The PHYCOLOGIST

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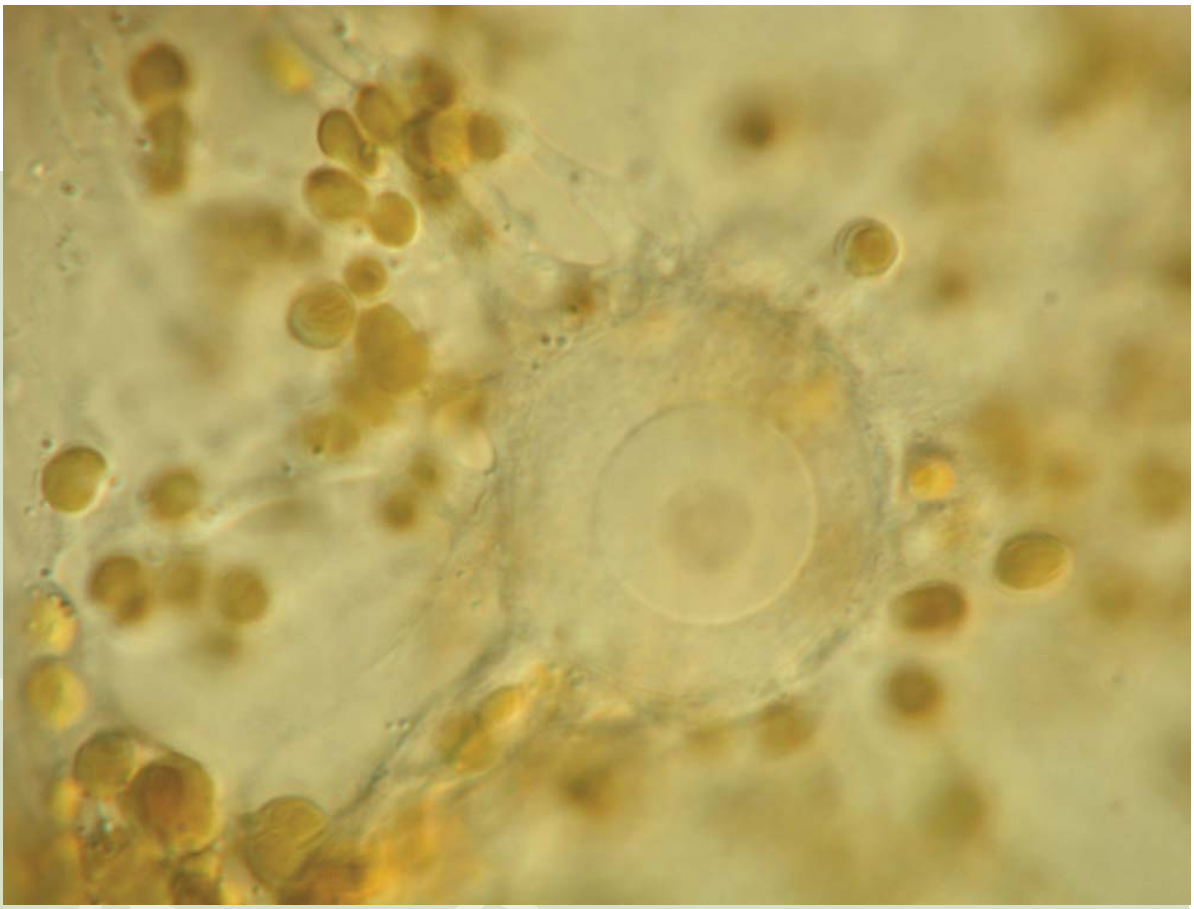

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In This Issue–What's New

As the astute reader will note, *The Phycologist* has changed in 2004. In the process of transferring typesetting and printing to local providers it was decided to change the format of *The Phycologist*. Notably to include full colour printing and to combine the abstracts of the BPS annual meeting with the main Spring issue, rather than print a separate supplement. The inclusion of a full colour cover enables us to print high quality colour photographs and other artwork. Submissions either with articles or as 'one offs' to be considered for the cover are welcomed. With a distribution to over 500 members and to other researchers at international meetings, *The Phycologist* is an important forum where you can raise issues, request information, publicise your phycological activities and research, in an informal format. We hope for an even wider readership with the production and circulation of a PDF version of *The Phycologist* to be accessed from the BPS website in the coming months.

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New BPS Treasurer

As from March 31st 2004 the new treasurer for the Society will be Dr Michelle Tobin whose address details are as follows: Dr Michelle Tobin, Scarborough Centre for Coastal Studies, Scarborough Campus, Hull University, Filey Road, Scarborough, N. Yorks, YO11 3AZ (e-mail: M.L.Tobin@hull.ac.uk). Documents will be transferred between the outgoing and new treasurers during March and all financial matters should now be directed to Dr Michelle Tobin. There may be a short delay before payments can be made but please bear with us.

The Society also welcomes two new ordinary members to Council: Dr Jan Krokowski from SEPA and Professor Geoff Codd, Dundee University. We would like to take this opportunity to thank the outgoing members of Council for their dedicated work on the Society's behalf during their tenure.

Cover Image: The nucleus and surrounding cytoplasm of the marine diatom *Coscinodiscus walesii*. Taken with Nikon Coolpix 4500 digital camera coupled to Nikon Optiphot microscope equipped with DIC optics. (Alison Taylor – Plymouth Optical Workshop 2003).

Important Plant Areas:
a draft list of important algal areas

Juliet Brodie & David John

Over the last six months we have invited members of the BPS to nominate the best and most important areas/sites for freshwater and/or marine and brackish-water algae in the United Kingdom. The response was excellent and so far over 170 sites have been nominated. All these are listed in the table below along with OD grid reference and reason for nomination. The distribution of these UK sites is shown on the map.

If you feel that any important algal site has been missed then send us a complete nomination form to arrive no later than 31 May. Nomination forms can be obtained by e-mailing or writing to us.

We have to draw up a short list of areas/sites and it is therefore important that each nomination is based on as much information as possible. For the majority of those already nominated we still require further information. If you have sent in a nomination but have not completed a nomination form then please contact us as soon as possible. Should you be aware of any important published or unpublished information on any of the listed sites that might further strengthen its nomination then we would be pleased to hear from you.

The Important Plant Area project in the United Kingdom is being organised to assist implement Target 5 of the Global Strategy for Plant Conservation: 'protection of 50% of the world's most important areas for plant diversity assured by 2010'. Producing an IPA inventory is the first stage of Target 5 implementation. Remember that an IPA is not a formal designation but is rather intended to support, inform and underpin existing efforts to protect the most important plant areas by the most appropriate means whether it be by legislation, incentives or advice. It is probable that existing areas are reasonably representative of sites important for vascular plants but not necessarily for other groups. It is likely our IPA inventory for the United Kingdom will identify unprotected sites which are important for algae (including charophytes) along with bryophytes, lichens and fungi.

