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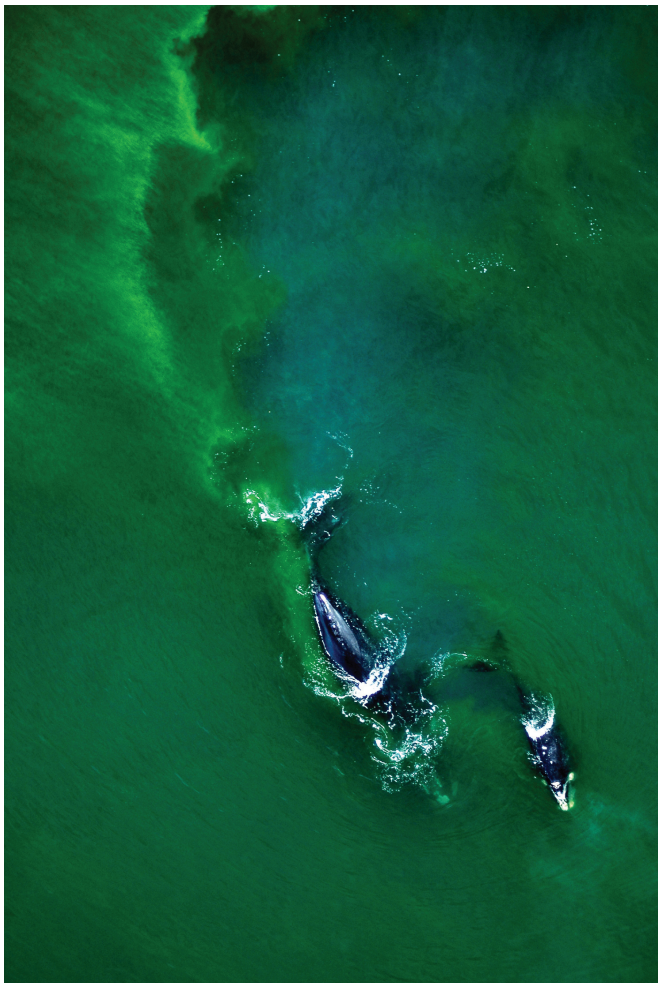
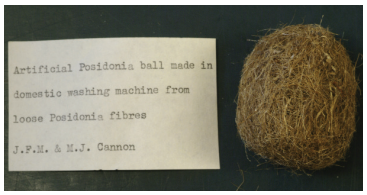
Review of the 58th Annual winter meeting Oban, 2010





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2010
British Phycological Society

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Editorial

Welcome to the first 'bouncy' edition of the new decade! As you can see it is once again a 'ball' packed edition. Many thanks for your contributions - do keep 'rolling' them in! If you are wondering why the ball references (perhaps in preparation for this year's World Cup?), and you want to find out what 'nun's farts' are - I'm sure I have your attention now - then please read on.

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The Phycologist - no. 78 Spring 2010

The spring edition is packed with reviews of the winter meeting, splendidly hosted by John and Christine, and all at SAMS. Even though the weather managed to keep some of us away, there was no snow (apparently) in Oban, and 103 delegates were registered. By all accounts it was another superb meeting and for those who didn't make it, I'm sure you will find it interesting reading the reflections on the founding of the BPS by its first Secretary, Harry Powell. The infamous BPS auction raised £150, which goes towards student support, and you can read the reviews provided by those students who received bursaries last year. The 2010 Manton and Poster prize winners also detail their stories - with the Manton prize being shared this year, and the Hilda Canter-Lund 2010 photographic winner is publicised. There is also an item from the Society of Biology's Chief Executive, detailing the first few months of the body representing interests of all biologists.

You may also wish to visit 'www.giantmicrobes.com' and see algae in a new fluffy light, and I would invite you to bring your wallets and purses to the next auction of the next winter meeting (in Cardiff), where you will be able to bid for the cuddly algae (courtesy of Giantmicrobes.com UK). And if you wish, you can email me answers to 'Name the alga!', with the 'results' published in the autumn edition! Happy reading.

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.

Reviews of the 58th BPS Winter Meeting, Oban

Some reflections on the founding of the British Phycological Society

Harry T. Powell
Scottish Association for Marine Science, Oban

(This is the text of a short speech given by Harry at the BPS Conference Dinner held in the Oban Bay Hotel, 8th January 2010)

I was born in Abergavenny, South Wales, in 1925, attended Grammar School there, then trained to be a marine biologist at the University College of Wales, Aberystwyth (1942 to 1948). My principal mentors there were Professor Lily Newton who ran the Botany Department and Professor T. A. Stephenson of the Zoology Department - both eminent marine scientists, as was Professor F. E. Fritsch (no less!) my external examiner for Hons. Botany. I spent the last two years there as research assistant to Lily Newton and then in 1948 I joined the staff of the Scottish Marine Biological Association (SMBA) at their Marine Station in Millport, on the Isle of Cumbrae, as Research Phycologist. I subsequently spent all of my career (1948-1989) with SMBA, at Millport until 1967, followed by our move to build a totally new base, the Dunstaffnage Marine Laboratory, on the mainland coast near Oban, Argyll in the period 1967 to 1971. Those labs were replaced by far better buildings and facilities, opened in 2004, where the BPS Conference 2010 is being held. The SMBA has meantime become the Scottish Association for Marine Science (SAMS) and the site is known as the Scottish Marine Institute.

As the young delegate for SMBA, I was thus able to attend the first major international meeting of botanists held after the Second World War. This was the VIIth International Botanical Congress, hosted by Sweden in 1950; the previous VIth Conference had been held in Amsterdam in 1935. As well as some sessions of phycological papers read in Stockholm, there were excellent field excursions (each lasting five days) to the Swedish west coast (leader, Prof Tore Levring) and to the Baltic coast (Dr Mats Waern) attended by a good number of British phycologists which provided an ideal opportunity to share our knowledge of algae and to get to know other phycologists from many parts of the world. We Brits started to think about the practicalities of holding similar regular meetings at our home universities and marine laboratories.

This led to an informal meeting based at Bangor University, arranged by Dr Margaret Martin (Local Secretary) and Dr Kathleen Drew Baker (Manchester University) in 1951, to which we invited everyone we could think of who might be interested. This was very successful and in the following year, in July 1952, we held the Inaugural General Meeting of the British Phycological Society as part of the large International Seaweed Symposium held in Edinburgh at the Institute of Seaweed Research, Inveresk. Many overseas delegates there signed up to be members of the BPS.

The same informal committee (with me acting as Secretary) followed this up rapidly by arranging in January 1953 the First Annual General Meeting of BPS at Queen Mary College, London (Local Secretary, Prof Maud Godward) at which we formally elected the first Council of the BPS (the result of a postal ballot of all members that I organised). It is of interest to note that the meeting adopted the following resolution from the informal group:

1. To hold regular future scientific meetings at academic centres and field meetings (as the best way for members to socialise and to get to know the algal flora).
2. Prepare a Revised Checklist of British Marine Algae and work towards producing a new Flora of British Marine Algae.
3. Arrange for a periodic News Bulletin to all members.

The early British Phycological Bulletins (1952 to 1965) were edited by Dr Elsie Conway (Glasgow University); this evolved into the British Phycological Journal in 1969 and finally into our prestigious *European Journal of Phycology* in 1993.

Dr Gordon Leedale of Leeds University succeeded me as Honorary Secretary in 1965, so I had the job for the first formative 13 years. This gave me (the youngest member of the committee) a lot of pleasure and satisfaction. Most of all I appreciated the opportunity to get to know personally so many professional colleagues of both the older and rising generations in both marine and freshwater disciplines. By January 1965 there were 205 members of the BPS. I later served as Vice-President of the Society (1970) and then as President (1971 and 1972).

My wife Grace also trained as a phycologist (at Glasgow University and Millport Marine Laboratory) and ever since the SMBA moved to Dunstaffnage in 1967 we have lived in the nearby village of Connel. I continue to visit the lab and to use its splendid library.

Grace and I are very pleased to have been invited as guests to the BPS Conference Dinner in Oban tonight. I have much enjoyed the talks at the lab and meeting many friends. May I conclude with my best wishes to the current Hon Secretary, Dr Jane Pottas (we share a deep interest in fucoid algae) and a warm Scottish farewell to you all - "Haste ye back"!

Jane Pottas (BPS secretary)
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When John Day suggested Oban as the venue for the 2010 Winter Meeting there were rumblings. "The west coast of Scotland in January?" "Won't it be difficult to get there?" "What about the weather at that time of year?" The pessimists' fears were confirmed by headlines announcing "No escape from Britain's big chill. Forecasters warn temperatures across UK will remain freezing. Scotland and east coast to receive heaviest snowfall" (*The Guardian*, January 4th). And on January 6th, the day the conference was due to begin, "UK faces coldest winter for thirty years" (*The Guardian*), "Britain in the deep freeze - The heaviest snowfalls for 50 years set to sweep nation" (*The Telegraph*). Could things get worse? As it turned out the majority of delegates managed to get there - Eileen Cox and Elliot Shubert on the night train from London, Patrizia Albertano flew in from Rome, Eileen Bresnan from the north east of Scotland..... Michelle Tobin, Sara Marsham and I battled through snow in central Newcastle before having a clear run over the Pennines and north to Oban. Those travelling from the south-west of England experienced the most difficulty and several, including Juliet Brodie and Paul Hayes, spent many frustrating hours at Bristol Airport waiting for a flight which eventually was cancelled altogether. "South faces worst snow for 20 years with 40cm of snow expected" (*The Times*). The absence of the president, president elect, several speakers and the chair of one of the special sessions meant some hasty rescheduling. What a headache for the organisers but Christine Campbell and John Day quickly produced a revised programme and

the conference ran smoothly - or so it appeared to the rest of us. Many thanks to them for all their hard work in organising and running the meeting.

The registration and drinks reception were held at the Oban Bay Hotel where many of us were staying so we didn't have to venture out into the cold afterwards. SAMS is actually at Dunstaffnage about 4 miles from Oban so buses were laid on to ferry those without their own transport to and from the labs each day. The location of SAMS at the Scottish Marine Institute must be one of the most stunning places to work, set as it is on the edge of a loch with views of mountains beyond. Ken Jones, Deputy Director of SAMS, welcomed us and gave a brief introduction to the work carried out there, some of the history and future plans. Then John Raven opened the first special session on Productivity and Photophysiology. All the talks in the session were interesting but I was particularly keen to learn about the photosynthetic activity of stromatolites as I was lucky enough to have seen the stromatolites in Shark Bay, Western Australia last year. In the afternoon there were parallel sessions - always a dilemma when there are choices to be made between talks as it is just not possible to be in two places at the same time. The Algal Biogeography session won out for me on this occasion. The offered talks in the Manton sessions were well received and I was especially interested in the presentation by Niall Rauh about the role of hypo-osmotic stress during early stage propagule development in shaping *Fucus* community composition. The sessions on algal biofuels and CO_2 sequestration, seaweed farming, and biodiversity reflect themes which have come to the attention of the general public and it was interesting to hear about current research in these areas. With sessions on host pathogen interactions, molecular biology, and toxins it meant that there was something for everyone. Posters covering a wide range of subjects including algal physiology, genetics and morphology and the use of algae in aquaculture, ecological monitoring and as biofuels stimulated much discussion. How encouraging also to see a student poster from an undergraduate, Christina O'Rourke from NUI, Galway, detailing the work of an Undergraduate Student Bursary Project part funded by the BPS.

A special guest attended some of the sessions - Harry Powell, the first secretary of the BPS, lives nearby and, despite having recently broken his arm in a fall on the ice, he and his wife, Grace, were able to come to some of the talks. I first met Harry several years ago when I was doing my PhD (on *Fucus spiralis*) and my supervisor suggested I write to him for information and advice which I did and on his invitation I went to Oban to meet him. He was extremely helpful, encouraging and interested. He still is. It was great to meet him and Grace again.

Jane Pottas and Harry Powell

Coffee and lunch breaks were held in the room where the posters were displayed and the noise level surely reflected the enthusiasm which everyone brought to the meeting. There was always something to talk about and someone to talk to. The caterers provided tasty and plentiful food including haggis and the local black pudding so there could be no doubt that we were in Scotland. To continue the Scottish theme this year's evening meal and quiz night were held at the Taj Mahal Restaurant in Oban. We made quite a large party and took over the whole place and enjoyed a very good buffet meal. The annual Geoff Codd Killer Quiz was replaced with an altogether gentler test - a film poster quiz. This sorted the bums from the boffins and it soon became clear who had misspent their youth. A good night was had by all. In view of the weather elsewhere in the UK, some delegates decided to leave on the Friday afternoon and therefore unfortunately missed the conference dinner and ceilidh. The evening was a great success - the meal, the company, the ceilidh band. I would say the dancing but that would be stretching a point, however, what the participants lacked in expertise they made up for with enthusiasm. After the meal Harry Powell gave a short speech about the beginnings and development of the British Phycological Society. As the last surviving member of the founding group he told us that he was the only man among a group of rather fearsome female phycologists. He was appointed secretary and no doubt had to do as he was told by them! Dare I say 'tis ever thus?!

And the weather in Oban? Although very cold, there was no snow in Oban at all ! The days of the meeting were beautiful - blue skies, bright sunshine and lovely views across the water to snow capped mountains. This rather sets the bench mark for next year's winter meeting. Over to you, Rupert !

Review of the Special Session: Host-pathogen interactions

Claire Gachon, SAMS
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This special session aimed at highlighting how the field of algal pathology has renewed itself over the last years, by covering a breadth of organisms, approaches and concepts. The talks were exclusively given by overseas speakers, reflecting the attractiveness of the BPS meeting to an international audience.

Willie Wilson (Bigelow Marine Laboratory, Maine) gave an introduction on the ecology of viruses in the sea. He also reported about some fascinating new technical developments in his lab, including how individual virus particles can be sorted by flow cytometry, and successfully used in downstream molecular analyses. Gwang-Hoon Kim gave a lively presentation of Porphyra diseases, mixing applied issues relating to crop protection by Korean nori producers and with more fundamental aspects of disease biology. Télesphore Sime-Ngando explained how his work on microbial pelagic foodwebs had led his group to realise to which extent the prevalence of chytrid parasites of algae in freshwater lakes had been under-estimated so far. Finally, Aurélie Chambouvet presented her PhD work on the regulation of toxic dinoflagellate blooms by host-specific parasitoids.

Overall, this session was a vivid illustration of the regained dynamism in the host-pathogen interactions fields. It will culminate by the production of an introductory review on algal diseases[1], which will be accessible to a broad audience.

[1] "Algal diseases: Spotlight on a black box". Gachon CMM, Sime-Ngando T, Strittmatter M, Chambouvet A, Kim G-H. Invited in Trends in *Plant Science*.

The 58th Annual Meeting of the BPS Oral and Poster Abstracts

Abstracts for Oral presentations

Special session: Productivity and photophysiology

The Functional Evolution of Photochemical Energy Conversion
John A. Raven
University of Dundee

Photochemistry in oxygenic photosynthesis involves chlorophyll *a* (very rarely chlorophyll *d*). The energetic requirements for the use of water as electron donor in assimilating carbon dioxide, the range energies available per photon over the solar spectrum and the spectral attenuation by natural waters are considered in relation to the number of photons needed to transfer an electron from water to carbon dioxide. While a one-photon mechanism for the electron transfer would be possible with the use of shorter wavelengths (400-500 nm) for primary photochemistry, (1) significant additional energy would be needed to phosphorylate ADP and (2) longer wavelengths in the solar spectrum would not be used in photosynthesis, The two-photon mechanism, with photochemistry using wavelengths of 680-700 (-730) nm, involves the use of some additional energy to generate the ATP for carbon dioxide assimilation. Chlorophylls as the photochemical catalysts using 680-730 nm photons allows the use of photons in the blue and red regions of the spectrum in very small cells with a minimal package effects; cells and organs with high absorptance allows chlorophyll to use almost all incident green light photons as well, at the cost of less effective absorption for individual chlorophyll molecules. The effective use of green light in small cells especially requires the use of specific pigments such as phycobilins.

UV impacts on aquatic plants: is it really only as negative as mostly reported?
DIETER HANELT
University of Hamburg

Anthropogenic stratospheric ozone depletion causes an increase of UV-B radiation on the earth surface, a threat to plants not adapted to higher UV-B irradiances. Investigations with aquatic plants from Belize (Caribbean), New Zealand and Spain, where UV-irradiances are naturally higher, are compared with former results of polar or species from moderate latitudes growing under low UVR. Photoinhibition was induced using a sun simulator to mimic the natural underwater radiation spectrum or plants were exposed to higher sun radiation close to the water surface. Photosynthetic activity during high light stress, and during recovery in dim light, was determined *in vivo* by measuring PAM fluorescence changes. A comparison of different species and locations of growth showed that the extent to which UV causes an additional decrease of photosynthetic performance during high light stress varies according to the depth of growth and UV transparency of the water body. However, a new finding was that some species were even more strongly inhibited when UV-B was filtered out of the simulated and natural sun spectrum, indicating a supporting effect of the short UVR wavelength range for recovery or against photoinhibition. These results were also confirmed in the field under natural radiation conditions in combination with UV-filters. Thus, UV-B does not solely cause negative effects on photosynthesis i.e. increases photoinhibition, but it may even support recovery processes in aquatic plants adapted to a high UV-radiation environment. The latter is in contrast to earlier studies, in which UV-B radiation was considered causing only harmful effects on photosynthesis of aquatic plants.

Diatom photophysiology: regulation and ecology
JOHANN LAVAUD
University of La Rochelle

In order to cope with fluctuating light intensities, diatoms have developed various mechanisms for photoprotection of their photosynthetic apparatus. Among theses mechanisms, the dissipation of excess energy (or NPQ for 'non-photochemical chlorophyll fluorescence quenching') is considered as one of the most important mechanisms on a short time scale (seconds and minutes). In higher plants, where the NPQ mechanism elucidation is a longstanding topic of interest, several regulatory components are necessary for the NPQ, including a transthylakoid proton gradient, de-epoxidized forms of xanthophylls, and PsbS, a light-harvesting complex (LHC) type protein. Diatoms show some intriguing peculiarities regarding the regulation of NPQ. New results on that aspect using some special mutants/transformants will be presented as well as its potential involvement in the ecophysiology of diatoms. The use of chlorophyll fluorescence in such work will be highlighted. Also the disturbance that NPQ can bring during in situ fluorescence measurements on diatom communities will be discussed.

Productivity in microalgal biofilms – adaptations for living in a muddy world
GRAHAM J. C. UNDERWOOD
University of Essex

Intertidal benthic microalgae (BMA) live in habitats characterised by rapidly changing environmental conditions. Light levels, temperature, salinity, and oxygen concentrations can rise (or fall) rapidly within minutes to hours. Despite this, BMA can be highly productive, and play an important role in many marine systems. This paper will review the key adaptations of these taxa, including physiological (photochemical and non-photochemical quenching processes, production and elimination of reactive oxygen species ROS, repair of damaged photosystems and photosynthetic "overflow" - excess organic carbon exudation), and behavioural (motility and avoidance behaviour) responses to high light and spectral quality. These strategies will be reviewed in the context of other stress factors, e.g. desiccation, and a consideration of what are the environmental limits for productive BMA functioning in marine intertidal habitats.

Photosynthetic activity of stromatolites: can they survive burial?
JACCO KROMKAMP[1] & RUPERT PERKINS[2]
[1] Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology
[2] University of Swansea

Living marine stromatolites can only be found nowadays in the Bahamas and Shark Bay, Australia. Here we give an overview of our results obtained from photosynthetic measurements performed using variable fluorescence (PAM) technique on stromatolites at Highborne Cay, Exuma Cays, Bahamas. After giving a brief overview on stromatolite organization we will focus on the capability of the cyanobacterial community in the stromatolites to survive burial, which is a common occurrence due to the highly turbulent environment in which they thrive. In contrast to the period in history in which they dominated, stromatolites are now often accompanied by diatom epiphytes and it seems that the photosynthetic organisms are P-limited. However, the diatoms do not seem to survive burial well in contrast to the cyanobacteria. Burial causes photosynthesis too shut down, as variable fluorescence decreases. Anoxic conditions are a requirement for this. After excavation, photosynthesis by the cyanobacteria is reactivated within a couple of hours in oxygenated conditions with low light as can be observed from a restoration of photosystem II photochemical efficiency. Oxygen dependent processes most likely affect the redox state of the plastoquinone pool and these determine the activation/reactivation processes, which seem to involve state transitions. The ability to survive burial for weeks may be an important factor in the role cyanobacteria as stromatolite builders.

Special Session: Host Pathogen interactions

Host-parasite interation of marine oomycetes *Olpidiopsis* sp. And *Pythium* Sp.
GWANG HOON KIM & TATYANA A. KLOCHKOVA
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An oomycete assignable to the genus *Olpidiopsis* was isolated from its summer host *Heterosiphonia pulchra* collected in Wando, southern coast of Korea where extensive *Porphyra* cultivation plantations are located. The *Olpidiopsis* disease has been observed in *Porphyra* farms in this area. The fungal infection process to different hosts was observed using time-lapse videography. When the salinity shock, prolonged vortexing and detergent treatment were given to the host cells the infection rate was enhanced. The *Olpidiopsis* infection was cell-type specific. Elongated tips of determinate branches showed much higher infection rate (>20 times) than other cells of the filaments. FITC-conjugated lectin labelling showed specific binding of ConA to the elongated tips. D-mannose, complementary to the lectin ConA, could block the infection very strongly suggesting that there was lectin-carbohydrate system involved in host-parasite recognition. D-mannosidase treatment of host plants significantly reduced infection rate confirming above data. Host plants gradually obtained the resistance to the fungal parasite when they were cultured together. The infection process of *Olpidiopsis* sp. was compared with *Pythium* sp.

Heterotrophic flagellates and hidden putative functions from zoosporic fungi in pelagic ecosystems
TÉLESPHORE SIME-NGANDO
Université Blaise Pascal, Clermont-Ferrand

In aquatic ecosystems, heterotrophic flagellates have received particular attention as grazers, and have been regarded as a homogeneous group of bacterivorous protists. More recently, environmental rDNA surveys of small heterotrophic flagellates in the pelagic zone of freshwater ecosystems have revealed the following findings: (i) the dominant phyla found differed significantly from those known from microscope studies, (ii) the retrieved phylotypes generally belong to well-established eukaryotic clades but with very large diversity within clades and (iii) a substantial part of the retrieved sequences is not related to bacterivorous but to parasitic and saprophytic organisms, such as zoosporic fungi (chytrids), fungus-like organisms (oomycetes), or virulent alveolate parasites (Perkinsozoa and *Amoebophrya* sp.). All these microorganisms are able to produce small flagellated zoospores to assure dispersal during their life-cycles. It is thus likely that previously overlooked functions, primarily parasitism and saprophytism, merit thorough attention (i) for an improved understanding of the roles of heterotrophic flagellates in pelagic ecosystems and, (ii) to transcend the concept of 'the microbial loop' in the context of modern pelagic microbial ecology.

Berry stone viruses: 30-years of climate control and face cream.
WILLIE WILSON
Bigelow Laboratory for Ocean Sciences

The virus genus *Coccolithovirus* (Cocco: derived from Greek kokkis, meaning "berry" or "grain" referring to their shape and Lith: from Greek Lithos, meaning "stone") is a group of large, double stranded DNA viruses that infect the globally important marine coccolithophorid *Emiliania huxleyi*. The first observation of virus-like particles in *E. huxleyi* was reported back in 1974 though they are now known to be one of the causative agents of *E. huxleyi* bloom demise. We have developed diagnostic molecular tools to analyse the dynamics of coccolithoviruses and their hosts during natural blooms. Virus infection of *E. huxleyi* increases production of the biogenic gas dimethyl sulphide (DMS), which has implications for climate feedback mechanisms. We have recently sequenced the 407,339 bp genome of one coccolithovirus and revealed that only 14% of the predicted genes confer any significant database homology. The genome encodes a range of unexpected genes never previously observed in a virus. Most notably are those involved in biosynthesis of ceramide, a sphingolipid better known for its role in face cream. Microarray analysis of genes on the virus genome has greatly enhanced our understanding of the propagation of this unusual virus and may help us understand why algal viruses have such large genomes.

