NMP.2011.4.0-3) under grant agreement n° 280860.

Benthic dinoflagellate diversity and their harmful potentials

Mona Hoppenrath

Senckenberg am Meer, DZMB, Südstrand 44, D-26382 Wilhelmshaven, Germany

The species diversity and geographic distribution of benthic marine dinoflagellates has not been fully explored yet. Less than 10% of the approximately 2000 known extant dinoflagellate species appear to be benthic. Currently we know about 190 described and named species in 45 genera. Species compositions of benthic habitats are quite distinct from those of planktonic habitats. They occur in different types of habitats and their morphology, their behaviour, and some of their life cycles seem to be well adapted to the benthic lifestyle. Many genera have unusual morphologies and appear to be not closely related to known planktonic taxa, and molecular phylogenetic analyses frequently show low statistical support for any relationship.

Some taxa are known to produce toxins, particularly in tropical and subtropical regions, which have

caused an increased research interest in benthic dinoflagellates. As ciguatera fish poisoning incidences are increasing, and the distribution of toxin producing benthic taxa seems to expand, an understanding of the species diversity and their identification is becoming more and more important. At least thirty species of seven genera - *Alexandrium*, *Amphidinium*, *Coolia*, *Gambierdiscus, Ostreopsis, Prorocentrum,* and *Vulcanodinium* – are involved. These taxa produce a profusion of different toxic and bioactive chemical compounds, some of which are the cause of major benthic harmful algal blooms. These blooms can cause serious human and environmental health problems. Recently the potentially toxic species have been subject of intense research activities.

The knowledge about the biodiversity, biogeography and ecology will be summarized with special emphasis on toxic taxa.

Antarctica cyanobacteria: from Scott's discovery expedition to microbialites in Dry Valley Lakes.

Anne D. Jungblut[1], Kate Wall, Tyler Makey , Dawn Y. Sumner, Dale T. Andersen & Ian Hawes

Department of Life Science, Genomics & Microbial Diversity Division, Natural History Museum, London

Antarctic terrestrial aquatic ecosystems in the McMurdo Dry Valleys, Southern Victoria and Ross Island include meltwater ponds and perennial ice-covered lakes, and their biology is dominated by benthic microbial mats that often take complex 3-D macroscopic morphologies. Cyanobacteria are key primary producers in these benthic environments and a major structuring agent of these multilayered three-dimensional structures. Recent findings have shown the sensitivity of these inland ecosystems to climatic-driven environmental change, and a better understanding of the distribution and response of cyanobacteria and other microbes to environmental gradients, will likely assist in evaluating the resistance and resilience of Antarctic freshwater benthic biology to change. Therefore, cyanobacterial mats collected during R. F. Scott's Discovery Expedition (1901-4) from the McMurdo Ice Shelf and Ross Island allowed the comparison of historic specimens with present-day cyanobacterial communities using next generation sequencing from similar geographic regions in Antarctica to identify changes in cyanobacterial diversity over the last 100-years since onset of human activity and climatic change. In addition, perennially-ice covered meromictic lakes in the McMurdo Dry Valleys, Antarctica, are useful models to study the relationship between cyanobacteria and environmental variables, because they have rich benthic cyanobacterial mat accumulations and stable stratification of physical and chemical conditions. We therefore evaluated the cyanobacteria and microbial mats using 16S rRNA gene clone library and next generation sequencing analyses.

An 'omics approach to DMSP metabolism in marine phytoplankton

Gill Malin[1], Nikki Hockin[1,2,3], Michal Bochenek[1,2,4] & Stanislav Kopriva[2,5]

[1]School of Environmental Sciences, University of East Anglia, [2]John Innes Centre, John Innes Centre, [3]Now at: KWS UK Ltd., [4]Now at: Bioengineering Laboratory, Université Catholique de Louvain, [5]Now at: Cologne Biocenter, Universität zu Köln.

Dimethylsulphoniopropionate (DMSP) is the precursor of dimethyl sulphide which is important in the sulphur cycle and might also influence climate. Here we focus on 2 'omics studies where we aimed to improve current understanding of DMSP metabolic pathways. In *Thalassiosira pseudonana* increased light and salinity and nitrogen deficiency increase intracellular DMSP and were used in enzyme activity, gene expression and proteome analyses. Activity of the sulphur assimilation enzyme adenosine 5'-phosphosulphate reductase (APR) did not increase with increased DMSP concentration. Coordinated sulphur assimilation gene expression was limited to sulphite reductase and with proteomic analysis only phosphoenolpyruvate carboxylase increased. DMSP synthesis might not have a simple 'on-switch'. Different components might be limiting with carbon and nitrogen substrate availability playing a central role in regulation of DMSP production. RNAseq analysis of sulphate-deficient and sulphate-sufficient *Emiliania huxleyi* (5 and 25 mM sulphate) gave 298 upregulated and 37 downregulated transcripts at 5 mM sulphate. Two of 4 putative DMSP synthesis gene homologues were not under significant transcriptional regulation and 2 were not expressed or expressed at very low level and unlikely to function in DMSP synthesis. Two DMSP degredation gene homologues were upregulated supporting the sulphur redistribution hypoth-

esis. Sulphate uptake and cysteine synthesis were upregulated as in plants and freshwater algae. So *E. huxleyi* seems to retain the response to artificial sulphate deficiency, but the general response is rather different with upregulation of carbohydrate and fatty acid synthesis genes that might redirect sulphur and carbon from DMSP to these alternative metabolite pools.

Follow up to MIDTAL: µAqua, MICROCOKIT and SMS

Linda K. Medlin

Marine Biological Association of the UK

In the EU project MIDTAL, a phylochip to toxic algae was developed and field tested in 5 European countries. This universal microarray, now patented, is commercially available. Free Starter kits containing 5 free slides are available and a beta test version is available with 20 slides. The identical protocol was transferred to another project: **µAqua** to detect freshwater pathogens: bacteria, cyanobacteria, protozoa and diatoms (for assessing water quality). Relevant to HABs is that this phylochip will detect *Planktothrix, Anabaena, Aphanozomenon, Cylindrospermopsis, Microcystis, and Nodularia* as well as their toxins. The toxin genes are on another chip because of the low level of expression (microarray signal) and we have developed a never-before-tested method of retrotranscription directly on the array prior to scanning and this method increased the signal from the expressed toxin genes up to 10 fold. This array will be tested in 6 European countries within this project. This array has been transferred to another European project, MICROCOKIT, where it will be tested over 2 years from 4 sites (pristine, anthropogenic, industrial, and agricultural) along the Tiber River to the Mediterranean Sea. MIDTAL probes will be transferred to another European project, SMS, where these probes will be used as the capture probes in a sandwich hybridisation assay using electrochemical detection as was developed in the EU project ALGADEC. Novel to this project is the development of a high density microelectrode array (MEA) detecting up to 100 probes with microfludics for final adaptation to a buoy.

Energy balance of microalgal biogas production

John J Milledge & Sonia Heaven

University of Greenwich

A mechanistic energy balance model was successfully developed for the production of biogas from the anaerobic digestion of micro-algal biomass from raceways. The energy balance model was used to consider the energetic viability of a number of production scenarios, and to identify the most critical parameters affecting net energy production. The output of the model demonstrated that no single method of harvesting studied (centrifugation, settlement or flocculation), produced a sufficiently greater energy output over operational energy inputs to make algal biogas production viable. Combinations of harvesting methods produced energy outputs 2.3 to 3.4 times greater than the operational energy inputs. Electrical energy to power pumps, mixers and harvesting systems is 5 to 8 times greater than the heating energy requirement. If the energy to power the plant is generated locally in a combined heat and power unit a considerable amount of "low grade heat" will be generated that is not required by the algal biogas process and for the plant to be efficient must be exploited. It is concluded that the production of micro-algal biogas may be energetically viable, but is dependent on the exploitation of the heat generated by the combustion of biogas in combined heat and power units to show a positive balance

Development of a multi-metric phytoplankton Index for the assessment of ecological status in Irish waters.

Sorcha Ní Longphuirt[1,2], S. O'Boyle, G. McDermott & D.B. Stengel[1]

[1]National University of Ireland, Galway, [2]Environmental Protection Agency

The Water Framework Directive (WFD) requires the inclusion of an index which determines structural changes in phytoplankton communities based on composition, abundance, frequency and intensity of algal blooms, and biomass. The existing Irish WFD method, based on Chlorophyll (chl) concentration and cell abundance, encompasses data from a three year rolling period thereby integrating bloom frequency. This method does not, however, allow for compari-

son with site- and date- specific environmental data which could give an indication of cause and effect relationships. The objective of this work was therefore to produce a phytoplankton Index which would comply with WFD requirements and be comparable with date-specific physiochemical data. Menhinicks Index and the evenness index (E_2) were added to the new Index to represent composition, and were chosen due to their monotonicity with abundance and hence ecological disturbance. Normalised ecological quality ratios (EQR) were calculated for each of the four metrics for each sampling point and the Index was calculated as the average of the four metrics. The new Index performed well against current EPA methods to determine ecological status and discriminated between undisturbed and eutrophic conditions. A principal components analysis highlighted the relationship between physio-chemical parameters and the Index for the combined dataset. The Index decreased with higher secchi depths and residence times and increase with river flow rates showing the influence of physical restraints (e.g. light availability and water movement) on the structure of the phytoplankton community. Development of the index will allow not only for compliance with WFD requirements, but with a method to determine the status of Irish estuarine phytoplankton communities over spatial and temporal timelines in line with changes in physiochemical parameters.

A collaborative approach to large-scale kelp cultivation in Europe

Benoît Quéguineur[1], Maeve Edwards[1], Karen Mooney2, Jennifer Champenois[3], Fleuriane Fernandes[3], Lynsey Melville[4]

[1]Irish Seaweed Research Group, National University of Ireland, Galway, [2]Queens Marine Laboratory, Queens University Belfast, [3]Centre d'Etude et de Valorisation des Algues, [4]Birmingham City University

The number of research groups/projects developing seaweed cultivation at sea has steadily risen across Europe in the past 5 years to the extent that most countries with an Atlantic seaboard also have a seaweed cultivation programme. The most collaborative of these programmes is the Energetic Algae project (EnAlgae), connecting a group of macroalgal and microalgal pilot facilities across Europe. The project aims (in part) to produce *Saccharina lattisima* and *Alaria esculenta* biomass at commercial scale for biofuel and other higher value products in North West Europe in order to militate against rising greenhouse gas emissions. Collaboration is central to the project's goals, whereby standard production and measurement protocols have been developed, resulting in standardised yield data. Accurate, replicable datasets for algal cultivation shared through an online portal represents the first attempt to provide end users (investors, policy makers, aquaculturists etc.) with open access to biological, financial and regulatory information through a decision support tool. In this talk we will present a comparison of environmental and cultivation growth data from pilot sites in France, Ireland and Northern Ireland (2012-2014). We will also demonstrate how complex data from a variety of different sources might be combined to produce a web-based decision support tool that will ultimately encourage the development of a new era in macroalgal biomass production in Europe.

The Search for Bioactivity in Marine Algae in Irish Waters

Margaret Rae[1,2], Vangelis Smyrniotopoulos[3], Daria Firsova[3], Svenja Heesch[1], Fabio Rindi[4], Jonathan Kennedy[5,] Helka Folch[6,2], Howard Fearnhead[7], Thomas Ritter[8], Mark P. Johnson[1], Alan Dobson[5], Deniz Tasdemir[3]

[1]Ryan Institute, National University of Ireland Galway, [2]Marine Biodiscovery Laboratory, Marine Institute, [3] School of Chemistry, National University of Ireland Galway, [4]Dipartimento di Scienze della Vita e dell'Ambiente, Universita´ Politecnica delle Marche, [5]Environmental Research Institute, University College Cork, [6]School of Biological Sciences, Queen's University, Belfast, [7]Department of Pharmacology and Therapeutics, National University of Ireland Galway, [8]Regenerative Medicine Institute, National University of Ireland Galway, Ireland.

Since the Beaufort Marine Biodiscovery Research award was made in 2007, over 280 marine algae have been collected from Irish waters in sizeable quantities to allow their bioactivities to be investigated. The algal contribution to the Beaufort Marine Biodiscovery Repository accounts for > 60% of the specimen collection housed at the Marine Biodiscovery Laboratory at the Marine Institute. The specimens go through the process described previously [1] in an attempt to discover novel bioactive molecules. Once extracts have

been made, they are tested in-house for antimicrobial activity and externally with our Beaufort Marine Biodiscovery Research partners in UCC and QUB for more extensive anti-microbial, anti-biofilm and quorum sensing activity. Within NUI Galway they have also been tested in anti-cancer and anti-inflammatory assays. The bioactive crude extracts are worked up at the NUI Galway School of Chemistry, by following bio-guided isolation processes to enable the purification and chemical characterization of the bioactive principles of the extracts. All the data is collected and stored in the Marine Biodiscovery Database held within the Beaufort consortium.

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References: 1. Rae, M. et al. (2013) Phytochem. Rev. 12: 555-565.

Biophysical interactions and their promotion of harmful algal blooms.

Dr. Robin Raine

Earth and Ocean Sciences, National University of Ireland, Galway

The biophysical interactions involved in the promotion of harmful algal events are reviewed with specific reference to harmful algal blooms that have occurred around Ireland. The direct and indirect effects of tides, solar heating and winds are considered over a range of length scales. Tidal mixing across the continental shelf, tidal flushing of bays, and the influence of tides on estuarine circulation are shown to have a primary influence on the distribution and timing of harmful algal events. The effects of winds in moderating coastal currents around the Irish coast and also forcing exchanges in water, and plankton, between bays and the adjacent shelf are also described. Similarly, the consequences of the annual cycle of thermal stratification of the water column on the promotion of harmful algal events are illustrated over a range of temporal and spatial scales. These include the timing of a harmful event (seasonality) down to physical effects associated with sub-surface high-density thin layers of harmful species.

Seaweed : A living resource for the industry

Monique Ras, Catherine Boyen, Mirjam Czjzek, Myriam Valero, Yannick Lerat, Katia Frangoudes, Martial Laurans, Philippe Potin

Roscoff Marine Station – CNRS

In France, seaweed exploitation has evolved through time, from iodine extraction in the 19th century to nowadays specific ingredients for food, agriculture and cosmetics. While the commercialisation of such products depends on the harvesting of natural populations, the need to preserve the resource is undeniable in order to maintain the industry. Moreover, there is an increasing interest from the private sector towards seaweed biomass due to its unique chemical composition, yet still poorly understood. In such a context, the French government has invested in research activities by funding a national project called IDEALG, which main goal is to develop the seaweed sector.

The IDEALG project brings together more than a hundred scientists, engineers and technicians from the academic and private sectors in order to increase knowledge on seaweed production, ecology, genetics, physiology and chemistry. Concern is also given for impact studies on the environment and on socio-economic aspects. Such an integrated approach of IDEALG aims to conceal fundamental science and society, thereby guarantying a sustainable development of the seaweed sector.

The first phase of the project (2011-2015) focuses on fundamental science along with developing specific tools able to help understand the evolution and reproduction of seaweed, explore the metabolic and chemical diversity and analyse socio-economic trends and behaviours related to seaweed exploitation activities. Such knowledge will be then transferred in a second phase (2016-2020) to potential applications leading to improved or new seaweed practices and/or bio-productions.