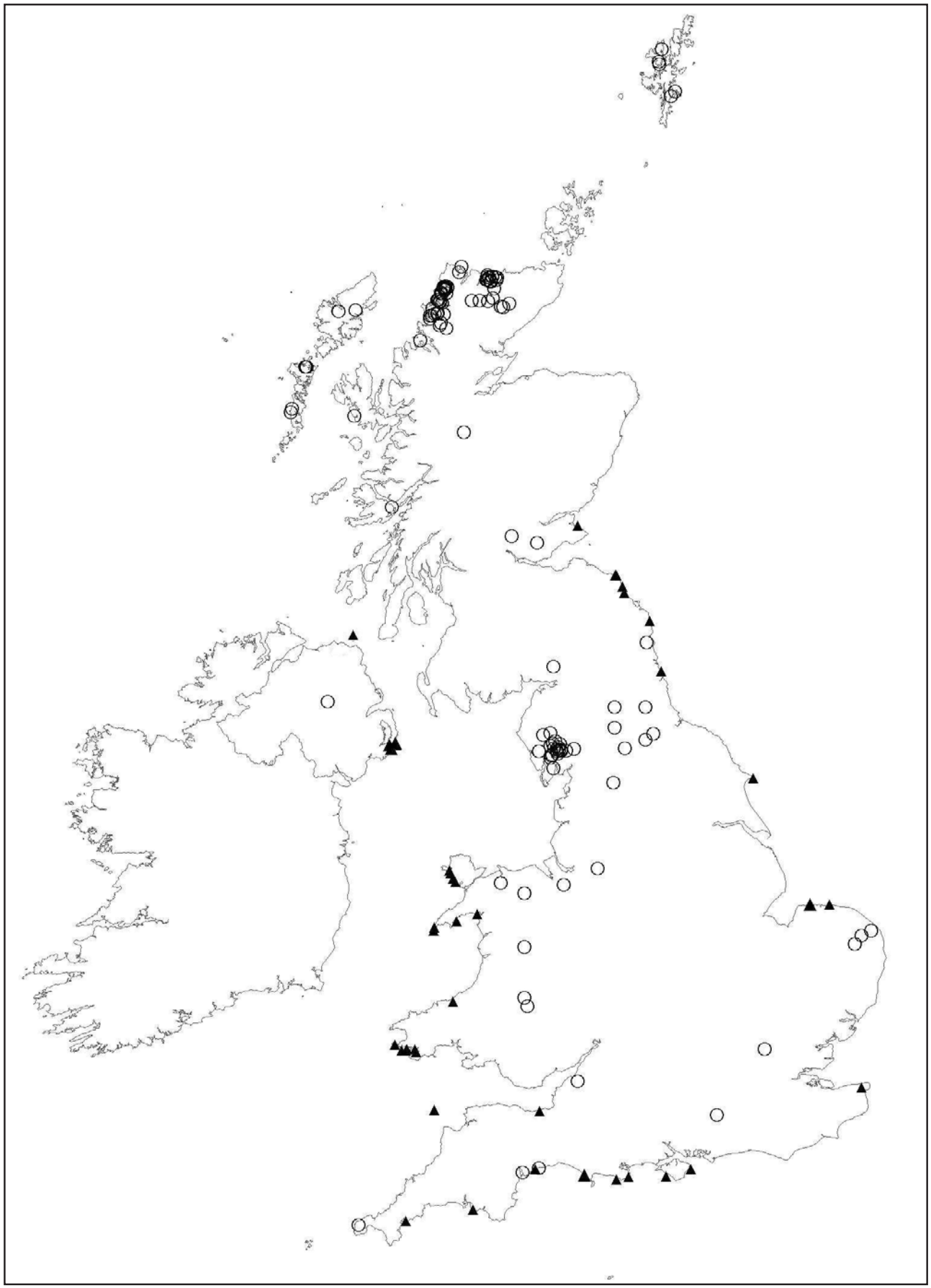
We would like to thank the following who have contributed to this important exercise by nominating or suggesting sites to us sites: Hilary Belcher, Alan Brook, Keith Clarke, Alan Donaldson, Bob Fletcher, Gavin Hardy, John Lund, David Jewson, Alan Joyce, Martyn Kelly, Kate Lock, Christine Maggs, David Mann, Osborne Morton, J. Moore, Susannah Peckham, S. Rostron, David Sigee, D.C. Stevens, Nick Stewart, Brian Whitton, David Williamson and Gabrielle Wyn.

Special thanks goes to James Chimonides (Zoology Department, NHM) for preparing the map.

Juliet Brodie (J.Brodie@nhm.ac.uk) and David John (d.john@nhm.ac.uk), The Natural History Museum, Botany Department, Cromwell Road, London SW7 5BD

Table listing the majority of the nominated Important Algal Areas

Name	OD Grid	Algological Interest
Marine/Brackish Water		
England		
Sidmouth	SY1287	Type locality of *Porphyra linearis* and *Porphyra dioica;* long history of study
Lilstock Beach	ST1644	Published research; several rare taxa; only site in UK for two species of *Acrochaete*
Roseland Marine Reserve	SW851360	History of study; endangered maerl beds
Kimmeridge Ledges	SY9177	Long history of study; diversity hotspot; many nationally rare species; only site in UK for *Ceramium circinatum.*
Lundy Island	SS1345	Long history of study; diversity hotspot, most northerly site of *Laminaria ochroleuca*
Pevrill Point, Swanage	SZ0379	Long history of study; diversity hotspot; many nationally rare species
Berwick-upon-Tweed	NT9952	Long history of study; diversity hotspot; many nationally rare species
Whiteness Gap area, Thanet	TR310670	Unique assemblages associated with limestone platforms and caves; type for some chalk cliff algae
Thanet Area	TR310670	Unique assemblages associated with limestone platforms and caves; type localities for some chalk cliff algae
Wembury	SX5147	Long history of study; diversity hotspot



Map showing the distribution in the United Kingdom of the nominated sites. Key: open circles, freshwater sites; closed triangles, marine/brackish water sites.

Table listing the majority of the nominated Important Algal Areas (*continued*)

Name	OD Grid	Algological Interest
Marine/Brackish Water		
England		
Bembridge	SZ6487	Long history of study; diversity hotspot
Lamberton Beach	NT9758	Long history of study
Low Newton-by-the-Sea	NU2424	Long history of study
St Mary's Island	NZ3575	Long history of study; diversity hotspot
Pettico Wick	NT9069	Long history of study (sublittoral algae); diversity hotspot
St Abb's Head	NT9169	Diversity hotspot; long history of study (especially sublittoral algae)
Flamborough Head	TA2570	Unique assemblages associated with limestone platforms and caves
South Wight Maritime	SZ48	Unique assemblages associated with limestone platforms and caves
Scolt Head Island	TF810465	Diatom assemblages
Blakeney Point	TG000465	Diatom assemblages
The Fleet	SY6081	Unusual assemblages; site for nationally rare charophyte *Lamprothamnium papulosum*
Wales		
Skomer	SM745089	Diverse algal flora; several nationally rare species and species near limits of range
Oyster Bank, Tremadog Bay	SH3530	Many nationally rare algae
The Sarnau	SN3151	Unusual and species diverse ephemeral algal communities
Pen Llyn (Bardsey) and SW corner of Lyn peninsula	SH1221	Diversity hotspot; nationally rare species
Milford Haven Waterway	SM8604	Nationally rare species associated with maerl beds
Rhosneigr Reef, Anglesey	SH3172	Diversity hotspot; nationally rare species in rock pools
Porth Cwyfan	SH335684	Diversity hotspot; nationally rare *Cystoseira* spp.
Cymyran Strait, Anglesey	SH290770	Unusual form of *Ascophyllum nodosum* ecad *scorpioides*
The Inland Sea	SH275795	Many nationally rare species
St Anne's Head	SM810029	Nationally rare species
West Angle Bay	SM849032	Diversity hotspot; nationally rare species
Enlli Llyn	SH1324	Diversity hotspot for littoral and sublittoral species; nationally rare species
Pen Llyn	SH5537	Diversity hotspot for littoral and sublittoral species; nationally rare species
Wear Point	SM939044	Diversity hotspot
Pennar Gut	SM9502	Nationally rare species
Scotland		
St Andrews	NO5318	Long history of study; diversity hotspot; unique pool floras
Northern Ireland		
Strangford Lough	J589496	Long history of study; diversity hotspot; many nationally rare species
Barr Hall Bay	J6146	High littoral diversity
Kearney	J6451	High littoral diversity
Kearney Point	J6451	High littoral diversity
Rathlin Island	D04	One of few site containing the brown alga *Desmarestia dresnayi*
Freshwater		
England		
River Coquet	NU212036	Long history of study by diatomists; abundance of nationally rare diatom *Didymosphenia geminata*
The Serpentine, Eaton Park	SJ4066	Long history of study; some nationally rare algae
Rostherne Mere	SJ732819	Long history of study, high diversity
Little Sea, Studland	SYZ08	Long history of study, high diversity; possibly nationally rare algae

Table listing the majority of the nominated Important Algal Areas (*continued*)