Ecological significance of parasitism by Syndiniales on the regulation of toxic and non-toxic dinoflagellate proliferations
AURÉLIE CHAMBOUVET & LAURE GUILLOU
Station biologique Roscoff, France

Red tides, caused by the proliferation of microalgae, are the most visible effects of recent global changes on marine phytoplankton. These world-wide recurrent problems are known since a long time ago, but they have seriously increased during these last decades. Causes for these extending toxic outbreaks are multifactorial; among them the recent eutrophication of the coastal waters, the multiple transfer of toxic strains from one site to the other caused by human activities (transported by ship ballasts or/and the use of a non-endemic bio-resource for aquaculture), and the global warming. Most species responsible for these proliferations belong to dinoflagellates. A few of them are also producing redoubtable poisons that can be paralytic, neurotoxic, diarrheic, or haemolytic.
Recent studies suggest the regulatory role of widespread marine parasites, belonging to the Alveolata phylum (Amoeboprhyidae, Syndiniales, Marine Alveolate Group II). This group of eukaryotes is one of the most important lineages retrieved from various environmental genetic libraries built from the smallest size fraction of the marine plankton. They have been consistently detected from a lot of marine habitats, from surface to deep ecosystems and from nutrient enriched coastal to very oligotrophic waters. Among Amoebophryidae, the genus *Amoebophrya* is known to infect a wide range of dinoflagellate species.
We checked presence of such parasites during three consecutive years in the Penzé estuary (French coasts), where toxic blooms of

Alexandrium minutum have been regularly reported since these last 15 years. We demonstrated that these parasites can be repeatedly linked with declines of different dinoflagellate species, including the toxic species *Alexandrium minutum*. Using specific oligonucleotidic probes, we demonstrated that these parasites were specific for a reduced number of hosts while a considerable genetic polymorphism was detected within a given population. We then hypothesised that invasive dinoflagellate species are also able to bloom because of the absence of these natural pathogens (the enemy release hypothesis). Their abilities to infect and control novel and invasive toxic micro-algae open up challenging questions in the context of the drastic changes undergone by marine planktonic assemblages in response to global change.

Founders Lecture

Natural and reconstituted phototrophic biofilms in water
PATRIZIA ALBERTANO
University of Rome

Phototrophic biofilms grow in all aquatic systems ranging from fresh water to hyper-saline. In these surface-associated microbial communities the major source of energy and biomass originates from cyanobacteria and microalgae. They thrive on submerged biotic or abiotic substrata in light-exposed aquatic environments and exopolymeric secretions (EPS), mostly polysaccharides, provide adhesion and cohesion to the microbial consortia. In nature, the phototrophic microbial communities are influenced by a number of abiotic and biotic factors and vary over temporal and spatial scales.
Microcosm studies recently contributed to the understanding of the different developmental stages during biofilm growth. Structure and architecture of freshwater and marine phototrophic biofilms were studied during their temporal development on removable transparent polycarbonate slides in special designed incubators. Biofilms grown at varying photosynthetic photon flux density, temperature and flow velocity showed reduced diversity, composition changes, and fast growing communities mostly dominated by single algal species that formed more or less stable structures. CLSM studies revealed that the contribution of bacteria in phototrophic biofilms was rather low when compared to the algal and EPS components.
Experiments on natural and reconstituted mixed cyanobacterial – algal species biofilms indicate promising application of these phototrophic communities. Most interesting uses are foreseen in treatment of effluent wastewaters, removal of heavy metals, abatement of microcystin concentration in lake waters, aquaculture, eco-sustainable production of biomass for oil extraction and biodiesel, soil amendment and self-sustained phototrophic microbial fuel cell to generate electricity through the synergistic interaction between photosynthetic microorganisms and heterotrophic bacteria.

Offered papers

Is the European *Karenia mikimotoi* an Alien?
MANAL AL-KANDARI, **DECLAN SCHROEDER**[1], MARIAN YALLOP, MARTIN EDWARDS &. PAUL HAYES
[1]Marine Biological Association

The genus *Karenia* G. Hansen and Moestrup 2000 consists of the well-known toxic species *K. brevis* (Davis) Hansen and Moestrup 2000 and *K. mikimotoi* (Miyake and Kominami ex Oda) G. Hansen and Moestrup 2000. *K. mikimotoi* was known under different names in Pacific and European waters, and has been in a state of taxonomic turmoil for over 20 years. The seminal study by Hansen et al. (2000) based on light and electron microscopy, nuclear-encoded LSU rDNA sequences, and pigment analysis confirmed that the European isolates formerly identified as *Gyrodinium aureolum*, *Gyrodinium* cf. *aureolum*, or *Gymnodinium* cf. *nagasakiense*, are conspecific with the Japanese *Gymnodinium mikimotoi*. Consequently, the European and Japanese isolates were renamed with new genus name *Karenia*. Here we will produce further molecular evidence for the conspecific nature of European and Pacific isolates, however, we nonetheless propose the separation of this species into distinct genotypes. Thereby re-opening the debate of whether the European *K. mikimotoi* is in fact a relatively new Pacific introduction.

Development of a methodology for the quantitative assessment of Ireland's inshore kelp resource.
BLIGHT, A., EGERTON, J., MCALLEN, R., FOSTER-SMITH, R. & SAVIDGE, G.
Queen's University Belfast

In its November 2000 report, the Irish National Seaweed Forum identified the potential for developing a mechanical kelp (*Laminaria digitata* and *L. hyperborea*) harvesting industry in Ireland. One of the aims set out by this report was to accurately quantify kelp biomass in order to facilitate the development of appropriate management plans and sustainable harvesting practices. There are three main objectives to this project: the first is to survey three inshore sites (one on the northeast coast, one on the southwest coast and one on the west coast of Ireland) and develop acoustic methodologies for the estimation of kelp standing stock; the second is to investigate the potential for differentiating between the two kelp species (*L. digitata* and *L. hyperborea*) and the third is to carry out and ground truth a series of acoustic trials to estimate kelp biomass. Surveys have been carried in County Down, Northern Ireland and County Cork, Ireland. Bathymetric data for these areas were collected using Geoswath, with DGPS used for accurate positioning. Acoustic measurements of the kelp were made using a Simrad ES60 echosounder at dual frequencies and analysed using Sonar Pro software. Diving surveys were subsequently used to ground truth the acoustic readings. The ES60 can clearly detect the kelp and there is a significant correlation between the acoustic height of the kelp from the substrate and that measured in situ. The acoustic measurements can also be used to derive estimates of the 'volume inhabited' by the kelp which shows a significant correlation with in situ measures of biomass.

Changes in the phytoplankton community in the North East of Scotland: observations since 1997
E. BRESNAN, S. L. HUGHES, S. FRASER, A. L. AMORIM, K. SMITH, M. ROSE, G. SLESSER, S. HAY, J. RASMUSSEN & M.R. HEATH
Marine Scotland-Science

A long term coastal ecosystem station, 5 km offshore of Stonehaven in the North East of Scotland (56º 57.8´ N, 02 º 06.2´ W), is monitored weekly for temperature, salinity, nutrients, phytoplankton and zooplankton. A number of changes in the phytoplankton community have been observed since the time series began in 1997. A four year period was identified from 2001 to 2004 where mid month chlorophyll values during the spring bloom were reduced. Dinoflagellate genera such as *Ceratium* show a decreasing trend in common with shorter time series from other Scottish coastal sites. During the early part of the time series the spring bloom was dominated by *Chaetoceros* species however since 2002, dense blooms of this genus are no longer observed and *Skeletonema* has become more abundant. This change in spring bloom composition is coincident with the end of a period of negative temperature and salinity anomalies observed from 1998 to 2002. Changes in zooplankton composition and predation pressure have also been observed since monitoring commenced.

An individual growth model for the kelp *Saccharina latissima* with applications to ecology and aquaculture

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SINTEF Fisheries and aquaculture, Norway

An individual based dynamic growth model for *Saccharina latissima* (L.) Lane, Mayes, Druehl and Saunders has been developed. The basic state variable in the model is frond area, but nutrient (nitrogen) and carbon storage are also simulated. As a consequence we get information about carbon, nitrogen and dry weight content of the alga - even the carbohydrate content. The following data are used as input: light (irradiance), temperature, external nutrient concentration and water current speed. Thus the model can be used to simulate the effects of varying environmental conditions on biomass and composition.
In the talk we will describe important aspects of the model. Emphasis will be on explaining the overall dynamics – how the model actually works and what it does. We will also discuss how the individual growth model may be used to build three dimensional population models, and how it may be implemented as part of a more complex hydrodynamical and ecological model system. Examples of the potential uses of the kelp model within ecology, aquaculture and algal research will be presented.
This work is part of the INTEGRATE project, a joint strategic programme on integrated aquaculture at the Norwegian University of Science and Technology and SINTEF.

Physiological response of *Chlorella vulgaris* to an environmental stress caused by high carbon dioxide concentration

CLÉMENT-LAROSIÈRE BARBARA, LOPES FILIPA, MINIER MICHEL, DOMINIQUE PAREAU, ISAMBERT ARSÈNE
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Using microalgae culture as carbon recycling system is a practical approach to the problem of the increased level of carbon dioxide in the atmosphere. By supporting the recycling of CO_2 into food products or bio-fuels without competing for agricultural land, microalgae biotechnologies offer sustainable solutions to the impending challenges we face in food supply, renewable energy production and climate control.
In the present study, carbon dioxide removal by a freshwater microalga, *Chlorella vulgaris* (CCAP 211-11B) was assessed. We focused on the physiological response of the algae to an environmental stress caused by high carbon dioxide concentration.
We used $NaHCO_3$ as carbon source and two concentrations were tested (20 g/L and 40 g/L) in order to evaluate their impact on the growth and the physiology of *Chlorella vulgaris*. Biomass, chlorophyll a concentration, exopolysaccharides (EPS), protein content and total inorganic carbon (TIC) concentration were daily measured. The culture developed at 20 g/L of $NaHCO_3$ presented a higher growth rate, an increase in chlorophyll a concentration compared with the cultures grown in the control medium and at 40 g/L of $NaHCO_3$. Additionally, the algae culture developed at 20 g/L of $NaHCO_3$ reached the stationary phase earlier than the two other cultures. The results of this study contribute to a better understanding of the carbon dioxide fixation and distribution into the cell. The next step is to study the effect of a higher algal biomass concentration on the removal of carbon dioxide.

Marine cyanaobacterial viruses; new host-phage systems and short-timescale resolution of virus dynamics

MARTHA CLOKIE
University of Leicester

Cyanobacteria and their viruses are extremely abundant in the oceans. Two dominant genera of cyanobacteria in the oceans are *Synechococcus* and *Prochlorococcus* and several viruses which infect them have been well characterised. Far less is known about the viruses which infect other marine cyanobacteria, in particular those which have a sedentary lifestyle. I discussed the characterisation, sequencing and annotation of the first two viruses to have been isolated which infect the cyanobacterium *Acaryochloris marina*. Both are siphoviruses and their genomes reveal surprising evolutionary insights. I also presented data from a recent study of *Synechococcus* viral abundance over short-timescales. Viruses from St. Kilda were isolated over every three hours over a three day period. Viral abundance followed an expected pattern of more viruses present during the night than during the day. At one time point however, the viral count was much higher (by two orders of magnitude) than at all the other time points. The plaque morphology of the abundant viruses suggests that we inadvertently witnessed a mass temperate phage induction event. Studies are ongoing to characterise theses viruses.

A question of generitypes, nomenclatural conservation and priority - *Dickieia* Berkeley and *Staurophora* Mereschkowsky refer to the same diatom genus.

EILEEN J. COX
NHM, London

While the majority of diatom genera have been erected on the basis of their wall morphology and structure, Mereschkowsky created a number of new genera with explicit reference to their cytoplasmic features. *Staurophora* was described for some brackish-marine diatoms with a single lobed chloroplast and a transverse thickening across the centre of the valve (stauros). Because of the subsequent overwhelming reliance on wall features, it was then subsumed in the genus *Stauroneis*. Earlier, *Dickieia* had been described for a naviculoid diatom that grew enclosed in mucilaginous fronds, but again, with the reliance on wall structure, this genus was abandoned. In this case, because there was no obvious transverse thickening or strauros, it was transferred to *Navicula*. More recently (Mann 1994), resurrected *Dickieia* as a genus, albeit with an amended description, while *Staurophora* had been reinstated slightly earlier (Round et al. 1990). This talk will show that the members of these genera share the same cytoplasmic and structural features, and should therefore be combined in a single genus, for which the name *Dickieia* has priority.

Algal biofuels – an assessment based on recent studies and experience in Ireland

MATTHEW DRING & GRAHAM SAVIDGE,
Queen's University Belfast

In spite of several extremely negative assessments of the prospects for economic production of biofuels from algae, mostly based on 20 years of work conducted by the National Renewable Energy Laboratory in the USA, the idea that algae can contribute to the world's energy supplies refuses to die (see *Nature* 461: 460-1, 2009). In the UK, the Carbon Trust issued its "Algae Biofuel Challenge" at the end of 2008, and offered funding of up to £16 million for fundamental R&D leading to large scale production of algal oil, and ExxonMobil has committed $600 million over 5-6 years to the same topic. The range of techniques for extracting carbon-neutral fuel from algae (either micro- or macro-) includes well known processes, such as anaerobic digestion of seaweeds, isolation of biodiesel from oil-rich microalgae, and fermentation of algae to ethanol, but other techniques are being proposed and deserve to be considered. More questionable are the suggestions that algae can be used for carbon sequestration, or can contribute to carbon-negative energy production. This paper reviews recent and current work in Ireland on a variety of approaches to exploiting algae as biofuel, and attempts to quantify the potential resources available.

Growth experiments of *Saccharina latissima* in a mesocosm and open system

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SINTEF Fisheries and Aquaculture, Norway

Two projects involving growth and chemical composition of *Saccharina latissima* (L.) Lane, Mayes, Druehl and Saunders will be presented:
1) Small plants of *S. latissima* were grown in a mesocosm system. Irradiance, temperature, water quality, C, N, P in the algae and growth measurements were done once a month for 10 months. Results show among other things rapid growth during the winter and spring, a depletion of nutrients due to an early spring bloom in the system and an increase in the internal carbon reserves in summer.
2) Ropes with lab-grown *S. latissima* plants were put out alongside a fish farm in Trøndelag (Norway) to see if the plants could take up excess nutrients released from the cages. Tissue samples and growth measurements were done every second month from April to October. Plants downstream, upstream and in the middle of the fish farm have different C, N and P values than a control station not affected by fish farming. The algae did not grow that well, supposedly due to the time of year they were put out at sea, and also because of the amount of epiphytes growing on the kelp surface, especially on plants situated in between the cages. Plants in the upper layer (0.5-2 m) were growing much poorer than the plants in the lower layer (4-5.5 m).
This work is part of the INTEGRATE project, a joint strategic programme on integrated aquaculture at the Norwegian University of Science and Technology (NTNU) and SINTEF.

Advances in the knowledge of diatoms with blue apices

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The marine diatom *Haslea ostrearia* (Gaillon) R. Simonsen has long been considered as the only organism able to produce a specific hydrosoluble blue pigment, the so-called marennine, known for the greening of oyster gills. In the last centuries, 'blue' diatoms have been worldwide described as *H. ostrearia*, most often only based either on the presence of blue pigment in cell apices, or of green oysters. Recent advances in the characterisation of marennine have shown that it is probably a non-hydrolysable polyphenol. Diatoms with blue tips, isolated in the Black Sea (Crimea) in Spring 2008, presented differences in the size and longitudinal stria density of the frustule, as compared to *H. ostrearia*. Micro-Raman spectrometry was used to determine the *in vivo* pigment signatures of both diatoms, which were significantly different. These pigments were therefore purified, and their biological activity tested. Sexual reproduction of the Ukrainian diatom has also been studied. Cardinal points and size of the initial cells were significantly shorter than those of *H. ostrearia*. Moreover, interbreeding between these two diatoms revealed unsuccessful, presuming these diatoms are different species. Other 'blue' diatoms were obtained from different parts of the world. Algae isolated from Swedish waters display the same morphology and Raman signatures as *H. ostrearia*, and were sexually compatible (initial cells of F1 generation were obtained) with strains from the Atlantic coast of France, while they did not mate with clones from the Black Sea. Diatoms from the Canary Islands and the French Mediterranean coast exhibited differences in their morphology, but similar *in vivo* Raman spectra of their pigment to *H. ostrearia*. Experiments are under way to study their sexual compatibility with *H. Ostrearia* and Ukrainian clones.

Diel periodicity and effects of nitrogen on chrysolaminaran metabolism in the marine diatom *Thalassiosira pseudonana*

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Diatoms contribute an estimated 40% of marine primary production, and have a significant impact on global biogeochemical cycles and climate. Storage compounds are important for their growth and survival in a constantly changing environment. The storage polysaccharide chrysolaminaran, a ß-1,3-glucan, has a very dynamic metabolism and can accumulate up to 80% of total cellular carbon. However, little is known about the metabolic pathways of glucan biosynthesis and degradation, and how they are regulated. Our objective was to study the metabolism and regulation of chrysolaminaran in the model marine diatom *Thalassiosira pseudonana* by analyzing gene transcripts, enzymes and metabolites. Based on the whole-genome sequence of *T. pseudonana* putative metabolic genes were identified and annotated, including *endo-ß-1,3-glucanase* (*endo*), *exo-ß-1,3-glucanase* (*exo*), *glucosyl transferase* (*gt*) and two *UDP-glucose pyrophosphorylase*s (*ugp*s). Gene transcripts were measured by quantitative RT-PCR, and custom peptide antibodies were raised against the corresponding proteins. During exponential growth under a 12/12-h light/dark cycle, chrysolaminaran contents oscillated between 1.5 pg/cell (end of scotophase) and 10 pg/cell (end of photophase). Transcripts also displayed strong diel oscillations, with biosynthetic genes (*gt* and *ugp*s) peaking during early to mid photophase and degradative genes (*endo* and *exo*) peaking during early to mid scotophase. Under nitrogen starvation, cells accumulated chrysolaminaran but showed less diel variation. The diel trends in gene expression persisted during nitrogen depletion, but the overall levels of transcripts were strongly reduced. The patterns of gene expression suggest that the diel periodicity and effect of nitrogen on chrysolaminaran metabolism are under strict transcriptional control.

Biochemical analysis of low-temperature induced antioxidants and its enzymes from a freshwater green alga, *Spirogyra varians*

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Simultaneous comparisons of radical scavenging activity and total phenoic contents from cold and warm temperature cultured *Spirogyra varians* were analyzed using DPPH and Folin Ciocalteu assay. When *Spirogyra varians* was cultured at low temperature (4°C) the antioxidant activity and total phenolic contents in methanolic extracts increases over time course. HPLC analysis of the extract showed four new compounds produced during cold acclimation process. The radical scavenging activities of the isolated compounds were 100% to 150% in comparison with ascorbic acid. Purification of the compounds was performed and the possible structures were predicted using H-NMR. The compounds were similar to gallic acid or flavonoid derivate which is involved in shikimate pathway. The activity of antioxidant enzymes (Catalase and Superoxide dismutase) was observed either unchanged or reduced during incubation at low temperature (4° C) suggesting *Spirogyra varians* overcome cold stress using above compounds rather than antioxidant enzymes. A shikimate pathway related gene involved in the cold acclimation process of *Spirogyra varians* was isolated. Protein and mRNA of shikimate pathway related gene was rapidly increased and accumulated during cold acclimation process (5 times than non

acclimated plants). Possible role of the gene for the production of the antioxidant compounds was discussed.

A sequence-tagged genetic map for the brown alga *Ectocarpus siliculosus* provides large-scale assembly of the genome sequence

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Ectocarpus siliculosus has been proposed as a genetic and genomic model for the brown algae. The complete sequence of its 200 Mbp genome has provided important insights into brown algal biology. However, a large-scale view of this genome has not been available because the assembly of the 10.5x shotgun sequence resulted in 1565 individual supercontigs ranging in size from 3.7 Mbp to 2 kbp. The aim in this study was to generate a sequence-anchored genetic map for *Ectocarpus* both as a means to map this sequence information onto linkage groups and to provide a tool for future genetic analyses employing this organism. To map genetic markers, a segregating F_2 population was generated from a cross between the sequenced strain (Ec 32) and a compatible strain from Chile. AFLP analysis indicated a significant level of polymorphism (41%) between the genomes of these two parental strains. A total of 1152 microsatellite markers were selected for analysis based on their location on long supercontigs, their potential as markers and their predicted ability to amplify a single genomic locus based on PCR simulations using the complete genome sequence. Of the 1152 markers, 407 (35.3%) were found to be polymorphic and to amplify products that could be genotyped using capillary electrophoresis. Analysis of the segregation of 406 markers in 60 individuals of the F2 progeny allowed the construction of a genetic map comprising 34 linkage groups. These markers anchored 325 of the longest supercontigs onto the map, representing 70.1 % of the genome sequence.

Monitoring macroalgal blooms in Scotland for the Water Framework Directive

SARAH HOLT & CLARE SCANLAN

SEPA, Aberdeen

A monitoring tool was developed by the WFD Marine Plants Task Team for assessing coastal and transitional waterbodies subject to possible eutrophication pressures. This focuses on the presence/absence of potentially nuisance blooms of opportunistic macroalgae. Spatial extent of algal cover within a waterbody is assessed using a combination of aerial photography or remote sensing imagery and assessment on the ground. Surveyors map the extent of blooms by walking round them with hand-held GPS, and recording percentage cover within quadrats. Average biomass is calculated using data collected from quadrats.

SEPA has just completed its third year of such monitoring in Scotland. We summarise our results to date, difficulties encountered and possible future work.

How can closely related species coexist for over one hundred thousand years?

DAVID JEWSON

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Lake Baikal in Siberia is the world's deepest lake and its sedimentary record goes back over 20 million years. Amongst the 'endemic' planktonic diatoms that are found as fossils in the sediment but still present in the lake are two species of *Cyclotella* that have coexisted for over one hundred thousand years. Culture and multidisciplinary field studies for the last 15 years have investigated the ecology of *C. baicalensis* and *C. minuta*. Morphological features of the cell wall are related to diameter and cannot be used to separate the species. Although both species can be found growing together in spring, their survival largely depends on what happens during summer stratification. Each species has evolved specialised adaptations for living at low temperatures and adjusting to the physical processes. *C. minuta* is the only planktonic diatom that manages a net cell increase in autumn and satellite thermal images will be used to show why they can do this and other species cannot. The cells of *C. baicalensis* are amongst the largest found in freshwater plankton (over 125 μm), yet they stay in suspension throughout the year, including up to 5 months under the ice.

Proteomic and genomic studies on the wound response of a marine red alga *Griffithsia monilis*

TATYANA A. KLOCHKOVA, JI WON YU, JONG WON HAN & GWANG HOON KIM

Kongju National University, Korea

When a red algal filament gets a fatal injury, a cascade of cellular event takes place. The dead cell may be replaced through the wound-healing process of cell repair. During cell repair the cells on either side of the dead cell cut off new cells towards the dead cell. The two new cells grow towards each other through the lumen of the dead cell. When they meet, they fuse; the resulting cell expands laterally to fill the cavity of the dead cell and is transformed into a typical intercalary shout cell. These processes include expression of the genes involved in cell division, production of signalling hormones and their receptors as well as cell extension factors. Several genes involved in wound response were isolated from a red alga *Griffithsia monilis* using proteomic and genomic methodologies and their possible roles in cellular re-differentiation and signalling process will be discussed compared with the wound response of coenocytic green algae.