Investigating temporal changes in seaweed communities of Brittany

Marine Robuchon, Régis Gallon, Eric Feunteun, Romain Julliard, Boris Leroy, Myriam Valero & Line Le Gall

Muséum national d'Histoire naturelle (Paris)

Understanding how biological communities respond to anthropogenic pressures is crucial to preserve biodiversity. Coastal communities are particularly exposed to anthropogenic pressures because human density and activities are concentrated in littoral zones and, moreover, the recent human-induced warming has been faster in the ocean than in the air. This warming is likely to affect coastal communities, especially organisms strongly dependent on temperature for their reproduction, metabolism and survival such as seaweeds. Models based on the evolution of sea surface temperature (SST) have shown that seaweed communities from biogeographical transition zones of temperate waters will be the most affected by this warming. Along the European coast, Brittany constitutes the transition zone between the cold-temperate and the warm-temperate biogeographical regions. Its flora is rich and one of the best and most anciently studied around the globe. Consequently, numerous data regarding the distribution of seaweeds in Brittany are available, including historical collections covering the preindustrial period (1800-1960) and recent records from biodiversity surveys made in the 1990s and in the 2010s. Using these recent records, we uncovered that red seaweed assemblages have markedly and differentially changed across different regions of Brittany during the last 20 years, in relation to the rise of both SST mean and SST amplitude. We now pursue the double aim of i) revealing putative changes on a greater period of time by studying historical collections and ii) to analyse those changes in terms of species traits, that will potentially reveal how ecosystem functioning has been affected.

OMG- *Lacuna vincta* ate all my seaweed

Chris Reilly, Shona Magill, Michele Stanley

Scottish Association of Marine Science

The sea snail *Lacuna vincta* is commonly found around the coasts of the UK and Ireland. Where it does occur it has a big appetite for grazing seaweeds and with an increase in macroalgal cultivation has the potential of becoming a "pest" organism. But we know relatively little about this organism and its feeding habits. If we are to understand the potential impacts of opportunistic grazing on cultivation sites then we do require more information relating to *L. vincta's* growth and feeding preferences. This presentation describes the feeding of *L vincta* on a selection of macroalgal species with 2 main aims: (1) Determining the growth rate of the snail throughout its life cycle by observing changes in growth rates and feeding habits in different size classes of snails, (2) Finding the macroalgae species that the snails preferred to graze by conducting preference feeding trials and free choice trials with *Laminaria digitata, Ulva lactuca, Palmaria palmata* and *Saccharina latissima.* As we see an increase in the amount of seaweed being cultivated questions now needed to be answered in terms of the potential associated risks to this form of agriculture and likely mitigation strategies.

Microalgal Synthetic Biology: Are we there yet?

Andrew Spicer, Joanna Szaub, Henry Taunt, Charlie Gilbert, Sam Sizer

Algenuity

Microalgae are perceived as the poorer cousins to yeast or bacteria within the context of established synthetic biology/industrial biotech platforms. This partly reflects the significant challenges associated with DNA transformation and the lack of readily available molecular tools and validated approaches in microalgae. Microalgal products make up a current global market that exceeds $3 billion/annually – this is dominated by higher value products including vitamins, antioxidants and omega-3 fatty acids. Many microalgal strains are encountered in nature growing in industrially relevant volumes and their growth requirements as well as their capacity to grow on waste streams utilising, for instance, waste water, flue gas effluents and waste heat makes them intriguing with regard to their suitability within industrial biotech platforms. Driven by external drivers including environmental impact, sustainability, cost and new routes to market, larger companies are starting to seriously

consider microalgae as biological production systems for commercially and socially relevant products, including bulk lipids, specialty oils, proteins, feeds, recombinant proteins and fine chemicals. I will present an overview of the industry as well as our progress towards the development of robust strategies and widely applicable molecular tools to make industrially relevant strains of microalgae accessible for exploitation as commercial production systems. I will include recent progress we have made in rapid lipid engineering of microalgal strains as well as the use of engineered microalgal strains for the production of triterpenoids. My goal will be to answer the question: Microalgal synthetic biology, are we there yet?

Area Based Management of Seaweed Resources as a Component of Integrated Coastal Zone Management; the case of *Ascophyllum nodosum* in North America.

Raul Ugarte

Acadian Seaplants Ltd. Canada

An ecologically sustainable harvest requires the implementation of a detailed area based management plan associated with a range of access, effort, exploitation and quota controls. Due to the wide geographical distribution of seaweed resources any management must be part of integrated coastal zone management. Implementation of limited or exclusive access to a resource that is integral with the intertidal or shallow subtidal requires a legislative foundation that frequently does not exist in all jurisdictions. Granting exclusive access to individual harvesters or companies has potential conflicts with private land ownership and over lapping jurisdictions. Federal and provincial laws in Canada overlap regarding coastal sessile marine resources despite the allocation of responsibilities under the Constitutional Act of 1867. The USA has private property rights that extend to the intertidal under the Colonial Ordinance 1641/1647 complicating the implementation of area based management of seaweed resources. Canada has implemented area based management for 90% of its harvestable *Ascophyllum nodosum* resources using two approaches to jurisdictional overlap. Maine has implemented a pilot scale area based management plan and is moving toward a state wide area based management plan. There has been a wide range of inputs into these management plans from science, general stakeholders, formal economic and social sources. No effective area based plan that has ecological sustainability as a goal can be static. There is a need for a flexible and adaptive management structure that integrates new science.

Phylogenetic species delimitation in the *Eunotia bilunaris/flexuosa* species complex (Bacillariophyta)

Pieter Vanormelingen[1], Olivier Declerck[2], Pavla Urbanková[3], Sofie D'Hondt[1,2] & Wim Vyverman[1]

[1]Protistology & Aquatic Ecology research group, Ghent University, [2]Phycology research group, Ghent University, [3]Department of Botany, Faculty of Science, Charles University in Prague.

There is mounting evidence based on molecular phylogenies and their congruence with sexual compatibility and valve morphology that there is a large (pseudo) cryptic species diversity in diatoms. A DNA barcoding database can be developed to identify these species, but in parallel a huge taxonomic effort will be necessary to define species limits based on data sources other than only valve morphology. Automated DNA-based species delimitation methods are suitable for a first rapid, large-scale and objective assessment of species limits. However, their performance should be evaluated using model taxa in which species limits are well-understood. Here, we apply two of these methods, statistical parsimony network analysis and the GMYC model approach, to the *Eunotia bilunaris/flexuosa* species complex, in which we currently recognize 16 species based on a combination of molecular phylogenies, mating trials, pH preference, and valve morphology. At the same time, we evaluate the suitability of four commonly used molecular markers, each of which proposed as DNA barcode marker, for species discovery.

Trends in the application of algae in medium to high value markets, with a focus on microalgae

Elien Vulsteke & Johan Albrecht

Ghent University

The last decade was marked by a surging interest in algae, boosting public and private research. The market that has known the strongest increase in algae application is the skincare market. Algae are a unique selling proposition to well-established and newly founded skincare brands, and consumers seem to be prepared to pay a surplus for algae skincare products. In the area of pharmaceuticals algae seem not as interesting as other marine organisms like sponges, which have until now resulted in the production of a few anti-viral drugs. Aside from these few examples, expensive bio-prospecting and lab cultivation difficulties have prevented the exploitation of the large pharmaceutical potential of marine organisms, including algae. The medicinal properties of algae are increasingly explored and acknowledged, as is the potential of microalgae to serve as drug production "factories" for complexly folded proteins. These "factory" microalgae could also find interesting use as oral vaccines.

Algae are sold as an animal feed ingredient to be incorporated as immunostimulants to reduce the excessive use of antibiotics in animal producing industries. In certain cases algae feed ingredients are meant to improve the product quality, e.g. omega-3 eggs with lower cholesterol content. The increased supply of algae on the market has put pressure on its price in recent years and as sufficient algae producers go to the market it will allow a larger scale, lower value application such as feed additives. This trend is also expected for functional ingredients for human food, as more producers of e.g. algae omega-3 oils reach commercialization.

ABSTRACTS OF MANTON PRIZE ORAL PRESENTATIONS

In first author alphabetical order.

Using flow cytometry to enumerate the cyanobacteria *Microcystis* in a lowland British reservoir and the relationship between cell abundance and environmental factors

Ian Chapman, Genoveva Esteban & Daniel Franklin

Bournemouth University

To monitor the temporal variation of *Microcystis* abundance in a British lowland reservoir (Dorset, Southern UK) a novel flow cytometric (Accuri C6) protocol was developed, which assessed the effects of environmental conditions on pelagic *Microcystis* populations. Flow cytometry distinguished cell abundance and variability within the population in terms of autofluorescence and light scattering (size), with environmental parameters recorded simultaneously. Laboratory data on the variability of *Microcystis* phycocyanin fluorescence and cell size in 4 culture strains were used to optimise the field detection of *Microcystis* over an 11 month period (July 2013 – May 2014). *Microcystis* cell numbers peaked during mid-July with 183,552 cells per mL, a peak which was followed by a population crash. A smaller peak in mid-September of 97,547 cells per mL was recorded, again followed by another population decline. *Microcystis* was present throughout the seasons with an average of 45,150 cells per mL in summer, reducing by 51% in autumn and a further 90% by winter. A general linear model revealed that temperature, dissolved oxygen and turbidity (all $p < 0.001$) were the main factors influencing cell abundance. This study provides further insight into the life cycle of *Microcystis* whilst providing a novel approach for high frequency monitoring of populations in the water column. Future studies will incorporate molecular probes with the aim of assessing cell physiological states during periods of environmental change.

Phylogenetic and morphological description of two re-discovered *Olpidiopsis* species, pathogens affecting macroalgae from the Adriatic Sea and Atlantic Ocean.

Kyle Fletcher[1,2], Pieter van West[2] & Frithjof C. Küpper[1].

[1] Oceanlab, University of Aberdeen, [2]Aberdeen Oomycete laboratory, Institute of Medical Sciences, University of Aberdeen.

Within the past ten years two new *Olpidiopsis* species; *O. bostrychiae* (2009) and *O. porphyrae* (2008), both red algal pathogens, have been described and phylogenetically located within the oomycetes. Due to morphological descriptions this assignment was never in doubt however it has recently been proposed that the *Olpidiopsis* genus be reclassified into three genera on the basis of host range. Recently two

"classic" (i.e. described before 1960) *Olpidiopsis* species have been rediscovered; a red algal pathogen, *O. feldmanni* (1952) and a putative brown algal pathogen *O. andreei* (1936), from the Adriatic Sea and Atlantic Ocean respectively. Here we present morphological and phylogenetic data upon these two species, with results indicating that this reclassification of the genus may have been pre-mature. Indeed morphological and molecular data presented here would support the use of zoospore flagellation as a better criterion for reclassifying this genus. The work done on these two species confirms the placement of *O. bostrychiae* as belonging to the genus and we suggest that further sampling of this diverse genus and other closely related genera (i.e. *Pontisma, Sirolpidium*) should be a seen as a priority for future work on oomycete pathogens of algae.

Stress intensifies sexual dimorphism in a long-lived alga

Martyn Kurr & Dr. Andrew Davies

Bangor University

Dioecy has been postulated to have evolved in photoautotrophs so as to permit sexual dimorphism in stressful habitats. By reproducing solely as a male or female, limited resources can be used more efficiently, selfing can be eliminated in densely aggregated populations, and individuals can fill niches unoccupiable by the opposite gender; thus broadening that species' potential to spread within an environment. It is expected therefore, that there should be a positive relationship between the magnitude of any sexual dimorphism and stress. Limited data exists to support the validity of this prediction, and thus far studies have been confined to the terrestrial environment with a primary focus on abiotic stress. Using the marine macroalga *Ascophyllum nodosum* is a model organism, this study incorporates demographic observations, physiological, morphological, biochemical, and behavioural assays to demonstrate a clear pattern of increasing sexual dimorphism with increasing abiotic and biotic stress. These findings are placed in an ecological context by indicating that this dimorphism and subsequent gender-specific trophic level interactions are modified with season, thus highlight the root cause of sexual dimorphism in this species. These findings provide a much-needed insight into how dioecy may have first evolved, and how sexual-dimorphism affords a pronounced degree of ecological plasticity in a simple organism occupying a constricted niche.

The Macroalgae Biorefinery – Laminaria for energy, feed and bioremediation

Mette Møller Nielsen[1], Annette Bruhn[1], Paula Canal Vergés[2], Michael Bo Rasmussen[1], Jens Kjerulf Petersen[2], Xiaoru Hou[3], Jonas Høeg Hansen[3], Dirk Manns[4], Anne Meyer[4] & Anne-Belinda Bjerre[3]

[1]Department of Bioscience, Aarhus University, [2]Danish Shellfish Centre, [3]DanishTechnological Institute – Energy and Climate, [4]Technical University of Denmark, Department of Chemical and Biochemical Engineering

The major challenge in making seaweed cultivation economically feasible in Europe is to reduce production costs and increase the biomass value in order to achieve a positive business case. The Macroalgae Biorefinery – a Danish strategic research project - exhibits a cross-disciplinary approach working on both lines.

Two native species of brown algae, *Laminaria digitata* and *Saccharina latissima*, are cultivated in the Danish embayment, Limfjorden. Mechanization of the handling processes is attempted by implementing existing mussel long-line cultivation technology. Following harvest, new wet pre-treatment processes are tested in order to make the seaweed biomass storage stable, without the resource demanding drying process. The biorefinery approach is initially focused on two products: bioethanol and fish feed.

Since the beginning of the project in 2012, *S. latissima* has been cultivated with an average yield of 1 kg (fresh weight) m^{-1}. Implementation of line mussel technology for deployment and harvest was successful. Further, a number of potential Danish cultivation sites have been tested in terms of production yield and in the perspective of selective breeding, analysis of the genotypic and phenotypic variation between Danish populations has been initiated.

We hope that selective breeding and mechanization

inspired by similar trades will increase yields and reduce costs, while optimized pre-treatments, extraction techniques and fermentation processes, will increase the value of the biomass. All adding to make the ends meet for feasible seaweed cultivation in Europe.

The Macroalgae Biorefinery is a four-year project (2012-2016) financially supported by the Danish National Strategic Research council.

Seaweed biodiversity in the south-western Antarctic Peninsula: Surveying macroalgal community composition in the Adelaide Island / Marguerite Bay region over a 35-year time span

Alexandra Mystikou[1,2,3], Akira F. Peters[4], Aldo O. Asensi[5], Paul Brickle[3], Pieter van West[2], Peter Convey[6] & Frithjof C. Küpper[1,7]

[1]Oceanlab, University of Aberdeen, [2]Aberdeen Oomycete Laboratory, University of Aberdeen, College of Life Sciences and Medicine, Institute of Medical Sciences, [3]South Atlantic Environmental Research Institute, [4]Bezhin Rosko, 40 rue des Pêcheurs, F-29250 Santec, Brittany, France, [5]15 rue Lamblardie, F-75012 Paris, France , [6]British Antarctic Survey, [7]Scottish Association for Marine Science, Oban, Argyll

The diversity of seaweed species of the south-western Antarctic Peninsula region is poorly studied, contrasting with the substantial knowledge available for the northern parts of the Peninsula. However, this is a key region affected by contemporary climate change. Significant consequences of this change include sea ice recession, increased iceberg scouring, and increased inputs of glacial melt water, all of which have major impacts on benthic communities. We present a baseline seaweed species checklist for the southern Adelaide Island and northern Marguerite Bay region, combining data obtained during a small number of surveys completed in 1973-5 and a 6-week intensive diving-based field campaign in 2010-2011. Overall, with a total of 41 macro-algal species recorded (7 brown, 27 red, 6 green, 1 chrysophyte), the region is species-poor compared to the north of the Antarctic Peninsula, and even more so in comparison with the sub-Antarctic. The key canopy-forming species is *Desmarestia menziesii*, which is abundant in Antarctic Peninsula waters, but lacking in the sub-Antarctic. *Himantothallus grandifolius*, which is a common species further north in the Antarctic phytobenthos, was absent in our recent collections. This paper also reports the first record of *Aplanochytrium* sp. (Labyrinthulomycetes) from this part of Antarctica and in association with *Elachista* sp..