Name	OD Grid	Algological Interest
Freshwater		
England		
Hickling Broad	TG410210	Diatoms
Bure Valley Broads	TG320160	Diatoms
Whitlingham Little Broad	TG252079	Diatoms
Priest Pot	SD357978	Diversity hotspot; some nationally rare algae; long history of study
Grizedale Tarn	SD 346944	Desmid diversity hotspot; 10 years surveyed
High Moss Tarn	SD375980	Desmid diversity hotspot; 10 years surveyed
Goosey Foot Tarn	SD338970	Desmid diversity hotspot; 8 years surveyed
Kelly Hall Tarn	SD288933	Desmid diversity hotspot; 10 years surveyed
Long Moss Tarn	SD292936	Desmid diversity hotspot; 10 years surveyed
Torver Tarn	SD281926	Desmid diversity hotspot; 10 plus years surveyed
Barngate Tarn	NY351011	Desmid diversity hotspot
Beacon Tarn	SD274901	Desmid diversity hotspot
Black Beck Tarn	NY201128	Desmid diversity hotspot
Blea Tarn (Langdales)	NY293044	Desmid diversity hotspot
Boo Tarn	required	Desmid diversity hotspot
Devoke Water	SD158969	Desmid diversity hotspot
Dock Tarn	NY274144	Desmid diversity hotspot
Gurnals Dub Tarn	SD502992	Desmid diversity hotspot
Holme Fell	NY3100	Desmid diversity hotspot
Lang How Tarn	NY318068	Desmid diversity hotspot
Lily Tar and nearby pools (Loughrigg Fell)	NY364040	Desmid diversity hotspot
Podnet Moss	required	Desmid diversity hotspot
School Knott Tarn	SD428973	Desmid diversity hotspot
Three Dubs Tarn	SD378974	Desmid diversity hotspot
Wharton Tarn (High Cross Tarn)	SD331988	Desmid diversity hotspot
Wrynose Pass, pools on summit	NY2702	Desmid diversity hotspot
Malham Tarn	SD8966	Long history of study; unusual assemblages of algae
Waterfall Beck, Malham Tarn Area	NZ2008	Long history of study; unusual assemblages of algae
River Wear	NZ24, NZ28, NY94	Long history of study
Hell Kettles (near Darlington)	NZ280140	Diverse assemblage of algae associated with calcareous water; national ly very rare brown *Pleurocladia lacustris*; long history of study
Red Syke, Upper Teesdale	NY92	Diverse assemblage of algae
Lower Bostraze (St Just area)	SW392321	Desmid diversity hotspot
Stream, Weston Combe (near Branscombe)	SY1688	Type locality and one of few sites of internationally rare *Gongrosira scourfieldii*
Kings Weir, River Lee	TL3705	One of the earliest and few sites in the UK from which all stages of *Thorea ramosissima* reported
Thursley Common	SU9040	Desmid diversity hotspot; long history of study
Abbot's Pond (near Bristol)	ST536732	Long history of study
Lake Windermere	SD38 & NY38	Long history of study
Wales		
Aberithon Turbary (near Newbridge-on-Wye)	SJ016575	Desmid diversity hotspot
Pant y Llyn (near Builth Wells)	SO048468	Desmid diversity hotspot
Cors y Llyn	SO017554	Desmid diversity hotspot
Llyn Hir	SJ0205	Desmid diversity hotspot
Llyn Teifi	SH785675	Desmid diversity hotspot

Table listing the majority of the nominated Important Algal Areas (*continued*)

Name	OD Grid	Algological Interest
Freshwater		
Scotland		
Loch Leven	NN019599	Long history of study; type locality for some planktonic algae
Blackford Pond	NT253709	Long-term diatom research
Isle of Mull	NM7236	Detailed baseline survey in the 1960s
Loch Borralie (Durness Loch)	NC3867	Blue-green algal flora
Lochan Braclaich	NC186146	Desmid diversity hotspot
Lochan Feoir	NC227250	Desmid diversity hotspot
Lochan Fada	NC200169	Desmid diversity hotspot
Culag Wood Bog	NC093214	Desmid diversity hotspot
Loch Bad an Og	NC116312	Desmid diversity hotspot
Loch Culag and nearby bog	NC093214	Desmid diversity hotspot
Loch Nan Eun	NC109238	Desmid diversity hotspot
Loch an Ordain	NC091240	Desmid diversity hotspot
Large bog pool, north of Loch Borralan	NC255115	Desmid diversity hotspot
Beosetter lochs, Isle of Bressay	HU490439	Desmid diversity hotspot
Johnnie Mann's Loch	HU332728	Desmid diversity hotspot
Loch of Housetter	HU363855	Desmid diversity hotspot
Loch Trebister	HU452394	Desmid diversity hotspot
Loch of Haggrister	HU337705	Desmid diversity hotspot
Loch Steinavat	NF8774	Desmid diversity hotspot
Loch nan Creige	NA883737	Desmid diversity hotspot
Loch Bornich, South Uist	NF733293	Diverse assemblage of algae
West Loch Ollay, South Uist	NF740326	Diverse assemblage of algae
Loch Leiniscal, Isle of Lewis	NB365295	Desmid diversity hotspot
Loch Sgaire, Isle of Lewis	NB197285	Desmid diversity hotspot
Loch Soval, Isle of Lewis	NG350255	Desmid diversity hotspot
Loch Tarff (west end Loch Ness)	NH423095	Desmid diversity hotspot
Loch Crocat	NC644590	*Desmidium* diversity
Crocat Sog	NC645592	*Desmidium* diversity
Lochan Dubh	NC649598	*Desmidium* diversity
Loch Modsaire	NC648618	*Desmidium* diversity
Clashbuie Sog	NC657636	*Desmidium* diversity
Loch Tuirslighe	NC658591	*Desmidium* diversity
Torrisdale Sog	NC671615	*Desmidium* diversity
Loch Blan a Bhaine	NC670613	*Desmidium* diversity
Loch Gobhar NI	NC685586	*Desmidium* diversity
Loch Gobhar	NC686577	*Desmidium* diversity
Council Depot	NC705623	*Desmidium* diversity
Loch Salachaidh	NC734622	*Desmidium* diversity
Loch Meadie	NC749614	*Desmidium* diversity
Apigail Sog	NC690573	*Desmidium* diversity
Loch Leacach	NC688573	*Desmidium* diversity
Newlands Pool	NC701617	*Desmidium* diversity
Loch Buidh Beage	NC744591	*Desmidium* diversity
Loch Chealamy	NC722506	*Desmidium* diversity
Palm Loch	NC710410	*Desmidium* diversity
Loch Rossail	NC402718	*Desmidium* diversity
Loch Naver	NC660385	*Desmidium* diversity
Loch Meadie	NC500390	*Desmidium* diversity
Lower Staing	NC576388	*Desmidium* diversity
Loch Badanloch	NC788332	*Desmidium* diversity
Loch Achnamoine	NF830697	*Desmidium* diversity
Loch Ruar	NC871358	*Desmidium* diversity

Table listing the majority of the nominated Important Algal Areas (*continued*)