Influence of water motion on the growth rate of *Laminaria hyperborea*

LOUISE KREGTING, GRAHAM SAVIDGE, & ANDREW BLIGHT

Queens University Marine Laboratory

Increasing interest in the commercial potential for extracting energy from waves and tidal currents inshore has led to the development of full scale prototype electricity generating devices. For one such wave device, it has been estimated that a commercially viable array may extract approximately half of the wave energy incident arriving on shore. Macroalgal growth is dependent on the movement of the surrounding medium; however the mechanism by which water motion influences the growth rate of macroalgae is multifaceted and includes nutrient transport effects, dynamic stress and suspension of light absorbing sediment. In this study we focus on the influence of the local flows on the seasonal patterns of kelp growth and the associated internal nutrient status of the plants. Measurements were made at monthly intervals from April 2009 of the growth rates of the kelp *Laminaria hyperborea* located at approximate depths of 5 m and 10 m (related to MLW) at each of two closely adjacent sites exhibiting high and low wave energy characteristics. The internal nutrient status (nitrate, ammonium and phosphate) of each population was also determined. Continual monitoring of the wave and current climate and water temperature was carried out at each site using an Acoustic Doppler Current Profiler. Relative light levels were also sampled semi-continuously while samples for the estimation of ambient seawater nutrient concentration were collected concurrently at the time of the plant surveys. The results will be discussed.

Phylogenetically-based variation in the regulation of the Calvin cycle enzymes, phosphoribulokinase and glyceraldehyde-3-phosphate dehydrogenase, in algae

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Photosynthesis is performed largely by the well-studied Embryophytes on land, but by a huge phylogenetic diversity of poorly-studied algae in water. We investigated the diversity of redox-regulation of phosphoribulokinase (PRK) and glyceraldehyde-3-phosphate dehydrogenase (GAPDH) in a wide range of algal groups under standard conditions. Redox-regulation of PRK was greatest in chlorophytes, low or absent in a red alga and most chromalveolates and linked to the number of amino-acids between two regulatory cysteine residues. Regulation of GAPDH was less variable than for PRK and not only related to the different forms of this enzyme. Addition of recombinant CP12, a protein that forms a complex with PRK and GAPDH, to crude extracts inhibited GAPDH and PRK inversely in the Plantae, but in most chromalveolates had little effect on GAPDH and inhibited or stimulated PRK depending on the species. Patterns of enzyme regulation were used to produce a phylogenetic tree in which cryptophytes and haptophytes, at the base of the chromalveolates, formed a distinct clade. A second clade comprised only chromalveolates. A third clade comprised a mixture of Plantae, an excavate and three chromalveolates: a marine diatom and two others (a xanthophyte and eustigmatophyte) that are distinguished by low content of chlorophyll *c* and lack of fucoxanthin. Regulation of both enzymes was greater in freshwater than in marine taxa, possibly because most freshwaters are more dynamic than oceans. This work highlights the importance of understanding enzyme regulation in diverse algae if their ecology and productivity is to be understood.

Barcoding diatoms: a candid view of successes and failures on the way to utopia

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The idea of using short DNA sequences to 'barcode' organisms is well established, though still controversial. In 2007, we evaluated partial *cox*1, *rbc*L, ITS rDNA and SSU rDNA as candidate barcode regions for diatoms, using the morphospecies *Sellaphora pupula* as a model system. *Cox*1 seemed optimal, giving excellent resolution of species and providing some population insights. Subsequent studies by others have revealed serious difficulties in the use of *cox*1 for other diatoms, leading to the suggestion that other genes, such as ITS rDNA or LSU rDNA may be preferable, although there is little understanding of why *cox*1 is problematic. However, for *Sellaphora*, *cox*1 remains excellent, both for primary exploration (to discover species, which is not the primary rationale for barcoding but important nevertheless in poorly understood groups like diatoms) and for characterizing diversity for identification. I will illustrate this and explore the extent to which barcode approaches replace or complement exploration of species-level diversity via morphology and mating experiments.

Cyanobacterial toxins in desert environments

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University of Dundee

Cyanobacteria are known to produce a range of toxic compounds in marine and freshwater environments. In desert environments in the State of Qatar, cyanobacteria are important components of the terrestrial environment, helping to stabilise the soil, contributing to its fertility, and permitting colonisation by other plants. We obtained cyanobacterial crusts from wadis and sabkha in Qatar and analysed these for the presence of cyanotoxins. Microcystins were identified by HPLC-PDA and ELISA and anatoxin-a(S) was detected in this environment from analysis by colorimetric acetylcholine esterase inhibition assay. In certain areas, as the desert crust can account for over 50% of the land surface, cyanotoxins may affect human health in this environment. The implications of these findings will be discussed.

Differential effects of increased CO_2 concentration and acidification on photosynthesis and growth of green and brown macroalgae

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[1]SAMS

We investigated the effects of increased CO_2 concentration and seawater acidification on the green seaweeds *Ulva lactuca*, *Acrosiphonia arcta* and *A. sonderi*, and the brown seaweeds *Laminaria digitata*, *Saccharina latissima* and *Pylaiella littoralis*. Algal discs of the sheet-like *Ulva*, filaments of *Acrosphonia* and *Pylaiella* and young sporophytes of the two thick-bladed kelp species were aerated in 1L bottles at extremely reduced (~160 ppm), pre-industrial (280 ppm), and highly elevated (700 ppm) CO_2-concentration, respectively, for 15 days at 15°C and under growth saturating photosynthetically active radiation (PAR). Water chemistry analysis showed that the CO_2-concentration correlated negatively with the seawater pH and dissolved CO_3, and positively with dissolved CO_2 and HCO_3. Increasing CO_2 concentration and the resulting seawater acidification had no significant effect on photosynthesis and growth of all brown algae examined. The green algae, in contrast, grew consistently faster at elevated than at reduced CO_2-concentrations although this effect was not always statistically significant. Our results revealed the ability of the investigated non-calcareous seaweeds to cope up with extremely low and high CO_2-concentrations to support photosynthesis and growth. The differences between brown and green algae may be related to the activity of carbon-concentrating mechanisms (CCM). There is an indication of a possible induction and suppression of CCM at low and high CO_2 concentrations, respectively, without extra energetic cost in most of the macroalgae investigated.

Monitoring rocky shore macroalgae in Scotland for the Water Framework Directive

CLARE SCANLAN & SARAH HOLT
SEPA, Aberdeen.

A monitoring tool was developed by the WFD Marine Plants Task Team for assessing the ecological status of the macroalgae of rocky shores in the U.K. and the Republic of Ireland. The tool is based primarily on species richness, but incorporates other parameters, including an assessment of the physical characteristics of the shore being surveyed.
SEPA has just completed its third year of such monitoring in Scotland. We summarise our results to date, issues encountered and possible future work.

Biofuel production and oil accumulation in micro-algae

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SAMS

Algae and plants have been exploited for centuries as a source of food. The need for replacing petroleum with renewable alternatives has led to research into biofuel production from micro-algae,

seaweeds and crop plants. We are currently undertaking screening processes to identify suitable strains of micro-algae for bio-fuel production in the Culture Collection of Algae and Protozoa (CCAP) at SAMS. Nile Red fluorescence, flow cytometry and gas chromatographic methodology will be exploited. Genetic mechanisms responsible for oil accumulation in micro-algae are poorly understood. Increased knowledge in this area is expected to lead to improvements in biofuel yield, applications and quality. Experimental approaches will be described that aim to further our understanding of the molecular factors responsible for oil accumulation in micro-algae.

Discrimination of toxic and non-toxic *Alexandrium* within a routine phytoplankton monitoring programme
SARAH C. SWAN & KEITH DAVIDSON
SAMS

Potentially harmful species of phytoplankton have been detected in Scottish coastal waters as part of routine regulatory monitoring of shellfish harvesting areas. The main organisms for concern are those that produce biotoxins, which can contaminate shellfish and pose a risk to human health if consumed. The genus *Alexandrium* is considered to be a key biotoxin–producer and toxins associated with paralytic shellfish poisoning (PSP) have been detected in shellfish harvested from classified production areas around Scotland. *Alexandrium* can be highly toxic and relatively dense blooms are not required before there is cause for concern. Hence, the presence of *Alexandrium* is taken as an indication of the potential for a PSP toxic event. Although a close link between *Alexandrium* in the water column and the present of PSP toxins can frequently be demonstrated, it has often been the case that dense *Alexandrium* blooms do not correspond to elevated shellfish toxicity. Four species of *Alexandrium* have been recorded around Scotland, one of which is *Alexandrium tamarense*. Historically, *A. tamarense* in Scottish waters was thought to be dominated by the toxic group I 'North American' strain, as opposed to the non-toxic group III 'Western European' strain found around the English coast. Analysis of *Alexandrium* populations by whole cell fluorescence in situ hybridization (WC-FISH) indicated the presence of both strains, often co-occurring at the same site. This methodology has the potential to supplement existing monitoring, and provide additional information on the likelihood of a toxic or, indeed, non-toxic event for both harvesters and regulators.

An investigation into the numbers of *Skeletonema* spp. In Loch Creran, a Scottish Sea Loch
CALLUM WHYTE
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The phytoplankton community in Loch Creran has been studied for over three decades. The number of *Skeletonema* cells observed in the loch during the annual spring bloom has fallen from over 14 million cells per litre in the 1970s to approximately 5 million cells per litre in 2008. This has been accompanied by a drop in biomass and an apparent change in the timing of the spring bloom. Various hypotheses for this change have been suggested including the detrimental effects of anti fouling compounds, increased grazing by bivalves and changes to the depth of the mixing layer. Preliminary results from these investigations will be presented.

Ligulate *Desmarestia* (Desmarestiales, Phaeophyceae) revisited: *D. japonica* sp. nov. and *D. dudresnayi* Lamouroux differ from *D. ligulata*
EUN CHAN YANG, AKIRA F. PETERS, IGNACIO BÁRBARA, DIETER GERHARD MÜLLER, WILLEM F. PRUD'HOMME VAN REINE, HIROSHI KAWAI & **FRITHJOF C. KÜPPER**[1]
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Ligulate and sulphuric-acid containing species of *Desmarestia*, occurring worldwide in temperate regions, were revised using a multi-genic and polyphasic approach. Sequence data, gametophyte characteristics and sporophyte morphology suggest the merger of 16 taxa in four different species. (1) *D. herbacea*, containing broad-bladed and richly branched forms, has dioecious gametophytes. The three other species have monoecious gametophytes: (2) *D. ligulata* which is profusely branched and, except for one sub-species, narrow-bladed, and (3) Japanese ligulate *Desmarestia*, here described as *D. japonica* sp. nov, which is morphologically similar to *D. ligulata* but genetically distant from all other ligulate taxa. This entity may have conserved the morphology of early ligulate *Desmarestia*. (4) *D. dudresnayi* includes unbranched or little branched broad-bladed taxa. A figure of the holotype of *D. dudresnayi*, the track of which was lost for decades, was relocated. Overall, this study contributes a timely re-assessment and simplification of the taxonomy of ligulate *Desmarestia* species.

Dynamic gene evolution in the *Ectocarpus* ROCO-LRR and NB-ARC-TPR proteins suggest a potential role in immunity_
ANTONIOS ZAMBOUNIS[1], MAREK ELIAS[2]& CLAIRE M.M. GACHON[3]
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Pathogen recognition is a critical first step leading to the onset of immune reactions. In animals and plants, direct or indirect pathogen recognition is mediated by a wealth of fast-evolving receptors and multigenic families, many of which contain ligand-binding and signal transduction domains, such as leucine-rich or tetratricopeptide repeat- (LRR / TPR) and NB-ARC domains, respectively. In order to identify candidates potentially involved in algal defence, we mined the Ectocarpus genome for homologues of these genes, and assessed the evolutionary pressures acting upon them.
We identified 269 LRR-containing genes, in particular a subfamily of ROCO LRR-GTPases, as well as a group of 24 NB-ARC-TPR proteins. Their organization in clusters is typical of fast-evolving families, whilst dN/dS calculations indicate diversifying selection acting on their LRR (respectively TPR) domain. Their sequence variability is underpinned by a remarkable intron-exon organisation whereby an individual LRR (respectively TPR) module is encoded by an exon, associated to signs of active exon shuffling. Altogether, we conclude that the Ectocarpus ROCO-LRR and NB-ARC-TPR families have a tremendous potential for genetic variation, and therefore constitute good candidates for being involved in recognition / transduction events linked to immunity. More generally, this works illustrates the potential of genome mining in order to identify candidate genes performing a specific set of functions.

Manton prize presentations

***Dictyosphaerium*- a genus with underestimated genetic variability**
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Members of the colonial coccoid green algal genus *Dictyosphaerium* Nägeli are common in freshwater habitats and characterized by a typical colonial morphotypes. The mother cell divides into four daughter cells during the autosporulation, which stay attached to the remnants of the mother cell wall. These remnants form gelatinous stalks which can lead to huge colonies with up to 64 cells and more. The cell shape and size, the connection to the stalks and the colony size can vary, and this variation was used for species delineation. Our

molecular analyses based on SSU and ITS rRNA gene sequences revealed a cryptic genetic diversity of the morphotype within the Chlorellaceae. Strains with the morphology of the type species *D. ehrenbergianum* evolve next to *Parachlorella* within the *Parachlorella*-clade of the Chlorellaceae and assigned the genus to the *Parachlorella*-clade. Next to *D. ehrenbergianum* cluster were different strains which correspond to other species within the genus *Dictyosphaerium*. The *Parachlorella*-clade consisted formerly only of members of the genera *Parachlorella, Dicloster* and *Closteriopsis*. According to our analyses, several independent lineages with the *Dictyosphaerium*-morphotype evolve in this clade, forming probably new genera in addition to the already known lineage characterized by *D. ehrenbergianum*. Surprisingly, strains with the morphology of different *Dictyosphaerium* species cluster not only in the *Parachlorella*-clade but in the *Chlorella*-clade as well, even intermixing with members of the genus *Chlorella*. These results demonstrated the paraphyletic origin of the *Dictyosphaerium*-morphotype and raised the question, whether formerly recognized species correspond genetically to new genera.

Impact of ocean acidification on the growth and productivity of *Symbiodinium*

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University of Essex

Studies on reef-building corals have shown that ocean acidification (OA) is likely to slow growth and productivity. Whilst these studies have rightly focused on the coral 'holobiont', examining the coral's symbiotic algae (dinoflagellates of the genus *Symbioidinium* spp.) in isolation is a necessary, if not critical, step in understanding key mechanisms by which OA impacts coral productivity. In addition, studying *Symbiodinium* in its free-living mode may also yield insight as to how other dinoflagellates may be impacted by OA. We examined the response, in terms of growth, productivity and resource allocation, of four different *Symbiodinium* phylotypes (A1, A1.1, A2 and B1) to OA conditions. Continuous cultures were acclimated to present day pCO_2 levels (380 ppm, pH 8.05) before undergoing a gradual pCO_2-shift to elevated conditions (780 ppm, pH 7.79) predicted for the year 2100. Rates of photosynthesis (Chl *a*-normalised gross oxygen evolution) remained unchanged for all phylotypes except A2, where it more than doubled. In addition, an increase in growth rate (d^{-1}) was observed for phylotype A1.1 (~1.6 fold increase) but not for the other phylotypes. Thus, the response of *Symbiodinium* to ocean acidification is phylotype-specific. These data will be discussed relative to cellular resource allocation (carbon and nitrogen) and mechanisms underpinning changes of productivity (via active fluorometry and membrane inlet mass spectrometry measurements). The implications of these findings for primary productivity, both as free-living phytoplankton and as symbiotic microalgae of reef-building corals, are explored.

Using microsatellites to determine bloom composition under conditions of viral and nutrient stress in the marine coccolithophorid *Emiliania huxleyi*

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National Oceanography Centre Southampton, University of Southampton

Emiliania huxleyi is a single-celled eukaryotic phytoplankton found throughout the world's subpolar oceans. During the North Atlantic summer, *E. huxleyi* cells are known to rapidly proliferate, forming extensive blooms which export large amounts of calcium carbonate to ocean sediments. Here we examine the genotypic composition of *E. huxleyi* populations isolated throughout two virally-affected mesocosm blooms of differing nutrient conditions in a Norwegian fjord (2008). Previous molecular studies of phytoplankton have successfully used highly variable regions of DNA called microsatellites to investigate genetic diversity at the intra-specific level. To our knowledge, this study is the first to apply microsatellite techniques to *E. huxleyi* isolates collected over the course of a bloom. Five previously-developed microsatellite loci were used to seek out patterns of genetic variation within 143 clonal *E. huxleyi* isolates. Analysis revealed a large amount of clonal diversity (5% to 45% of alleles showed unique length variations). Pair-wise comparisons between sampling days revealed highly significant variation both among individuals collected from a single sample (22% of total variation) and among individuals collected from different samples (77% of total variation). F_{ST} analysis revealed very few significant results, suggesting that differing viral numbers and nutrient conditions were not associated with genetically distant populations on the timescale sampled. In addition, significant heterozygote deficiencies were observed during all stages of both blooms. The results show that microsatellites are sufficiently variable molecular markers to detect fine-scale genetic variation in *E. huxleyi* blooms and are a first step in analyzing *E. huxleyi* population dynamics over time series.

Performance of microalgae for power-plant CO_2 mitigation

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Microalgal photobioreactors have been proposed as a viable technology as part of the process for capturing the carbon dioxide emitted in power plant flue gas. The benefits of such processes might include reduced costs of CO_2 emission from fossil fuel plant, coupled with bioenergy production. From the perspective of process efficiency, we examined the fate of photosynthetically fixed carbon in mass algal cultures. *Chlorella vulgaris* and *Dunaliella tertiolecta* were cultured in 20 L photobioreactors. Culture performance throughout the growth cycle was measured by sampling the particulate and dissolved carbon and nitrogen pools. As expected, dissolved organic carbon accumulated throughout growth, reaching a maximum of 7% and 18% of total organic carbon at the end of the growth period in the two species respectively. This indicates a potentially significant loss of biomass to the culture fluid which, if not recovered, could lead to a reduction in the achieved light-to-biomass energy conversion efficiency of microalgal technologies. The release of organic matter into the culture filtrate was also investigated by measuring the optical properties of the dissolved organic matter. Spectrophotometric measurements of chromophoric dissolved organic matter showed a strong increase in absorption throughout growth, suggesting that this technique might be suitable for making cost–effective routine measurements of dissolved organic matter in microalgal cultures. These results will be discussed within the context of overall efficiency of growing intensive algal cultures as part of carbon capture technology.

The effect of antibiotics on microbial DMSP catabolism.

ANDREW MOGG, NATALIE WAGER, DAVID GREEN, MARK HART, & ANGELA HATTON
SAMS

The biogenic gas, dimethylsulphide (DMS), is theorized to influence the Earth's radiation balance. The main pathway for the production of DMS appears to be via the conversion of the algal precursor molecule dimethylsulphoniopropionate (DMSP) and both bacteria and algae have been implicated in this process. Here we present the results of a field experiment to assess the relative importance of natural algae and bacteria in DMSP catabolism, using antibiotics as a bacterial inhibitor. Initial findings show that, in the presence of standard antibiotics, the conversion of DMSP to DMS by natural algal-bacterial communities is greatly reduced. However, the effect of antibiotics on algae deserves more attention.

Cyanotoxins in Irish Lakes: Detection and environmental change

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There has been little research done on the occurrence and distribution of cyanotoxins in lakes in the north of Ireland. With many lakes and ponds used for recreation, tourism and potable water, it is important to assess the possible risks posed by cyanotoxins present. As a result of changing nutrient conditions of the lakes due to the Nitrates Directive, increasing water temperatures and the invasion of zebra mussels, the cyanobacterial composition of these lakes is also changing. The ability of zebra mussels to also influence the production of microcystin toxins has been well documented, although often with conflicting results. Also, there have been many reports of the influence of environmental factors such as temperature, irradiance, phosphorus and nitrogen levels on the occurrence and production of microcystins. Over the past year a series of surveys was carried out on 30 different lakes in Ireland to examine the cyanobacterial biodiversity and the occurrence of microcystin toxins. A range of environmental variables and zebra mussel presence were also measured. The main cyanobacteria present are all potential toxin producers, forming blooms in late summer: *Anabaena flos-aquae*, *Aphanizomenon flos-aquae, Microcystis aeruginosa* and *Planktothrix agardhii*. High performance liquid chromatography-tandem mass spectrometry (HPLC-MS/MS) was used to detect several different microcystin variants, present in all lakes surveyed and phosphorus was correlated with microcystin concentrations. A more intensive parallel study was also carried out on the two major lakes in Northern Ireland, Loughs Neagh and Erne to determine if there was any seasonal or environmental influence on the occurrence of microcystin toxins.

Development of methods for assessing the quantitative ecology of phytoplankton chytrid parasites

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Recent studies have unveiled a substantial diversity of parasites among microbial eukaryotes in pelagic ecosystems. In freshwaters, the retrieved diversity of parasites was dominated by fungi, primarily chytrids which are infectious agents of various prokaryotic and eukaryotic phytoplankton species. Chytrids are characterised by the production of fruit body (sporangium) from which disseminating propagules (zoospores) are released, and the related epidemics can represent a powerful shaping force for host species evolution, coexistence, and population dynamics. However, few quantitative data are available, mainly because of methodological limitations. We have developed two complementary methods for the study of the two life stages of pelagic chytrids, based on size fractionation of natural samples. Sporangia where analysed via epifluorescence microscopy following specific staining with the fluorochrome calcofluor white, while zoospores where quantified via a rRNA oligonucleotide probe that we have designed for fluorescence in situ hybridization (FISH). Both protocols were applied to natural freshwater samples collected during different seasons in two French lakes. The diversity of chytrids and the prevalence of infection increased from the oligotrophic Lake Pavin to the eutrophic Lake Aydat, while temporal changes in parasites seem influenced by the host community composition. The molecular probe offers a quantitative tool for distinguishing zoospores in natural samples and values were higher in Lake Pavin than in Lake Aydat, reaching up to 36 % of the total abundance of nanofla*gellates*. The ecological implications of these findings are discussed in the context of aquatic microbial food web dynamics.

Investigating the role of hypo-osmotic stress during early stage propagule development in shaping *Fucus* community composition.

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MBA, UK & Bristol University

Temperate rocky shore habitats comprise complex interacting physical gradients and show temporal fluctuations in a number of environmental parameters. The varying levels of stress associated with these gradients and fluctuations contribute to the competitive interactions between organisms in this habitat. On the other hand, physical heterogeneity creates numerous potential ecological niches that may underlie both high biodiversity and biomass. The resistance to physical stress of fucoid algae has previously been demonstrated through adaptive mechanisms within established adult populations. However, this has not been fully examined in early developmental stages, such as gametes and embryos that are potentially exposed to the same physical factors as adults and are likely to be more vulnerable to stresses. We have demonstrated that zygotes and embryos of three different *Fucus* species that colonize different heights on the shore display different physiological strategies for tolerating osmotic stress. We have developed new approaches to monitor fucoid propagule supply and recruitment *in situ*. Field studies reveal that physiological tolerance mechanisms identified from laboratory experiments have real ecological relevance in terms of survival, recruitment, and community.

Studies on diversity, taxonomy and distribution of microalgae in Mansar-Surinsar wetland of Jammu, Jammu and Kashmir State, India: Ecological significances and potential applications.