Sexual reproduction and life cycle of the recently described *Tovellia aveirensis* (Dinophyceae)

Mariana S. Pandeirada, Sandra C. Craveiro & António J. Calado

University of Aveiro

Tovellia aveirensis (Dinophyceae) was recently described from a tank in Aveiro University campus, Portugal. This species produces resting cysts with a medial constriction and numerous spines that are usually branched at the tip, in contrast with previously described *Tovellia* cysts, which typically possess axial horns and pre- and postcingular protuberances or short spines. Although knowledge of the life cycle of freshwater dinoflagellates is still fragmentary, a comparison point is afforded by von Stosch´s (1973) detailed description of life stages of *T. apiculata*. The life cycle of *T. aveirensis* was studied with cultures established from resting cysts. Asexual reproduction occurred in division cysts. Sexual reproduction soon followed mixing of compatible strains. Fusing pairs were initially connected by a hyaline bridge apparently formed from globular structures associated with the ventral ridge of at least one of the gametes. The resulting planozygote displayed two longitudinal flagella and swam for 1-10 days before either dividing or producing the characteristic resting cyst. Examination of forming cysts showed that spines grew to final size over a few minutes. Resting cysts remained dormant for over a month, rarely germinating shortly after formation. Cyst germination usually resulted in two cells, each with one longitudinal flagellum. Nuclear cyclosis was not observed, although it was searched for in over 30 cysts and in germinated swimming cells. The cyst nucleus moved from the hypocone to the paracingulum area before dividing into two; this is hypothesized to represent the first meiotic division because the resulting nuclei were nearly half the size.

Stress resistance of filamentous conjugating green algae (Zygnematophyceae) from polar regions.

Martina Pichrtová, Tomáš Hájek, Jana Kulichová, Josef Elster, & Andreas Holzinger

Charles University in Prague

Filamentous Zygnematophyceae are typical components of green algal mats in polar hydroterrestrial environment. In such habitats algae are subject to various stresses, e.g. freeze-thaw cycles, desiccation or high irradiation and therefore, special adaptations are expected that enable them to survive in such an extreme environment. In this work we investigated stress resistance of these algae in both field and experimental conditions. Firstly, the isolated strains were characterized by their rbcL sequences, because no sexual reproduction was observed which is needed for morphological species determination. Several different *Zygnema* sp. genotypes were revealed and surprisingly also one *Zygnemopsis* sp. with vegetative *Zygnema* morphology. We found out that at the end of summer the cells gradually lose their typical vegetative appearance with large vacuoles and stellate chloroplast and form mature, stationary-phase-like cells filled with storage material, reduced chloroplast lobes and thick cell walls. Such mature cells are usually called akinetes or pre-akinetes. We showed that the formation of pre-akinetes can be induced by nitrogen starvation. Moreover, if they are hardened by mild dehydration stress, the pre-akinetes become desiccation resistant. Nevertheless, their viability and recovery after desiccation depends on the drying rate. Our results indicate that the pre-akinetes play a key role in the survival in extreme conditions where production of other types of specialized cells (e.g. zygospores) is largely suppressed.

Synthetic Ecology Approaches to Create Effective Mixed Communities for Open Pond Algae Cultivation

David Russo, J. Pandhal, A. Beckerman

University of Sheffield

In 2012, an AB-SIG report identified a wide range of ways in which algae could be converted to biofuels and bioenergy. The routes included cultivation methods and feedstock types and therefore we aimed to gain a better understanding of natural micro-algal blooms. The goal was to gain insights into large-scale production of algal communities for bioenergy as well as helping to understand whether harvesting from the natural environment is a feasible approach for feedstock generation. A metaproteomic platform was developed to uncover microbial community characteristics across an induced bloom. 15 L buckets, inoculated with an environmental sample, were grown in constant light and temperature using a media to imitate freshwater lakes. Measurements of water quality (pH, temperature, DO) and chemistry (micronutrients, NH_4^+, NO_3^-, PO_4^-) were undertaken. Proteins were extracted from cells using an optimised protocol. Proteins and peptides were fractionated using SDS-PAGE and liquid chromatography, respectively, and run on an ion trap and a Q-TOF MS/MS system. The spectra interpreted using Mascot and EasyProt algorithms and proteins functionally clustered using COG. A decrease in nitrate occurred until it dropped below detectable levels after 9 days. DO increased simultaneously. An increase in DOC was observed across the experiment. Temporal analysis of metaproteomic profiles shows high bacterial energy generation (ATP synthase) early and late bloom. Photosynthesis became more prominent mid to late bloom. Nitrogen fixation was only evident late bloom when protein synthesis was also highest. Metaproteomics provides a signature of ecosystem function combined with standard ecology data. The metabolic profiles provide clues for large-scale cultivation of mixed algal-bacterial communities in terms of processes undertaken and organism composition.

An ecosystem approach to seaweed farming

Aimée Walls, Maeve D. Edwards, Louise B. Firth & Mark P. Johnson

Ryan Institute, National University of Ireland, Galway

In recent years, there has been an increase in research of temperate seaweed aquaculture, with the general focus on the production of biomass and composition of harvested material. These studies have not looked at the wider context in developing seaweed aquaculture. Seaweed sites are situated in inshore waters and can transform water quality, may selectively act as habitat for species and change the recruitment of

species to nearby habitats. With this project I plan to bridge the knowledge gaps between the commercial uses and the ecosystem impacts of seaweed farming. This PhD project intends to quantify and relate seaweed farms to ecosystem functions, with four main objectives. 1- An assessment of the habitat value of seaweed farms, 2- The potential role of seaweed farms in integrated multi-trophic aquaculture (IMTA), 3- Assessing the potential impacts of seaweed farms on the local ecosystems, and 4- An economic evaluation of the ecosystem services from seaweed farms. This PhD research will be a very important first step into understanding the effects of temperate seaweed aquaculture on the local environment, and the identification of ecosystem services associated with this commercial activity.

Rock pools as refugia? Do photosynthetic communities negate ocean acidification

Chris Williamson[12], Goss B[2], Lee S[2], Yallop M[1], Brodie J[1], Perkins, R[2]

[1]Natural History Museum London, [2]Cardiff University

An assessment of the carbonate chemistry environment experienced by three calcifying macroalgal species of the genus *Corallina* was undertaken in intertidal rock pools in the southwest UK at Combe Martin and Heybrook Bay over summer and winter daylight and night-time tidal emersion periods, in combination with assessment of their photosynthetic productivity. *Corallina* species are considered particularly vulnerable to the impacts of ocean acidification (OA) given their deposition of high-Mg calcite. However, studies examining the impact of OA on intertidal *Corallina* have incubated species in reduced, yet constant, pH conditions, neglecting natural fluctuations in carbonate chemistry experienced *in-situ* that may buffer the effects of-, and / or confer increased resilience to-, future OA. This study demonstrates that intertidal *Corallina* experience significant and rapid fluctuations in carbonate chemistry over daylight tidal emersion, greater in magnitude and in the opposite direction to changes predicted to result from future OA. Community photosynthetic utilization of pCO_2 and HCO_3^-, driven by ambient solar irradiance, causes rapid increases in pH and CO_3^{2-} saturation. *Corallina* species demonstrate photo-acclimation over daylight emersion periods, though this cannot compensate for inorganic carbon limitation experienced when high irradiances prevail, resulting in decreased productivity. Night-time changes in carbonate chemistry are smaller in magnitude than during daylight emersion, with undersaturation of calcite or aragonite not observed. Data highlight rock pool systems as potentially important refugia for calcifying organisms from the effects of future OA.

Novel strategies for the production of high value compounds in transgenic microalgae

Julie A Z Zedler[1], Doris Gangl[1], Artur Włodarczyk[2], Björn Hamberger[2], Poul Erik Jensen[2], Saul Purton[3] & Colin Robinson[1]

[1]Centre for Molecular Processing, School of Biosciences, University of Kent, [2]Copenhagen Plant Science Centre, Department of Plant and Environmental Sciences, University of Copenhagen, [c]Algal Biotechnology Group, Institute of Structural and Molecular Biology, University College London

The model organism *Chlamydomonas reinhardtii* has been shown to hold significant promise as a novel production platform. Transformation of the nuclear genome is still a non-trivial process due to random gene insertion and frequent silencing. Insertion of transgenes into the chloroplasts is an alternative strategy. Previous studies have mainly focused on the production of recombinant proteins, but not much has been done to investigate the feasibility of high value compound production in microalgae. We aim at introducing metabolic pathways into microalgae to produce high value compounds. In this regard terpenes are of particular interest as they can often not be synthesised chemically due to their complexity. To date, these compounds are often extracted from higher plants at low yields. Producing them in microalgae could be a sustainable and cost-effective alternative. In the cell abundant precursor molecules could be used for light-driven product formation.

In first proof-of-concept studies we have been able to express a large (91 kDa) bifunctional terpene synthase using a recently-developed low-cost transformation protocol. Homoplasmic transformants were obtained with the expressed enzyme accounting for 3.7% of total soluble protein. Furthermore, the CYP79A1 membrane-bound protein in the dhurrin pathway was shown to be active in the chloroplast. These results are promising for establishing *Chlamydomonas* as a “green yeast” in the future.

British Phycological Society
62nd Annual Meeting
ABSTRACTS OF POSTER PRESENTATIONS

In first author alphabetical order. Student posters for Manton prize consideration are identified as such above abstract title.

1. Cryptic genetic diversity correlates with secondary metabolite diversity in Antarctic *Plocamium cartilagineum*

Margaret O. Amsler, Ryan Young, Jacqueline von Salm, Charles D. Amsler, Juan Lopez-Bautista, James B. McClintock, & Bill J. Baker

University of Alabama at Birmingham

Plocamium cartilagineum, a red macroalga common in Antarctic subtidal hard bottom communities, is known to harbor numerous secondary metabolites, particularly halogenated monoterpenes, which act as potent chemical defenses against herbivory. A sympatric grazer, the amphipod *Paradexamine fissicauda,* defies this - readily consuming *P. cartilagineum* and evidently sequestering its defensive metabolites. No-choice and four-way choice bioassays conducted at various times of a single year and between years yielded varied though still significant feeding rates. Subsequently, collections within 3 km of Palmer Station (64° 46'S, 64° 08'W) were made to investigate genetic and secondary metabolite characters of individual *P. cartilagineum*. Three individuals were collected from seven different dive sites. Genetic analysis of *cox*1 genes cladded into two phylogroups and *rbc*L analysis grouped similarly with one exception. Neither gene differed enough to warrant species level-separation. Subsequent GC/MS QqQ analyses revealed five distinct chemogroups strongly correlating to the phylogroup and often to the collection location. Antarctic *Plocamium* may be undergoing cryptic speciation as is seen elsewhere, and its chemical diversity could be either a partial consequence or even a partial driver of this.

2. Investigating total antioxidant capacity in microalgae isolated from Irish aquatic habitats

Lorraine Archer, Dónal Mc Gee, Eoin Gillespie & Nicolas Touzet

Centre for Environmental Research, Sustainability and Innovation; School of Science; Department of Environmental Science; Institute of Technology Sligo.

Microalgae are a heterogeneous and diverse group of microorganisms constituting potential sources of high-value compounds with application in the *nutraceutical,* functional food, animal feed, biofertilisation and biofuel sectors. There has been renewed interest in the last decade in natural sources of antioxidants, particularly as health products and industrial preserving agents.

Microalgae can exhibit adaptive responses to oxidative stress and utilise an antioxidant defence system comprising a range of enzymes (eg. superoxide dismutase or catalase) and non-enzymatic metabolites (eg. ascorbic acid, glutathione or carotenoids). This study aimed at assessing the antioxidant potential of microalgae strains isolated from aquatic habitats in Ireland and successfully brought into culture. First, the genetic characterisation of the microalgae was carried out by means of 28SrRNA gene targeted PCR, sequencing and phylogenetic tree construction. A number of cultures were then grown in nutrient-enriched media in an illuminated incubator to generate biomass. A set amount of biomass (cell biovolume basis) was concentrated from 10-20 microalgae strains and antioxidants were extracted in 50% ethanol. The extracts were then screened for total antioxidant activity using a modified volumetric Trolox-ABTS assay. The threshold limit for the selection of microalgae warranting further investigation was set to 40% inhibition of the $ABTS^{+}$, which was reached for 50% of the strains tested.

Future work will focus on complementing the results with other antioxidant assays (total phenolic compounds and total carotenoids) and growing the most promising strains in scaled up culture vessels so as to investigate the effects of physiological stress on antioxidant capacity.

3. STUDENT POSTER

Preliminary survey of sediment-associated flagellate protists in a mudflat of Ria de Aveiro (NW Portugal)

Inês Silva, José R. Oliveira, Mariana S. Pandeirada & Sandra C. Craveiro, António J. Calado

Department of Biology, University of Aveiro

Ria de Aveiro (NW Portugal) is a coastal lagoon with three main branched channels and associated mudflats, ponds and salt pans. Regular samples were taken from a mudflat near Aveiro University from October 2012 to July 2013 and its community of sediment-dwelling flagellate protists was examined. The area has two tidal cycles per day and an input of freshwater runoff. Sediment-associated water had salinity 14–38 psu, pH 7.5–8.3 and temperature 15.5–23ºC. Samples were collected about 1h after the peak of low tide and processed by two methods: 1) cell migration from spread sediment and 2) washing off with melting seawater. Target species were recorded on video and photographed under light microscopy. Common flagellates belonged to the Dinophyceae and Euglenophyceae, and some are new records for Portugal, e.g., *Amphidiniopsis swedmarkii* and *Togula britannica*. The dinoflagellate community included heterotrophic species such as *Cryptoperidiniopsis brodyi*, a pfiesteriacean whose role in this environment deserves attention. The dinoflagellate group harbouring diatom symbionts was represented by *Kryptoperidinium foliaceum* and *Durinskia baltica*, the latter species resembling those reported from freshwater in this region. The euglenophyte *Euglena viridis* (possibly var. *halophila*), occurred in sufficiently high numbers to colour areas of sandy sediment of green during spring and early summer. *Euglena obtusa*, although not so abundant, was regularly found in finer sediment samples. In addition, the samples regularly contained an assortment of colourless euglenophytes and other flagellates, of which *Metromonas simplex* was the most common. This is the first survey of sediment flagellates in this region.

4. CYANOCOST: an EU COST action for Cyanobacterial bloom and cyanotoxin risk management

Codd, G.A.[1], Blaha, L.[2], Brient, L.[3], Hiskia, A.[4], Kaloudis, T.[5], Meriluoto, J.[6], Quesada, A.[7], Sivonen, K.[8], Svircev, Z.[9]& Visser, P.M.[10]

[1]Stirling University, [2]Masaryk University-RECETOX, [3]University of Rennes , [4]NCSR Demokritos, [5]EYDAP SA, [6]Åbo Akademi, [7]Autononous University of Madrid, [8]University of Helsinki, [9]University of Novi Sad, [10]University of Amsterdam

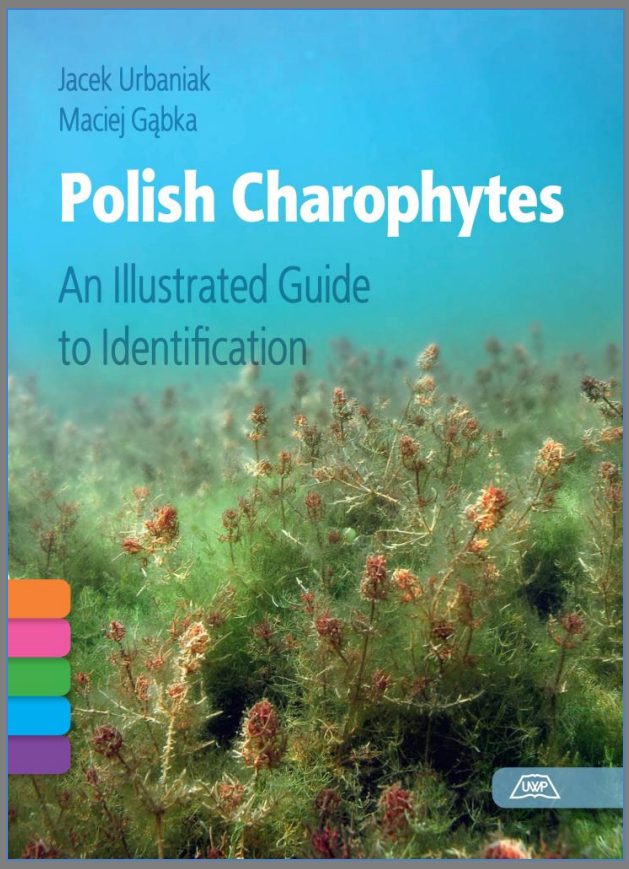
CYANOCOST includes over 100 active participants from 34 countries including throughout Europe and the USA. This EU Action (website: cyanocost.com) runs from 2012 to 2016 and is focussed on the assessment and mitigation of problems presented throughout Europe and beyond by cyanobacteria and cyanotoxins in water resources. Working groups are: (i) collecting data on cyanobacterial mass populations and cyanotoxins in European fresh-, transitional and some coastal waters, plus data on associated impacts on human health, the economy and wider society; (ii) identifying appropriate current and potential methods for cyanobacterial and cyanotoxin monitoring and analysis by phenotypic and molecular biological methods, physico-chemical, immuno- , enzyme- and bioassay methods ; (iii) identifying effective and potential measures for the reduction of cyanobacterial bloom development by in-lake and catchment methods, and for the removal of cyanobacterial cells and cyanotoxins in drinking water treatment processes; (iv) collecting and preparing materials for dissemination to end-users and stakeholders in the water resources and environmental sectors, and for the general public. Sharing and the transfer of best practices throughout the Action are key aims. This is being achieved via short-term scientific visits between laboratories, with methods workshops planned for the second half of the Action. Four handbooks, co-authored from throughout the membership are in preparation: (1) Cyanobacterial monitoring and cyanotoxin analysis; (2) Molecular methods; (3) Prevention, control and mitigation of cyanobacteria in freshwaters; (4) Drinking water treatment and cyanotoxins.