Name	OD Grid	Algological Interest
Freshwater		
Scotland		
Loch Uidha na Geadaig	NC143256	*Desmidium* diversity
Loch Torran lochan	NC164257	*Desmidium* diversity
Loch Leitir Easaidh	NC168264	*Desmidium* diversity
Loch Innes Fraoich	NC165263	*Desmidium* diversity
L E car park Sog	NC173262	*Desmidium* diversity
Loch Phollain SW 1	NC88321	*Desmidium* diversity
Loch Doire Duibhe	NC176393	*Desmidium* diversity
Loch Creag an Eith	NC209364	*Desmidium* diversity
Knock Calva	NC185375	*Desmidium* diversity
Duartbridge	NC195375	*Desmidium* diversity
Knock Calva NE 1	NC186385	*Desmidium* diversity
Loch Mhuilinn	NC165392	*Desmidium* diversity
Claise Fearna	NC202467	*Desmidium* diversity
Claise Fearna E1	NC206466	*Desmidium* diversity
Claise Fearna E3	NC206464	*Desmidium* diversity
Claise Fearna SE 1	NC203456	*Desmidium* diversity
Loch Glac na Lunn, Laxford	NC252462	*Desmidium* diversity
Claise Fearna SE 2	NC200455	*Desmidium* diversity
Loch Fiacal	NC233490	*Desmidium* diversity
Loch Beiste Brice	NC238502	*Desmidium* diversity
Loch Mhullaich	NC234505	*Desmidium* diversity
Loch Craig Fraoich	NC241501	*Desmidium* diversity
Loch Thull	NC243503	*Desmidium* diversity
Loch Caillich (round pool)	NC248515	*Desmidium* diversity
Loch Mhuilin Loisgte	NC244519	*Desmidium* diversity
Loch Ard E1	NC233520	*Desmidium* diversity
Loch Ard 1	NC231520	*Desmidium* diversity
Loch Loire Duibhe	NC231523	*Desmidium* diversity
Portlevorchy	NC224514	*Desmidium* diversity
PLVE2	NC232512	*Desmidium* diversity
Loch Fheoir	NC263520	*Desmidium* diversity
Loch Lamhaidh	NC245529	*Desmidium* diversity
Loch Craig Fraoich	NC237496	*Desmidium* diversity
Northern Ireland		
Lough Neagh, Traad Beach	H955870	Nationally rare diatoms; long history of study

Plant Diversity Challenge

Juliet Brodie & David John

The Environment Minister, Elliot Morley, launched the UK's response to the Global Strategy for Plant Conservation on 17 February 2004 in Kuala Lumpur at the seventh meeting of the Conference of the Parties to the Convention of Biological Diversity. It took the form of a 53-page booklet entitled *Plant Diversity Challenge* and set out the actions needed to be carried out in the UK to rise to the challenges posed by the 16 targets of the Global Strategy.

The process of responding to the Global Strategy began when the BPS was one of 60 organisations present at a meeting held at the Royal Botanic Gardens, Kew on 5 February 2003. The Algal Biodiversity and Conservation Committee had input into some of the presentations and sent in submissions during the 3-month consultative period. Thanks to our efforts the algae are well represented under the following targets in *Plant Diversity Challenge*.

- Target 1: Developing a working list of species.

Ongoing actions contributing to meeting the target - 'Maintaining and updating the vascular plant, bryophyte, lichen, freshwater algae and charophyte checklists'

High priority additional work - 'Ensuring that update mechanisms are put in place for the NBN [National Biodiversity Network] Species Dictionary, that will ensure that the ongoing work on checklists [including ones on algae] is widely accessible'

Lower priority or long-term additional work - 'Collecting and describing algae and fungi'

- Target 2: Assigning conservation status to species

Ongoing actions contributing to meeting the target - 'Revising the conservation assessment for charophytes in Great Britain'

High priority additional work - 'Developing Red Data Lists for algae'

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View of Wembury, Devon: a diversity hotspot.

"Algae are not plants anymore!"

Ralph Lewin's splendid poem 'Phycology by Fiat' ends with 'For algae are not algae any more' (Lewin, 2003). Perhaps UK phycologists do not need quite such a gloomy approach, but one of the present authors (AMD) found that the situation was almost as bad when the OCR (Oxford Cambridge and RSA Examiners) exam board deducted marks from her A level Biology students if their project reports described seaweeds as plants. Subsequent conversation between AMD and BAW soon made the latter realize where many of the strange or incorrect comments in first-year Durham University undergraduate essays or bizarre questions after lectures originated. The A level syllabus and the various recommended textbooks have much to answer for.

It is hardly surprising that most UK students come to university will little enthusiasm for plants, let alone algae. The current OCR syllabus has a strong 1970s zoology flavour. (The syllabuses of the other main exam boards are closely similar.) There is no mention of algae or of the oceans, whereas the work of the Royal Society for Protection of Birds gets a specific mention. Cyanobacteria and algae can, however, be introduced by a teacher as examples of components of two of the five obligatory kingdoms (Prokaryote and Protoctista, respectively), which were introduced by Margulis and Schwartz (1988). (Protoctista include diverse groups such as protozoa, oomycetes, slime moulds and all the eukaryotic algae.) Plants are the eukaryotic photosynthetic organisms which are not algae. These books emphasize the importance of classifying organisms into species, genera, families, orders, classes, phyla and kingdoms, all of which may be fine for large animals, but a major hindrance for organisms such as algae. The only other justification for an A level teacher to mention algae would be in the sections on photosynthesis, pollution, ecosystems or fieldwork. Although unlikely to affect the students, the OCR syllabus is also in need of correction, because of inconsistencies in layout and wording - enough to make the editor of a journal wince.

The textbooks are even worse. The six most likely to be available to students all include incorrect statements about cyanobacteria or eukaryotic algae, although the errors differ from book to book. Cyanobacteria get relatively little mention, though Jones and Jones (1997) manage to use three different terms - cyanobacteria, blue-greens and blue-green bacteria - within a short space. They show a photo labelled *Microcleus* (*sic*) and *Anabaena*, though the latter is almost certainly not *Anabaena*. The only mention of cyanobacteria by Jones et al. (2001) is a photo labelled *Cylindrospermum* sp.; it is, however, an excellent photo of *Anabaena*. Clegg and Mackean have a coloured sketch of *Anabaena* which bears little resemblance to the organism; it has, for instance, a vaguely spore-like structure, but no heterocyst. There is an even weirder sketch of the ultrastructure of a cyanobacterial cell, where there is a large central area of DNA and the photosynthetic membranes are moderate infolds of the plasma membrane. The several prominent granules scattered through the cell are unlabelled. However, Taylor et al. (1997) have a similar diagram which labels these as phycobilosomes, in spite of the lack of attachment to any membrane. The main fact that Roberts et al. (2000) tell their readers about cyanobacteria is 'although they carry out photosynthesis and respiration, they cannot carry out both at the same time, so they only respire in the dark'. Bailey and Hirst (2001) report that 'in bright light cyanobacteria "produce hydrogen gas as well as oxygen, unlike modern plant chloroplasts". Both these statements appear to be attempts to simplify complex matters by authors who do not really understand the situation. For instance, the latter statement presumably prefers refers to the fact that cyanobacteria with nitrogenase produce hydrogen during nitrogen fixation. Of course there is a need to simplify the facts in a text aimed at A level students, but not such oversimplification. Almost the only comment on cyanobacteria by Fullick (1994) is 'The photosynthetic bacteria include the cyanobacteria', a statement sure to confuse any student looking at an elementary microbiology text. The only other detail is a poor coloured photo labelled *Oscillatoria*, but which could be almost any filamentous form.

There is a little more about eukaryotic algae, but just as much nonsense. The formal definition of algae in the kingdom Protoctista by Bailey and Hirst (2001) includes 'Algae have cell walls containing cellulose', while Rowland (1992) is even more emphatic 'All the algae have cellulose walls'. In the sections dealing with kingdoms or algae in particular almost all the books have a number of other generalizations which are untrue or at least give a false impression. Rowland (1992), for instance, states that 'most algae show alternations of generation in their life cycle', while Fullick (1994) states that red algae are mainly found in tropical waters, whereas among the 'Chlorophyta, only a few such as the sea lettuce inhabit... the sea'. Fullick also has a diagram of *Chlamydomonas* which shows the pyrenoid and associated starch grains as a structure outside the chloroplast. Almost all these books use the term 'feed' where algae obtain materials to aid growth, such as 'some algae feed on organic material'. As the term is not defined (for algae, at least), it is no surprise that it means slightly different things in different books.

The books emphasize the simplicity of algae and often also their small size. Their generalizations contradict the diversity of algae in nature and the complexity of some forms. Jones and Gregory (2001) state that protoctists are simple eukaryotic organisms, Barbor et al. (1997) state that algae are 'simple photosynthetic organisms', while Fosbery et al. (2001) state that 'Protoctista are eukaryotes: unicells or assemblages of similar cells'. Algae and their role in the oceans are rarely mentioned; Bailey and Hirst (2001), Clegg and Mackean (2000) and Clegg (2000) all describe the carbon cycle without any mention of algae, as do Jones and Gregory (2001) in their chapter on energy and ecosystems.