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The present studies have been conducted in Lake Mansar & Lake Surinsar from May 2007 to April 2009 to get an estimate of algal diversity in an unexplored and important wetland of Jammu & Kashmir State. The lakes together comprise a composite fresh water wetland (a Ramsar Site) with total area of 350 ha located in lower Western Himalayas of India. In addition to providing drinking water for local inhabitants, these lakes also form an ideal habitat and breeding ground for many endangered and threatened avifauna and aqua fauna. There are severe threats to these water bodies viz., extraction of water for irrigation and drinking, siltation, anthropogenic pressure, soil erosion, agricultural and municipal waste contaminations etc. that have devastating effects not only on the algal diversity but also on the physico-chemical characteristics of the habitat water.
In total, 212 species of microalgae belonging to five major classes i.e., Chlorophyceae (36%), Cyanophyceae (32%), Bacillariophyceae (24%), Xanthophyceae (5%) Euglenophyceae (3%) have been taxonomically enumerated and identified. Interestingly, species like *Chlorococcum humicola* Naeg., *Closterium dianae* Ehrenb., *Cosmarium granatum* Breb., *Ankistrodesmus spiralis* Turn., *Oedogonium curvum* Pringsh., *Nostoc calcicola* Breb., *Bulbochaete nana* Wittr., *Coelastrum microporum* Naeg., *Spirogyra polymorpha* Kirch., *Spirulina major* Kutz., *Chlorella vulgaris* Beij., *Pediastrum tetras* Ehrenb., *Pinnularia viridis* (Nitzsch) Ehrenb., etc., are important as they constitute basic food components of turtle species viz., Indian Flapshell Turtle (*Lissemys punctata);* Indian Soft-shell Turtle (*Aspideretes gangeticus)* and herbivores fishes like *Puntius chonchonius, Channa gachua, Rasbora rasbora, Labeoa rohita, Trichogaster fasciatus, Danio rerio, Mastacembelus armatus,* and *Ophiocephalus punctatus* inhabiting these lakes. Currently we are working on applications of some algal strains as supplement fish feed. In addition to other ecological significances, recommendations on future perspective of utilizing microalgae for aquaculture development in the region also have been discussed.

Is a changing environment affecting phlorotannin production and germination in zoospores of three kelp species from Spitsbergen?

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University of Bremen

Kelps are important primary producers group in marine coastal ecosystems. Their zoospores represent the bottle neck in kelp life history due to their high susceptibility to changing abiotic factors in particular temperature and radiation conditions. With respect to UV radiation, the polyphenolic phlorotannins are under discussion to predict future consequences for kelp distribution and survival. Consequently, the intention of this study was to test whether phlorotannins in kelp zoospores can be induced by changes in radiation conditions and temperature and how these changes influence their performance. Zoospores of *Alaria esculenta, Laminaria digitata* and *Saccharina latissima* from Spitsbergen were exposed to four temperatures between 2 and 17°C, under elevated levels of UVR and high photosynthetically active radiation (PAR) to provide different stress levels related to natural conditions in the present or in the near future, respectively. Phlorotannins in the external medium and in the zoospores were measured by Folin-Ciocalteu method and germination rate was used as a fitness parameter. Germination strongly decreased at high temperatures, under UV-B and high PAR exposure in all three species. Especially, the combination of high PAR and UVR had scathing effects on germination pattern. In contrast, phlorotannin concentrations did not change much under any of the provided stress scenarios neither within the external medium nor within the zoospores. This leads to the conclusion that increasing temperatures and enhanced UVR will strongly affect kelp zoospores germination and that the potential of phlorotannins to act as UV-and high PAR protective substances in early life stages is limited.

Proteomic investigation of the compatible interaction between *Ectocarpus siliculosus* and the oomycete pathogen *Eurychasma dicksonii*

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The Scottish Association for Marine Science

The intracellular, obligate-biotrophic pathogen *Eurychasma dicksonii* is the most widespread eukaryotic pathogen of marine brown algae, and also the most basal member of the oomycete lineage. This algal parasite has the broadest host range described so far for marine pathogens and occurs worldwide in cold and temperate waters. Currently, nothing is known about the molecular biology of the interaction between this generalist pathogen and its brown algal host. Therefore we have established molecular tools to address the questions of algal stress response and oomycete infection strategies. Proteomic investigation of the susceptible interaction between *Ectocarpus siliculosus* CCAP 1310/4 and *Eurychasma* CCAP 4018/1 via two-dimensional electrophoresis revealed a number of proteins that are differentially expressed during the course of infection.
These results represent first insights into the response of *Ectocarpus siliculosus* upon biotic stress.

Abstracts for Poster presentations

First observations of a *Pseudo-nitzschia subpacifica* bloom in Scottish waters

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Marine Scotland - Science

The diatom genus *Pseudo-nitzschia* (Peragallo) observes a distinct seasonality in Scottish waters. Members of the *P.* '*delicatissima* type' group (diameter <3µm) dominate the spring diatom bloom while members of the *P.* '*seriata* type' group (diameter >3µm) can dominate in late summer/early autumn. Examination of *Pseudo-nitzschia* populations since 2001 using transmission electron microscopy (TEM) has shown the summer/autumn *Pseudo-nitzschia* blooms to be dominated by the domoic acid producing species *P. australis* and *P. seriata*. During 2008, TEM analysis of a *P. 'seriata* type' bloom collected from the Shetland Islands revealed the presence of a bloom of *P. subpacifica*. *P. fraudulenta* was also observed. This study represents the first record of a bloom of *P. subpacifica* in Scottish waters.

Intertidal macroalgae ecology in a tidal rapid environment within the Channel Islands.

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Knowledge relating to intertidal macroalgae ecology in tidal rapid environments is patchy, particularly within the Channel Island region. Such environments are becoming increasingly important due to future applications of offshore marine renewable devices. Combining standardised survey methods with experimental sampling strategies has the potential to further understand these areas.
Macroalgae abundance and community composition were assessed seasonally every three months for a period of one year at two bays on Alderney, adjacent to the Alderney Race tidal channel. Bays were split into three sections based on shoreline heights, with five 100 meter fixed transects located within each section. Ten random 0.5 m² quadrats were assigned along each transect, with macroalgae assessed in terms of abundance and canopy percentage cover. Five experimental 0.5 m² tiles were also randomly placed within each shore height at both bays and assessed in terms of macroalgae abundance, percentage cover and rate of colonisation. A total number of 42 macroalgae taxa were identified; with both bays dominated by fucoids during all transect survey sampling seasons and shore heights. Understorey and cryptic species were located in lower shore environments throughout the year, with opportunistic species such as *Enteromorpha* and *Ulva* species increasing during spring and early summer sampling seasons. Tile surveys portrayed comparative successional temporal patterns, with initial opportunistic species growth in early spring succeeded by fucoid sporeling growth and cover. This combined survey approach outlined macroalgae seasonality and colonisation in a tidal rapid environment which could be applied to marine renewable baseline impact assessment schemes.

Effects of demersal trawling on phytoplankton cyst redistribution

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Marine Scotland – Science

Demersal trawling can have a significant impact on benthic communities in the marine environment. However, little work has been performed to examine how it influences the re- distribution of phytoplankton resting cysts that are present in the sediment. To investigate this impact, three different ground gear segments, characteristic of the ground gears of trawl fishing gears, and a trawl door were towed in the Moray Firth on the Scottish north east coast. The sediment plume behind each of these gear components was examined for the presence of phytoplankton resting stages. *Protoperidinium* spp., *Protoceratium* spp., 'round brown' type cysts and unidentified diatom cysts were dominant within the resuspended sediment plume. Analyses indicate that different gear components can influence concentrations of cysts resuspended, suggesting that fishing with certain gear types can influence the redistribution of phytoplankton resting stages in the marine environment.

Co-Digestion of Microalgal Biomass with Cellulose for Hydrogen Production

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The mass culture of microalgae has been proposed as a technology potentially suitable for carbon dioxide mitigation from fossil-fuel power plant, and for the production of biofuel. The anaerobic digestion of algal biomass may be an option for improving the economic viability of microalgal bioenergy processes. In this work, the untreated biomass of two microalgal species, *Chlorella vulgaris* and *Dunaliella tertiolecta*, was tested as a co-substrate with cellulose. Experiments were carried out using an anaerobic cellulolytic consortium maintained under thermophillic conditions, and the following parameters were measured: head-space gas composition, short chain fatty acids (SCFA), VSS (inc. elemental composition - carbon hydrogen, nitrogen, sulphur)), and ammonium. After five enrichment phases the maximum hydrogen yield was 8.1 mmol/g VS, and was obtained from a 1:2 wt/wt ratio of *D. tertiolecta* biomass to cellulose. This compared to just 4.9 mmol/g and 2.5mmol/g H_2 obtained from cellulose and *D. tertiolecta* biomass alone. *C. vulgaris* yielded 4.5 mmol/g H_2 when used exclusively, and 3.5 mmol/g H_2 when combined with 1:2 wt/wt with cellulose. No CH_4 production was detected in any of the treatments. Degradation of D. tertiolecta biomass was accompanied by a decrease in C:N ratio, while *C. vulgaris* showed comparatively little change in elemental composition. The dominant SCFAs produced by *D. tertiolecta* decomposition were acetic and butyric acid, *C. vulgaris* produced predominantly butyric acid, whilst cellulose alone produced mainly lactic and butyric acid. It was concluded that the co-digestion of *D. tertiolecta* biomass with cellulose could significantly improve the overall H_2 yield of the two substrates. *Chlorella vulgaris* seemed resistant to degradation, reflected in both H_2 yield and elemental composition, possibly due to the presence of a robust cell wall.

Time course study of oxygen production in the kelp *Laminaria digitata* in two contrasted environments of the French side of the English Channel

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Université de Lille, France

Photosynthetic rates of marine macroalgae are highly dependent on the constant variation of abiotic factors such as light, temperature and nutrient availability that can vary on many different time scales. Changes of the solar irradiance as well as local specificities of a site can modulate both the total amount of light received by macroalgae during a day as well as the extreme values of light. Present methods used to investigate photosynthetic rates of subtidal macroalgae, such as modulated fluorescence (Diving PAM), require specific logistic like scuba-diving and as a consequence, sampling is limited. The autonomous closed-chamber we developed allowed high frequency monitoring. Responses of *Laminaria digitata* photosynthetic rates along whole tidal cycles were thus investigated by continuous measurements of the oxygen fluxes. Comparisons were obtained in both contrasted seasons and contrasted environments (Western and Eastern parts of the French side of the English Channel). Results highlighted (1) the evidence for a seasonal acclimation of photosynthetic parameters and (2) the differential patterns of oxygen production between two distinct populations of *Laminaria digitata* in two contrasted environments. This system, combined with complementary fluorescence measurements and pigment analysis, provides a new tool to study in detail the photosynthesis of aquatic plant under natural field conditions during immersion.

Interannual variation of the diatom genus *Skeletonema* (Greville) in Scottish waters

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Marine Scotland - Science

Marine Scotland - Science operates a coastal ecosystem monitoring programme around the Scottish coast where long term phytoplankton time series are being generated at six sites. Considerable regional and interannual variation has been observed in the recorded intensity of the spring diatom bloom. The diatom genus *Skeletonema* (Greville) comprises a significant component of this spring bloom. Analysis of time series data from 2001 shows *Skeletonema* was observed at lower cell densities from 2001 – 2004 on the east and west coasts and in the Northern Isles. Increased *Skeletonema* abundances were recorded during the period from 2005 to 2008. This increasing trend corresponds with increased numbers of the large *Calanus* spp. copepods observed since 2006 at the east and west coast Scottish sites where zooplankton is sampled concurrently.

Can Raman spectrometry discriminate between 'blue' diatoms ?

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[3]-MMS Nantes, Université de Nantes, France
[4]-Karadag Natural Reserve of the National Academy of Sciences, Ukraine.

Since its description as *Vibrio ostrearius* in 1820, the marine diatom *Haslea ostrearia* (Gaillon) R. Simonsen has long been considered as the only organism able to produce marennine, a specific hydrosoluble blue pigment which accumulates in cell apices. Methods to purify and quantify marennine allowed its characterisation as an original blue polyphenolic pigment. Multiple analyses have been carried out on marennine but its chemical structure still remains unexplained. Another diatom which also produces a bluish pigment, has recently been isolated in the Black Sea. Its pigment has been purified, and is still under analyses. These two diatoms have not interbred, and are probably different species, which raised a concern about occurrences of 'blue' diatoms previously identified as being *H. ostrearia* in other marine environments. A request for samples of 'blue' diatoms posted on ALGAE-L and DIATOM-L lists allowed to get samples from Sweden (Dr Angela Wulff), Canary Islands and Mediterranean Sea (Dr Gert Hansen). These strains were preliminary studied by scanning electron microscopy. Microscopy data showed that the Swedish diatom and *H. ostrearia* are very similar, and the three other strains present significant morphological differences.
The blue pigments of the different strains were studied using micro-Raman spectrometry because this technique is simple, non-destructive and can be used *in vivo* in aqueous media. The comparison of Raman spectra with the spectrum corresponding to marennine shows clearly two varieties of pigments: marennine in French (Atlantic Ocean and Mediterranean Sea), Swedish, Canarian and Mediterranean strains and a marennine-like pigment present in the Ukrainian diatom.

In situ measurements of photosynthetic oxygen exchange by a fully-automated benthic chamber under immersed conditions: preliminary results in _Laminaria digitata_

F. GEVAERT, G. DELEBECQ, D. MENU & L. BRUTIER
Université Lille1, France

A new fully automated closed-chamber system was developed in order to provide accurate measurements of the photosynthetic responses of large marine algae *in situ* during immersion under the interactive effects of the conditions experimented in the field. Either entire macroalgae or parts of a thallus can be placed inside the chamber under a transparent Perspex dome. Circulation and homogenization of the media inside the chamber are assumed by two external pumps. A third pump is also connected to the chamber and allows an intermittent renewal of the water enclosed in the chamber in order to maintain the algae in conditions close to ambient environment and to avoid supersaturation. The filling of the chamber and the renewal of the medium is only possible when a liquid level sensor detected water around the chamber. All the mechanics are driven by an electronic card that allows choice in the filling time, the time of measurement and the time of the renewal of the medium. Environmental parameters values (dissolved oxygen concentration, light, temperature, pH, conductivity) are recorded inside the chamber during incubations periods. Dissolved oxygen concentrations are assessed by a novel method based on lifetime optical fluorescence sensor technology (Optical Dissolved Oxygen Sensor) that provides an extremely stable and precise measurement of dissolved oxygen. Preliminary results, obtained in *Laminaria digitata* are discussed.

Biodiesel Production from Microalgae

D. J. GILMOUR
University of Sheffield

Global warming, energy security and increasing energy demands in the context of decreasing petroleum reserves are the drivers for intensified interest in new sources of fuels. Transportation fuels make up 27% of global energy requirements and it is the fastest growing sector. First generation biofuels were based on crop plants, e.g. ethanol from corn or biodiesel from soybean. A major problem with first generation biofuels was competition with food crops leading to food price increases. Second generation biofuels based on the lignocellulose (woody) parts of plants avoid this problem, but require the lignocellulosic feedstocks to be converted to sugars via chemical and/or microbiological pre-treatment. This is a significant cost increase and technologically difficult. Therefore, third generation biofuels from microalgae are generating a lot of interest as a better alternative to first or second generation plant based biofuels. A range of microalgae, including *Nannochloropsis, Isochrysis, Tetraselmis* and *Dunaliella,* are potential producers of biodiesel due to their ability to accumulate triacylglycerol (TAG) to at least 20% of dry weight. Downstream processing of the TAG uses the well established transesterification reactions from first generation biodiesel production. The major limitations to the use of microalgae for biodiesel production are: scaling up biomass production in outdoor ponds or photobioreactors and harvesting the algae biomass in an energy efficient way.

Comparison of Expressed sequence tags from male and female gametes of _Scytosiphon lomentaria_

JONG WON HAN, TATYANA A. KLOCHKOVA, JUN BO SHIM, RHO WON KIM & GWANG HOON KIM
Kongju National University, Korea

We analysed sex-related genes in a brown alga *Scytosiphon lomentaria* by comparison of EST libraries. The total of 4,067 expressed sequence tags (ESTs) from male and female gametes of *S. lomentaria* were analysed. Clustering and assembly of these ESTs resulted in a total of 2,342 unique sequences with 323 contigs and 2,019 singleton ESTs for the two libraries. About 20% of genes known and putative functions could be assigned that corresponded to 965 protein functions and distribution between male and female was similar. But 80% of genes were unknown (13%) or no hit (67%) (e-values, >1.0 x e^{-5}). Total 456 sex specific genes (219 male specific genes and 137 female specific genes) were detected among two libraries including singleton ESTs and only 46 contigs (consists more than 3 sequence tags) were related sex specific (17 male specific and 29 female). We confirmed sex specific regulation of those genes and discussed about specific roles.

Algal recovery of an estuarine tidal embayment formerly subject to acid mine drainage and papermill waste

VICTORIA HANNING & **MARTIN WILKINSON**
Heriot-Watt University

The Inner Bay at Inverkeithing (Fife, Scotland) is a partially land-locked tidal embayment with a long history of anthropogenic input from acid mine drainage (AMD), paper mill effluent, ship breaking and a quarry. The paper mill waste was treated starting 1999 and ceased in 2003 and the AMD has been treated at source for about 10 years. A comparison was made of benthic algal parameters in the Bay between 1981 and 2009 to determine change consequent on reduction of the effluents. Species richness of seaweeds has increased only slightly from 23 to 29 species, but with the addition of major zone-forming species *Ascophyllum nodosum* and *Pelvetia canaliculata*, absent in 1981. The levels of microphytobenthic chlorophyll were slightly lower than in 1981, possibly owing to seasonal difference in sampling times, but the photosynthetic oxygen exchange of the sediments under standard laboratory conditions was an order of magnitude higher in 2009 on both a unit chlorophyll and an area basis. The low seaweed species richness, despite some recovery, suggests the estuarine nature of the embayment is a factor in its biological impoverishment, besides the anthropogenic inputs, supported by lower growth of fucoid explants in the Bay compared with surrounding open coast sites.

Iodine speciation in marine microalgae cultures: _Isochrysis_ aff._galbana_, _Dunaliella salina_, _Chaetoceros gracilis_ and _Phaeodactylum tricornutum_

L. HERNÁNDEZ JAVIER, S.VAN BERGEIJK & J. PEDRO CAÑAVATE.
IFAPA Centro El Toruño, Spain

The growth of four species of microalgae, (*Dunaliella salina, Chaetoceros gracilis, Isochrysis* aff. *galbana* (T-iso) and *Phaeodactylum tricornutum)*, together with iodine speciation was studied in natural seawater and in artificial seawater medium prepared without iodine addition. A special methodology was developed for the measurement of iodine species in the experimental seawater media. Particularly, adaptations of the existing electrochemical methods for measuring iodide (Campos, 1997) and iodated in seawater (Herring and Less, 1974) by CSSWV and DPP, respectively, were proposed with an acceptable accuracy. The detection limit was determined to be in 7.8 no for iodide and 30 no for iodate in artificial seawater. The results showed that microalgae grew well in medium with very low iodine concentrations, which suggests that iodine does not play an essential role as a microelement for algal growth. However, new experiments should be designed to explore what exactly is the I-requirement of microalgae.

An investigation into marine biofouling and its implications on the durability of treated and untreated concrete sea defences

PETER HUGHES,
University of Central Lancashire

Marine biofouling, the colonisation of concrete sea defences, by unwanted biological organisms, is a major and expensive problem for many coastal authorities. This research will investigate how and why algae colonise marine concrete sea defences and examine its effects upon concrete durability. It will focus on algae spore interaction with the concrete surface, settlement, adhesion, 'pull-off' damage and how the colonisation may be controlled and reduced. The action of concrete cleaning methods (both physical and chemical) on concrete sea defences can alter their properties and may alter the susceptibility of the concrete to algal growths. The colonisation of the new concrete revetment armour units at Blackpool's central area coastal protection scheme, by algal growths is investigated in terms of their dependence on certain physical and chemical parameters of the environment and the concrete including the supply of nutrients, surface roughness and moisture availability. This work will examine how nanostructured coatings, engineered surface topography and photocatalytic 'self cleaning' concrete may discourage marine biofouling, and evaluate the effects and performance of anti-fouling and fouling-release coatings.

Comparison of fucoid community measures with Water Framework Directive tool scores for a range of shores in the Firth of Forth

JOSIANE KIRK & **MARTIN WILKINSON**
Heriot-Watt University

Eight shores ranging from the outer Firth of Forth (Scotland) to the lower Forth estuary, including both rich shores and those known to have suffered considerable anthropogenic impact, were used to compare aspects of the growth of apical frond tip explants of *Fucus vesiculosus* with measures of the naturally-occurring fucoid community and with Ecological Quality Ratio (EQR) scores for each shore calculated using the Reduced Species List (RSL) and Full Species List (FSL) tools for monitoring for the European Water Framework Directive (WFD). Growth rate of explanted segments and photosynthetic and respiratory rates and ion leakage after 5 weeks explantation were similar for all shores except Joppa, a site of well-documented sewage impact, where growth, photosynthesis and respiration were significantly lower and ion leakage significantly higher. Natural populations of *Fucus vesiculosus* varied between the sites but at Joppa and the other formerly sewage impacted site, Granton, large numbers of small plants had reached reproductive maturity at a significantly smaller size than at the other sites. EQR scores differed between all shores, with the lowest scores at the sewage-impacted shores, but were generally higher with the FSL than with the RSL. In this study the EQR scores discriminated shores more than did the fucoid measures.

The shorter, the better? Duration of Rapid Light Curves (RLCs) for determining in situ the photosynthesis of microphytobenthos biofilm

LEFEBVRE S., MOUGET J.-L. & LAVAUD J.
Université du Maine, Le Mans, France

Rapid light response curves (RLCs) using pulse amplitude modulation (PAM) fluorimetry are especially convenient to assess *in situ* the high spatio-temporal variability and dynamics of microphytobenthos (MPB) photosynthetic productivity. However the photoacclimation of the MBP cells and the light dose accumulation during RLCs strongly influence the pattern of RLCs and the subsequent determination of photosynthetic parameters ($rETR_{max}$, α and E_K). This drawback is directly dependent from the duration of RLC irradiance steps; a feature which has been established only in laboratory conditions. We have investigated on intertidal mudflat MPB biofilms the effect of 10 s and 30 s duration of irradiance steps under *in situ* high and fluctuating incident light. Although a similar trend of MPB cell photoacclimation was observed with the 10 s- and 30 s-RLCs, there were significant differences highlighted by frequent underestimations of α-10 s or $rETR_{max}$-30 s. Discrepancies were mainly explained by the occurrence of photoprotective non-photochemical quenching (NPQ) which differently impacted the 10 s- and 30 s-RLCs. Consequently, a good, fast (with 10 s-RLCs), direct and simultaneous determination of $rETR_{max}$ and α was virtually impossible. We positively tested a correction made *a posteriori* of α-10 s via the re-estimation of E_K based on the NPQ light kinetics. Thanks to this procedure, we propose that 10 s irradiance steps (the shorter) offer the most reasonable compromise (the better) for the RLC assessment of MPB photosynthesis *in situ*, overcoming its variability and dynamics.

Iodine in algae: significance in nature and possible health effects - some preliminary results from a biodegradation experiment

UDO NITSCHKE, PETER PA SMYTH & DAGMAR B STENGEL,
National University of Ireland, Galway

Brown macroalgae accumulate significant amounts of iodine from seawater, and iodine volatilisation into the atmosphere is thought to be linked to the formation of marine aerosols which influence climate change and air quality. The release of algal iodine may thus play a key role in the Earth's iodine cycle. Iodine is also an essential micronutrient for the human diet and both iodine deficiency and excess can cause health problems. This project aims to understand how algal biodegradation and abiotic stresses contribute to algal iodine effluxes that potentially affect human health. Work will focus on longterm iodine effluxes from different brown macroalgae and their contribution to seawater and atmospheric iodine concentrations. Furthermore, culture experiments will be conducted to assess the role of iodine in algal responses to different environmental regimes (e.g., temperature, light, salinity). Finally, tissue culture experiments with different extracts of iodine rich brown seaweeds will be used to investigate a potentially antiproliferative effect on breast cancer cell lines. Here, a biodegradation experiment was conducted to quantify the iodine release of *Laminaria digitata* (Laminariales) and *Fucus serratus* (Fucales) over three weeks under low temperature and low light conditions in culture. Maximum PS II quantum efficiency (F_v/F_m) remained unaffected over the duration of the experiment, suggesting that the environmental conditions used only caused little physiological stress. Preliminary results show that both species loose remarkable amounts of iodine into seawater even under lowstress conditions, which appear to be independent of initial iodine content. The absolute amount of released iodine from both *L. digitata* and *F. serratus* was similar.