5. Meeting the challenges of the developing the algal biotech sector

John G Day & Michele S Stanley

Scottish Association of Marine Science

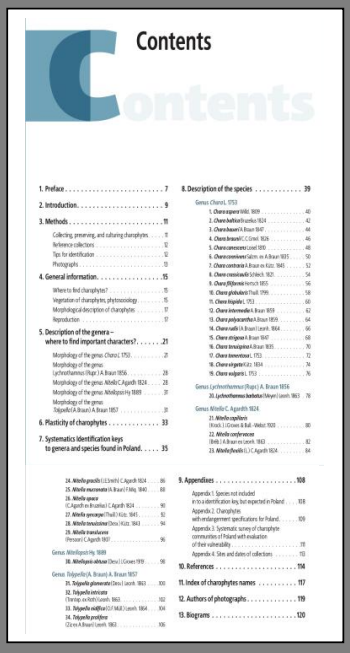
Microbial Biological Resource Centres (BRC's) includ-

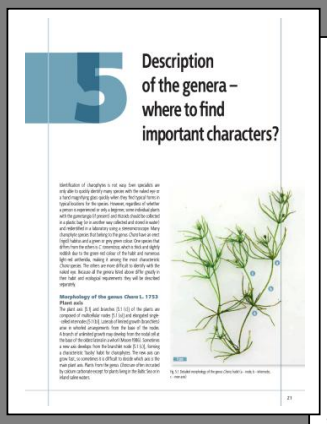


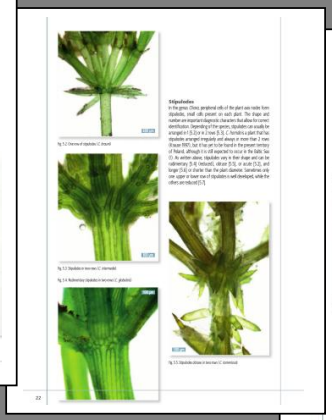
With this book, we want to contribute to the material for the identification of charophyte species, often quite correctly considered difficult to distinguish. This book concentrates on charophytes that can be found in Poland, but it should also be helpful for people from other countries where charophytes can be found.

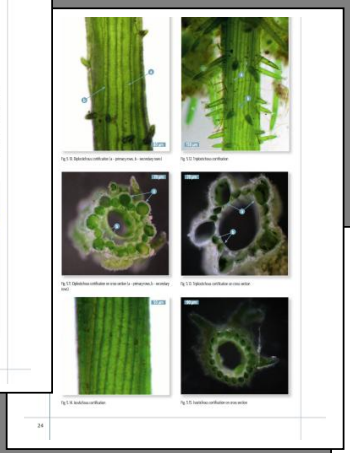
- More than 300 photographs
- Detailed description of morphological features of the species
- New and actual syntaxonomical checklist of charophyte vegetation

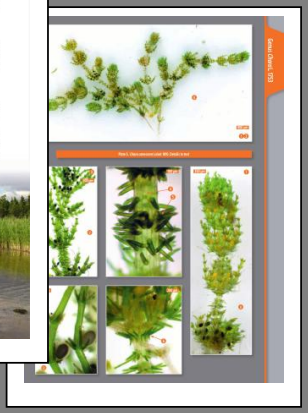
Jacek Urbaniak & Maciej Gąmbka
In Spring 2014











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REMINDER: Sixth Announcement
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John Archibald, Ellen van Donk, Georg Pohnert & Ester Serrao

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algae in stressful environments; algal biodiversity and ecosystem function; algae-microbiome interactions; shedding new light on photosynthesis; global change and algal assemblages; the fate of marine forests; phylogenomics; molecular cell biology; ecology, physiology and taxonomy of freshwater phytoplankton; algal diversity and species delimitation; genetic engineering in algae; algae and signalling; omics and genetic resources; algal lipids; *Symbiodinium* as a model organism

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ing: service collections such as the Culture Collection of Algae and Protozoa (CCAP), academic research collections or those in the biotech sector all serve as reservoirs of microbes, for a diverse range of applications including: research; teaching; as biological, biomedical or ecological toxicological standards; or for commercial exploitation. A crucial objective of all BRC's is to ensure that they use appropriate conservation strategies irrespectively of whether they hold 10 or 10,000 strains, to enable them to supply "fit for purpose" biological resources. In the phycological community this is increasingly relevant as there are ongoing major investments in algal biotech. At SAMS we are currently involved with four major projects: the EU INTERREG project EnAlgae, the SME led FP7 project AT~SEA, the EU KBBE funded SeaBioTech bioprospecting project and the BBSRC -DBT India funded - Sustainable Bioenergy from microalgae: a systems perspective . In all of the above, and for that matter all other comparable projects, guaranteeing consistency of the algal master-cultures is a key challenge for the development of future algal-derived products. Uniquely in biotechnological exploitation of micro-organisms routine serial-transfer of algal cultures is accepted by many practitioners as the optimal method of long-term maintenance. Whilst there is evidence of genotypic and functional stability, there are also examples of deleterious changes including morphological changes and loss of metabolite production. Furthermore, there are risks, not only of loss of a valuable trait, but of mislabelling, or even catastrophic failure of the master stock-cultures. This poster outlines the current status and the challenges ahead for ensuring availability of fit for purpose stock-cultures.

6. From microscope to NGS: A case study of diatom-chytrid pairings

Mélanie Gerphagnon[1,2], Cecilia Rad-Menéndez[2], Télesphore Sime-Ngando[1] & Claire M.M. Gachon[2#]

[1]Laboratoire Microorganismes: Génome et Environnement, [2]Culture Collection of Algae and Protozoa, SAMS, Scottish Marine Institute

Parasitic zoosporic fungi are ecologically significant in various aquatic ecosystems through their roles in controlling host populations, and are a proven link in the trophic food web. The last decade was mainly focused on increasing our knowledge on their previously overlooked diversity, especially in aquatic systems. However, recent advances in next-generation sequencing (NGS) technologies promise to revolutionize the study of these pathogens, by providing a comprehensive view of the genome structure and the unexplored reservoir of novel metabolic pathways. As a model, we are investigating the pairing between the bloom-forming diatom *Asterionella formosa* and a pathogenic chytrid morphologically identified as *Rhizophydium planktonicum*, isolated from Pavin Lake, France. We design an original experimental study, which combines laboratory cultivation with transcriptomics and field experiments. In this way, we are aiming to gain useful knowledge of the ecology (life cycle, host range, infectivity) and the biology (metabolic pathways express during the parasitic and dissemination phase) of the chytrids and their phytoplanktonic host. We present here some data on the life cycle of the chytrid, infectivity of the parasite and its impact on growth of diatom cultures.

7. New records of the green alga *Rosenvingiella constricta* (Setchell & N.L.Gardner) P.C.Silva (Prasiolales, Trebouxiophyceae) from Ireland and Scotland

Svenja Heesch

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

Rosenvingiella constricta (Setchell & N.L.Gardner) P.C.Silva is a filamentous member of the green algal order Prasiolales. Originally described from the North American west coast (type locality: Tomales Bay, Marin Co., California), it is now known from California north to British Columbia, from Kamchatka, Russia, and from Australia (Tasmania) and New Zealand. In the Atlantic, reports are limited to Greenland and northern Europe, where it has until now only been found along the Baltic Sea coast (Kattegat, Gotland), on Helgoland in the German Bight, and inland in Manchester, UK. Two new records of *R. constricta* are presented here, from Scotland (Easdale Island, Argyll & Bute) and Ireland (Inishbofin, Co. Galway). In both locations it occurred in the supralittoral on rocky shores, in a similar habitat to a related marine species, the bladed *Prasiola stipitata* Suhr ex Jessen. These additional records suggest that *R. constricta* could be more common around European coasts than previously thought.

8. Hidden diversity within diatom morphospecies: a case study on *Frustulia saxonica* species complex.

Jana Kulichová, Pavla Urbánková & Vojtěch Scharfen

Charles University in Prague

The most commonly reported *Frustulia* taxa worldwide are the morphospecies *F. saxonica* and *F. crassinervia*; both are characteristic members of phytobenthos in acid, peaty waters (such as *Sphagnum* bogs). We sampled diverse localities in Europe, North America, and New Zealand to obtain monoclonal cultures in order to i) analyse the phylogenetic structure at the sampling sites, ii) describe the distribution patterns and ecology of the lineages. Our results showed that morphological features used to distinguish traditional species *F. saxonica* and *F. crassinervia* occurred across several molecular phylogenetic lineages. Closely related *Frustulia* lineages had restricted, scattered or wide distributions. We suggest that differences in sequence frequencies of lineages between samples and regions can be explained by specific environmental requirements and/or by dispersal constraints.

9. Ecological response to restorative intervention (Phoslock®) in Loch Flemington: a nudge in the right direction?

Pauline Lang[1], Lenka Procházková[2], Sebastian Meis[3], Bryan M. Spears[3], Jan Krokowski[1], Ian Milne[1] & John Pottie[4]

[1]Scottish Environment Protection Agency, [2]Charles University [3]Centre for Ecology and Hydrology, [4]Broombank, Loch Flemington, U.K.

Loch Flemington located in Nairnshire, Scotland, is a shallow waterbody which has suffered a long-standing history of potentially toxic cyanobacteria blooms associated with high phosphorus concentrations and resulted in a catastrophic fish kill in the 1990s. To address these issues, in March 2010, the phosphorus-binding agent, Phoslock®, was applied to Loch Flemington with the objective of improving water quality conditions. SEPA holds stakeholder interest in the ecological recovery of Loch Flemington and, in collaboration with CEH supports a citizen's science monitoring scheme. This paper reports on phytoplankton community composition changes following treatment in the context of metrics designed for meeting EU Water Framework Directive targets, and a desired reduction in the public health risk related to blue-green algae.

10. Phytoplankton species new to UK freshwaters: fascinating discoveries made from Scottish lochs

Pauline Lang & Jan Krokowski

Ecology Assessment Unit, SEPA

Freshwater phytoplankton communities are important indicators of the biointegrity of standing waters; used by the Scottish Environment Protection Agency (SEPA) to assess the ecological status of freshwater lochs in Scotland, under the EU Water Framework Directive. This work describes classification results from SEPA monitored lochs and the discovery of a number of fascinating phytoplankton species, found during routine analysis, which are completely new to the British algal flora. These findings contribute to knowledge of UK freshwater biodiversity and species distribution from a European perspective.

11. STUDENT POSTER

Bio-prospecting the water bodies of the west coast of Ireland for high value carotenoids extracted from microalgae.

Dónal Mc Gee, Lorraine Archer, Eoin Gillespie & Nicolas Touzet

Sligo Institute of Technology

The biodiversity of microalgae and their potential for mass cultivation in closed-system photobioreactors has fostered the rapid development of their biorefinery for high-value biotechnological products. In this study, microalgae strains isolated from water bodies of the west coast of Ireland were successfully brought into culture and screened for high value carotenoid pigments. Due to their antioxidant properties, carotenoids have wide applications as functional foods and as biopharmaceutical adjuvants for the treatment of

chronic inflammation, diabetes, cancer, age related muscular degeneration or cardiovascular disease.

Pigment extraction and optimisation of the HPLC UV-DAD separation were conducted to 1) solubilise pigments from microalgal wet biomass, 2) verify their compatibility with the chromatographic set up and 3) reduce analysis time. Microalgae strains representing different phylogenetic groups were selected for a preliminary screening trial to identify the presence of pigments, including lutein, zeaxanthin, astaxanthin, fucoxanthin and α/β-carotenes. Pigments were identified using retention times and UV-vis spectral fine structure compared to a mixture of pigment standards.

Pigments were sufficiently extracted for selected cultures with minimal solvent fronting. A biovolume of culture generating a satisfactory chromatographic signal:noise ratio was determined for routine screening of the culture collection. The chromatographic separation method proposed by Van Heukelem *et al*. (1992) yielded sharp pigment peaks and the gradient profile reduced the analysis time from 60 min to 20 min.

Future work will focus on quantification aspects and identification of water soluble fluorescent pigments so the most promising strains can be selected for further analysis and scaled up in pilot photobioreactors.

12. STUDENT POSTER

Assessing The Structural Integrity of Coralline Algae

Leanne A Melbourne, Julia Griffin, Daniela N Schmidt & Emily J Rayfield

Bristol University

Coralline algae are important habitat formers on the UK shelf. While the impact of ocean acidification on the physiological performance of the species has been well studied, little research has focussed in on the effect on their structural integrity. Using the engineering technique of Finite Element Analysis (FEA), previous research employing 2D FE-models has suggested increased vulnerability to fracture (e.g. wave action) in algae grown under high CO_2 conditions (Ragazzola et al. 2012). Here we develop a set of 3D geometric FE-models that represent coralline algae growth and compare how well these represent the structural performance of a biologically accurate 3D FE-model.

3D models were created in Abaqus FE-modelling software using measurements derived from natural specimens of *Lithothamnion glaciale* and compared to one created from computed tomography (CT) scan data of a real specimen. All models were loaded with a pressure comparable to wave action and stress and strain in response to this load was computed by the model.

The biological model and an individual cell (compartmentalised) geometric model had similar average stresses and stress distributions due to the extra cell walls aiding in dissipating the stress throughout the structure, whereas the model with seasonal variation overestimated these average stresses. This compartmentalised model was then used to recreate Ragazzola's (2012) structural integrity tests. Results reiterated that changes in geometry in response to climate change have the potential to affect the structural integrity of the organism, however this altered structure is more stable than Ragazzola's 2D model implied.

13. Pyrolysis of Invasive Seaweed Species

John J Milledge, Alan Staple & Patricia Harvey

University of Greenwich

Japanese wireweed, *Sargassum muticum* is an invasive species to Great Britain that is causing problems in certain areas of the Kent coast. The destruction of this seaweed is currently carried out at considerable financial and energy cost. Pyrolysis is the thermal decomposition of the organic components of dry biomass by heating in the absence of air. The distribution between solid, liquid and syngas depends on the biomass and the pyrolysis temperature and time. Slow pyrolysis with lower temperatures (~ 400^{o} C) tends to produce more solid char. The char from the pyrolysis can be an effective soil ameliorant, a sequestration agent due to its stability or burned as a fuel.