Although students are forbidden to use the term plant for any alga, several authors forget and let the term slip into other parts of their text. For instance, Jones and Jones (1997) refer to 'plant nutrients in the sea', while Clegg (2000)

describes Calvin's experiments on photosynthesis as being done on 'unicellular plants'. However, in his recent and very useful book on plants in the Advanced Biology series, Clegg reverts to 'a unicellular alga' and at least defines the plant kingdom on the first page (Clegg, 2003). Insistence on using the term Protoctista for algae, including huge seaweeds, conflicts not only with popular use, but also that of professional scientists. The term Protoctista has never once occurred in any of the almost 1800 papers submitted to the *Journal of Applied Phycology* (edited by BAW), which commenced at about the same time as the book by Margulis and Schwartz.

The situation will become even more complicated, because of the introduction of the new Salters-Nuffield A level syllabus, which is currently being trialled in 50 schools around the country. This aims 'to bring the treatment of the subject completely up to date, dealing with the frontiers of the subject as well as laying down a secure foundation of fundamental biology'. 'The course should be taught within a contextual storyline related to the modern world and the application of biology'. Biological principles are introduced when required to aid understanding of the 'storyline', but greater emphasis is placed on learning skills and understanding (including ethical issues) rather than learning a large volume of scientific information.

Six of the nine 'storylines' appear to provide no scope for teaching about any photosynthetic organism, let alone algae. However, 'Climate change', 'Plants can't run, can't hide' and 'On the wild side' look as if they could provide scope for mentioning algae, provided the teacher has the knowledge, enthusiasm and tolerance for such titles. However, if the teacher has little interest in algae, it seems doubtful if they will ever be mentioned.

Unfortunately it is not only algae which are treated poorly in these texts. Other members of staff at Durham have experienced similar problems. In one case the lecturer tried to point out the scientific nonsense in his own subject area to his daughter taking A level Biology. However, though the daughter appreciated learning the facts, she was realist enough to know that she also had to remember the incorrect information to get the marks in the exam!

Alison Donaldson with A-level biology students from Newcastle College on a Northumberland beach.

Why do teachers tolerate nonsense in the present A level syllabus and why do mainstream publishers fail to ask professional scientists to check the wording and figures supplied for their books? It took the present authors less than two hours to check any text related to prokaryotes, algae or the environment in all the books mentioned here. One immediate idea for a solution to the problem was to make authors of textbooks stating that all algae have cellulose walls eat a large plate of ice-cream prepared from homogenized *Cladophora*! However, a more practical start would be for the British Phycological Society council to encourage teachers using the present A level syllabus to assemble information about such problems, perhaps making use of the Society's website. Hopefully, this would be a step towards a much more vigorous approach to encouraging young people to be aware of the wonders of algae. The authors had most helpful replies to emails about this article to the present OCR Subject Officer, so it would be well worth forwarding any consolidated comments to him*

If the Salters-Nuffield syllabus is adopted widely, much will depend on the extent to which algae get into the news. Scare stories about toxic algae, mystery invaders and USA schemes to enrich the Pacific Ocean with iron will be essential, even if the pupils lack the factual information to assess such topics critically.

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The British Phycological Society archive

THE BPS has now celebrated its Silver Jubilee and during these 50 years there have been many changes and developments in the study of algae, some of which have been reviewed recently in a BPS publication (Norton, 2003). Since it was founded, the Society has been active in promoting phycology both in the UK and internationally through regular meetings, the publication of the *European Journal of Phycology* (through it various guises), the initiation of such projects as the Floras and Seaweed mapping Schemes, and in encouraging young phycologists through bursaries and prizes.

Throughout its life, however, the Society has been nomadic, having no permanent home and the records of the Society have been passed from officer to officer as they have succeeded each other. This has meant that nowhere is there a repository for, amongst other things, the Minutes of Council Meetings, a complete set of the Journal or the Newsletter, or any correspondence or memorabilia.

In view of this, the Council has decided that the time is ripe to establish a BPS Archive with the aim of bringing together anything that may be of interest to the history of the Society. This will include, for example:

- The acquisition and holding of a complete set of the *Journal* (under its various titles);
- The acquisition and holding a complete set of the Newsletter (*The Phycologist*);
- The holding of a complete of Council Minutes;
- The holding of minutes of Committees such as the Flora Committee;
- To act as a repository for correspondence that might be of value in recording the history of the Society;
- The acquisition of any memorabilia (photographs etc.) pertinent to the Society;

though of course this list is not necessarily exhaustive.

The Archive will be housed at the Laboratory of the Marine Biological Association of the UK in Plymouth and the Council is grateful to the Director (Professor Steve Hawkins) and the Librarian (Linda Noble) for their generous hospitality. The holdings will be open to visitors, by arrangement with the archivist, though it will not be usual for holdings to leave the Archive. Photocopies of holdings will be available at a small charge for copying and postage.

So now, it is up to you, the members of the BPS to create the archive! Dive into the innermost recesses of your cupboards, filing cabinets, attics, cellars, sheds and garages, and if you have anything at all that you can donate, or know of any material elsewhere that you feel should be included, please get in touch with me. The Society is happy to pay postage or carriage, or arrangements can be made for material can be collected.

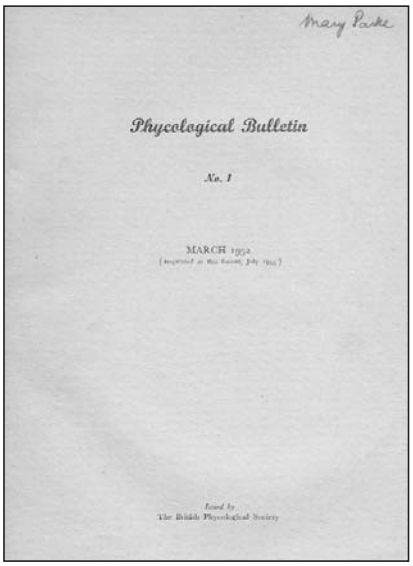
I look forward very much to hearing from you. My contact details are:

J.C. Green, 15 Hedingham Gardens, Plymouth, Devon PL6 7DX
E-mail: jcgrn@freenetname.co.uk
Tel: 01752 775028

Norton, T. A., ed. (2003). *Out of the Past: Collected reviews to celebrate the Jubilee of the British Phycological Society*. British Phycological Society.

Mary Parke sampling in Salcombe in the mid 60s.

Tony Fogg sampling at Port Erin in the mid 50s.
Photographs courtesy of Dr G. Boalch.



Mary Parke

Phycological Bulletin

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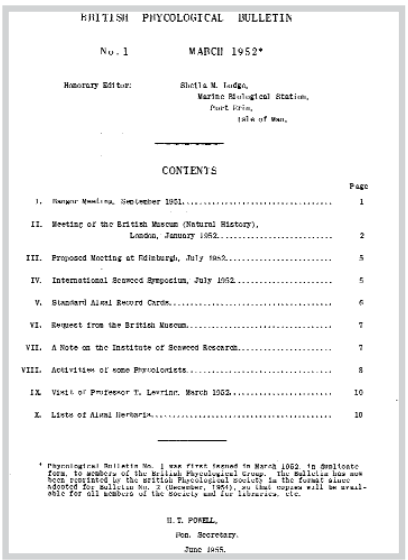

BRITISH PHYCOLOGICAL BULLETIN

No. 1 MARCH 1952*

Honorary Editor: Sheila M. Indge,
Marine Biological Station,
Port Erin,
Isle of Man.

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* Phycological Bulletin No. 1 was first issued in March 1952 in duplicate form, to members of the British Phycological Group. The Bulletin has now been reprinted by the British Phycological Society in the format since adopted for Bulletin No. 2 (December, 1954), so that copies will be available for all members of the Society and for libraries, etc.

H. T. POWELL,
Hon. Secretary.
June 1955.

Front page and page of content of the first *Phycological Bulletin* in March 1952.