Characterisation of pigment levels and composition in the brown seaweed *Ascophyllum nodosum* in Galway Bay

CHRISTINA O'ROURKE, SOLÈNE CONNAN, CHRISTINE ESCHMANN & DAGMAR B. STENGEL
National University of Ireland, Galway

The brown seaweed *Ascophyllum nodosum*, which densely inhabits sheltered rocky shores, is an important habitat provider for other species but also a major contributor to coastal productivity. This study examined the spatial variation in pigmentation of *A. nodosum* from Galway Bay, western Ireland. Thalli were collected from a number of sites representing different environmental conditions such as variation in salinity, nutrient levels and turbidity. After a detailed assessment of the optimum extraction and storage procedures the following pigment levels and composition were characterized by HPLC analysis: chlorophyll *a*, chlorophyll *c*2, fucoxanthin, violaxanthin and *b*-carotene. At three sites variability of

pigmentation, within *A. nodosum* beds (highest, middle and lower shore) and within thalli (tip, middle and base) was studied. In culture experiments under controlled laboratory conditions, the adaptive capability of *A. nodosum,* to adjust its pigment composition in response to different environmental parameters is being investigated.

Intra-species Characterisation of the Centric Diatom *Thalassiosira pseudonana.*

CECILIA RAD MENENDEZ, MICHELE STANLEY & JOHN G. DAY
Scottish Association of Marine Science

Over recent years, developments in diatom genomics have generally increased the quantity and quality of data available to the scientific community. There are ongoing projects to sequence the genome of a wide diversity of algae. Some of these have been completed and these include the "model" diatoms *Phaeodactylum tricornutum* and *Thalassiosira pseudonana*. High quality genomic data allow us to study genetic diversity at an intra-species level. The aim of this study is to analyse molecular markers of nine *T. pseudonana* strains from diverse geographic origins. No significant differences have been found so far using single gene markers; however, early findings using an alternative whole genome approach have demonstrated that there are some differences. We anticipate that further analyses of other genome regions should help to identify differences between strains.

Mating Interactions of the Harmful Dinoflagellate *Alexandrium tamarense* in UK Coastal Waters

KLAIRE NEALE,
University of Westminster

The project aims to define the geographical distribution and mating interactions between toxic Group I and non-toxic Group III ribotypes of *Alexandrium tamarense* in UK regions where dual ribotypes have been shown to co-occur. It will endeavour to discover the mating potential between the toxic Group I and the non-toxic Group III ribotypes of *A. tamarense* isolated from Belfast Lough and the Orkney Islands, both regions where dual ribotypes have been shown to geographically overlap. This objective will be achieved through the application of laboratory mating experiments and fieldwork conducted using Belfast Lough and the Orkney Islands as model systems. The research will focus on answering questions such as whether there are barriers to successful mating between groups that maintain distinct ribotype populations in these regions or whether such mating does occur in the water column, the viability of hybrid progeny and the potential for gene flow between toxic and non-toxic groups. The project is jointly supervised by a team from the University of Westminster and Agri-Food and Biosciences Institute (AFBI), Belfast. There will also be collaboration with the Anderson laboratory, Woods Hole Oceanographic Institution in the US, where there has been ongoing research into the potential for the deliberate introduction of non-toxic *Alexandrium* species to mitigate toxic bloom formation.

Dinoflagellate microalgae, possible sustainable sources for biodegradable biopolymer production

SHARMA, K., ROY, I. & PERCY, L.
University of Westminster

Owing to the rapid increase in global solid wastes in the form of synthetic polymers otherwise known as plastics, which are highly resistant to biodegradation, the need for a sustainable and biodegradable green plastic has emerged. One particularly interesting class of 'green plastic' polymers are polyhydroxyalkanoates (PHAs). PHAs are intracellular polymers produced by a variety of bacterial species and used in a wide range of applications, from packaging to medical applications. The large-scale industrial production of PHAs from bacteria by fermentation is an expensive process, necessitating the search for novel alternative sources of PHAs. Interestingly, cyanobacteria including *Synechococcus* sp. and *Synechocystis* sp. have been found to contain a PHA synthase gene and to produce PHAs. Since dinoflagellates are known to host a range of marine bacteria and there is evidence of incorporation of proteobacterial genes within their genome, dinoflagellate cultures could also be possible sources of PHAs, which forms the basis of this undergraduate research project. The dinoflagellate cultures considered for this project were *Alexandrium tamarense* (Group I), *A. tamarense* (Group III) and *Amphidinium carterae*. The project involved two distinct approaches: chemical methods concerned with the extraction of polyhydroxyalkanoates from dinoflagellate cells using dispersion method of extraction and molecular methods involving the design and use of an appropriate PCR assay to search for the PHA synthase gene within the respective strains. These methods were performed on both non-axenic and axenic cultures. Analysis and results will be discussed in this presentation.

Vitamin C content of the haptophyte *Isochrysis* aff. *galbana* (T-iso) dependent on growth phase.

STEF A. VAN BERGEIJK, EUGENIA ZUASTI, EDUARDO JIMÉNEZ & CATALINA FERNÁNDEZ-DÍAZ
IFAPA Centro El Toruño, Junta de Andalucía, Spain

Marine microalgae play an indispensable role as direct or indirect feeds for the aquaculture of larval or juvenile stages of various bivalves, crustaceans and fish. *Isochrysis* aff. *galbana* (T-iso) is one of the most commonly used microalgae in marine aquaculture, mostly appreciated for its high content in highly unsaturated fatty acids, essential for larval development. However, marine microalgae contain many other compounds which may contribute to the quality of nutrition for aquaculture species, like vitamins. In the framework of a research project on the role of vitamin C and iron in the development and immune system of marine fish larvae in aquaculture, we investigated the vitamin C content of T-iso at different growth phases. We show that during stationary phase vitamin C content was about half the vitamin C content measured during exponential phase, while other biochemical parameters, like protein, carbohydrate and total lipid content showed less variation. Some samples were also analyzed for iron content, which was shown to be correlated with the vitamin C content.

***Porphyra leucosticta* as a potential species for commercial-scale seaweed aquaculture in Ireland? Preliminary results on spore release, germination and the development of blades using a free-living conchocelis culture**

A WERNER, C MAGGS & M J DRING
Queen's University, Belfast

Porphyra is considered the most valuable maricultured seaweed in the world with an annual production of approximately 1.01 million metric tons wet weight, nearly exclusively cultivated in Asia. In European countries, seaweed aquaculture remained small-scale with production only for niche markets. With changing demands by the food and health industry, and the biotechnology sector, the expansion of shellfish aquaculture, and new developments in production of sustainable energy, such as biofuels, large-scale seaweed aquaculture is seriously reconsidered in maritime Europe. Policy of the Irish Government is to advance research into and the establishment of commercial seaweed aquaculture. Three species were identified as having high commercial potential, one of them *Porphyra* spp. Stock cultures of free-living conchocelis of native *Porphyra* species were kindly provided by J. Brodie of the Natural History Museum, London. *Porphyra leucosticta* showed simultaneous and constant development of conchocelis and blades from conchospores and archeospores in suspension culture and was

therefore chosen for further studies. Spores released from reproductive blades were used in small-scale experiments to determine optimal germination conditions, such as day length, light intensities and nutrient supply. Zygotospores were also seeded on Kuralon string for out-growth in the sea. Conchocelis developed well on the string after two months in the hatchery. Small blades were first seen about a month in the sea. These are first promising results on the cultivation of *P. leucosticta* in British waters.

Oxylipin production in the green algae *Ulva*
THOMAS WICHARD
Friedrich Schiller University Jena, Germany

Oxylipins comprise of diverse metabolites derived from the oxidation of polyunsaturated fatty acids (PUFA). Initial fatty acid oxidation occurs via the formation (e.g. enzymatic) of fatty acid hydroperoxides. Subsequently breakdown reactions result in a wide array of metabolites with multiple physiological and ecological functions. These fatty acid transformations are highly diverse in marine algae. For instance red algae metabolize C20 PUFAs mainly via 12-lipoxygenase-initiated pathways; brown algae metabolize both C18 and C20-acids, whereas green algae metabolize predominantly C18-acids at C-9 and C-13. Also, in this study the green algae *Ulva sp.* (Chlorophyte, collected in Helgoland, North Sea, Germany) contains mainly C18-PUFAs. However, using the 11-lipoxygenase pathway, *Ulva* sp. produces elevated amounts of volatile C10-polyunsaturated aldehydes (2,4,7-decatrienal and 2,4-decadienal) derived from the less abundant eicosapentaenoic acid and arachidonic acid.
The production of these C10-aldehydes can be easily determined in *Ulva* by headspace solid phase microextraction or by *in situ* derivatisation with pentafluorobenzyl-hydroxylamine (PFBHA), however the identification of the second C10-product derived from C20-PUFAs is not easily achievable. Using deuterated PUFAs and UPLC-MS analyses I aim to decipher the complete lipoxygenase mediated pathway. It turns out that *Ulva* sp. (collected in Helgoland) uses similar biopathways as recently identified in the marine diatom *Thalassiosira rotula*. A survey of several *Ulva* species from distinct habitats revealed a high degree of plasticity in this pathway. Only certain species are able to produce these unsaturated aldehydes despite harbouring identical PUFAs. The potential ecological functions of aldehyde production are discussed.

Expanding the CCMP: A new culture collection for Marine Bacteria/Archaea and Viruses
WILLIE WILSON & DAVID EMERSON
Provasoli-Guillard National Centre for Culture of Marine Phytoplankton (CCMP), Bigelow, USA

The Provasoli-Guillard National Centre for Culture of Marine Phytoplankton (CCMP) serves as a central repository to receive, maintain and distribute living cultures of marine phytoplankton. Spanning a broad diversity and holding approximately 2600 strains, it is the worlds largest culture collection dedicated to marine phytoplankton. It is designated by the U.S. Congress as the official phytoplankton collection for the nation. Its core activity is supplying up to 3000 cultures each year to scientists, educators, biomedical researchers, and businesses worldwide. Our future plans include re-housing the collection in a new state-of-the-art Bigelow Centre for Blue Biotechnology (BCBB) by early 2011. Significantly, we will expand the collection to include marine bacteria/archaea and viruses. It will be the the world's first collection of cultured marine viruses.

Morphological studies on a *Fistulifera* sp. (Bacillariophyta) from the Gulf of Gdańsk (southern Baltic Sea)
ALEKSANDRA ZGRUNDO & EILEEN J. COX
University of Gdańsk, Poland

The diatom genus *Fistulifera* was erected by Lange-Bertalot in 1997 for three small naviculoid species, which commonly occur in eutrophic, mesosaprobic to polysaprobic freshwaters. In 2006 a *Fistulifera* sp. (two strains) was isolated from the Gulf of Gdańsk, and has been cultivated in the Collection of Baltic Algae in the Institute of Oceanography, University of Gdańsk. We have recently been conducting experiments into the effects of salinity on the morphology of the Gulf of Gdańsk strains, using a variety of microscopical techniques. While it is clear that these strains belong to *Fistulifera*, they show some differences from published accounts. We document the morphology of live, uncleaned and cleaned specimens, using LM, CLSM and SEM. The chloroplast arrangement is documented for the first time, new data are presented on the girdle region, and the structure of the fistula is compared with isolated pores in other raphid diatoms. A similarly constructed pore is found in species of *Proschkinia*, but the phylogenetic relationships of the genera are unclear. We present a comparative survey of all known *Fistulifera* spp. and discuss some of the uncertainties about the genus, and questions raised by Lange-Bertalot.

Manton Prize Winners

Franciska Steinhoff
University of Bremen, GLOMAR graduate school
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Born 500 km far from the seaside, I was always fascinated and attracted by the sea. Raised with the support to look behind the common answers in combination with a lot of curiosity and interest for Mother Nature, I started to study Biology at the University in Kiel. From the backward perspective, Biology gave me the unique opportunity to combine all natural sciences in one without limiting the scope to only one of them. During my studies, I attended courses in Marine Biology/Oceanography and was a participant of the international study program BIOCEAN in Denmark and realized that marine sciences were exactly what I was always looking for. But there was one subject, I was especially fascinated by: algae. Later on, the opportunity to go to the Alfred Wegener Institute in Bremerhaven came up to prepare my Diploma thesis about ultrastructural analysis of kelp zoospores in the group of Prof Dr Christian Wiencke. After graduation, I was offered a PhD position with a self-designed project within the graduate school of GLOMAR in Bremen, hosted by Prof Dr Kai Bischof. Captured by kelp zoospores, the PhD project is focusing on UV protective substances in early life stages of kelps in Arctic regions. To date, I attended three expeditions to Spitsbergen, working with climate change and its effects on coastal communities dominated by kelp species. My talk at the BPS was therefore dealing with the effects of climate change on Polar kelp zoospores and the consequences for the future. Soon, I will finish my PhD thesis. Afterwards, I would like to continue with a PostDoc project on phycology preferably in Scandinavia.

My thanks go to the BPS for giving me the opportunity to give my first talk in front of a native English-speaking audience in such a relaxing and friendly atmosphere. Before I came to Oban, names in the conference program were only names but now they are connected with inspiring thoughts and scientific discussions.

Karen Mooney
PhD Student, IAFLU
Queen's University, Belfast

Being from a seafaring family I have always had a love of lakes and the sea in my blood. Ever since I was a child I loved to imagine what creatures might live in those waters that seemed so mysterious and exciting! Throughout my undergraduate degree I developed and increased my knowledge of the aquatic environment and with that grew an enthusiasm that has driven me to research in this area. It was while on a field course on the shores of Strangford Lough in Northern Ireland, in the freezing cold and pouring rain that I realised I was really enjoying myself - aquatic science was the career for me!

I have always been interested in the interactions between organisms and their aquatic environment and how we as humans can affect this. I was especially interested in the

activities of phytoplankton and how such tiny individuals can function together to provide the basis for whole ecosystems. After my undergraduate degree I was accepted for a PhD with Prof Chris Elliott at Queens University and Dr Bob Foy and Professor Jack Hamilton at AFBI, in Belfast. The project is funded by DEL and the NI Water Service. My topic is on the toxins produced by freshwater cyanobacteria and environmental factors that may influence them. The NI Water Service is interested to see whether the presence of cyanobacterial toxins are likely to pose a problem for potable water in Northern Ireland. The presence of the invasive zebra mussel *Dreissena polymorpha* in many Irish lakes has given an extra level of complexity to the project. In North America *D. polymorpha* has been found to increase the toxicity of lakes due to indirectly selecting for toxic *Microcystis* species via preferential filter feeding. I am seeking to determine whether the mussels filtering actions may be affecting microcystin concentrations of invaded lakes in the north of Ireland and to determine if the presence of zebra mussels has any environmental effect on the lakes. Over the previous two years I have optimised a HPLC/MS-MS method for the detection of microcystins and incorporated this into intensive sampling programmes. I have found up to 5 microcystin variants co-occurring in all lakes sampled and with some concentrations recorded being of significant concern. As yet I'm not convinced that *D. polymorpha* are having the same effect on microcystin concentrations here as in North American lakes. The project is a combination of many things that I love working on, incorporating environmental interactions, invasive species, climate change and phytoplankton composition. I have developed a kind of awed reverence for cyanobacteria and feel extremely lucky to have been given the opportunity to examine these organisms and find out something new about them.

I aim to complete this year and after, I hope to continue being involved in this research and work with the public perception of scientific research and why it is so important. Hopefully I can go some way in answering the question that keeps burning in my mind about why cyanotoxins are produced and what is their function!

I would like to express my sincere gratitude to the BPS for awarding me with both a travel bursary and the Manton Prize. I met some wonderful people at the conference and I have always loved the relaxed, friendly and motivating atmosphere that I always find from the BPS meetings, I hope to see you all again next year!

Poster Prize Winner

Krishna Sharma
University of Westminster
krishna_r_sharma@hotmail.com

My summer studentship project, which I later continued as my final year undergraduate project was environmentally based and involved the development of methods for the detection of Polyhydroxyalkanotes in marine microalgae, in particular the dinoflagellate *Amphidinium carterae*. To the best of my knowledge, there has been no prior publication on this subject so the project was novel to our phytoplankton laboratory in the University of Westminster. The summer project was funded by the British Phycological Society and has allowed me to gain valuable experience in both the fields of biotechnology and phycology. I achieved some intriguing results over the summer which I presented in my poster during the BPS Annual conference, 2010 at Oban.

I have never worked with algal cultures before this project. As a result of this experience I have developed a fascination for dinoflagellates. My University in London has an impressive collection of dinoflagellate cultures from around the UK and this presents a perfect environment for me to build up on my keen interest in phycology and use of algae in the field of environmental biotechnology. The potential toxicity caused by certain species of *Alexandrium* is also a study area which interests me. I intend to pursue a research degree in an area based on the phycological applications in biotechnology in the future. Hopefully I would also have the opportunity to explore a variety of species of *Alexandrium* and their habitat across various European coasts sometime in the near future.

The 58th Annual meeting of the BPS held in Oban, Scotland, was the first scientific conference I have attended. The experience was extremely enriching and I enjoyed meeting with eminent scientists in the field of Phycology and presenting my work to the attendees. I thank the British Phycological Society for funding this summer project in June 2009, and also for providing me with a bursary to attend the BPS annual meeting 2010 in Oban. It was a privilege and pleasure to be amongst such august company in a warm, inspiring and welcoming environment. I would like to extend my gratitude to the BPS for presenting me with the Poster Prize; it is indeed a humbling and encouraging experience for me.

British Phycological Society
58th Annual General Meeting
SAMS, Oban, Friday 8th January 2010, 5.30pm

Present: Patrizia Albertano, Christina Bock, Paul Brazier, Melanie Broadhurst, Martha Clokie, Geoffrey Codd, Eileen Cox, John Day, Matt Dring, Jane Jamieson, David Jewson, Martyn Kelly, Frithjof Küpper, Stephen Maberly, James Macgregor, David Mann, Sara Marsham, James Metcalf, Udo Nitschke, Jane Pottas, John Raven, Poonam Sharma, Elliot Shubert, Steve Slocombe, Michelle Tobin, Jo Wilbraham, Martin Wilkinson
In the absence of Juliet Brodie (President) Geoffrey Codd (GAC) as Immediate Past President took the chair.

1. Apologies

Juliet Brodie, (President), Mike Guiry, Paul Hayes (President Elect), Jan Krokowski, Agnes Mols Mortensen, Rupert Perkins

2. Minutes of Winter Council meetings and 57th AGM, January 2009

The minutes were approved: proposed by Elliot Shubert and seconded by Eileen Cox.

3. Matters arising

None

4. Reports from Officers

a) Secretary

Jane Pottas opened by thanking John Day and Christine Campbell for organising the Winter Meeting at SAMS. Although the meeting had drawn 103 delegates, the bad weather in the south west of England prevented several, including the President and the President Elect, from travelling to Oban. She said that she had carried out her normal secretarial duties over the previous year and there was nothing out of the ordinary to report.

b) Treasurer

Michelle Tobin reported that the Society's financial situation remains good with income in 2009 notably higher than in 2008. The Society had received an advance of £30,000 from Taylor and Francis for Volume 44 (2009) of the *European Journal of Phycology* with any additional income to be paid in early 2010. Grants and studentships have increased mainly due to an increase in student applications. The Hilda Canter-Lund Prize was awarded for the first time. Available funds are in the region of £10,000 with unrestricted reserves currently standing at around £111,000. The use of these monies will be discussed at Council to see how they can be used most effectively to support the Society and its members. Michelle pointed out that the BPS needs a reserve policy document as it is a requirement of the Charities Commission. Michelle thanked all Council members for their assistance, in particular Sara Marsham for Membership issues; GAC, Rupert Perkins and Gill Malin for the Student Awards & Training Committee work and other members for support and guidance.

GAC thanked Michelle for her work as Treasurer. The report was accepted: proposed by Eileen Cox and seconded by Martin Wilkinson.

c) Membership Secretary

Sara Marsham reported that the on-line database continues to work well, with very few problems encountered by the membership. A renewal notice for 2010 has yet to be circulated due to complications with PayPal. Notices will be sent out in January via BPS-L and Algae-L and also by post for those members who have not provided an e-mail address. The current active membership of the Society is 460 (351 fully paid up, 92 paid to end of 2008, 5 complimentary members and 12 Honorary Life Members), which is up by 37 fully paid-up members from the end of 2008. Twenty three fewer members were in arrears than at the end of 2008. Recruitment remains stable with 58 new members joining the Society in 2009, compared to 60 new members in 2008, and the renewal rate has improved. The ongoing problem of payment by standing order continues. Although members have been instructed to cancel them, 12 remain whom the Membership Secretary is unable to contact and the BPS has to continue to accept their payments (often at an incorrect subscription rate). Members are reminded to update their email and contact details with the Membership Secretary. Of 318 fully paid-up members, 227 receive the *EJP* including 21 of the student members. The first three issues of volume 44 of the *European Journal of Phycology* have been distributed without problem and the team at Taylor and Francis has been extremely helpful in distributing copies of the journal to those members who have been late with their applications and renewals. Sara drew members' attention to her report in the Autumn 2009 issue of *The Phycologist*, alerting members to the services offered by Taylor and Francis via their informaworld platform. Members can currently renew online using PayPal but issues regarding the setting up of a PayPal business account remain unresolved and are to be discussed at Council. Renewal notices will be sent out in the next two months. To meet the increasing number of requests for financial assistance and to allow the BPS to continue to generously support student members, it was agreed at the Summer Council meeting to amend the student subscription charges. A report published in the Autumn issue of *The Phycologist* proposed that the standard annual student membership be raised to £10 and that a new 3 year student membership (to cover the duration of a PhD) for £20 be introduced. Both proposals received unanimous approval. They will take effect from 2011 and the website will be updated. Sara thanked Michelle Tobin, Jane Pottas, GAC, Mike Guiry and Pier Kuipers for their help.

GAC thanked Sara for her work as Membership Secretary. The report was accepted: proposed by Matt Dring and seconded by John Raven.

d) Student representative report

Agnes Mols Mortensen reported that she has established good contact with the student members and that they had discussed areas of interest for potential workshop/lecture topics at the annual Winter Meetings. Multivariate statistics, scientific writing, molecular analysis and the building of phylogenetic trees were suggested. Agnes thanked the organizers of the 58th Annual Meeting for including a lecture (An introduction to multivariate data analysis in ecology) and a workshop (Careers in phycology) to meet the interests of student members. She had informed the

students that she would not be at the meeting in Oban and apologized for her absence.

In the absence of the Agnes Mols Mortensen her report was accepted without comment. Proposed by Martha Clokie and seconded by Eileen Cox.

e) Editors-in-Chief of the European Journal of Phycology

Eileen Cox reported on behalf of herself and John Day. As part of the new Production agreement with Taylor & Francis, the page allocation for 2009 was increased and volume **44** part 4 was extended to reduce the current backlog of accepted, unpublished papers. In total, 50 papers have been published. As in previous volumes, there was a good spread of subjects and this will continue in volume **45**. Significant efforts have been made to reduce both the manuscript processing time and the length of time between acceptance and publication in hard-copy. All manuscripts that were processed outside Manuscript Central were published by August 09 and all of the "problem" manuscripts on the Manuscript Central system have been dealt with. This has successfully reduced the average processing time for manuscripts and will, by volume **45**, reduce the average time between acceptance and publication. On-line publication for the majority of manuscripts in 2009 preceded the hard-copy issue by 2 months, with a number of manuscripts being available on-line up to seven months prior to publication. Assistant Editors covering Microalgal Systematics (Elliot Shubert) and Macroalgal Systematics (Alison Sherwood) have been appointed in the last year. Rejection rates remain high, with 60% of manuscripts being rejected. Rejection rates vary depending on the subject area, but more than sufficient good quality manuscripts are being received to fill the Journal. The Scholar-One/Manuscript Central system is working well with assistance provided by Elliot Shubert (Managing Editor). 104 manuscripts were submitted electronically in 2009 and no manuscripts are being processed outside the Manuscript Central system. The *EJP* impact factor has risen to 1.826, which is 25/87 journals in Marine and Freshwater Biology. This represents a 21% increase at a time when that of other phycology journals has fallen. On the data available for up to 2007, the percentage of papers with >5 citations has increased, with a reduction in the number of papers not being cited and the 5 year impact factor is >2, suggesting that the papers have long term value. The journal publishes a good spread of papers from many countries, confirming its international recognition. T&F continue to put in considerable efforts and resources to develop and market *EJP* which they consider one of their "flagship" journals and are keen to explore opportunities to enhance the journal further. Both EICs are stepping down (Eileen Cox having served 6 years, John Day is resigning due to changed professional position) and there will be a period of transition over the next 12 months until David Mann takes over as Editor-in-Chief. T&F will produce corrected updated lists of editors and assistant editors. Eileen expressed their thanks to all the Assistant Editors and to Elliot Shubert as Managing Editor and the team at T&F for all their support, assistance, goodwill and hard work during their tenure as EICs of *EJP*. Two prizes were awarded for the best papers, nominated by the Assistant Editors. The best paper went to **Theriot, E.C.**, Cannone, J. J., Gutell, R.R. & Alverson, A.J. (The limits of nuclear-encoded SSU rDNA for resolving diatom phylogeny - EJP **44**: 277-290); the best paper by a young investigator to Harris, G.N., Scanlan, D.J. & Geider, R.J. (Responses of *Emiliana huxleyi* [Prymnesiophyceae] to step changes in photon flux density, *EJP* 44:31-48).