The research attempts to answer the question: Could slow pyrolysis be an energy efficient means for the destruction of Japanese wireweed and produce a potential product, biochar? A simple test rig was developed to establish the yield of biochar, biocrude and syngas from the slow pyrolysis of *Sargassum*

muticum. An energy balance was calculated using compositional data from the analysis of the seaweed feedstock, higher heating values (HHV) from bomb-calorimetry and literature values.

The energy required to heat 1 kg of dry seaweed by 400° C for slow pyrolysis was estimated at 0.5 MJ. The HHV of syngas and biocrude produced from the pyrolysis totalled 2.9 MJ. There is, therefore, sufficient energy in the biocrude and syngas fractions produced by the pyrolysis of seaweed to power the process and produce useful biochar, but insufficient energy for drying.

14. Biogenic weathering of heritage calcareous building stone due to colonisation by subaerial algal assemblages

L. Morrison[1], E. P. Lynch[1,2], F. Rindi[3] & M. D. Guiry[4]

[1]Department of Earth and Ocean Sciences and [2]School of Natural Sciences, National University of Ireland, Galway, [3]Dipartimento di Scienze della Vita e dell'Ambiente

Università Politecnica delle Marche, [4]Ryan Institute, National University of Ireland, Galway, Ireland

Orange, red and pink patinas dominated by the filamentous green alga *Trentepohlia umbrina* (Kützing) Bornet are common features of limestone buildings in Galway City, Ireland, the presence of *Trentepohlia* tending to coincide with enhanced damage and deterioration of the limestone surface. Samples of the algae on fragments of limestone were collected from two heritage limestone buildings in the city: the 19th-century Quadrangle Building, NUIG and the 14th-century Collegiate Church of St. Nicholas. The patinas have been analysed and characterised by Raman Spectroscopy, Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectrometry and image-processing stereophotogrammetry. This facilitated a microstructural and morphological characterisation of the growths and their effects on the limestone. The combined application of SEM and stereomicroscopic techniques has allowed the first ever 3-D reconstruction of the surface of the *Trentepohlia*-dominated patina, enabling the investigation of topographical features (texture and structure). The formation of these *Trentepohlia* assemblages gives rise to aesthetic changes and microstructural alterations in the building-stone surface.

15. An Individual-Based Approach to Modelling Invasive *Undaria pinnatifida*

James T. Murphy[1,2], Mark P. Johnson[1] & Frédérique Viard[2]

[1]Ryan Institute, National University of Ireland, Galway, [2]Station Biologique de Roscoff

Alien seaweeds represent one of the largest groups of marine aliens in Europe, and constitute between 20 and 29% of all alien marine species. They are major primary producers in coastal areas, and large-scale substitution of dominant native seaweeds with alien species will consequently alter coastal productivity and food web structure, and therefore impact ecosystem services. In this study, an agent-based modelling approach is taken, in association with data already gathered by the host institution from field studies, ecological experiments and molecular work, to study the impact of the Asian kelp seaweed *U. pinnatifida* (an emblematic invader in the English Channel) on native biodiversity under variable climatic conditions. In order to achieve this we have developed a generic individual-based model of coastal ecosystems for investigating the underlying mechanistic basis for ecological features and invasive potential of this species. Our model framework can be used to explicitly represent complex spatial and temporal patterns of invasion in order to be able to predict quantitatively the impact of these factors on invasion dynamics of *U. pinnatifida*. This would be a useful tool for making accurate risk assessments of invasive potential under different environmental conditions and for choosing optimal management strategies in order to minimise future control costs.

16. Biomass from brine: growing algae on nitrate-rich wastewater

Brenda Parker, Ross Dennis, Alexandra Jamieson, Steve Skill, Alison Smith, Beatrix Schlarb-Ridley & Matthew Davey

InCrops, University of Cambridge

Elevated levels of nitrate in water abstracted from

boreholes has led the water industry to take action by installing anion exchange systems. The waste by-product from column regeneration is a brine wash with high concentrations of nitrate. This study looks at the potential for brine wash to support algal growth, generating biomass and remediating a waste stream. The feasibility of this process was tested in batch mode with a range of marine microalgae:

Laboratory studies:

F/2 media was prepared, with brine wash substituting for nitrate at various concentrations. The growth of *Phaeodactylum tricornutum*, and *Tetraselmis suecia* was measured.

Initial results show that *Phaeodactylum and Tetraselmis* could tolerate levels of nitrate 5 fold higher than that of f/2A further acclimation study showed that *Phaeodactylum* could tolerate nitrate concentrations at 30 fold higher than f/2 with little change in growth rate.

Small scale outdoor growth studies

No significant difference for the addition of CO_2 versus non CO_2 was observed for biomass production of *Phaeodactylum and Tetraselmis* in winter months.

Large scale PBR work

Brine wash was used as a direct source of nitrate in a 100L PBR containing *Phaeodactlyum.* The growth of *Phaeodactlyum* in the brine reactor was comparable to the growth in standard f/2.

17. STUDENT POSTER

Green cushions: prostrate *Codium* species in New Zealand

Néstor M. Robinson, Judy Sutherland, Wendy Nelson & Rafael Riosmena-Rodríguez.

University of Baja California Sur

Despite the occurrence of the alien species *Codium fragile* spp. *fragile* in New Zealand coastal waters, other New Zealand species from this genus remain unstudied with molecular methods. In this study, we investigated relationships of the prostrate forms of this genus in New Zealand, using the *tuf*a and *rbc*L markers, and morpho-anatomical characters. Based on the data obtained in this study, five *Codium* prostrate species were recognized in New Zealand. Clades defined by molecular markers were consistent with variation in morpho-anatomical characters. Although clades which appear to represent different species are clearly differentiated in our analysis, the correct application of names is not always clear. For instance *Codium cranwelliae* can be identified as a taxonomic unit, but specimens that had been identified using morphological features as *Codum dimorphum* were resolved in two different clades. In order to resolve such taxonomic problems DNA of type specimens for these species will be required. We also obtained sequence data for the endemic, branched *C. gracile* in New Zealand. Regarding the distribution of the *Codium* prostrate species in New Zealand, we have observed a strong influence of Sea Surface Temperature (SST) on the distribution of species; excluding a widespread species (*Codium* sp. 1) in New Zealand, other *Codium* prostrate species as *C. cranwelliae, Codium* sp. 2 and *Codium* sp. 3 occur at northern New Zeland (warm-temperate region) whereas *C. dimorphum* occurs exclusively in the southern region (cold temperate waters).

18. Influence of substrate and pH on diversity of aeroterrestrial alga *Klebsormidium*

David Rysanek, Holzineger, A. & Škaloud, P.

Faculty of science, Botany depart, Charles University in Prague

Estimate of protist diversity has become a highly controversial topic during the last 10 years. Huge protist diversity could be caused by limited distribution and/or by different preference of habitats, but in the case of aeroterrestrial alga *Klebsormidium* the diversity is not influenced by limited distribution, but mainly by habitat preferences. In our study, we collected 100 strains from sandstone, basalt, granite, and limestone, sampling 2-3 localities per substrate. The sequences yielded a total of 27 genotypes having strict habitat preferences on substrate. To investigate the ecophysiological differences among the strains isolated from sandstone and limestone, we have chosen 12 strains from four different genotypes growing on these habitats. We measured grow of alga in a pH gradient (4, 5, 6, 7, and 8) by two different methods. First, we used PAM fluorometer for measuring the activity of photosystem II; second we directly counted the cells inoculated on agar plates. Our results show that all strains are able to grow over the whole range of pH, but with different reactivity. All strains from limestone grew best in pH 7-8, but in pH 4-5 they grew very slowly. Sandstone strains exhibited two different

growth responses. Strains from the first investigated genotype grew best in pH 6, whereas the remaining strains grew almost similarly in all pH values. Our results thus not only demonstrate a strong ecological differentiation of *Klebsormidium* clades, but also point to the existence of ecophysiological differences among the particular genotypes, even growing on the same habitats.

19. STUDENT POSTER

Advective transport of harmful algae blooms

Beatrix Siemering, Mark Inall, Eileen Bresnan & Keith Davidson

Scottish Association of Marine Science

The dinoflagellate *Karenia mikimotoi* is commonly found on the West Scottish coast in low density. However, in some years, *K. mikimotoi* forms harmful high density blooms that can cause mortalities of farmed finfish. These blooms are thought to develop offshore and be transported by water movements towards the coast. The aim of this project is therefore to provide a fuller understanding of the distribution of harmful species around Scotland and the role of advective transport of harmful blooms to coastal sites. Data from literature, laboratory studies and field sampling will be collected and combined with bio-physical models to test hypotheses about bloom formation and transport. Determining key factors leading to onshore bloom formation might support the prediction of future events and reduce damage to aquaculture sites.

20. An enigmatic new *Dasya* species (Rhodophyta, Ceramiales) from southwest Norway

Kjersti Sjøtun, Erling Heggøy, Tove M. Gabrielsen & Jan Rueness

Department of Biology University of Bergen

A new *Dasya* has been found in a landlocked fjord (poll) in southwestern Norway. The alga is small (1-3 cm) and sparsely branched, and axes are completely covered with cortex cells. It is set with long (3-4 mm) and flaccid pseudolaterals, and during autumn it showed high growth of adventitious monosiphonous branches. Only a few individuals with tetrasporangia were recorded, and no sexual reproductive structures were observed. Culture studies showed that individuals developed stichidia with four rows of tetrasporangia on the pseudolaterals. The spores showed high mortality and a few which survived did not develop normally. After two years in culture a few male plants have developed. The recruitment of the new *Dasya* is thus completely dependent on vegetative reproduction through fragmentation. A comparison of its morphological characters with those of other *Dasya* species was carried out, but without finding a fit. Sequences of COI and *rbc*L were obtained, and a comparison with available sequences of members of Dasyaceae showed that it belonged to the subfamily Dasyoideae. However, it did not show any close relationship with other *Dasya* species, included European ones with available sequences.

21. STUDENT POSTER

Single-locus species delimitation in the diatom genus *Frustulia*

Pavla Urbánková, Jana Kulichová, & Vojtěch Scharfen

Charles University in Prague

Considerable part of diatom diversity is still unknown and many traditional species are in need of a taxonomic revision. Molecular methods proved to be a powerful tool for species discovery. Nowadays, single-locus data are easy and inexpensive to obtain. Therefore, even though there are problems connected with the use of single-locus data for evolutionary inference, they are frequently used for species delimitation. One of the commonly used approaches for species delimitation based on single-locus data is Generalized Mixed Yules Coalscent (GMYC). GMYC was repeatedly used in metazoan groups, but its validations for protists are scarce.

We examined performance of the GMYC approach on the diatom genus *Frustulia*. Strains in our analysis were morphologically diverse and originated from freshwater samples that were collected worldwide. Entities delimited by the GMYC were cross-checked with the morphology and the geographical origin of isolates in order to evaluate the performance of this method.

BPS Reminiscences!

The British Phycological Society and me

Christine Maggs, BPS President

As inspiration to write this, I was reading Juliet Brodie's musings on the 60th anniversary of the BPS. Juliet noted the birds and the snowdrops as she wrote – and today there are frogs singing and spawn swelling. It must the season for presidential reminiscences.

My love affair with plants started soon after I was born. Mum parked my pram under the trees while she was seeing her patients, because I liked trees. Dad said that if he had had to read Flower Fairies of the Spring to me one more time, he would have screamed! But it was OK – I graduated to the Ladybird book of Flowers, and then to the Collins Guide (helpfully colour coded).

Seaweeds were the focus during summers spent at Hayling Island on the south coast of England. Later I found out that around this time my grandfather, an antiquarian bookseller, purchased a copy of Stackhouse's (1801) Nereis Britannica and gave it to my father (obviously my destiny was set and it was really mine!). There was no suitable guide to seaweeds so I spread my collections out on the beach and they remained mostly nameless. (Many years later, thanks to Francis and Ann Bunker, there is a photographic Seasearch guide to seaweeds that children can use, as well as amateurs.)

For undergraduate botanists at Oxford, seaweed was not included in the curriculum, but some friends and I from the diving club went on a diving expedition in 1977 to Cabo Frio, RJ, Brazil, where I met my first real phycologist. Dr Yocie Yonishigue-Braga had published her PhD on the seaweeds of Rio de Janeiro province, and was very generous in helping me identify my samples. I was delighted to meet up with Yocie recently in Rio, and to thank her for her early mentorship.

Having obtained my life-changing BA (2.2) from Oxford, I was unable to start the planned PhD on kelp ecology with Joana Kain. Instead, I became a diving botanist with Keith Hiscock in Orielton, Wales. Times were different then: Mum came into the interview with me, and asked Dr Brian Dix to confirm that although I was replacing two women on maternity (Sue Hiscock/Scott and Nettie Little) that pregnancy was not the inevitable outcome for all female staff hired at Orielton! While working for Keith, I found my first new species, *Schmitzia hiscockiana*, and I was put in touch with Mike Guiry in Galway. Mike didn't care about my 2.2, and he offered me a PhD studying maerl, which I accepted of course.

Mike told all his students to join the phycological societies, and we did. We attended the BPS meetings, as many PSA meetings as possible, and I was privileged to attend the first International Phycological Congress in Newfoundland (kiss the cod!). I went back to Canada for two years' postdoc with Jack McLachlan and Carolyn Bird then returned to Ireland, got married, with Max Hommersand

Chris and Mike in 1982 at the 1st International Phycological Congress in Newfoundland, Canada

wrote the Ceramiales volume of the Seaweeds of the British Isles, obtained a NERC Advanced Fellowship studying invasive seaweeds, and finally got a lectureship at Queen's University Belfast and had a baby. As I couldn't do all-nighters in the lab any more, I took up editing and was Editor-in-Chief of the European Journal of Phycology (EJP) for a decade (some of the time sharing the role with Matt Dring), and have recently resumed this role, alongside Juliet Brodie.

Algal research is now big business, whether it's growing biofuels, marine aquaculture, harvesting seaweeds for industrial extracts, or prospecting novel bioactives. Obviously this is good for all of us. There's still plenty of opportunity for pure research into cell biology, systematics, biogeography, etc. The BPS and EJP have remained relevant throughout these last decades of expanding algal exploitation, though we must also recognize the roles of more specialised societies and journals.

Gill (in the accompanying piece) wonders about the continuing use of the confusing term phycology. My main concern for the future is how the academic publishing industry will fare. The Society's income is heavily dependent on the Journal (we have an excellent contract with Taylor & Francis, who have supported us strongly), but this will be challenged by developments such as Open Access publishing requirements (the HEFCE green model is particularly unpleasant), nearly instantaneous publication by journals that don't edit manuscripts, and the emphasis on Impact Factor over quality and longevity.

Moving BPS onward and upward: it's time to tell us what you want!

Dr Gill Malin,
BPS President-Elect

I was introduced to the wonders of microalgae and seaweeds as a Biology undergraduate at the University of Liverpool. We did a 2nd year course in Marine and Freshwater Algology and a memorable field course on the varied rocky shores of the Isle of Man with George Russell as our inspiring and enthusiastic teacher. While the reds, greens and browns were fun to work with, despite the horizontal rain, the small stuff perhaps captured my imagination the most. In my 3rd year I chose the botany degree with a specialisation in algology and a dissertation project on the physiological effects of desiccation on cyanobacteria.

I completed my BSc in Botany and I think I joined BPS soon after I started my PhD, but my memory is a bit hazy on that. I'm pretty sure I gave my first talk at a BPS meeting and another talk I gave as a postdoc at a BPS winter meeting in Norwich led me to the job I do today. As a PhD student, I clearly recall staring at the growing band of BPS journal issues on the bookshelf above my computer-free laboratory 'desk' as I thought through experimental plans and sought inspiration for writing my thesis. Never in my wildest dreams did I think that one day I would be BPS President elect.