Field course reports

Kindrogan Course- A Week Identifying Algae in the Countryside of Scotland

This past summer I had the wonderful privilege of attending a freshwater algae identification course in the Perthshire region of Scotland. The course was held at the Kindrogan Field Center, only ten miles from the quaint little town of Pitlochry. Set back in the hills alongside a farm, it was a beautiful get-a-way to concentrate on the morphology and taxonomy of all groups of freshwater algae. The course is designed for people with various levels of phycological knowledge who desire to augment their algae identification skills. Participants included hobbyists, an artist, water company professionals and a graduate student. The weeklong course was packed with days of lectures, collecting and looking through the microscope, then topped off with algal discussions in the Kindrogan bar. Collection trips involved the surrounding area and samples were taken from various habitats including fast moving streams flowing from highland peat bogs, standing waters of lakes and ponds, and even roadside ditches and bird baths. Some discoveries that were personal highlights included the freshwater red algae *Lemanea fluviatilis* and *Audouinella hermannii*. Additionally, this course solidified that the extensive morphological diversity of desmids and diatoms never ceases to amaze me. During one collecting excursion we were trained on how to retrieve a lost plankton net without getting wet; a skill that may come in handy for any aquatic biologist. There was also a freshwater algal ecology course running in parallel with the identification course, led by Dr John Kinross. Those involved with the identification course had the opportunity to assist with the collections, requiring early-morning and late-night treks to the local pond and stream. We analyzed the variance of dissolved oxygen, chlorophyll concentrations and pH over three days, and evaluated the differences in algal species composition. The week was capped off with an evening of algal charades, which turned out to be mentally, and physically, challenging. The course instructors, Dr Eileen Cox and Dr Elliot Shubert, made the experience quite enjoyable and worthwhile. This was an excellent opportunity to meet other people with various algal interests and to exercise identifying the diverse group, and I greatly encourage the attendance of others with algal interests.

Algae class experiencing first-hand how to retrieve a plankton net lost amongst *Chara* in Loch Kinardochy, Scotland.

Hilary A. McManus
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Durham Course - Introduction to Freshwater Algal Identification (July 2003)

I attended the annual Freshwater Algal Identification course run by Dr David John and Prof Brian Whitton at Hild-Bede College and School of Education, University of Durhan. There were 11 attending the course and I was one of four international participants. During the five-day course we were presented with the perfect balance of the theoretical lectures and practical work. The course was well designed for those with limited experience and those more experienced with algae.

The course was a great opportunity to learn more about identification of the freshwater algae as well as to practice various collection techniques. The fieldwork was extremely useful since I learnt a number of techniques needed to sample in a wide range of microhabitats. The samples covered included periphyton and plankton, both microalgae and macroalgae. The opportunity to bring our own samples and the possibility to discuss them with fellow participants was greatly appreciated. The laboratory work was greatly assisted by having available a comprehensive collection of floras and monographs as well as expert supervision. Every working place in the laboratory was supplied with *The Freshwater Algal Flora of the British Isles* (John, Whitton & Brook 2002) and participants were introduced to the CD-ROM photo catalogue that accompanies it. We also had every opportunity to use other CDs containing interactive keys for the identification of blue–green algae and green algae.

The course lectures covered topics ranged from taxonomy through to the ecology of all freshwater algal groups. I have been fortunate in being able to learn more about the use of algae for monitoring of lakes, reservoirs and rivers, and the implications of the EU Water Framework Directive. At the end of the course I attended an optional tour of the River Wear taken by Professor Brian Whitton and provided me with a great opportunity to recall many of the facts I had learnt. There is no doubt that my future work will benefit greatly from the skills and knowledge acquired on the course. New scientific knowledge and new friendships have certainly helped to broaden my horizons. I believe that the credit for such a successful course should be given to my excellent tutors who managed to maintain the friendly atmosphere which, combined with their professionalism, has greatly increased my enthusiasm for freshwater phycological research. Finally, I would like to thank the BPS for financial support which enabled me to attend this course.

Marija Gligora, Faculty of Science, University of Zagreb, Croatia

Galway Course - Introduction to Freshwater Algal Identification

For the first time in its history the Freshwater Algal Training Course run by Professor Brian Whitton (Durham University) and Dr David John (NHM) was held outside the normal environs of Durham University. Professor Mike Guiry invited the organisers to run the course in Galway, using the facilities of the Martin Ryan Marine Institute in the National University of Ireland, Galway, from 8 to 13 June 2003. The aim of the course was to provide the participants with a broad training in identification and the ecology of all freshwater algal groups, with the emphasis on those algae more common in Ireland and others important for environmental monitoring and the cause of nuisance problems. Fourteen participants from both the private, public and academic sectors attended (NUI, Galway, University of Limerick, University College Dublin, Queens University Belfast, Clare, Cork and Monaghan County Councils and the Environmental Protection Agency).

The week began with lectures and practical demonstrations on microscopy by Peter York from the Natural History Museum. He explained and demonstrated the various techniques that can be utilised in microscopy to enhance the specimen for study and photography, such as Phase Contrast Illumination, Colour Correction and Contrast Enhancement by filters, Crossed Polarised Light Microscopy and Automontage.

Dr Martyn Kelly (Bowburn Consultancy), on his first visit to Ireland, walked us through the remarkable world of diatom identification and taxonomy. Using prepared slides and live samples collected in Galway, he introduced us to the more common genera and increased our confidence in using the identification keys through one-to-one guidance and group work.

The bulk of the lectures and practical work given by both Professor Whitton and Dr John concentrated on the cyanobacteria, the main freshwater algal groups, both micro and macro and the more common groups of sub-aerial algae. Morning lectures introduced us to the taxonomy and ecology of the various genera, with special emphasis given to environmentally and ecologically sensitive and important species. Live and preserved samples were used throughout the practical sessions. A broad range of identification keys were freely available for consultation, however the most commonly used and available to each individual student was the excellent and comprehensive *The Freshwater Algal Flora of the British Isles* (John, Whitton & Brook, 2002). One afternoon was spent in the spectacular surrounds of Ross Lake and Moycullen bog in Connemara (only a 20 min drive from campus) learning the many techniques involved in sampling from various microhabitats. We gathered many water samples and these were investigated with zeal as a direct consequence of our newly acquired knowledge and rapidly increasing confidence. The week ended with a slide-based quiz that tested our ability to identify the more common and not so common cyanobacteria and algae, with the winner treated to a very nice bottle of wine.

As you can gather I found this course to be highly enjoyable and as a postgraduate student working on marine macroalgae it has opened up a completely new area of Phycology to me. The enthusiasm of the organisers immediately rubbed off on me and I came away from the course with a great deal of satisfaction and confidence in my ability to accurately identify many of the common freshwater algae. I wish to acknowledge the financial support I received from the BPS, which allowed me to attend this course.

Ciarán J. Loughnane, Dept of Botany, Martin Ryan Marine Institute, NUI, Galway

Awards and Training – How to apply for BPS funding

The BPS council offers support for research students to attend BPS meetings and overseas meetings as well as student summer research bursaries. There is also funding available to assist participation in field courses. From time to time Council considers requests to support special projects, for example a contribution to support a meeting or symposium, support for collections, public understanding of science and special publications. An application form with details of how to apply is included in this issue of *The Phycologist* and is also available in electronic format on the BPS website: http://www.brphycsoc.org

Alison Taylor

Annual BPS Meeting, Birmingham, January 4–7 2005

The Annual BPS Scientific Meeting will be hosted by Birmingham University on January 4-7 2005. Two special topics are planned: 'Pole-to-Pole Phycology' (organisers **John Anderson** and Johanna Laybourn Parry) and 'Biomonitoring and Conservation' (organisers **Jan Krokowski** and Dave John). Details of the meeting will be available on the BPS website in the summer with **abstract submission in September 30 2004** and final **registration deadline December 1 2004**. A preliminary program will appear in the Autumn *Phycologist*. If you would like to discuss possible contributions to the special topics the organisers can be contacted by email as follows; John Anderson n.j.anderson@lboro.ac.uk and Jan Krokowski jan.krokowski@sepa.org.uk

BPS Annual Meeting, Lancaster University, January 4–7 2004

The 52nd Annual meeting of the Society was hosted by Lancaster University with Jackie Parry and colleagues being the local organisers. In spite of some tiresome travel delays most delegates managed to arrive for the opening evening supper of Lancashire hot pot, washed down with local beers and accompanied by traditional music, a fine way to catch up with colleagues and friends.