Frithjof Küpper commented that he was still concerned over the length of time to publication. This is being addressed by getting papers onto iFirst to minimise delays. Many papers are rejected on technical grounds because authors do not follow instructions. There is a problem (a) getting reviewers and (b) getting them to review on time but in future they will be harried and may not be used again if they are slow to review. Eileen urged anyone who was asked to review to accept.

GAC commented that *EJP* has a global readership and impact and thanked Eileen, John and Elliot on behalf of the BPS for all their hard work. The report was accepted: proposed by Michelle Tobin and seconded by John Raven.

f) Editor of The Phycologist

Jan Krokowski reported that there were no major problems, the 2009 spring issue was printed and dispatched by mid-April, and although the autumn issue was delayed by the postal strike it was dispatched by early November. The layout and typesetting continue to be expertly provided by Ms Agnès Marhadour, in Portugal. Printing continues to be provided by Monument Press in Stirling, Scotland. Typesetting costs have remained constant since 2005 but there has been a steady increase in overall cost, attributable to increased contributions for the autumn editions and increasing postage. The current annual cost of the newsletter (spring and autumn) is £8.98 per member. Jan reiterated that without the members' support the newsletter would not exist and he encouraged all BPS members to make contribu tions. The deadline for submission of articles for spring is March 1st, and 1st September for the autumn edition. He thanked SEPA's Administration staff in East Kilbride (Donna Farren, Dorothy Fotheringham and Kirsten Tracey) for their enormous continued help in posting the newsletters.

In the absence of Jan Krokowski, GAC thanked him for his excellent work in editing *The Phycologist* which is regarded as a flagship feature of the Society, and his report was accepted: proposed by Martyn Kelly and seconded by Michelle Tobin.

g) Webmaster

Mike Guiry reported that the British Phycological Society website had been maintained continuously from the University of Galway server for the last six months with very little interruption. The server's records indicate an up-time of 99.99%. Traffic increased 12.78% for the period 10 Dec 2008 to 10 Dec 2009. The pattern of usage is still the same as previously reported. As previously, the on-line payment of subscriptions is giving some difficulties and Pier Kuipers, Michelle Tobin and Sara Marsham are working together to introduce a PayPal-based system of credit-card payment.

In the absence of Mike Guiry, GAC thanked him for his work on the website and his report was accepted: proposed by David Mann and seconded by Matt Dring.

h) Student Awards and Training Committee

GAC (Chair A & T Committee) reported that the Committee had refined the guidelines (deadlines, eligibility, Society membership requirements) for the Student Bursaries and Student Undergraduate Research Project schemes; worked on the establishment of the new Project Awards scheme (aims, scope, conditions of award, application procedure), details of which are available via BPS website from July 2009; and evaluated 37 applications by BPS Members for funding support. A wide range of eligible activities had been supported this year, with applications having been received from Croatia, France,

Germany, India, Ireland, Turkey and the UK. The total sum awarded, January - December 2009 inclusive, was ca. £13,970 (Student Bursaries: 30 applications, 23 awards; Summer Undergraduate Projects: 2 applications, 2 awards; Project Awards: 5 applications, 1 award). Applications had been rejected because they had missed publicised deadlines (October 1st and December 1st), or due to ineligibility of the applicant or because specified information had been missing. Applicants were urged to read the funding guidelines. A 3-month requirement for membership of the BPS before being eligible to apply for BPS funding is now in place for postgraduate student applications (other than for support to attend BPS Annual Meetings). Applicants to all BPS schemes are advised to seek partial financial support from elsewhere and to indicate the source and amount of such support. Whilst this is not mandatory, it is a useful factor in enabling the Society to distribute its own funds more widely. Virtually all of the awards made by the BPS in 2009 were thus partial awards. The awards scheme policy is to be reviewed in June 2010. The Fritsch Collection Project Grant Application was considered and an offer of support (£3000), with conditional requirements, had been made by the President but was not accepted due to changed circumstances.

GAC thanked Michelle Tobin, Rupert Perkins and Gill Malin for their work on the Committee and Prof. Mike Guiry for his help with webpage additions and changes. The report was accepted: proposed by Martin Wilkinson and seconded by Frithjof Küpper.

i) Biodiversity and Conservation Committee

Martin Wilkinson (Chair B & C Committee) reported that the Committee had met twice in 2009. The 2nd edition of the Freshwater Flora is on schedule for submission of edited copy to CUP in April 2010. Bob Fletcher has completed a draft of the manuscript of Seaweeds of the British Isles, Brown Seaweeds Volume, Part 2 and Bill Farnham is currently reviewing it. The Green Seaweed volume continues to sell well. Stock of those parts in print of The Seaweeds of the British Isles has been transferred from NHM to the NHBS which should improve marketing but 3 parts are now completely sold out and rewriting or reprinting is being considered by the Committee. The Seasearch Seaweed Guide is being produced by Francis Bunker and Chris Maggs for the Marine Conservation Society with BPS support. The Big Seaweed Search was launched on 21st August 2009 from the Natural History Museum with the support of OPAL. This will involve the public in mapping some of our commonest seaweeds. It is really important to have such outreach projects to involve the public in our subject especially in view of possible climate change implications. Attractive identification and explanatory leaflets to help the public have been designed. Another mass observation project on freshwater pond life might have algae and higher plants included. A proposed link with Plymouth for a seaweed recording scheme was not successful. The NHM is developing a database which will take time to come to fruition. The usual regular field meetings and workshops have continued - (i) Seaweeds Chris Maggs and Francis Bunker, Pembrokeshire, May; (ii) Freshwater, Durham - Dave John and Brian Whitton (iii) Diatoms, Kindrogan - Eileen Cox and Elliot Shubert. A marine workshop on Coralline and Other Algal Crusts has been organised for 1-3 February 2010 at the Plymouth Marine Laboratory by Juliet Brodie, Jason Hall-Spencer and Chris Maggs. Martin is to write a report on the work of the Committee for *The Phycologist*.

GAC thanked Martin Wilkinson and the B & C Committee for their work and the report was accepted: proposed by Dave Jewson and seconded by Martyn Kelly.

5. President's Award

No report due to the absence of the President. The definition and administration of this scheme and selection of recipient(s) is to be a matter for the BPS President. The President will consult the A & TC in the assessment and decision-making process.

6. Federation Reports

a) Federation of European Phycological Societies (FEPS)

GAC reported that the latest Council Meeting and 2009 AGM of FEPS were held at the Natural History Museum, London, on 23 June 2003. In addition to the new membership of the French Phycological Society (April 2009), arrangements are in progress (from Nov. 2009) to enrol the Czech Phycological Society in the Federation. These additions increase the membership of constituted national phycological societies/groups to 10, representing 12 European national phycological groups, namely: Belgium, The Czech Republic, France, Germany, Greece, Hungary, Ireland, Italy, The Netherlands, Poland, Spain and the United Kingdom. FEPS is considering the establishment of a pan-European Directory of Experts in phycology, its ramifications and applications. This idea is also currently being pursued at national level by some national Member Societies (e.g. BPS). The FEPS website is under development at http://www.feps-algae.eu/cms/ . Good progress continues on the organisation the Fifth European Phycological Congress: *Exploring the Phycocosmos: A European Perspective* (September 4-9, 2011, Rhodes). Discussions are in progress with Taylor & Francis regarding the publication of the FEPS journal, *Perspectives in Phycology*.

The report was accepted: proposed by Michelle Tobin and seconded by James Metcalf.

b) Federation of European Microbiological Societies (FEMS)

No report in the absence of Paul Hayes.

c) Society of Biology

No report in the absence of Paul Hayes.

7. Hilda Canter-Lund Prize

Martyn Kelly reported that 23 entries had been received from around the world but only three from the UK, which he felt was rather disappointing. Martyn and David Mann (the judges of the prize) will write an article for The Phycologist outlining the ways in which images can be enhanced. The winner of the prize is Dr Mariano Sironi, Associate Professor in Vertebrate Zoology at the National University of Córdoba, Argentina for his photograph of a southern right whale mother with her calf swimming along the shores of Peninsula Valdes in Argentina in a green tide tentatively composed of *Lepidodinium* sp. The winning photograph and other entries may be seen on the BPS website.

Elliot Shubert enquired whether the winning image could be printed and framed to be auctioned at next year's Winter Meeting to raise funds for the Society. This is possible as the owner retains copyright but the BPS has rights for two years.

GAC thanked Martyn and David for their work in organising and judging the competition.

8. Future Meetings

The 2011 winter meeting is to be held in Cardiff where Rupert Perkins is the local organiser.

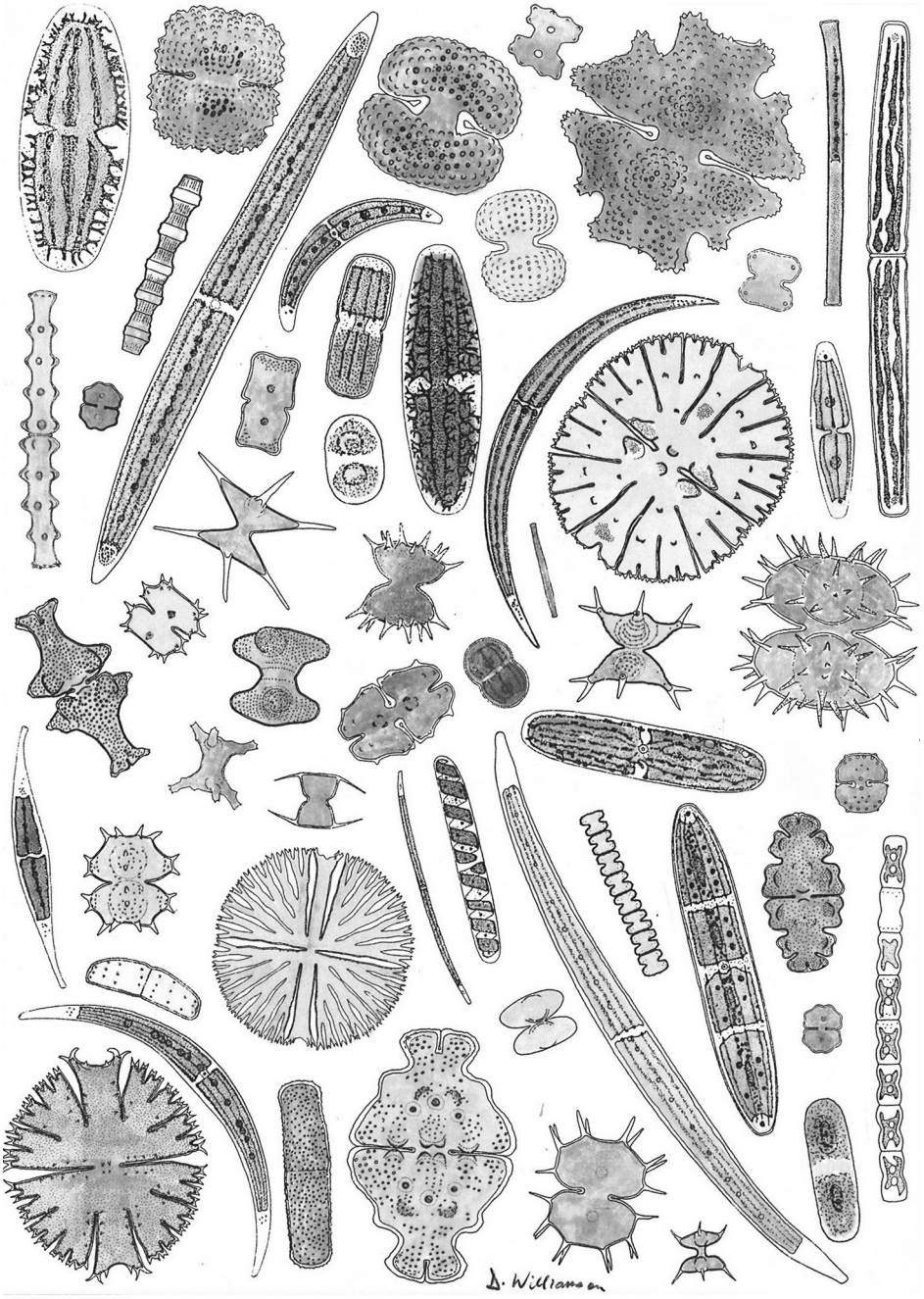
9. Membership

The term of office of three Ordinary Members of Council has come to an end. GAC thanked retiring Council members Martha Clokie, David Mann and Thomas Proeschold. Five nominations were received and a ballot was organised in November 2009 to elect three new members. Those elected to office were Eileen Bresnan (proposed by Jan Krokowski and seconded by Sara Marsham), Gill Malin (proposed by Juliet Brodie and seconded by Paul Hayes) and Linda Medlin (proposed by Richard Crawford and seconded by Jane Pottas). All accepted their nomination and their election to Council.

10. Any other business

Ms Poonam Sharma thanked the Society for their support which allowed her to attend the Meeting.

On behalf of the Society, GAC thanked John Day and Christine Campbell for organising and hosting the Winter Meeting at the Scottish Association of Marine Science at Oban and Taylor & Francis for sponsoring the reception. He also thanked Jane Pottas for her secretarial work throughout the past year.The meeting ended at 6.35pm.



Desmids. Courtesy of David B. Williamson.

Annual Report for the year ended 30 September 2009

The British Phycological Society

Registered Charity No. 246707

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

Membership of the Council of the Society:

Executive Members

President:	Professor J. Brodie	Treasurer:	Dr M.L. Tobin
Vice President:	Dr P. Hayes	Eds (*Eur. J. Phyc.*):	Dr E.J. Cox
Overseas Vice President:	Professor P. Albertano		Dr J. Day
Immediate Past President:	Professor G. Codd	Ed. (*The Phycologist*):	Dr J. Krokowski
Secretary:	Dr J.Pottas	Webmaster:	Professor M.D. Guiry
Membership Sec:	Dr S. Marsham		

Ordinary Members

Dr M. Clokie	Dr D. Mann	Dr J. Metcalfe	Dr R. Perkins
Professor C. Maggs	Dr M. Kelly	Dr T. Proeschold	Professor M. Wilkinson
Dr M. Yallop	Ms A. Mols Mortensen		

Principal bankers:	Bank of Scotland, 39 Albyn Place, Aberdeen
Solicitors:	Wolferstans, 60/64 North Hill, Plymouth
Independent Examiner:	Flannigan, Edmonds and Bannon, 2 Donegal Square East, Belfast

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

The Society has continued to give financial support to activities that promote phycological research, disseminate phycological knowledge and assist young phycologists to present their findings at scientific meetings. The 2009 annual winter meeting and AGM were hosted by the Natural History Museum and thanks go to Dr Eileen Cox, Prof. Elliot Shubert and their team for organising a very successful meeting in London. As usual the range and standard of presentations was excellent. Congratulations go to Thomas Silberfeld and Hella Behrund whose contributions earned them the 2009 Manton Prize and Poster Prize respectively. Twelve students received support to attend this meeting from the Scientific Meetings Fund (SMF) (ten in 2008). The auction, quiz and sales raised £209, with thanks going to Elliot Shubert for his continued efforts. The meeting returned a surplus of £5700 and this money will be used to support the 2010 and 2011 meetings.

The Society supported thirteen students to attend identification courses, workshops and conferences (including 1 for Durham and 2 for Kindrogan). Two summer studentships were awarded in 2009 (none in 2008). One project award was made this year (£2000). The Society received an encouraging number of applications for funding in this financial year and was able to support a good number of student members to develop and present their phycological knowledge both in the UK and abroad.

During this financial year the society has supported one student to attend an overseas conference and six students to attend field courses and workshops. Unfortunately despite advertising no summer studentships were awarded in 2008. Members are encouraged to consider this source of funding for introducing students to phycological research.

During 2009 honoraria were awarded to the following council members: the Membership Secretary, Secretary and the Editor of *The Phycologist* each received £750, the Treasurer received £1000 and the Editors of the European Journal of Phycology received a total of £1500.

The Journal performed well financially and the balance to the Society from Volume 43 was £31,173.03 (£31,588.33 for Volume 42) due to the guaranteed annual income of at least £20,000 from the publishers, Taylor and Francis (T&F). Following the renewal of the contract with T&F the Society has received an advance of £31,000 guaranteed income for Volume 44.

The Society's financial situation remains good. The Society has now changed bank accounts within Bank of Scotland to provide the Society with a higher rate of interest on short term deposits and to facilitate a more flexible current account. The Scientific Meetings Fund was topped up to a total of £25000 to allow the Society to support students with travel awards, summer bursaries and field courses from the interest it receives.

Finally, I would like to thank all Council and Society members for their co-operation and support during this financial year.

The British Phycological Society

Registered Charity No. 246707

Statement of Financial Activities for the Year ended 30th September 2009

	Note	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2009 £	Total 2008 £
Income and Expenditure						
Incoming Resources						
Subscriptions 2007		0.00	0.00	0.00	0.00	2,125.00
Subscriptions 2008		616.50	0.00	0.00	616.50	5,999.00
Subscriptions 2009		5,305.00	0.00	0.00	5,305.00	0.00
Journal profit share 2008		31,173.03	0.00	0.00	31,173.03	31,588.33
Journal profit share 2009		30,000.00	0.00	0.00	30,000.00	0.00
Auction/quiz/sales proceeds		0.00	209.00	0.00	209.00	240.00
FW Atlas		232.75	0.00	0.00	232.75	397.91
Interest		7,390.04	0.00	0.00	7,390.04	359.83
Winter Meeting 2009		5,700.00	0.00	0.00	5,700.00	359.83
Winter Meeting 2009 cc registrations		5,180.00	0.00	0.00	5,180.00	0.00
Winter Meeting 2008 surplus		0.00	0.00	0.00	0.00	4,388.36
EJPMC		2,491.00	0.00	0.00	2,491.00	5,418.00
Total Incoming Resources		**88,088.32**	**209.00**	**0.00**	**88,297.32**	**50,516.43**
Resources Expended						
Grants, studentships & awards	**2**	10,339.57	2,247.06	250.00	12,836.63	10,971.14
Publications expenditure	**3**	14,707.67	0.00	0.00	14,707.67	14,861.61
Meetings & Committee Expenses	**4**	17,932.98	0.00	0.00	17,932.98	7,852.75
Administration Costs	**5**	11,294.58	0.00	0.00	11,294.58	7,490.76
		54,274.80	**2,247.06**	**250.00**	**56,771.86**	**41,176.26**
Net Incoming (Outgoing) Resources for the Year		**33,183.52**	**(2,038.06)**	**(250.00)**	**31,525.46**	**9,340.17**
Fund at 1 October 2008		79,172.91	25,000.00	4,694.09	108,867.00	99,526.83
Transfer (General to SMF)		(2,038.06)	2,038.06	0.00	0.00	0.00
Fund at 30 September 2009		**110,948.37**	**25,000.00**	**4,444.09**	**140,392.46**	**108,867.00**

Balance Sheet as at 30 September 2009

		2009 £	2008 £
Current Assets			
Debtors	**7**	7,700.00	5,888.36
Short term deposits		136,344.71	92,043.30
Cash at bank		10,038.75	25,366.34
		154,083.46	123,298.00
Liabilities: amounts falling due within one year	**8**	13,691.00	14,431.00
Net Assets		**140,392.46**	**108,867.00**
Funds	**9**		
Unrestricted		110,948.37	79,172.91
Restricted		4,444.09	4,694.09
Designated		25,000.00	25,000.00
		140,392.46	**108,867.00**

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

The British Phycological Society
Notes to the Account for the Year ended 30 September 2009

1 Accounting Policies

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

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

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

Funds
Restricted funds comprise unexpended balances of donations and interest to be applied for specific purposes. At 30 September 2009, the Society's only restricted fund was the Manton Fund. Designated funds are those set aside out of unrestricted funds for specific purposes. At 30 September 2009, the designated fund of the Society was the Scientific Meetings Fund ("S.M.F.").

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

	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2009 £	Total 2008 £
2 Grants, Studentships & Awards					
Travel awards for Winter Meeting	0.00	2,247.06	0.00	2,247.06	2,560.00
Awards for courses, travel, Summer Bursary	8,039.57	0.00	0.00	8,039.57	5,261.14
Manton Prize	0.00	0.00	250.00	250.00	250.00
Poster prize at Winter Meeting	150.00	0.00	0.00	150.00	150.00
Special Project Grants	2,000.00	0.00	0.00	2,000.00	2,750.00
Hilda Canter-Lund award	150.00	0.00	0.00	150.00	2,750.00
	10,339.57	**2,247.06**	**250.00**	**12,836.63**	**10,971.14**
3 Publication expenditure					
Journal	6,588.00	0.00	0.00	6,588.00	6,669.00
Editors' Honoraria (2009)	1,500.00	0.00	0.00	1,500.00	0.00
Editors' Honoraria (2008)	0.00	0.00	0.00	0.00	1,500.00
E.J.P. Management Committee	0.00	0.00	0.00	0.00	1,028.97
The Phycologist	4,297.20	0.00	0.00	4,297.20	3,704.72
EJP Editorial Assistant Expenses	2,322.47	0.00	0.00	2,322.47	1,958.92
	14,707.67			**14,707.67**	**14,861.61**
4 Meetings & Committee Expenses					
Council Meeting 2009	3,135.26	0.00	0.00	3,135.26	0.00
Council Meeting 2008	0.00	0.00	0.00	0.00	2,678.19
Biodiversity Committee Expenses	532.64	0.00	0.00	532.64	377.80
Winter Meeting 2009	14,059.70	0.00	0.00	14,059.70	0.00
Winter Meeting 2008	0.00	0.00	0.00	0.00	3,952.54
Federation of European Phycologists	0.00	0.00	0.00	0.00	844.22
	205.38	0.00	0.00	205.38	0.00
	17,932.98			**17,932.98**	**7,852.75**
5 Administration Costs					
Public liability insurance	385.88	0.00	0.00	385.88	367.50
Independent Examiner's Fee	1,400.00	0.00	0.00	1,400.00	1,082.50
Credit Card Charges	849.55	0.00	0.00	849.55	748.30
Bank Charges	379.80	0.00	0.00	379.80	165.00
Executive Honoraria (2009)	3,250.00	0.00	0.00	3,250.00	0.00
Executive Honoraria (2008)	0.00	0.00	0.00	0.00	3,250.00
Federation of Bioscience Federation Subcription	486.00	0.00	0.00	486.00	566.00
Miscellaneous (membership refund)	0.00	0.00	0.00	0.00	36.50

Notes to the Account for the Year ended 30 September 2009 (cont.)