Today more information than you could ever use is a mouse click away and visits to the library are increasingly rare. We all sit at a computer far too long on an almost daily basis and every lab instrument seems to require a computer and fancy software, whereas it sometimes feels like real thinking time is a luxury. Finding a university where you could study for a degree in Botany and specialise in algology would be a challenge indeed. Type phycology into an internet search and up pings 'not to be confused with psychology' – so annoying - it's clearly not a familiar term for the layman! Also there are many amongst the scientific and commercial communities working on algae, or using them as tools, who would never refer to themselves as phycologists. Panic not, I am not suggesting that BPS changes its name – bring that up at a BPS Council meeting and it could certainly be a 'light blue touch paper and retire' moment! How much does the name really matter, isn't it rather what you do with it?

The landscape of phycology has changed radically since BPS was established as an academic society in the early 1950s. Obviously our world has changed too. The period since

1950 is that where clear indicators for shifts in the state and functioning of the Earth System due to human activities have become increasingly clear. The so-called 'human imprint' affects the freshwater, open sea, ocean, coastal zone and other damp ecosystems that algae need to thrive. Many professional and amateur phycologists focus on one or more of these environments and the BPS already has a long-standing and very active Biodiversity and Conservation Committee. Making our world far more sustainable is critical and to address the urgent challenges we must also explore the use of algae for bioremediation, carbon sequestration, production of fertilisers, food, food supplements and additives, animal feed and supplements, for feedstocks for industry and renewable energy etc. I probably missed a few, the list is long. BPS has a role educating school children and the public and the next generation of academic and commercial phycologists, irrespective of whether they use the word phycology in describing what they do.

We celebrated the 60th anniversary of the BPS in 2012 and with Paul Hayes in the President's 'seat' BPS Council looked back at what had been achieved and discussed the ongoing process of shaping the future of the BPS. We all agreed that there are aspects of phycology that we do not represent well and felt it was important to be proactive. We decided to set up 3 fixed term groups: Algal Applications to consider business and commercial considerations, Research and Awards to discuss the role of the BPS in promoting algal based research and Publications to discuss the *European Phycological Journal*, *The Phycologist* and alternative forms of publication. In the last 3 years, all of these groups have done good work that we will be letting you all know about in more detail in the coming months.

What can the BPS membership do and what can BPS Council do for you? First of all tell everyone about algae and what phycology is – literally spread the word. Encourage your friends, family, colleagues, students, postdocs, people in the street to join or continue their membership in the BPS. Finally, let the BPS Council know what you want from the society. Your ideas are always most welcome, but I am conscious that we don't ask as often as we should.

A bright phuture

Professor Charles Amsler, Vice President Overseas

In a sense I suppose that I ultimately became a phycologist by negligence, although the negligence didn't cause it, it just opened the avenue towards that end. About half way through the pre-fall semester "freshman week" as a soon to be undergraduate I heard other "frosh" talking about their meetings with their advisors and eventually I asked how they knew about those. The perplexed response was that it was in the envelope of information we'd been given at the beginning of the week. I hadn't realized that there was anything in there of importance so with all the other exciting activities of being a new college student I hadn't gotten around to opening that yet.

My negligence in missing the meeting with my freshman advisor got me a meeting not long after with the Dean of Freshman. I don't recall how the appointment was set up, but am pretty sure it wasn't something I could have missed by not opening a manila envelope with my name on it. The only things I recall about the conversation were that she put me at ease right away and that we talked about my coming to Duke because of my desire to become a marine biologist and how impressed I was by the undergraduate opportunities to study at the Duke Marine Lab. She told me that because of that interest I needed to see Dr. Richard Searles in the Botany Department and that I should consider being an interdepartmental Botany-Zoology major so that I could have him as my long term academic advisor.

I did, and as part of setting up my interdepartmental major I scheduled taking Invertebrate Zoology and Marine Phycology at the Marine Lab in the summer between my sophomore and junior years. To me at that point "marine biology" meant "invertebrate zoology" which is why I wasn't interested in being a straight botany major. But Dr. Searles seemed like a really great advisor and I wanted to take his phycology course too.

In reading back through the BPS founders' and later officers' descriptions of the early days of the BPS that were written for The Phycologist on the 60th anniversary of the Society, one cannot miss the emphasis that while there were some men around, the driving forces in establishing the Society were from women. My introduction to phycology in Rick Searles' course mirrored that. It was a transformative experience for me, and one dominated by women. One of my classmates, Nancy White, reminisced about it in her blog (http://www.fullcirc.com/weblog/2007/05/1978-algae-and-old-connections_19.htm) as such:

> "I had a flash from my past yesterday when I got an email from … one of my classmates in a Marine Phycology course at the Duke Marine Lab in 1978, taught by Rick Searles. Chuck was tracking down members of the class to try and reconstruct a poem we wrote to Dr. Searles at the end of the course to share at a 50th Anniversary party for Rick and his wife, Georgie… The culmination of the summer school experience

required poetry. It was one of those times where the people, the learning and work, the setting, and the leadership all converged to create an amazing experience that was seared into our memories. We were in love with the algae, staying to work and play in the lab until late at night. We had a persistent inclination to tear-inducing laughter. We sang in the lab. We were, I think, 11 women and 2 men and the women were powerful, funny and a force to be reckoned with. Chuck was a real mensch to thrive in that pool of estrogen."

Powerful as all those wonderful women in the phycology course were, and as much as I cherish that algal-immersive experience, there was also this cute blond woman taking an invertebrate embryology course the same summer term. She saw me carrying scuba tanks across the dorm parking lot and (easily) convinced me to take her diving. One thing led to another. I've often said that for whatever reason, in that one summer term I was at a point in my life I was ready to make long term commitments. I've been with phycology and Maggie O'Leary Amsler ever since.

Fast-forwarding a few years to what became the last year of my postdoc, there was a faculty opening for a Phycologist at the University of Alabama at Birmingham advertised in the back of Science, and they wanted a phycologist who could also teach microbiology. My postdoc had been in a microbiology lab working on chemotaxis in E. coli while learning techniques I intended to (and ultimately did) apply to algae. Several friends in my phycological cohort told me that they saw the ad and thought "that's Chuck" and I must admit that my jaw easily could have left a bruise on my chest when I saw it. Nearly 21 years after taking the job, I'm still happily at UAB.

While there were lots of jobs I was qualified for and applied for when I was on the faculty job market, I only recall a couple other ads for a "phycologist" per se. Although I stopped reading Science from the back when I got my job, I have not heard of one since. That is one major change between the generation before me and the one after me. I believe I was in the later part of the transition between them. Yet I still have no shortage of students who want to work in phycology with me (Antarctica helps a lot) including a lot of powerful young women. And while academic jobs are scarce all around, phycology students of mine and my colleagues who want academic positions rather than one of the multiple other career tracks they can take don't seem to have any greater problem finding such jobs than those of my colleagues in other fields. The difference is that the jobs are advertised for the kind of research question rather than the research organism.

While I occasionally hear some phycologists lament that, I don't think it is a bad thing at all. I recall being at a faculty job seminar as a MS student and having the candidate start off showing a slide of the animal she was working on and saying that every good biology research project starts with an organism. One of the faculty later told me that had been a telling mistake because every good biology research project starts with a question. There are an unlimited number of great questions that algae are perfect for. And there are a lot of important questions necessary to understand algae as a critically important group of organisms. My department at UAB just hired a new Assistant Professor who works on cyanobacteria and sees his "home" professional society as PSA. We hired him because he asks really cool and important questions. It surprises me not at all that he asks them as a phycologist. To my eyes, the phuture is bright.

Confusion between phycology and psychology

Jane Pottas, BPS Secretary

In my role as BPS Secretary I receive a number of emails asking for information or advice. I often contact BPS members or Council members and forward emails to them so that they can correspond directly. On occasion I have to make up for the shortcomings of Google. Here are two examples of what I mean, one amusing, the other not.

Good morning Dr Pottas,

I am currently studying on the Army's Intermediate Command and Staff Course. ICSC is a 9 month course to prepare Army Officers for the rank of Major. Part of the course is to present for 20 minutes on a particular leader from history. I am studying Goring, a complex character to say the least.

I was hoping you might be able to put me in contact with a psychiatrist who could give an opinion on aspects of Goring's character, free of charge, from information I give them.

Thanks for your assistance and I look forward to hearing from you.

Yours etc.

I replied

Dear xxx

Your search for the British Psychological Society has been foiled by Google (as happens quite often). I am the Secretary of the British Phycological Society and we study algae - specifically seaweed in my case. I'm not aware that Goring had any interest in seaweed!

Good luck with your research and beware of Google!

Best wishes etc

My correspondent emailed back, "Very amusing! Thanks very much."

The second example was not at all funny.

Hello

My husband, who is only 48, has two types of dementia. We have seen two specialists. The first made the diagnosis and arranged medication; the second said he would need a phycologist. We are confused - does he need a specialist phycologist as he didn't have this before.

I replied

Dear xxx,

I am sorry to hear about the distressing circumstances you find yourself in. I am the secretary of the British Phycological Society - we study algae, e.g. seaweed, so I suspect that a search on Google has led you to the wrong BPS which is a common mistake.

This is the link to the British Psychological Society

http://www.bps.org.uk/

You will see that on the Quicklinks menu on the left side of the home page there is a link for Find a Psychologist. Other details for the British Psychological Society are .... etc.

I wonder if psychologists are approached for advice and information about diatoms or seaweed. I suspect not.

62nd BPS meeting in Galway, July 2014

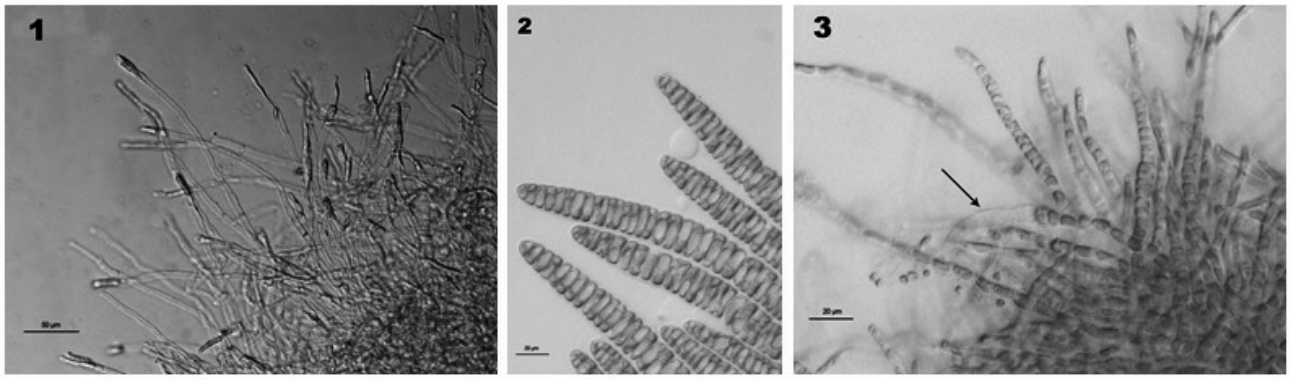
For the second year in a row the British Phycological Society Annual Meeting was held in July, with an excellent organisation and strong attendance. This year the BPS meeting took place in Galway, Ireland and I would consider it as successful as the previous one that I had the chance to attend in Belfast in July 2013. I am entering the third and last year of my Ph.D. (University of Aberdeen) and the BPS annual meetings so far have been the highlights for presenting my research progress.

I would like to thank the British Phycological Society for another very well organised meeting in July 2014 in Galway and for the bursary that awarded me in order to attend once again the annual meeting. All of the presentations were very interesting and motivating and the Irene Manton Prize oral and poster presentations very well prepared and stimulating. My talk was about the seaweed biodiversity in the south-western Antarctic Peninsula and I presented a baseline seaweed survey for the southern Adelaide Island and northern Marguerite Bay region, with a total of 41 macroalgal species recorded.

I really enjoyed the interaction with other phycologists and especially the fruitful discussions after the sessions. I was glad to meet again colleagues from around UK and get the most recent updates of their work. At this point I should mention that the British Phycological Society encourages young phycologists to present their research to the phycological community and to get useful feedback. This is how it worked for me, as the work that I had presented, "Seaweed biodiversity in the south-western Antarctic Peninsula: surveying macroalgal community composition in the Adelaide Island/Marguerite Bay region over a 35-year time span", is now in press in the journal Polar Biology. I am very glad that I got the chance to discuss my findings with key people in the phycological field that attended the meeting and my talk.

BPS meetings so far have given me inspiration for my research on the Antarctic seaweed flora and lots of new ideas. I am looking forward to attend next year's meeting which will be together with the 6th European Phycological Congress in London in August 2015, a meeting not to be missed.

Alexandra Mystikou, University of Aberdeen, a.mystikou@abdn.ac.uk



Micrographs of laboratory cultures of three new records from the south-western Antarctic Peninsula: 1: *Ulvella leptochaete* CCAP 6000/1, 2: *Capsosiphon groenlandicus* CCAP 6004/1, 3: *Elachista antarctica* CCAP 1308/1 (arrow indicates empty plurilocular sporangium)

Cyanobacterial biodiversity in Antarctic Cryoconites: An initial sequencing

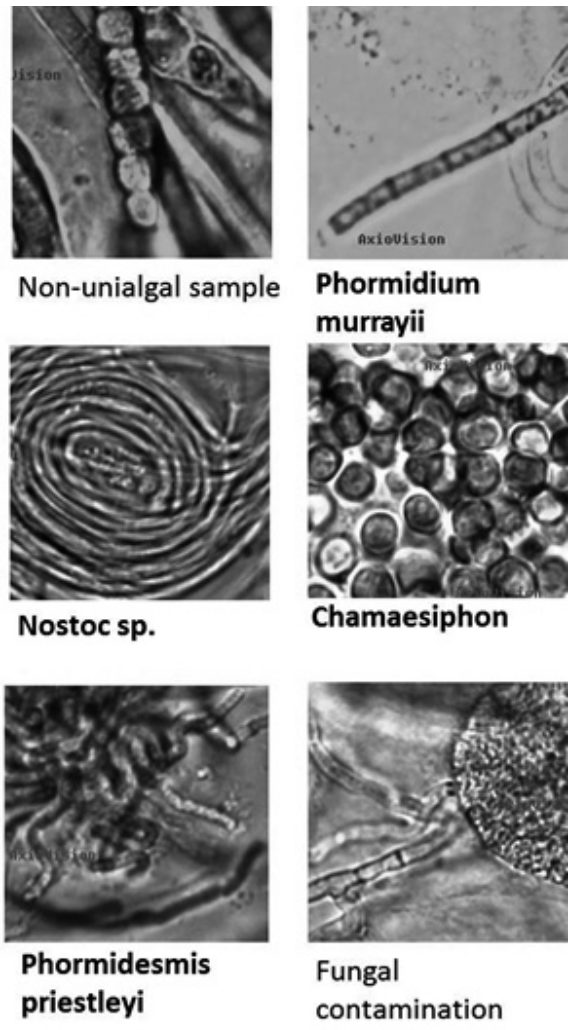
Josi Buerger
josi.buerger@gmail.com

Cyanobacteria are among the oldest known photosynthetic life forms and inhabit the harshest environments on Earth including glaciers. Cryoconite holes, small pockets on glacial surfaces, are unique freshwater micro-ecosystems that are an excellent example of cyanobacteria hardiness and taxa distribution. Thanks to the Small Grant Scheme of the British Phycology Society, I was able to carry out a summer studentship at the Natural History Museum with Dr Anne D Jungblut on cyanobacteria culturing and sequencing of cyanobacterial isolates brought back from her recent expeditions to Antarctica.

Cryoconites are formed by the distribution of sediment by aeolian forces. The accumulation of particles darkens the ice, which increases solar absorption and the melting rate. Isolated chambers then form in the upper glacial ice layer. These holes were considered abiotic environments until the discovery of cyanobacteria in them opened up new research questions on the biology of cryoconites and biogeographic distribution of cyanobacteria in Arctic, Antarctic and Alpine regions.