The scientific content of the meeting was diverse and this year the meeting was opened with a special themed session on algal signalling. We were fortunate to have Chris Bowler (Naples/Paris) to start the session with his update on calcium based signalling in diatoms. Chris also presented his group's work on the signalling associated with aldehyde-induced cell death. The theme of chemical signals was continued with contributions from Gary Caldwell (aldehydes) and Ina Plettner (ethylene). After the coffee break Jim Callow and Karen Tait presented data on how *Enteromorpha* zoospores utilise chemical signals during settlement. How environmental signals are encoded to produce a cellular response was the subject of two further talks by Alison Taylor (algal action potentials) and Colin Brownlee (calcium – based signalling in *Fucus*). This special session was a great success and the BPS Council have committed to support at least one themed session at each Annual Meeting. Next year there will be special sessions on 'Pole-to-Pole Phycology' and 'Biomonitoring and Conservation' at Birmingham and the following year in Plymouth a session on 'Post-Genomic Phycology' is planned that will enable some of the key advances from algal genomics to be discussed.

The day continued with a session on algal physiology and before the evening receptions Rick Wetherbee (Melbourne, Australia) gave the Founder's Lecture. This was a fascinating tour of the cell surface of diatoms, illustrated with beautiful images and amazing video microscopy demonstrating how some species achieve motility. The evening's receptions included for the first time a student and post-doc forum which provided some helpful feedback to Council via Charmaine Blake, the BPS student representative on Council (see article in this issue). No doubt Council will consider the refreshment budget to have been money well spent and that further student and post-doc receptions will be encouraged! The evening continued with the BPS auction and Karaoke. One raised over £600 pounds for the BPS student fund and the other raised the hairs on the head of any unsuspecting passer-by, I will leave you to judge which was which.

The second day of the scientific program was opened once again by Chris Bowler who contributed a special lecture on the annotated *Thalassiosira* genome. Chris outlined some striking metabolic features that not only highlight the similarities to plants but also to animals. It is clear that over the next few years diatom genomics will lead to very exciting and no doubt unexpected discoveries in diatom biology.

The Manton prize session comprised a great diversity of projects and presentations and after some difficult judging the prize was awarded to Katrina Marshall, for her presentation on bacteria-*Enteromorpha* symbiosis. The final talk of the day was a special lecture marking the centenary of the birth of Irène Manton by Barry Leadbeater. Barry's talk was an entertaining, insightful and warm tribute to her life and work. One aspect of Irène's life was her passion for art which was illustrated by a fine display of her collected pieces in the Peter Scott Gallery where delegates enjoyed a wine reception before the conference dinner.

President and Vice-President elect doing it "Their Way"

The BPS "Girl Band"

The final day of the meeting followed a familiar format with parallel sessions on taxonomy and algal physiology before delegates departed. The meeting ran very smoothly, was a great success and enjoyed by all. For this we thank Jackie and her team for all their careful planning and behind the scenes work.

Alison Taylor

Student/Post-doc Wine Reception, BPS Winter Meeting 2004

At this years winter meeting we held a student wine reception, with the aim of getting students and recent students together and getting some feedback from them about what they wanted from the society. It was a very successful evening, wine flowed and students chatted amongst themselves and with representatives of the council. It proved a very worthwhile exercise as students gave us lots of information, which we were able to relay to the BPS Council at the end of the conference meeting. One of the topics we wanted students to give us a feedback on was the possibility of a separate student meeting, or student forum as part of the BPS meeting. The main response from students was that they saw a benefit in having a student day or session as part of the main meeting and that this could also give an opportunity for 1st and 2nd year students a chance to present short talks, something in addition to the Manton prize session - which could then perhaps become the focus of students at a latter stage in their study. *(continued next page)*

Student/Post-doc Wine Reception, BPS Winter Meeting 2004 (continued)

Some of the other points raised have already resulted in the following:

- Student grants for travel to the BPS meeting, field courses and other conferences are going to be more widely advertised.
- Notification of successful applications for travel awards are now going to be given out prior to meetings to enable students to budget effectively. Application deadlines will be moved forward to facilitate this. Further details will be given by the Awards and Training Committee.
- A BPS/MBA course on collecting and identifying seaweeds is being held in Plymouth, 19-21 April, and all BPS students are able to apply to the society for support to attend, more details on the BPS website.

As part of an advertising drive to raise the profile of the society, Council are looking for willing student volunteers to take a BPS poster and literature to other conferences. The student/s will receive financial assistance for the meeting in return, so if you would like to do this please let us know.

The committee will be considering further suggestions from its student members at its summer meeting, so if you have anything else you would like to be discussed, including the student BPS forum, please let us know by mid-June.

We think all the students attending the meeting found it a worthwhile experience with a very interesting program and we look forward to seeing you in Birmingham in January 2005!

Best wishes

Charmaine Blake, Student Representative (c.blake@qub.ac.uk)
Dr Graham Scott, Honorary Membership Secretary

BPS Manton Prize Winner 2004 – Katrina Marshall

Brought up all over the world, I completed my education in Britain. I always enjoyed biology, especially anything to do with the sea and inspired by my teachers I applied to St Andrews University to study Marine Biology. During my degree I undertook various courses, I was interested in fouling communities and was introduced to the world of the diatom by David Patterson. I ended up completing my third year research project on the lipids present in polychaete eggs.

After my degree I moved to South Carolina and taught environmental education for a year. It was a fantastic opportunity for me to learn more about the marine ecosystems of an entirely different region and I branched out into freshwater ecology as well. I enjoyed learning and decided at this point I would like to study more, so I applied to the University of Wales, Bangor to undertake a Masters in Marine Environmental Protection. While on this course I was again introduced to a range of topics about the marine environment of which, biofouling was a small part of the course. For my research project I chose to study the water contamination in an industrialised bay in central Chile. After my masters I worked for a short while at an environmental consultancy during which a large part of my work was researching the body burden of radionucleides in shore birds.

It was while working there that I applied to study for my PhD in Birmingham with Jim and Maureen Callow and Ian Joint at Plymouth Marine Laboratory. The Laboratory in Birmingham is interested in adhesion of *Ulva* spores to surfaces and leading from this was an interest in how periphytic bacteria affect differentiation of the adult plants. My PhD work is part of the NERC thematic programme of Marine and Freshwater Microbial Biodiversity. The overall aims of the project are to study prokaryote: eukaryote cell signalling, with further investigation of microbial interactions in natural assemblages. I am now at the end of my third year of my PhD and have been investigating the relationship between *Ulva linza* (syn. *Enteromorpha linza*) and its associated periphytic bacteria. The project has entailed the creation of an axenic culture of *Ulva* and a culture collection of the periphytic bacterial strains. Bioassays have been developed to assess the affect of the individual bacterial strains or their supernatants on the morphology and growth of the axenic plants. The results indicate that certain strains and their supernatants do stimulate a change in morphology and growth, although some affect one but not the other parameter. The mechanism of these changes is unknown and so requires further investigation.

It is my intention to continue in phycological research and as a consequence of my PhD I am particularly interested in the relationships that exist between bacteria and algae.

I would like to thank the Society for the funding which allowed me to attend the 2004 Winter Meeting and everyone at Lancaster for organising a very enjoyable and stimulating few days.

Katrina Marshall
Bioadhesion Biofouling Research Group
University of Birmingham
http://www.biosciences.bham.ac.uk/labs/callow/ent

Katrina collecting samples

BPS Poster Prize 2004 – Thomas Wichard

I was born (1976) and raised in Bonn (Germany). After my school days I studied biochemistry at the University of Regensburg from 1995-2001. My main research interest was the regulation of gametogenesis and release of gametes in the green algae *Ulva*. In the lab of Professor W. Oertel I worked on my diploma thesis 'Biochemical and physiological characterisation of a swarming inhibitor from *Ulva mutabilis*'.