	Unrestricted General	Designated S.M.F.	Restricted Manton	Total 2008	Total 2007
	£	£	£	£	£
5 Administration Costs (cont.)					
General Expenses	(176.25)	0.00	0.00	(176.25)	176.25
FEMS subscription	387.71	0.00	0.00	387.71	152.43
FEPS subscription	327.78	0.00	0.00	327.78	341.53
Website Maintenance	2,485.71	0.00	0.00	2,485.71	781.00
	18.40	0.00	0.00	18.40	0.00
	1,500.00	0.00	0.00	1,500.00	0.00
	7,490.76	486.00		**7,490.76**	**7,667.01**
		0.00			

6 Reimbursment of Council members' expenses

Seventeen (2008: Twelve) Council members received £3,135.26 (2008: £2,678.19) as reimbursment of travel and overnight accommodation for expenditures incurred during the year on Society business. No monies were paid to any Council member in respect of subsistence.

7 Debtors	2009	2008
	£	£
Interest receivable	2,000	2,000.00
Prepayments	5,700.00	3,888.36
	7,700.00	**5,888.36**

8 Liabilities: Amounts falling due within one year		
Accruals	3,191.00	3,931.00
Provision for the *Journal* and *The Phycologist*	10,500.00	10,500.00
	13,691.00	**14,431.00**

9 Analysis of Net Assets between Funds

	Unrestricted Funds	Restricted Funds	Designated Funds	Total Funds
	£	£	£	£
Fund balances as at 30 September 2009 are represented by				
Current assets	124,389.37	4,694.09	25,000.00	154,083.46
Current liabilities	(13,441.00)	(250.00)	0.00	(13,691.00)
Total Net Assets	**110,948.37**	**4,444.09**	**25,000.00**	**140,392.46**

Report of the Independent examiner to the Members of the British Phycological Society

We report on the accounts of the Society for the year ended 30 September 2009, which are set out on pages 29 to 31.

Respective responsiblities of trustees and examiner:

The Council Members are responsible for the preparation of the accounts. The Council Members consider that an audit is not required for this year (under section 43 (2) of the Charities Act 1993 (the 1993 Act)) and that an independent examination is needed.

It is our responsibiliy to:

* examine the accounts (under section 43 (3) (a) of the 1993 Act):
* to follow the procedures laid down in the General Directions given by the Charity Commissioners (under section 43 (7) (b) of the 1993 Act); and
* to state whether particular matters have come to our attention.

Basis of independent examiner's report:

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

Independent examiner's statement:

In connection with our examination, no matter has come to our attention which gives us reasonable cause to believe that in any material respect the requirement:

* to keep accounting records in accordance with section 41 of the 1993 Act and;
* to prepare accounts which accord with the accounting records and comply with the accounting requirements of the 1993 Act; have not been met.

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

BPS Winter meeting, Oban

Poonam Sharma
PhD Candidate, Aquatic Ecology Lab.
Department of Botany, University of Jammu, Jammu & Kashmir, India
poonambot2005_ju@yahoo.co.in

I am currently a fourth year PhD student working on the biodiversity, morpho-taxonomy and ecology of fresh water algae in wetland ecosystems of Jammu and my thrust areas are Limnology, Ecology and Phycology. I have identified naturally occurring algal strains belonging to different group such as Chlorophyceae, Bacillariophyceae, Dinophyceae, Xanthophyceae and Cyanobacteria during all these years. I joined the British Phycological Society during my visit to National University of Ireland, Galway, where I attended the 3rd Congress of International Society of Applied Phycology (ICAP) in 2008. I was fortunate to receive the financial support from BPS, permitting me to travel from J&K, India to Scotland, where I attended the 58th Annual meeting of the British Phycological Society. The meeting was hosted by the Scottish Marine Institute, Oban, Argyll, Scotland from Jan 6-9, 2010 and was attended by over 100 delegates from the UK and overseas. It was my first BPS Annual Meeting and, as such, it was a matter of pleasure for me to represent India in that prestigious meeting.

I arrived a day before the meeting in Oban, after a long and hectic journey of more then 24 hrs because of delayed flights. On January 6 we had a welcome reception by the organizers at Oban Bay Hotel where almost all the BPS Council members and conference delegates were present. We had an interactive session there.

On January 7, the meeting was declared open with a welcome address by SAMS Deputy Director Dr. Ken-Jones, followed by Special session "Productivity and photophysiology" which was chaired by Dr Rupert Perkins with a very informative talks by Prof John Raven, Prof Dieter Hanelt, Prof Johann Lavaud, Prof. Graham J.C. Underwood and Dr. J. Kromkamp. After lunch there were two parallel sessions covering a variety of topics like Algal Biogeography, Algal Biofuels & CO2 sequestration with lectures by various eminent algologists. The other parallel session was for Student lectures & Manton award presentations in which 10 presentations were made. My presentation entitled "Studies on diversity, taxonomy and distribution of microalgae in Mansar-Surinsar wetland of Jammu, Jammu and Kashmir State, India: Ecological significances and potential applications" was held during the post lunch session. That was my first presentation in an International conference. A workshop which was organised and chaired by Dr. Anuschka Miller in an evening session was quite fruitful for young scientists who were looking to take phycology as a career. The quiz organised by Prof. Geoffrey Codd on famous movie names was another source of attraction along with dinner at the famous Taj Mahal Resturant in Oban town.

The second day of the meeting began with a fascinating and thought-provoking session on "Host pathogen interactions" organized and chaired by Claire Gachon with guest lectures from Prof. Gwang Hoon Kim, Prof. Telesphore Sime-Ngando, Dr. William Wilson and Dr. Aurelie Chambouvet who threw light on the importance of Host-parasite interaction on the life of organisms. This special session was followed by two other parallel sessions on important topics like Algal Molecular Biology, Algal Biotechnology/Physiology with lectures demonstrating the current trends on algal research and their potential for biotechnological applications. The afternoon session which started with the Presidential address by Prof. Patrizia Albertano on Natural and reconstituted phototrophic biofilms in water was also very interesting and informative. The meeting concluded in the afternoon with two parallel sessions which saw the presentation of papers on topics ranging from Seaweed farming, application of algae in aquaculture and bioremediation, algal biodiversity and systematic. The conference dinner on the concluding day was very special in which Student awards were presented for Manton prize and Poster prize followed by the famous Scottish dancing.

Overall, my experience of attending the BPS meeting was no doubt the best in my life and quite a productive one and it was an encouragement to see the PhD researchers, postgraduates and under-graduates using the BPS meeting as a forum for disseminating their research before the learnt and vibrant minds. I believe the ability to communicate research is an important skill for any young scientist to learn, and the best way to learn is to do so. I am grateful to the BPS for giving me an opportunity to present my work in such a friendly, supportive and stimulating atmosphere, especially when I presented my paper, I got lots of brilliant suggestions on research techniques and also the further possible directions to pursue my work. I learned a lot during all these days. I hope to take the knowledge, contacts and experience I gain in the UK back to India, where I will pursue a career in limnology and phycology. Overall, the conference was enlightening, exhilarating, and thoroughly enjoyable.

I am extremely thankful to the British Phycological Society for awarding me the student bursary thereby supporting my attendance in the meeting. Furthermore, I would like to thank and congratulate the organisers, especially Dr. John G. Day, for their extremely well organisation and making the BPS winter meeting a grand success despite the harsh weather in UK. I sincerely wish to express my gratitude towards my Supervisor Prof. Vijay Kumar Anand for his continuous support and encouragement for my research work.

The mysterious girdle view: A beginner's perspective on the freshwater algal course

5-12 June 2009, Kindrogan Field Centre, Enochdhu, Blairgowrie, Perthshire, Scotland

Sebastian Meis
CEH, Edinburgh

Studying freshwater systems for more than three years by now I mysteriously managed to survive assessing algae by determining total chlorophyll concentrations alone. However, since I started my PhD in the field of lake restoration it began to dawn on me that a closer look at this group of primary producers seemed more than worthwhile. My project focuses on shallow lakes which are detrimentally affected by eutrophication. I am investigating the use of the relatively new phosphorus binding agent PhoslockTM (a lanthanum modified clay product) which strips phosphorus from the water-column and, once settled to the lake bed, reduces sediment phosphorus release. As both water-column phosphorus concentrations and the underwater light climate are likely to be influenced by a PhoslockTM application, I am expecting the phytoplankton community as well as the benthic algal community to change as a consequence. As neither of those changes can be sufficiently analysed only by total chlorophyll concentration, I signed up for the algal course in June 2009 and was fortunate to receive a stipend from the British Phycological Society which allowed me to get started with the identification of algae.

The course was conducted by Dr Eileen Cox (Natural History Museum London), Prof Elliot Shubert (Natural History Museum London) and Dr Laurence Carvalho (Centre for Ecology & Hydrology Edinburgh), and focused primarily on the identification of freshwater algae from various habitats. Sampling techniques for ditches, rivers, ponds and lakes were practiced and the fresh material was subsequently identified in the lab using various keys. In addition to familiarisation with the major algal groups and their identification, the course provided a general overview on algal morphology, structure, reproduction and ecology. This included, for example presentations about cyanobacterial toxin production, the use of algae in lake classification tools, quantitative analyses of phytoplankton and the role of algae in the Water Framework Directive.

In conclusion, the course is very appropriate for beginners who wish to learn how to identify freshwater algae. It provided a sound introduction on the use of keys and pointed out common pitfalls for beginners in the use of such keys. As participants were invited to give a short presentation about their current work and projects, it was also possible to get a lot of advice in direct relation to 'real world' problems. A minor drawback in my opinion was that identification was conducted predominantly on fresh material and not on a comparison of preserved and fresh samples, as some characteristics used in keys are not applicable, or not so easily applicable to preserved samples. I really enjoyed the course and would like to thank the fellow participants for the good atmosphere, the tutors for their enthusiasm and patience during the course and the BPS for their financial support.

Taxonomy of Recent Dinophyceae, (Sylt, Germany)

Jelena Godrijan
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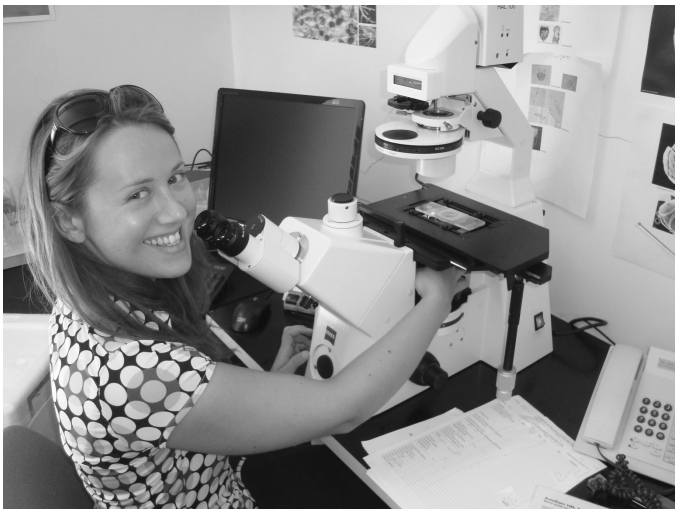
It was a cold and windy autumn on the island of Sylt in 2009 (from October 26th till November 5th) for my fellow participants and I, who were fortunate to learn about Dinophyceae. The howling of the wind and the constant drizzle over that piece of north Germany presented ideal scenery for the days we spent listening to the lectures and looking through the microscope.

The course was held in the Alfred Wegener Institute for Polar and Marine Research, Wadden Sea Station's well equipped course room (with both LEICA microscopes and view of the sand beach), by the respectable guest scientist Malte Elbrächter, who was kind enough to try to pass on to us the knowledge he has been collecting over the years and indicate the burning questions still awaiting answers in



taxonomy of Dinophyceae. (Dinophyceae are referred to under the botanical code, but from now on I will use the term dinoflagellates as it is more commonly used for the group).

Each day was dedicated to morning and afternoon lectures followed by discussions and microscopy exercises. The taxonomic problems concerning identification of certain species within each of the dinoflagellate orders were dealt with. This also provided a great opportunity to work with samples of the AWI's culture collection, live samples from Wadden Sea and especially those from the participants. A fair amount of time was also dedicated not only to the toxicity problems, feeding preferences and life cycle of dinoflagellates, but also to laying the basics for taxonomy, a science on the verge of dying out. Looking back, the most valuable knowledge I was left with were tabulation patterns of all the different armoured groups, together with basic taxonomical terms and awareness of many, many nomenclatural problems.

During the course one could not only notice the richness of life under the microscope, but also the vibrant cultural exchange among the participants, thirteen of them, who came from Tunis, Kuwait, Chile, Iran, Argentina, Turkey, Croatia, Namibia, Pakistan, Ireland (Spain), France (Germany) and Germany. Most of the evenings were spent in the "Tage Raum" of the AWI`s Guest house cooking, discussing and enjoying social games from all over the globe. One evening some inspired paper writing even occurred. A realisation of participants' resemblance to the dinoflagellates was noted during the course, as some displayed typical dinoflagellate characteristics (even bioluminescence). So, one could not pass on the perfect opportunity for applying the knowledge gained to a description and diagnosis writing exercise.

I am immensely grateful to the British Phycological Society for the financial support without which I could not have attended the course. My current research focuses on the phytoplankton community structure in the shallow basin of the northern Adriatic Sea, so this course was the crucial foundation for my future work not only on monitoring projects but especially with the PhD. Being one of the youngest on the course I was given the opportunity not only to learn from Malte, but also from other participants during and after course hours. I also hope the publication on the thirteen invasive dinoflagellate species discovered and described for the first time in the waters of the Wadden Sea in autumn of 2009 will be made, after some major revisions by Malte, of course.

9th International Phycological Congress (IPC9)

Mohammed Ajeesh C.P
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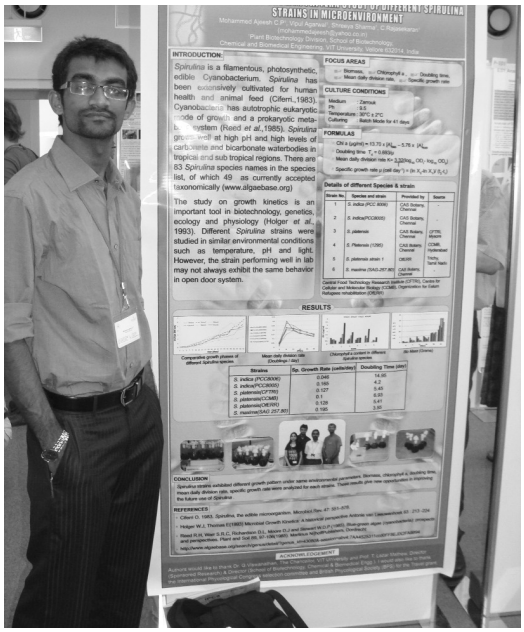
The 9th International Phycological Congress (IPC9) was hosted by the International Phycological Society (IPS) in association with the Japanese Society of Phycology (JSP) and was held at National Memorial Olympic Youth Centre, Tokyo, Japan on 2-8 August, 2009. This CONGRESS was organized by G.education Co.,Ltd, Tokyo, Japan. The congress attracted more than 500 participants (students and experts) from 44 countries world wide. I am a Ph.D. Candidate working on Biochemistry of Spirulina and presented a poster on Comparative Growth Pattern study of different Spirulina strains in microenvironment. I was sure that, IPC9 would be a great venue and a big platform for young researchers like me.

The opening ceremony of the congress kick started on 2nd August 2009 at 4 pm at the Arts Building's large hall and was followed by a welcome reception.

IPC9 included several keynote speakers who work in different areas of phycology. Taizo Motomura, Chuck D. Amsler, Nils Kröger and E. V. Armbrust did the plenary lecture on August 3,4,6 and 7th respectively. Besides workshops, IPC9 themes included Comparative evolutionary genomics, Phytoplankton dynamics & life cycle, Chemical ecology, Frontiers of algal speciation research, Symbioses, Algae, Bio-fuel & CO_2 sequestration, Algae under multiple stress, Biodiversity & ecological function, Algal disease, Alien algae & invasive species, Biological & environment education, Phylogeny - new advances and insights, Algae & Bioremediation. Arrangements for the talks were well planned and simultaneous sessions were held in 3-4 rooms at a time.



Nearly 10-15 presentations (each 20 minutes) was presented on every theme by the speakers and a lot of discussions were held after every talk.

Poster presentations were held on 4th and 6th August 2009 and there were 436 posters on different topics such as Phylogeny & Taxonomy, Species Biology, Symbioses & Genomics, Morphology & Cytology, Diversity & Ecology, Physiology & Biochemistry, Application and Others. I found a lot of scientific interactions and exchange of thoughts among the phycologists during poster presentations. Posters were allowed to be kept at the respective boards till 7th August 2009. Many of the presenters were well prepared with either their visiting card or a short summary of their work. All the abstracts were published in *Phycologia* (July 2009, Vol. 48 No. 4 Supplement).

The accompanying persons were given chances to participate in Flower Arrangement & Origami, Tea ceremony and sea weed art experience. Organizers were kind enough to arrange Free Mid Congress full day tour on 5th August to Katsuura Seaweed Collection Tour, Mt. Fuji - Lake Saiko Tour, Lake Kasumigaura-Tsukuba Science City Tour, Kamakura Tour, Tokyo Tower and Ueno Museum Tour and a half day tour to Ueno Museum. Registered participants were allowed to choose either of the mid congress full day tour, but many preferred the trip to Mt. Fuji (including me). Every tour was either directly or indirectly related to sciences. Our group visited the Biodiversity Centre of Japan at Yamanashi Prefecture, Japan during our trip to Mt. Fuji.

During the Banquet on 6th August 2009 at Keio Plaza, Tokyo, everyone looked very informal and enjoyed the occasion. Felix L. Figueroa (Malaga University, Spain) surprised the audience with Spanish folksongs and later phycologists from Latin America, Korea and Japan followed.

Farewell reception was held on 7th, and 4 best posters were awarded prize money of 250 USD each. IPC10 is scheduled in 2013 in Florida.

On 8th August 2009, the 3rd Tsukuba 3E Forum meeting as the Satellite symposium of IPC9 was held at Tsukuba International Congress Center, Tsukuba on 8th August 2009 and was convened by Isao Inouye and Makoto M. Watanabe (Univ. Tsukuba). The objective of the symposium is to exchange information on algal fuel researches of USA, EU, Australia, Korea and Japan and to survey the possibility of future international research collaboration

IPC9 was well planned and organized and I also thank the Organizers for taking great care in looking after the participants during the entire course of the congress which included accommodation, transportation and mid congress tours.

I express my sincere thanks and gratitude to the British Phycological Society for awarding me the BPS Travel grant to attend and actively participate in this great event.

SAHFOS and MBA Marine Phytoplankton Taxonomy Workshop (Plymouth, UK)

Suncica Bosak
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Last summer I was privileged to participate in the 1st International Phytoplankton Identification Course held from 6th till 17th July 2009 at The Marine Life and Environmental Sciences Resource Centre of the Marine Biological Association of the United Kingdom in Plymouth, UK. The workshop was organized by joint efforts of Sir Alister Hardy Foundation for Ocean Science (SAHFOS) and the Marine Biological Association (MBA) and was aimed at all of those working within the marine phytoplankton field. I am a 2nd year PhD student working mostly on the identification and enumeration of marine phytoplankton for my thesis and am also responsible for the state phytoplankton monitoring program in the Adriatic Sea. This course presented me with the opportunity to further develop my determination skills and the proposed program looked very interesting, so it was with great anticipation that I looked forward to attending this event.

I must admit that the two weeks in Plymouth exceeded my expectations, and I was expecting a lot. My nineteen fellow participants and I came from nine countries all over the world bringing with us varying degrees of experience and expertise in the marine phytoplankton field, hence we were able to learn a lot from sharing knowledge amongst ourselves. The workshop program included keynote lectures by leading scientists, introductory presentations followed by informal discussions and sessions on microscopy. It was an excellent opportunity for daily personal contact with the world's best authorities in phytoplankton taxonomy and ecology. The lectures given by Diana Sarno, Carmelo Tomas, Gerald Boalch, Barry Leadbeater and Alison Taylor encompassed the main facts and information on methods and criteria for correct species identification and provided an updated theoretical background for the morphology, taxonomy, classification and phylogeny of the main phytoplankton groups. The course also covered some interesting technical topics. For instance, we learned about microscopy techniques, the isolation & culturing of microalgae and cryopreservation as well as molecular techniques and classification from Melvin Dodd, Richard Pipe, John Day and Linda Medlin, respectively. Maria Jutson and Claire Taylor introduced us to the Continuous Plankton Recorder survey and Plymouth Culture Collection. Practicals involved identifying algae from the collection and from net tows sampled in the English Channel. The help of our patient, helpful and very knowledgeable tutors motivated us so well that we wanted to find and recognize as many species as we could under the microscope. The central lessons which we took home from the course are as follows. For appropriate and accurate identification a range of traditional and molecular approaches are required and there are endless advantages and crucial differences in observing live rather than preserved samples.

These two weeks managed to be both rigorous and informal. A weekend excursion was organized to the Eden project in Cornwall, a visitor attraction constructed in an unused china clay pit. The complex comprises of a number of domes that house plant species from around the world, each dome emulating a natural biome. The Rainforest Biome, which is the largest greenhouse in the world, emulates a tropical environment, The Mediterranean Biome a warm temperate environment, and the Outdoor Biome represents the temperate regions of the world. The wine and nibbles reception and excellent course dinners were especially fun and we had the opportunity to team up with our fellow 'workshopers' and enter a quiz with questions which probed our general and scientific knowledge.

I sincerely wish to express my gratitude to the British Phycological Society for facilitating my attendance of this course. I am also grateful to the organizers, Julie, Claire, Maria and Richard for taking really good care of us and to our instructors for sharing their knowledge, demonstrating patience and running the classes so smoothly. Of course, I must acknowledge my colleagues for their kindness, numerous cultural exchanges and some truly unforgettable moments. Except furthering my interest in and broadening my understanding of phycology I am lucky that I have been able to experience the international sense of humour, met unique people from different part of the world and found new friends. All in all, the course was extremely worthwhile and I would recommend it to everyone who likes phytoplankton, people and great fun.

13th International Symposium on Phototrophic Prokaryotes

Owen Jackson
University of Leeds

'As I arrived at the Hotel Centre-Ville in Montreal, I began to realise that the conference I was attending, the 13th International Symposium on Phototrophic Prokaryotes, was larger than I had expected. Held in a large, well-appointed hotel on the edge of the world-famous Montreal Old Town, ISPP 2009 had attracted nearly 300 speakers from over 30 countries to present their work on this diverse and interesting field, covering everything from cyanobacterial populations of open oceans to the use of purple nonsulphur bacteria to produce hydrogen for industrial applications. Here to do my first presentation to an international conference I was both excited and daunted to see the list of names of speakers: the great and the good of cyanobacterial research, and many whose names occur frequently in my reference lists!

The proceedings kicked off with a very enjoyable and interesting keynote by Prof. Tony Walsby on his long and distinguished career, which included pictures of HRH The Prince Of Wales collapsing gas vesicles, having a species named after him (Haloquadratum walsbi, of course) and an important reminder that older research is being forgotten in the pursuit of modern references. Other presentations of particular interest to me over the next 5 days included Prof. Birgitta Bergman's work on genomic and proteomic analyses of marine cyanobacteria, Dr. Bernd Masepohl's presentation on nitrogen and molybdenum control of nitrogen fixation, work on cyanobacterial chemotaxis presented by Prof. Jack Meeks and the previously misunderstood (and, as it turns out, pretty important) non-coding DNA regions of cyanobacterial genomes, presented by Prof. Jeff Elhai.

On the morning of the second day I gave my 20 minute presentation on aspects of signalling in the Gunnera-Nostoc symbiosis to a room containing many of those whose papers I have read so avidly over the past few years, and received questions and good feedback on my work. I was also able to make contact with several researchers from the US and Sweden who I have since contacted and have been able to provide me with excellent experimental data which will aid my research.