The sample collection and DNA sequencing of cryoconite cyanobacteria is motivated by two main research questions. Firstly, cyanobacteria are keystone taxa in these micro-environments: photosynthesis provides oxygen and enables higher species to follow the initial cyanobacterial colonisation. Secondly, biotic composition of cryoconites may differ between Arctic, Antarctic and Alpine glacial regions. An analysis of species across the cryosphere will provide insight to the evolutionary distribution and colonisation of cyanobacteria species.

The cyanobacteria samples I worked with were collected in the field by drilling through the cryoconite ice lids and remo-



ving sediment samples. These samples were shipped back to the Museum and cultured in liquid and on solid agar BG-11 media under light exposure at 10 °C. In order to carry out further analysis, a sample needs to be unialgal, i.e. only contain one species of cyanobacteria. I identified single-phenotype samples by light microscopy, which also introduced me to the stunning morphological diversity of these cryoconite samples (Image 1).

DNA extraction was carried out on unialgal isolates using standard cyanobacteria extraction protocol. PCR and sequencing was performed using cyanobacteria-specific 16S ribosomal RNA gene primers. I analysed the sequence results by BLAST queries and compared the data against the microscopy images (Table 1).

Overall the quality of obtained sequence data was fair. Out of 20 samples, 9 could be identified with high certainty using the BLAST database as indicated in the Table. Chamaesiphon was the most common sequence match, which may indicate that it is more suited to the culturing methods than other species. A number of sequences could not be identified by BLAST sequence comparison and were likely not unialgal (not included in Table). In addition, some samples were compromised by fungal contamination (Image 1). Sample 14 was of interest as its sequence quality was high yet the BLAST query matched to "uncultured environmental cyanobacteria sequence" collected by unspecific environmental sequencing and previously uploaded to BLAST by Dr Jungblut herself. This may potentially point towards a novel subspecies.

The next step of this research will be further purification of the not yet unialgal cyanobacterial cultures and repetition of the DNA extraction. In addition, the sequence data will be used for in-depth phylogenetic analysis.

In addition to 6 weeks of lab work, I also had the unique opportunity to participate in the Natural History Museum's outstanding public engagement. Dr Jungblut regularly blogs about her Antarctic expeditions for the NaturePlus platform and I contributed with a mini-series on my experiences at the Museum. The posts reached over 1600 page views by offering a glimpse into the lab-based elements of her work. In addition, I helped to organise and man a stall on cyanobacteria research in Antarctica as part of the Museum's well-attended Science Uncovered event.

Spending my summer at the Museum was a rewarding experience. I realised that while cyanobacteria can offer a glimpse into our evolutionary past, they can also shed light on the future. In light of global warming and melting of the ice caps, understanding the formation of new freshwater ecosystems in the cryosphere is highly relevant to managing climate change. Dr Jungblut's research at the NHM on small green things plays an important role on understanding our big green planet.

FIGURE 1 (left). Microscopy images of a variety of Antarctic cyanobacterial samples.

Images were generated with AxioVision Microscopy Software and show both non-axenic samples and axenic samples selected for DNA extraction and sequencing.

TABLE 1. BLAST results of 16S rRNA gene of cryoconite cyanobacteria cultures.

Cyanobacterial isolate	BLASTn result	Similarity (%)
1	*Chamaesiphon subglobosus* (PCC 7420)	99%
5	Chroococcales sp.	95%
8	*Chamaesiphon subglobosus*	98%
12	*Phormidium murrayii*	100%
14	Environmental sequence	100%
17	*Chamaesiphon* sp.	98%
18	*Chamaesiphon globosus*	99%
19	*Chamaesiphon globosus*	99%
20	*Phormidium* sp.	99%

Josi Buerger is a recent graduate from the Univerity of St Andrews and is currently enrolled at Imperial College for an MRes in Molecular Plant and Microbial Science. She rather enjoyed throwing seaweed at her siblings during childhood and has decided to pursue this interest at postgraduate level by studying algae and cyanobacteria.

josi.buerger@gmail.com

Attendance at the World Conference on Marine Biodiversity, China, October 2014

Joseph Kenworthy, Scottish Oceans Institute, University of St Andrews,

jmk6@st-andrews.ac.uk

In October I was very fortunate to be able to attend the World Conference on Marine Biodiversity (WCMB), held in Qingdao, China (http://wcmb2014.csp.escience.cn/dct/page/1). This was the third meeting of its kind, bringing together a multinational audience of marine biologists. At this event, I was able to present research undertaken during my PhD in a talk entitled "The context dependency of multiple stressor effects on estuarine sediment communities: a cross continental study." This paper detailed experiments undertaken from a collaborative project between the University of St Andrews, in Scotland, and Macquarie University in Sydney, Australia. It detailed manipulative experiments investigating the effects of nutrient enrichment and physical disturbance on intertidal microphytobenthos and macrofaunal communities.

My research was presented and received positively, positioned in a special session on the effects of multiple stressors on marine biodiversity. While singular stressors have been studied extensively, multiple stressor effects are becoming more popular among the scientific community. Not only are multiple stressors likely to coincide in natural systems, but they are also not straightforward to interpret based upon studying singular stressors, resulting in additive, cumulative or synergistic effects dependant on the system or stress in question. While the research I presented fit snugly within the remit of this session, equally it was applicable to my studies to learn about contemporary research of multiple stressors on different systems. Ultimately attendance at this session allowed me to gain new insights and perspectives on familiar topics.

Besides enjoying the fantastic Chinese banquets, the conference organised brewery tour, and the opportunity to see interesting talks, this meeting facilitated the exchange of knowledge and cultures with an international audience. This event became a great networking platform to meet researchers from close to home, as well as those from further afield, such as within China and Asia, as well as the Americas and Europe. As a 3rd year PhD student this was extremely important and beneficial to start the ball rolling for life beyond PhD and to get me thinking of career progression as an early career scientist. Other activities included attending a workshop on getting published in international journals. This was extremely beneficial given that experiments are coming to a close and publications are the next step on my PhD journey.

I am very grateful to the British Phycological Society for allowing me this opportunity for financial support to be able to attend this conference. Without which I would have been unable to see some fantastic talks on closely (and not so closely) related subject areas, meet interesting people, and disseminate my research to a large scientific community. This conference has been both beneficial in terms of career progression and simply gaining valuable experience presenting my research to an international audience.

Identification of cryptic marine algal species from the western Antarctic Peninsula

Figure 1 (left). *Himantothallus grandifolius* at 10m, East Norsel Point.

Figure 2 (top). Palmer Station.

Figure 3 (bottom). Collecting on SCUBA. Photo: Kate Schoenrock

Kathryn M. Schoenrock, University of Alabama at Birmingham, USA, ksrock@uab.edu

Marine macroalgae are abundant along the western Antarctic Peninsula and form communities that are comparable to temperate kelp forests (Figure 1). Today approximately 124 species have been recorded on the continent but the continent is likely under sampled. Within the Antarctic algae, endemism is prominent (44% of Heterokontophyta, 36% of Rhodophyta and 18% of Chlorophyta) and new taxa are continually being identified, perhaps a result of cryptic biodiversity within morphological characteristics. With this in mind I undertook this research endeavour in order to supplement my field and laboratory studies in order to have the correct species identification when examining community dynamics as well as their response to climate change.

My targets were the crustose Corallinales (CCA) which can cover large portions of the benthic substrate across depths. Three morphologies of CCA commonly found encrusting rocks, bedrock substrate, and invertebrate shells in the subtidal surrounding Palmer Station, Antarctica were the target of this study (Figure 2). In order to accomplish this work, target morphologies were collected from the subtidal environment surrounding Palmer Station on SCUBA (Figure 3). Sections of CCA individuals were chiselled from their substrata and preserved in silica gel for transport to the USA, while the rest of the individual was labelled, dried, and shipped to the University of Granada in Spain for morphological identification via SEM (Dr. Juan C. Braga's lab). At the University of Alabama at Birmingham I extracted CCA DNA and targeted the SSU, psbA, and LSU genes for amplification. I hope to build a phylogeny and align it with morphological data collected by our collaborator, Dr. Braga, shortly.

The British Phycological Society's Small Grants Scheme provided funding for PCR reagents and sequencing my samples. I have no doubt that the results of this study will support other research in this region as well as a major portion of my dissertation. Thank you.

NEW VERSION OF THE 'CODED LIST OF FRESHWATER ALGAE OF BRITAIN AND IRELAND 2014'

Brian A Whitton, School of Biological and Biomedical Sciences, Durham University, Durham DH1 3LE, UK, b.a.whitton@durham.ac.uk

David M John, Life Sciences Department, Genomics and Microbiology Division, Natural History Museum, Cromwell Road, London SW7 5BD, UK, d.john@nhm.ac.uk

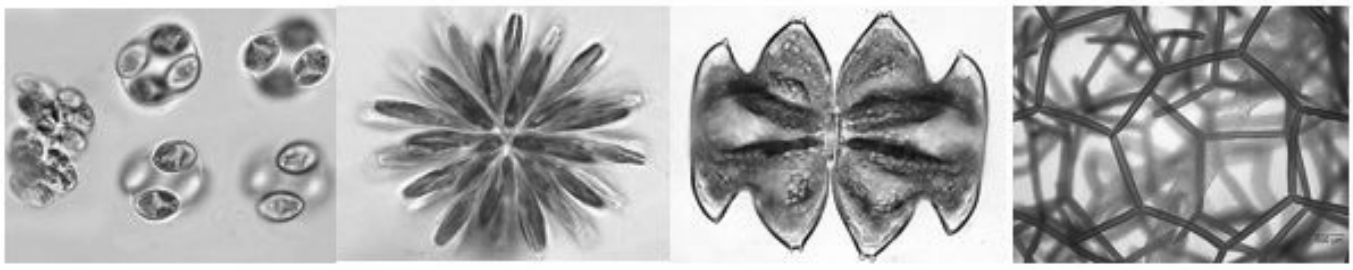
An updated version of the coded list of all currently accepted records of freshwater and terrestrial cyanobacteria and photosynthetic algae from Britain and Ireland has been compiled, with the exception that diatoms have not been updated since the 2003 version of the Coded List. The 2014 version incorporates all the taxonomic and nomenclatural changes made subsequent to the 2003 on-line version and includes newly recorded species. The almost 5500 species and subspecies in over 580 genera include brackish water and intertidal cyanobacteria, since a few occur in freshwater and marine environments. As the diatom list has not been revised since that provided by M.G.Kelly and E.Y.Haworth in 2003, the 2000 diatom species represent a considerable underestimate. Apart perhaps for a few diatoms, all the organisms listed have been recorded at some time and, in the great majority of cases, the sources can be found in the bibliography accompanying the Coded List. The freshwater algal flora of the British Isles is probably still much under-recorded, so the scarcity and ever-declining number of phycologists with taxonomic training in Britain and Ireland means that anything approaching a complete list is unlikely in the near future.

The unique 8-digit codes are widely used by those recording algae in the British Isles and worldwide interest in the coded list is reflected in the many hundreds of times the earlier version was download. Both new and old numbers are given where nomenclatural changes or taxonomic transfers have required a number change. This Coded List is the only numerical system for coding freshwater algal records in which an 8-digit number relates directly to the taxonomic system, as opposed to an arbitrary number in a continuous list as used in some other recording systems. The new version is the first authoritative and critical assessment of the British freshwater algal flora to be published for over a decade.

This is the fifth update of a list prepared originally in 1978 for what was then the Water Data Unit of the (UK) Department of the Environment. Those who were involved with earlier versions were Christine Sinclair, J. W. Hargreaves, the late Nigel T.H.Holmes, Leslie R. Johnson, Paul N.G.Boulton, Martyn G. Kelly and Elizabeth Y.Haworth, together with support from Roger V Moore at the Institute of Hydrology. Isabella Tindall of the Centre for Ecology and Hydrology at Wallingford prepared the list for publication on the CEH website.

The new version was published in December 2014 on the Centre for Ecology and Hydrology website and is downloadable as an Excel spreadsheet and the bibliography as a PDF file.

Whitton BA, John DM (2014) Coded List of Freshwater Algae of Britain and Ireland 2014. Centre for Ecology and Hydrology Website. World-wide Web electronic publication (http://www.ceh.ac.uk/data/algae/algae_index.html).



Coded List of Freshwater Algae of Britain and Ireland 2014

In search of the Welsh Tetracyclus

North Wales has long been a favourite collecting ground for the freshwater algae. Some of our earliest British records come from here: J. J. Dillenius (1742) collected material near Snowdon and Lewis W. Dillwyn (1809) made collections at Beddgelert in 1801. The diatom *Tetracyclus lacustris* was first figured and described by John Ralfs in the Annals and Magazine of Natural History (1843). Ralfs stated that it was...'found by the Rev. T. Salwey in Llyn Prefeddyr (Perfeddau), Barmouth, sparingly among *Fragilaria hyemalis* (= *Diatoma hyemalis*)'. John Ralfs spent a considerable time during this period at nearby Dolgellau where he visited the surrounding tarns and mires. These excursions provided him with desmids for his classic work on the British Desmidiaceae which appeared in 1848. Thomas Salwey (1791-1877) lived in Shropshire but made many excursions to the Barmouth area to collect plants. His speciality was lichens but he had a wide interest in botany that clearly extended to the freshwater algae although he never published on them. Presumably the two botanists had met in Wales at some time. Llyn Perfeddau is situated at the head of Cwm Nantcol in one of the wildest parts of Wales. There is no path to the lake and the landscape is quite unforgiving. Salwey must have made a considerable effort to reach it. I have been interested in the freshwater algae of North Wales for some time, having lived in Bangor for several years in the early 1970's as a research student. This account describes my first visit to the lake to seek out the species. Llyn Perfeddau is the type locality for the genus *Tetracyclus*, although the species is now known under the less informative name of *T. glans*. As far as I am aware, epilithic algae have not been collected from this lake since Salwey's visit over 170 years ago.

The excursion begins at Maes-y-Garnedd in Cwm Nantcol. This is where the narrow road from Llanbedr, near the coast ends. There is a small car park next to this farmhouse, parts of which are over 600 years old. It was once owned by Colonel John Jones, one of the signatories to Charles 1st's death warrant in 1649. A little-used public footpath leads up into the Rhinog Mountains from here but Llyn Perfeddau lies well away from the path in a rocky side-valley carpeted in ling, purple moor grass and bracken. This is about the worst combination of vegetation to confront the walker in mid-summer and is made especially difficult when strewn with blocky boulders and hidden scree. Almost every possible obstacle appears to confront the explorer and a health-and-safety list of hazards would be as long as your arm, particularly when the odd river and dry stones wall are added for good measure. After a drawn-out ascent of 200 m the ground levels out and the going becomes easier. Soon the lake is within sight, only occupied on this occasion by a pair of Canada geese. It is a small body of water measuring approximately 125 x 100 m and is probably only a few m deep, at an altitude of 465 m. The shore consists of shingle and cobbles of the hard Cambrian gritstone and greywacke for which the Rhinogs are famous. Aquatic macrophytes were poorly represented. Only *Littorella uniflora* was seen, but was fairly common in the deeper water. To the northeast, the big cliffs of Rhinog Fach loom over the lake. Washings of littoral algae were made from stones in c. 20 cm of water from the N, S, E and W shores along with the *Littorella*. The algae formed a loose brownish skin to the

Table 1 Littoral algae from Llyn Perfeddau, North Wales (Nat. grid ref. 23/659264). August 30th 2014. For other algae the AFOR scale is used. For nomenclature see John et al. (2011) for non-diatom algae and Krammer & Lange-Bertalot (1991) for diatoms. * For diatoms percentage frequency of frustules is given, + indicates <1%. Diatoms were cleaned chemically and 500 frustules counted for relative frequency measurements.

Phylum/Genus	Species	Frequency*
Cyanobacteria		
Dichothrix	orsiniana	O
Homoeothrix	balearica	A
Merismopedia	punctata	O
Snowella	lacustris	O
Chlorophyta		
Ankistrodesmus	falcatus	O
Asterococcus	limneticus	R
Euastrum	denticulatum	F
Glaucocystis	nostochinearum	O
Bacillariophyta		
Achnanthidium	minutissimum agg.	61
Anomoeoneis	brachysira	21
Cocconeis	pediculus	+
Cyclotella	sp.	+
Cymbella	gracilis	1
Diatoma	hyemalis	+
Eunotia	faba	+
Eunotia	serra var. tetraodon	+
Fragilaria	tenera	1
Fragilaria	virescens	+
Frustulia	rhomboides	+
Gomphonema	acuminatum	1
Gomphonema	minutum	9
Navicula	radiosa	+
Tabellaria	binalis	+
Tabellaria	flocculosa	3

rocks in all but the exposed E shore, but the flora was similar at all four stations. The reduced abundance on the east shore, where a wave-washed beach was formed was probably due to wave action. The supralittoral was colonised by the calcifuge lichens *Ephebe lanata* and *Hymenelia lacustris* and the surrounding soils by the ubiquitous alien *Epilobium brunnescens*. The algal flora was not particularly rich, and desmids, often a prominent component of upland lakes were not common. The species found are listed in Table 1 where the flora is seen to be dominated by a blue-green alga and four species of diatom. The list contains epilithic algae that are a common component of upland oligotrophic lakes in many parts of Britain. The water contains few dissolved solids, and an analysis gave the specific conductivity as 56 $\mu S\ cm^{-1}$, dissolved Ca 2.1 ppm and pH 5.2. Ralfs noted that *Tetracyclus* was uncommon in his sample, so a good search was made of the latest collections but without success. This diatom has a unique morphology in valve view (Fig. 2) so is unlikely to have been missed among the several thousand frustules examined. It was also searched for in the nearby Llyn Hywel which had a similar water chemistry and flora apart from an abundance of *Stigonema* species. *Diatoma hyemalis* which Ralfs noted associated with *Tetracyclus* at Perfeddau, still occurs but appears to be rare, since just a single frustule was observed in the entire collection.

Tetracyclus has an interesting morphology as it possesses both septa and valve costae. These are best seen in girdle view but chemical treatment disrupts the frustules into the valves and silicified intercalary structures termed copulae (Fig 2 d,e). Copulae of this type were in fact quite common in the preparations but these belonged to the related and very common *Tabellaria flocculosa*.

The apparent loss of *Tetracyclus* in Llyn Perfeddau is unfortunate but perhaps not surprising given the dramatic changes in the water chemistry of many poorly buffered waters in Britain as a result of acidification and enrichment (Battarbee et al., 1988). However, as it is an uncommon diatom, little is known of its requirements, and the acidification of Llyn Perfeddau cannot be extreme since it would otherwise contain little if any *Achnanthidium minutissimum*. It still occurs locally in the English Lake District, and I have collected it recently on submerged rocks in Derwent Water. Here the mean pH is currently close to neutral-

Figure 1 (above right). View of Llyn Perfeddau looking NE toward the cliffs of Rhinog Fach.

ity and the calcium level, inferred from the alkalinity is an order of magnitude higher than that of Perfeddau. Several lakes and tarns of the Rhinogau were investigated for their diatoms in a lake acidification survey of the 1980's by Rick Battarbee and co-workers, mostly as unpublished reportsand they include Llyn Dulyn, Llyn Irddyn and Llyn y Bi. The last named is only a kilometre east of Llyn Perfeddau, but *Tetracyclus* does not appear to have been reported.

Acknowledgements

Thanks to the landowner for permission to visit the site and to Rick Battarbee for his valuable comments.

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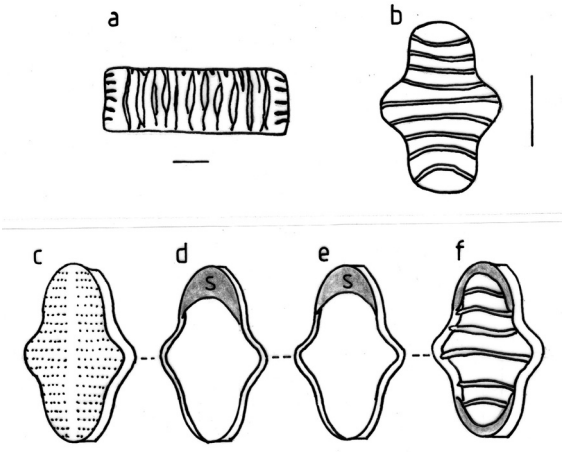

Figure 2 (right). *Tetracyclus lacustris* Ralfs.
a-b Drawings of the type material from Llyn Perfeddau. a) girdle view, b) valve view showing costae.
c-f) Exploded view of *Tetracyclus*. c) Valve showing fine punctae on the valve face, costae are hidden beneath; d, e) copulae showing septa (s); f) internal view of valve showing costae. Bar 10 µm.

DURHAM COURSES ON FRESHWATER ALGAL IDENTIFICATION

Van Mildert College and School of Biological and Biomedical Sciences, Durham University, Durham, UK

Organizers: Brian Whitton (Durham) and David John (London)

Accommodation, meals and evening lectures will be in Van Mildert College. Lectures and practicals during the day will be in School of Biological and Biomedical Sciences (about 600 m away). Parking near the College is available for anyone bringing a car, but this should be reserved in advance.

Van Mildert College can provide accommodation for anyone wanting to stay extra nights at the beginning or after the 9 July. Payment of about £34 for bed and breakfast can be included in the main invoice, provided organizers know well in advance, but otherwise payment can be paid directly to the college after arrival. For those attending both introductory and advanced courses, bed and breakfast accommodation and some, but not all, meals, are provided free for the intermediate days between the courses. The College has facilities for accessing the internet.

The courses (run since 1992) are a mix of lectures and practicals, together with at least one field excursion. Members should arrive by 1700 on the Sunday (though they can take their room earlier in the day). Lectures/practicals usually run from 0900 until 2120, including Sunday evening.

Available will be a wide range of algal literature, the new edition of 'The Freshwater Algal Flora of the British Isles' and each participant will receive an updated copy of the DVD accompanying the second edition and a comprehensive course manual; it is also hoped to have a new version of the CD containing interactive identification keys available by then.

Funding to provide partial support is available from various sources, including for students who have been members of the British Phycological Society for at least three months (essential!). Details are on the BPS website (http://www.brphycsoc.org/funding.lasso), but it is recommended that an application is submitted as early as possible (deadline 1 May 2015).

Members are encouraged to bring boots for field excursion(s) and (preferably) fresh samples from their local waters. There is no need to bring a laboratory coat, as these will be loaned. Some people may find it useful to bring their own portable computer, but the risk of loss for this and other equipment such a camera must be covered by their own insurance. Overseas members need not bring clothes for the field visit - these will be loaned.

Durham course participants in 2013.

Introduction to Freshwater Algae

Sunday 28 June - Friday 3 July 2015

The course provides training for staff in water agencies, water companies, consultancies, research students and others in the identification of microscopic and macroscopic freshwater algae. The emphasis is on the more widespread and environmentally important organisms. Topics include methods of sampling, preservation, harmful and nuisance algae, monitoring and implications of the European Water Framework

Tutors are Prof. Brian Whitton and Prof. David John; Drs Gordon Beakes (University of Newcastle), Alan Donaldson (consultant) and Martyn Kelly (Bowburn Consultancy) also contribute.

Field excursions Afternoon visit to pond at Cassop Vale on Tuesday 30 June. Following the end of the formal course at lunch-time on Friday 3 July, there is an optional further field visit. This is to sites along the River Wear and then streams polluted by heavy metals in the Nenthead - Alston region, followed mid-evening by a pub meal in Alston.

Inclusive cost for all participants other than full-time research students is £900 (no VAT charge) for those making a firm reservation by 1 May. The discounted price for full-time students is £800. Participants wishing to join the optional field trip on 3 July can stay the extra night free of charge.

Provisional and firm reservations for one of 16 places should be made by email (b.a.whitton@durham.ac.uk) to B.A.Whitton Algal Training, 74 Archery Rise, and Durham DH1 4LA, UK. A full refund will be made to anyone paying in advance, but then cancelling before 31 May, while 50% refund will be made to anyone cancelling between then and 19 June.

Advanced Course on Cyanobacteria (Blue-Green Algae) and Green Algae

Sunday 5 July - Thursday 9 July 2015

The course provides training on identification of freshwater cyanobacteria (blue-green algae) and green algae at a more advanced level than in the Introductory Course. It is planned especially for those who have attended one of the introductory courses, but also for others with considerable experience of field material or who would benefit by refreshing their knowledge.

Tutors are Prof. Brian Whitton and Prof. David John; Dr Alan Donaldson (consultant) also assists.

Field excursions All-day to the Sunbiggin Tarn region and River Eden on Tuesday 7 July. For those staying overnight on the 9 July, there will be a tour of northern Pennine streams, including those below old heavy-metal polluted spoils .

Inclusive cost for all participants, other than full-time research students, is £660 (no VAT charge) for those making a firm reservation by 1 May; no extra charge for those wanting to stay until after breakfast on 10 July

Provisional and firm reservations for one of 14 places should be made by email (b.a.whitton@durham.ac.uk) to B.A.Whitton Algal Training, 74 Archery Rise, Durham DH1 4LA, UK. A full refund will be made to anyone paying in advance, but then cancelling before 31t May, while 50% refund will be made to anyone cancelling between then and 19 June.

Attendance on both courses

A discounted rate and provision for the intervening weekend can be arranged. For this and further information on all the courses, contact the course organizers and checkthe BPS website - http://www.brphycsoc.org/courses.lasso or davidjohn02 website - http://www.davidjohn02.com/Trainingwebsite02/text/index.htm

Brian Whitton b.a.whitton@durham.ac.uk phone +44(0)191-¬386-¬7504

David John d.john@nhm.ac.uk phone +44(0)208-464-¬6367(home), +44(0)207-942-5078 or Department of Life Sciences, Division of Genomics and Microbiology, Natural History Museum, Cromwell Road, London SW7 5BD, UK

FRESHWATER ALGAE COURSE 2015

Where and when?

Kindrogan Field Centre, Enochdhu, Blairgowrie, Perthshire, Scotland (near the tourist area of Pitlochry),

Friday, 26 June – Friday, 3 July 2015. This is the **20th** year that the course has been offered.

Kindrogan Field Centre

The Kindrogan Field Centre is a self-contained and fully equipped field station set in wooded grounds on the banks of the River Ardle in the picturesque Scottish Highlands. It lies within easy reach of some of the remotest areas of the UK with inspiring landforms and a rich range of wildlife habitats. There is accommodation for 113 persons. The Centre has been modernized and has a common room, library, dining room, drying room, five classrooms / laboratories, conference room and bar. Take a virtual tour inside the centre and the surrounding area at: http://www.field-studies-council.org/kindrogan/

What is the course about?

The course takes full advantage of the excellent range of relatively unspoiled aquatic and terrestrial habitats in this beautiful area of Highland Perthshire to provide a sound introduction to the recognition, identification and ecology of freshwater algae. Emphasis will be placed on the use of the microscope and taxonomic keys (print and electronic) for identification to generic and species level, but also broader aspects of algal morphology, structure, reproduction, and classification (morphological and molecular). We normally see live examples of all major algal groups, including freshwater reds and browns.

For those with some prior knowledge of the algae, we hope that the opportunity to study samples from a range of habitats will broaden their knowledge and/or allow them to focus on particular groups.

Field trips, on foot or by vehicle, will be varied, but not strenuous and will be complemented by laboratory work, illustrated talks and class discussion. An all-day field trip will sample numerous lochs, streams, rivers and marshes, including a whisky distillery tour.

The last evening we assemble in the bar for our world-famous "algal charades".

Who are the course tutors?

The **Course Tutors, Dr Eileen Cox and Prof Elliot Shubert**, have taught this course for the past 19 years and they have a wide-ranging expertise on freshwater algae. Eileen and Elliot specialise in diatoms and green algae respectively. Eileen is Head of Post Graduate Studies at The Natural History Museum, London. She has published a key to live diatoms. Eileen is currently Editor for Diatom Research and on the Editorial Board of Fottea. Elliot is Editor-in-Chief of Systematics and Biodiversity at The Natural History Museum. He has published a chapter (with Georg Gaertner) on the non-motile coccoid and colonial green algae (Freshwater Algae of North America, 2nd edition) and is an Associate Editor for the European Journal of Phycology. We will be joined for part of the course by **Guest Tutor, Dr Laurence Carvalho**, Centre for Ecology and Hydrology, who will give a presentation on the EU Water Framework Directive with special reference to lakes and will describe their counting methods, and **Guest Lecturer, Prof Emeritus Geoff Codd**, University of Dundee, who will give a presentation on cyanobacterial toxins.

Who are the participants?

The course is open to individuals with different backgrounds ranging from beginners to those who would like to refresh their knowledge of particular groups of algae or experience collecting in a different region of the world. Previous participants have come from over 35 different countries.

What is the full cost of the course?

The course costs **£490** per person (approx. **626€** or **$741**), which includes shared occupancy accommodation (sole occupancy accommodation is **£560**) + all meals (please notify the Centre if you have any special dietary needs) + transport from/to Pitlochry and to field sites + use of the library and internet + tuition. Non-residents are charged **£367**. This is excellent value for money and costs significantly less than other freshwater algal courses on offer.

Is there support for students? Yes, support for a student stipend is available. Do not delay, apply today!

1. The British Phycological Society: http://www.brphycsoc.org

The deadlines for applications are: **1 February, 1 March, 1 May, 1 September & 1 December**. The sooner you apply, the better your chances are of receiving a stipend. Please note that you have to be a bona fide student member of BPS for at least three-months prior to making an application for financial support. **http://www.brphycsoc.org/funding.lasso**

2. Phycological Society of America: http://www.psaalgae.org

Graduate students who are members of the PSA are eligible for financial support to attend a phycology course at a field station from the Hannah T. Croasdale Fellowship. **http://www.psaalgae.org/website/opportunities/grants/croasdale.html**

The **Hannah T. Croasdale Fellowships** are designed to encourage graduate students to broaden their phycological training by defraying the costs of attending phycology courses at biological field stations. The purpose of the award is to broaden phycological training and not necessarily to further research goals. Proposals to study at field stations associated with universities other than the student's own are especially encouraged. Awards are made directly to the student in amounts up to $1000 each. Completed application and letter of recommendation should be sent to: Amy Carlile (**acarlile@newhaven.edu**) by **March 1st**.

3. The British Ecological Society:
http://www.britishecologicalsociety.org

Specialist Course Grants available for BES members only (undergraduate and postgraduate) allocated on a first-come-first-served basis. The grant covers the course fee, which includes accommodation, but not travel. Complete an Application form, which is available from the BES office or downloadable from this webpage. **http://www.britishecologicalsocietygrants.org/TrainingAndTravel/**

How do you get to Kindrogan?

Edinburgh and Glasgow have international airports. The airports have a coach connection to the main railway station in the respective cities.

The nearest mainline railway station is Pitlochry, which is on the London Kings Cross-Edinburgh-Inverness route. Participants will be met at Pitlochry by Kindrogan staff.

Where can I find more information?

- For detailed information about the Kindrogan Field Centre:
http://www.field-studies-council.org/centres/kindrogan.aspx

- For information on the Field Studies Council:
http://www.field-studies-council.org/

- Course information and booking for 2015:
http://www.field-studies-council.org/individuals-and-families/courses/2015/kd/freshwater-algae-52338.aspx

If you have any other queries, please contact:
e.shubert@nhm.ac.uk

Prof Elliot Shubert, The Natural History Museum,
Cromwell Road, London SW7 5BD
United Kingdom
Tel 020 7942-5606 (UK),
Tel +44 207 942-5606 (International)
Fax 020 7942-5229 (UK)
Fax +44 207 942-5229 (International)

Third annual meeting of the Molecular Life of the Diatoms – Seattle Washington USA

http://www.ocean.washington.edu/story/Molecular+Life+of+Diatoms+2015

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

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