The highlight of the social calendar was the Wednesday evening party - as we were in Quebec we were bussed out into the Francophone countryside and taken to a traditional Quebecois "sugar shack". Before the meal started it was the traditional ISPP international sports contest - continuing with the Canadian theme this was street hockey. Knock-out rounds whittled the teams down to a Mainland Europe vs the USA final, which the USA won in a fairly unconvincing fashion! A short ride in a horse and cart took us to the sugar shack - think Alpine log cabin, lively fiddle folk music and plenty of filling, meaty food covered in maple syrup and you're pretty much there. The sight of a hundred or so previously reserved and stoic academics doing a conga around the room isn't one I'll forget in a while. Good food and drink, and a very fun evening which everyone seemed to enjoy, even the chap who managed to get bitten by a horse!

I came away from the conference with a much broader picture of the current state of cyanobacterial research than I could have got from a month of reading papers. It has allowed me the opportunity to present my work to the leaders in my field, and has also given me several ideas which I have since been working on for my own research. I would like to thank the organisers for a wonderful conference, and to the very kind grants from the BPS and SGM, without whose support I could not have attended this excellent event.

Hilda Canter-Lund Photography Award 2009

The winner of the 2009 Hilda Canter-Lund prize for the best photograph of an alga was awarded to Mariano Sironi of the Instituto de Conservación de Ballenas for his stunning photograph of a southern right whale mother with her calf swimming through a green tide (tentatively composed of *Lepidodinium* sp.) off the coast of Peninsula Valdes in Argentina. This image can be seen on the front cover. The judges commented that this picture had a "simple yet elegant composition, which illustrates how microscopic organisms may have an impact that belies their size.

The full shortlist can be seen at http://www.brphycsoc.org/Hilda_Canter-Lund_Prize.lasso. In total, 25 entries were received, from 15 different countries. Submitted images varied from macroscopic images (such as the winning entry) to scanning electron micrographs. The judges were looking for a number of qualities in the winning entry: it had to be of high technical and aesthetic quality whilst, at the same time, illustrating an aspect of algal biology. Mariano's photograph is an example of what Henri Cartier-Bresson referred to as the "decisive moment": he was in the right place at the right time, had his camera ready and captured a stunning image. Looking ahead to the 2010 competition, the lesson for us all is to be ready: brush the dust off our lenses, check our memory card has space and our batteries are fully charged and be receptive to the wonderful views that we are privileged to see when we peer down our microscopes or go out into the field.

Martyn Kelly
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Society of Biology - The first months

As most readers will be aware, the Society of Biology formally came into existence on 1 October 2009 following the unification of the Biosciences Federation and the Institute of Biology. Although we plan to build on the heritage of these two important bodies it is important for all of us to see the Society as a new organisation with a different outlook and approach to its organisational parents. For the first time we have one body to represent the interests of all biologists in the UK creating a single powerful voice to advise and inform Governments and make a difference. That aspiration can only be realised if we are a nimble organisation, quick to respond to opportunities, capable of learning from our mistakes and willing to work in partnership. We also need to be truly proactive to really drive the policy agenda.

At the time of reading this article we will be less than six months old and there will still be plenty of opportunity to shape the way we work. But, to do that we need to understand what matters to our members, how you will judge if we are delivering for you and how best to involve you. Any member of the team here would be delighted to hear your thoughts and, as the newest recruit, I am particularly keen to learn about the way your organisation would like to be represented by us.

The Society of Biology is a single unified voice for biology:

" advising Government and influencing policy;
" advancing education and professional development;
" supporting our members,
" and engaging and encouraging public interest in the life sciences.

The Society now has over 70 Organisational Members and nearly 12,000 individual members. This represents 80,000 biologists, giving us the legitimacy to speak with authority in all our work.

Our Council have identified four priority areas for 2010:

Firstly, practical biology. No matter which biological discipline undergraduates or postgraduates follow there needs to be the opportunity to practise science at the bench or in the field. It is simply not tenable to expand undergraduate science education without additional resource to facilitate hands-on experience of designing real experiments and interpreting the results. As Keith Gull, Professor of Molecular Biology at Oxford University and Council member of the Society of Biology said in a recent interview to the Standard, responding to Lord Mandelson's announcement on spending cuts, "A perfect Storm is gathering. Our next generation of scientists will need to look very carefully at the quality of degrees on offer. If we want top scientists - to innovate, to find out fundamental truths and to get us out of recession - this is simply not good enough." (sic). There has to be the resource to properly fund practical biology both in schools and in the higher education sector. We will be pushing this message at every opportunity, especially in the run up to the election.

Secondly, the impact of biology, a central theme in the recent consultation on the Research Excellence Framework. Most biologists accept that the public have a right to know that the money they spend on research is being spent wisely. Its impact on our economy, health care system, environment and society is important to recognise. But it has to be a sophisticated measurement. We plan to build on existing work and present a consistent and clear case around the impact of biology from blue sky research to the most applied. Case studies will be an important part of that. If you have data or views to share please email me at markdowns@societyofbiology.org.

Thirdly, we will continue to work on a pilot accreditation programme to report back to the Office for Life Sciences. The Government has asked us to look at ways in which some biological science degrees can be accredited to give greater confidence to students and employers that they provide the solid grounding needed for employment. There is no doubt that the topic arouses strong views. The academic community doesn't want to be forced into a corner with no room for innovation in their degree programmes or to become a surrogate for technical training programmes, whilst industry bemoans the lack of hands-on laboratory skills of many graduates. I am convinced there is a route to delivery of a solution that meets the needs of both camps. A lot rests with the terminology used. Any accreditation programme we take forward will benefit from wider consultation and will certainly not be compulsory. It is likely to focus on core requirements for biological science courses to be accredited, such as numerical content, experimental design, opportunity for hands-on experimentation and intellectual rigour. It is certainly not about accrediting individuals or asking for coverage of specific training tasks or a defined list of techniques. For sure, biology is more diverse than chemistry or engineering, but by starting in specific areas real benefit can accrue, along with experience. To find out more visit www.societyofbiology.org.

Finally, we will of course be talking to all the parties in the run up to the General Election, forcing them to focus on their science agenda and representing the interests of biology, raising its profile and using our work on "impact " to argue for investment.

The Society will also be working on many wider education, science policy and public understanding of science issues and, of course, trying to evolve new services to benefit our members. We welcome your suggestions for the Society.

Dr Mark Downs PhD FSB
Chief Executive, Society of Biology

MORE ON BALLS AND THEIR FORMATION

Recent articles on algal balls in *The Phycologist* have prompted us to continue the theme. In 2009 Scanlan and Holt reported on *Spermothamnion* balls in Caithness (spring issue, number 76), followed by Scanlan discussing *Aegagropila linnaei* ('*Cladophora*') balls in freshwater lakes (autumn issue, number 77).

Another freshwater example is the *Cladophora*/*Larix* ball in which *Cladophora* filaments entangle the needles fallen from larch trees lining the water's edge (Fig. 1). All specimens illustrated are in the herbarium of the Natural History Museum, London (BM).

The balls thus formed are compact, dark brown and spiky and have been known to reach the size of a football. Those fished out of lakes formed by the meandering river Inn near the village of Sils-Maria in Switzerland have been emulated by local confectioners. Their likeness made from marzipan and coated with chocolate may be seen alongside the real thing in the local shop windows (J. Smith, pers. comm.).

Here are some examples of balls occurring in marine situations.

Sixty years ago one of us (LMI) contributed an article to The Illustrated London News (Newton - now Irvine - 1950) describing the sudden stranding of huge numbers of *Cladophora* balls at high tide level in the southern half of Torbay, Devon, in a 10 foot (3metres) belt, 9 inches (22.8cm) deep and over a mile (1.6km) long (Fig. 1). With an average diameter of an inch (2.5cm), there must have been over 7 million balls in a single layer! As far as we know, nothing like this has occurred before or since, at least on a scale to attract public attention. We would be interested to hear of any sightings of seaweed balls on a similar scale elsewhere.

Coralline algal balls, commonly known as 'rhodoliths', are fairly well known. These are the result of either growing as a nodule around a hard core (e.g. small stone) or by branches continuing to live after becoming detached. An exposure to moderate water movement is required to turn over the crusts or branches of these newly settled corallines to create the rhodolith balls. From experiments with models and specimens in wave tanks, Bosence (1983) showed that ellipsoidal forms are more easily transported than spheroidal forms with discoidal forms being the most stable. Rhodoliths are known from the Poles to the Tropics in non-muddy marine environments and up to at least 100 metres deep. They provide a diversity of niches which support a wide range of plants and animals. In the British Isles (Irvine & Chamberlain 1994) they occur in the west of Ireland (Fig. 2) and in Falmouth Harbour. Living rhodoliths have been shown to be up to tens of thousands of years old and provide a long term record of seafloor conditions.

Well known in the Mediterranean and around the coast of Australia are balls of the seagrass *Posidonia oceanica*, the 'Fibre-ball Weed' (Fig. 1). Its long, narrow leaves have fibrous basal sheathes, the fibres of which persist after the leaves decay. The fibres become matted together as they are rolled up and down the beach by the waves. They can be cast up in large quantities and have even been used commercially (for making paper, stuffing mattresses etc.) and also medicinally. Local names for these balls include the Catalan 'pets de monja' (nun's farts), which is used on the Balearic Islands, and the German 'seeknödel' (sea dumplings).

We examined balls in the herbarium collections at the Natural History Museum and found that those made solely of freshwater *Cladophora* filaments are hollow (Fig. 1), whilst the *Cladophora*/*Larix*, *Posidonia* and marine *Cladophora* balls are solid. We would be interested in knowing of the hollow/solid status of balls as observed by other collectors.

Ball formation seems to be the result of complex rolling water movement. This hypothesis was tested convincingly by a former Keeper of Botany at the Natural History Museum, John Cannon, who employed the services of an automatic washing machine and a deconstructed *Posidonia* ball. He scattered the loose fibres into the machine and watched (it was a top loader) as they were put through several wash cycles. The result was a typical *Posidonia* ball equal to nature's own (Fig. 3). The washing machine was none the worse for the experience.

Figure 1. Clockwise from centre front- ball of *Cladophora* filaments mixed with larch needles from Malham Tarn, Yorkshire; freshwater *Cladophora* ball cut in half to show the hollow centre; large freshwater *Cladophora* ball from county Clare, Republic of Ireland; marine *Cladophora* balls from south Devon (shown in front of their contemporary storage tin); *Posidonia* balls from Tunisia; Japanese postage stamp showing freshwater *Cladophora* balls underwater.

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Figure 2. A rhodolith of *Lithophyllum dentatum* from Galway, Republic of Ireland.

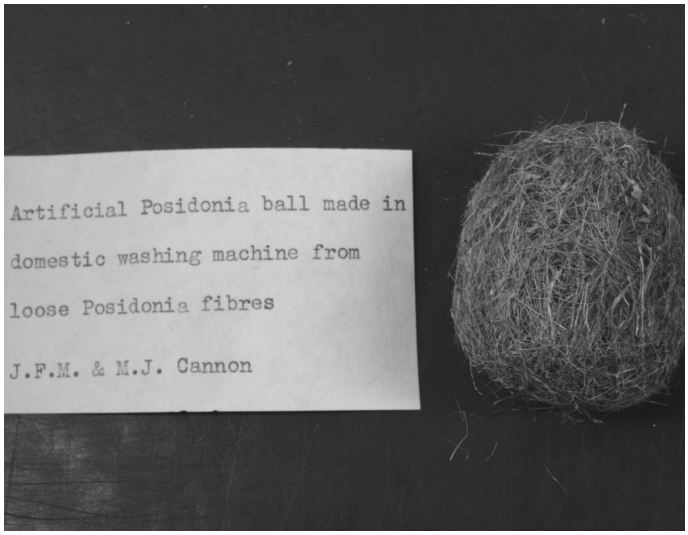

Figure 3. A *Posidonia* ball reconstructed in a washing machine.

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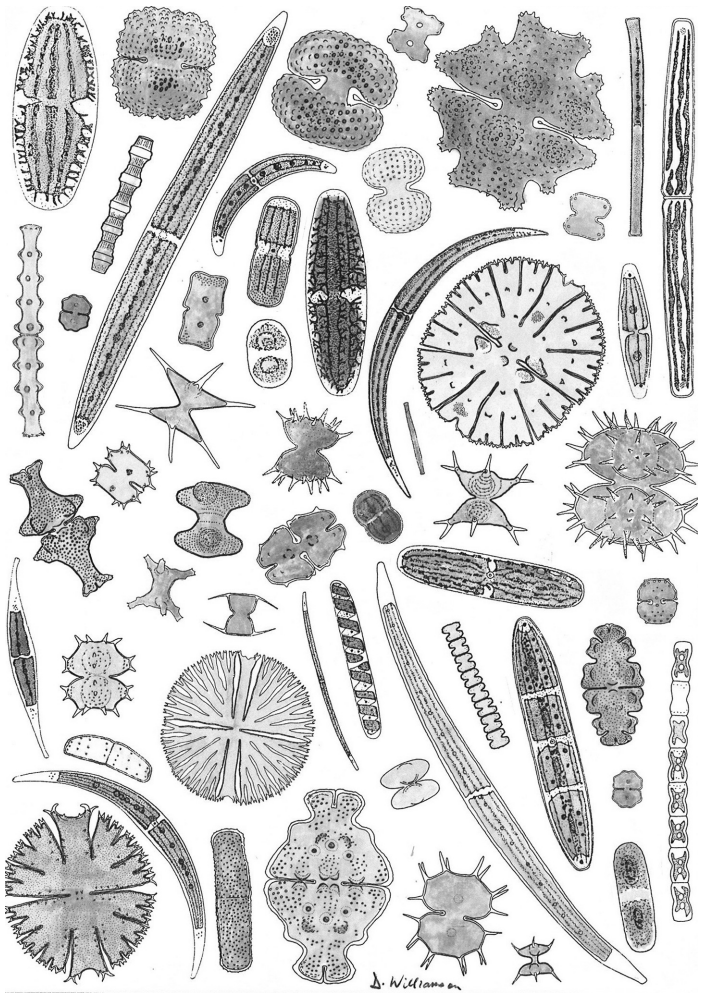

Desmids. Courtesy of David B. Williamson.

Name the Alga!

A tradition of the Kindrogan freshwater algae course is the participation in algae charades, which tests the participants newly acquired skills in identification. The following are participants from the 2009 course in various poses - how many algae can you name? Photos courtesy of Nicole Ross (Scottish Environment Protection Agency).

1.

2.

3.

4.

5.

6.

Freshwater algae course 2010

Where and when?

Kindrogan Field Centre, Enochdhu, Blairgowrie, Perthshire, Scotland (near the tourist area of Pitlochry), **Friday, 4, June - Friday, 11 June, 2010**. This is the 15th year that the course has been offered,

http://www.field-studies-council.org/kindrogan/

What is the course about?

The course takes full advantage of the excellent range of 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 the identification to generic and species level and their ecological importance.

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.

The course focuses on how to get to grips with identification, and the broader aspects of algal morphology, structure, reproduction, and classification (morphological and molecular).

Who are the course tutors?

The course tutors, Dr Eileen Cox and Prof Elliot Shubert, have taught this course for the past 14 years and they have a wide-ranging expertise on freshwater algae. Eileen and Elliot conduct research at The Natural History Museum, London, specialising in diatoms and green algae respectively. Eileen has published a key to live diatoms. Elliot has published a key to the non-motile coccoid and colonial green algae and is Associate Editor for the *European Journal of Phycology* and Editor-in-Chief of Systematics and Biodiversity.

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 he will describe their counting methods, and Guest Tutor, Prof Geoff Codd, Biological Sciences, 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.

What is the full cost of the course?

The course costs **£440** per person (approx **€ 528** or **$700**), which includes sole occupancy accommodation, all meals (please notify the Centre if you have any special dietary needs) and tuition. Shared accommodation is **£370** (approx **444€** or **$590**) per person and **£326** per person for non-residential. This is excellent value for money and costs significantly less than other freshwater algal courses on offer. This is the same fee as 2009..

Is there support for students?

Yes, support for a student stipend is available from:

1. The British Phycological Society,

http://www.brphycsoc.org/funding.lasso. The deadlines for applications are: 30 September, 1 December, 1 March and 1 June. The sooner you apply, the better are your chances are of receiving a stipend. Please note that you have to be a student member of BPS three-months prior to making an application for financial support. **DO NOT DELAY, APPLY TODAY.**

2. Graduate students who are members of the **Phycological Society of America** are eligible for financial support to attend a phycology course at a field station from the Hannah T. Croasdale Fellowship.

http://www.psaalgae.org/ops/grants.shtm

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 should be sent to **Eric Linton linto1ew@cmich.edu by March 1st. DO NOT DELAY, APPLY TODAY.**

3. **The British Ecological Society**

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

http://www.britishecologicalsociety.org/articles/grants/attendmeetings/

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/kindrogan

Course information for 2010 and a booking form will be available soon on the FSC website:

http://www.field-studies-council.org/

If you have any other queries, please contact:

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Durham Freshwater Algal Identification Course

Sunday 4 July - Friday 9 July 2010

Venue: Hild-Bede College and School of Education, University of Durham, Durham, UK

Organisers: Professor Brian A. Whitton (Durham) and Professor David M. John (London)

The aim of this long running course (since 1992) is to train staff from consultancies, research students, governmental and non-governmental laboratories, water companies and overseas visitors in the identification of the commoner and environmentally-important freshwater algae. The large majority are microscopic but included are macroscopic forms important for assessing the ecological status of waters. Other topics covered include sampling, ecology, monitoring, harmful and nuisance algae, and implications of the European Water Framework Directive.

The course provides an introduction for those with limited experience of freshwater algae, but has optional components for those who already have more background knowledge.

The course is a mixture of lectures and practicals, together with an afternoon field trip. Members should arrive by 1730 on the Sunday and the daily programme runs from 0900 to 2120 each evening. It ends formally after lunch on Friday, though there is an optional afternoon trip to sites along the River Wear.

Professors David John and Brian Whitton give the majority of the lectures. Dr Gordon Beakes (University of Newcastle), Dr Alan Donaldson (consultant) and Dr Martyn Kelly (Bowburn Consultancy) will also contribute.

Residence and meals are in Hild-Bede College that is situated on a hill above the River Wear and therefore commands a fine view over the river and city; it also has an excellent reputation for food and drink. Arrangements can be made for special diet requirements.

Members are encouraged to bring a laboratory coat and boots for a short field visit and (preferably) fresh algal samples from their local waters. Everything else is provided including access to The Freshwater Algal Flora of the British Isles and three identification CDs. Some may find it useful to bring their own portable computer, and the risk of loss is covered by insurance. A training manual (2010 revision) will be distributed in advance of the course. Overseas members need not bring a laboratory coat or clothes for the field visit - these will be loaned.

Travel: Durham is on the main rail line between London King's Cross and Edinburgh. Trains are about once an hour and the journey from London (260 miles) takes three hours. A taxi from the station to Hild-Bede College (about 1.5 miles, but a long hill for walkers) costs about £3.50. The nearest airport is Newcastle-upon-Tyne. There is a rail route from Newcastle airport to Durham, though this involves changing at Newcastle main rail station and the overall journey can take anything from one to two hours, depending on the connection at Newcastle. A taxi from Newcastle airport to Durham (26 miles) takes 35-45 minutes and costs about £45. The organizers usually meet members at the airport if they arrive on a day prior to the course, but this may be difficult on the Sunday.

Cost: The inclusive cost for all participants other than full-time research students is £870 (no VAT charge). The discounted price for full-time students or people from countries outside Europe is £770. Students who are members of the British Phycological Society (**http://www.brphycsoc.org/funding.lasso**) may apply directly to the Society for some support. Full details are given on the BPS website. It is recommended that applications be submitted as soon as possible. Hild-Bede College can provide accommodation for anyone wanting to stay an extra night at the beginning or end of the course (about £32 per night). Payment can be included in the main invoice, provided organizers are informed well in advance; otherwise it should be paid directly to the college after arrival. Dinner on Friday (but not bed and breakfast) will be provided free to anyone wanting to stay the night.

Booking: Provisional and firm reservations for one of the 15 places should be made by email to b.a.whitton@durham.ac.uk, to be followed by an official order OR a deposit of £50 to B.A.Whitton Algal Training, 74 Archery Rise, Durham DH1 4LA, UK. Payment is required by 15 June. A refund (less any £50 deposit) will be made to anyone paying early, but cancels the reservation before 15 May, while a 50% refund will be made to anyone cancelling by 15 June.

For further information you are welcome to contact:

Brian Whitton: b.a.whitton@durham.ac.uk, phone ++44(0)191-386-7504 or David John: Department of Botany, Natural History Museum, Cromwell Road, London SW7 5BD, UK d.john@nhm.ac.uk, phone ++44(0)208-464-6367.

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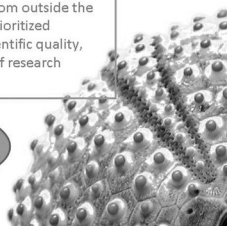

All details at www.assemblemarine.org

The Alga *Dunaliella* Biodiversity, Physiology, Genomics and Biotechnology edited A. Ben-Amotz, J.E.W. Polle and D. V. Subba Rao (2009) Science Publishers, Price £91.00

I first came across the unicellular green alga *Dunaliella* on a fateful day in 1978 when I chose my final year research project to be carried out in the Department of Botany, University of Glasgow. My first choice, which I was allocated, was to work with the eminent phycologist Professor Don Boney and a new lecturer Dr Mike Hipkins on the effect of salt stress on the photosynthesis of *Dunaliella* tertiolecta. The final year project turned into a PhD project with Prof Boney and Mike and I have continuously grown *Dunaliella* species ever since, including for a few weeks on the window sill of my mother's house! With this background, I am bound to warmly welcome a new 555 page book devoted to my favourite alga. Indeed this is the second book that has been written solely about *Dunaliella*, the first book appeared in 1992 and was edited by one of the current editors (Ami Ben-Amotz) along with Mordhay Avron. The current book consists of 21 chapters of varying length (more about that later) co-authored by 41 acknowledged experts in a range of topics related to *Dunaliella*. The coverage is indeed broad and any scientist looking for an introduction to *Dunaliella* taxonomy, physiology or biotechnology will not be disappointed. The major reason that two books have been devoted to *Dunaliella* species is due to their ability to grow over a very wide range of salinities. The mechanism (glycerol production and degradation) is well documented, although how *Dunaliella* cells prevent the leakage of glycerol through the cell membrane remains to this day an open question. It was realised that *Dunaliella* could provide an excellent source of glycerol and some strains (principally D. salina) also produce high levels of β-carotene when stressed with high light or low N levels. The most up to date ideas for cultivation of *Dunaliella* in open ponds to produce β-carotene are covered in several chapters of the book. Glycerol production from *Dunaliella* is no longer even remotely commercially viable due to glycerol being a by-product of biodiesel production from crops. Talking of biofuels, Chapter 19 of the book (Huesemann and Bennemann) covers this area of *Dunaliella* biotechnology. There is no doubt that *Dunaliella* species are candidates for biofuel production and this point is well made by Huesemann and Bennemann, although it is also clear that neither is really a *Dunaliella* expert and they have to keep reminding themselves to mention *Dunaliella* among all the other good microalgal candidates for biofuel production! The other very useful chapters are by Gonzalez *et al* and Polle and Qin, which cover the molecular advances from taxonomic and molecular tool kit viewpoints. This is where the future of *Dunaliella* science lies. There are many other worthy chapters in this excellent book, but there are a couple of drawbacks. Firstly, chapter size (and formats) are very diverse and some of the longer chapters are simply too long. Brevity is often a good thing and in a book like this, authors should be introducing their subject to potential new investigators. It is no coincidence that some of the shorter chapters (e.g. Beardall and Giordano on inorganic nutrient acquisition and metabolism) are much more successful than some of the longer chapters. The second drawback is a large number of minor errors which affect some of the chapters, this is particularly true of the chapter by Subba Rao on cultivation of *Dunaliella* species. Nevertheless, this book provides a wonderful window on research involving *Dunaliella* and I am already anticipating a third book once we have full genomic sequences for several *Dunaliella* species.

D.J. Gilmour
University of Sheffield

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 in JPEG or TIFF file-format no less than 600 dpi resolution**. The editor reserves the right to edit the material before final publication.

Submission of Copy and Deadlines

Copy should be submitted to:

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