After a year of civilian service I joined as a PhD student to the junior research group of Dr habil. G. Pohnert at the Max Planck Institute for Chemical Ecology in Jena in 2002. I am now investigating the diatom-copepod-interaction with the focus on the defence strategies of diatoms. My special attention lies on the enzymes involved in the production of deleterious polyunsaturated aldehydes. I have developed a particular interest in characterisation and functionality of these enzymes. In co-operation with marine biological stations (Roscoff, France) we are trying to confirm their ecological relevance in the laboratory before focussing on field studies. My major approaches involve chemical analysis, biochemistry and fieldwork.

It was the first time I attended the BPS Winter Meeting. The lectures and discussions were very exciting and helpful for my ongoing PhD. I am looking forward to the next meeting in Birmingham.

ABSTRACTS of ORAL PRESENTATIONS

BRISTISH PHYCOLOGICAL SOCIETY ANNUAL MEETING

LANCASTER UNIVERSITY JANUARY 4–7 2004

Diatom signalling in response to external stimuli

Chris Bowler

Molecular Plant Biology, Stazione Zoologica, Naples, Italy and Dept of Biology, Ecole Normale Supérieure, Paris, France.

Marine diatoms are the most successful group of photosynthetic eukaryotes in the oceans, and contribute close to one quarter of global primary productivity on Earth. As such, they are likely to possess sophisticated systems for perceiving and responding to changing environmental conditions. We have begun to characterize diatom responses to environmental stimuli by using transgenic *Phaeodactylum tricornutum* cells expressing the calcium-sensitive photoprotein aequorin, based on the premise that calcium is likely to be an important second messenger in diatom signal transduction systems. Indeed, our results have revealed sophisticated calcium-based sensing systems for responding to turbulence, osmotic shock, and the presence of bioavailable iron. We have further utilized this system to study diatom responses to allelochemicals in the environment, such as the aldehyde decadienal, which is produced from wounded diatom cells. Our results demonstrate a dramatic calcium-based sensitization system for perceiving low concentrations of decadienal, and show that the aldehyde induces cell death in diatoms via the generation of nitric oxide (NO) and other reactive oxygen species. These results have important ecological implications for understanding the molecular basis of bloom termination.

Diatom-derived aldehydes as molecular signals in benthic marine environments

Gary S. Caldwell, Matthew G. Bentley and Peter J.W. Olive

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Diatoms liberate a suite of volatile organic compounds (VOCs) following cell membrane disruption. Of these VOCs, unsaturated short chain aldehydes (SCAs), particularly the decadienals and decatrienals, have been identified as highly toxic to the reproductive processes and early developmental stages of invertebrate grazers. The SCAs are cytotoxic and teratogenic and can potentially limit invertebrate population recruitment success. In addition to an anti-herbivory function, it has been postulated that SCAs also function as allelochemicals. Diatoms are capable of detecting the presence of SCAs in their environment with exposure eliciting an intracellular calcium signal response resulting in the eventual death of the cell. Here we explore the hypothesis that diatom-derived SCAs are functioning as infochemicals in marine systems by directly influencing the evolution of invertebrate life history strategies, forcing susceptible species to spawn in suboptimal environmental conditions. In addition, we shall discuss the possibility that SCAs and other diatom-derived bioactive molecules are functioning as molecular signals in diatom-dominated biofilms. This work was supported by a Seabait Ltd/Uni. Newcastle upon Tyne industrial bursary and by NERC grants GR3/12453, GST/02/2164 & GR3/JRE158.

Ethylene: first insights into the function of a multipurpose hormone in marine algae

Ina Plettner, Michael Steinke and Gill Malin

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Ethylene (ethene; $H_2C=CH_2$) is one of a range of non-methane hydrocarbons (NMHC) that are highly relevant for atmospheric chemistry and global climate. It is a well-known higher plant hormone that is involved in the regulation of plant development, senescence and fruit ripening, and the signalling system that allows for plant responses to light (particularly UV-B radiation). Additionally, infection by pathogens such as viruses and fungi also impacts on the production and release of ethylene by terrestrial plants. The aim of our study is to determine whether marine micro- and macroalgae also actively produce and respond to ethylene. The marine NMHC data that do exist point to production occurring via photochemical breakdown of dissolved organic matter, suggesting only an indirect link with marine productivity. This contrasts with the situation for terrestrial higher plants where there are established links between ethylene production and biochemistry, physiology and ecology. Data will be presented from investigations into ethylene production by marine phytoplankton in response to microzooplankton grazing and viral infection. In a mesocosm study ethylene concentrations increased with the demise of a population of *Emiliania huxleyi*. For the macroalga *Ulva intestinalis* (formerly *Enteromorpha intestinalis*) we have monitored ethylene production with growth and in response to different light intensities, and found a substantial increases in ethylene concentration when low light acclimatised samples were shifted to high light conditions. We also have evidence that *U. intestinalis* synthesises ethylene via the 1-aminocylopropane-1-carboxylate (ACC) pathway and that ethylene perception leads to chlorophyll degradation as in higher plants. It is possible that additional production pathways exist for algae e.g. via the activity of acrylate decarboxylase on acrylic acid (a cleavage product of dimethylsulphoniopropionate the DMS precursor). This route was proposed for cell-free extracts of red and green algae in the 1970's and our ongoing tests provide further evidence for this suggestion. Taken together our data suggest that, as in higher plants, ethylene may play a multi-facetted role in algae.

Surface selection and inter-species communication in biofilm processes involving *Ulva* (syn. *Enteromorpha*)

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Ulva is a common intertidal alga and an important biofouling organism. Its success is partly due to its response to settlement cues that promote rapid recruitment to, and exploitation of a surface in a competitive, turbulent environment. Our main objective is to understand the role of diffusible chemical, physico-chemical, biological and topographical signals in stimulating and inhibiting attachment of the motile zoospores of *Ulva* to surfaces. Zoospore settlement studies have revealed a differential response to surface chemistry and hydrophobicity. In general, settlement increases as hydrophobicity increases, although the strength of attachment of settled spores to hydrophobic surfaces is less than to hydrophilic surfaces. Zoospores also respond to a number of external chemical cues e.g. fatty acids, topographic cues and biological cues e.g. bacterial biofilms (see associated abstract by Tait *et al.*). Recent evidence also suggests that the settlement of barnacle cypris larvae is influenced by *Ulva* biofilms. Chemical communication between different phylogenetic groups may be more common than previously supposed and this has important implications for our understanding of how marine biofilm communities develop. This work is funded by the Office of Naval Research (USA).

Cell-to-cell communication between *Ulva* zoospores and marine biofilms

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Zoospores of the green algae, *Ulva* (previously called *Enteromorpha*), settle preferentially on bacterial cells in biofilms. We have unequivocally demonstrated that this process is mediated, at least in part, by N-acyl homoserine lactones (AHLs) – the best understood signalling molecules involved in bacterial cell-to-cell communication. Using *Vibrio anguillarum* mutants defective in AHL production, *Escherichia coli* strains harbouring plasmid-bourne AHLs and synthetic AHLs, zoospore settlement was

shown to respond to the presence of AHLs. Over 100 bacteria were isolated from the rocks colonised by *Ulva* and assayed for their affect on zoospore settlement. Many, but not all, are capable of stimulating settlement of zoospores. Of the inductive isolates, we have demonstrated a relationship between both the cell density and the age of the biofilm, and how this is related to AHL production by the biofilms. Progress has also been made on elucidating the zoospore AHL-detection method. A better understanding of the mechanisms involved may provide new, novel means of controlling macroalgal biofouling.

The action potential in algae

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The action potential in animal and plant cells is a widespread phenomenon. The membrane depolarisation, ion flux and intracellular calcium elevations associated with these events are involved in both rapid physiological responses to external stimuli and in slower developmental changes. In algae there are notable examples of action potentials, for example in the filamentous halophyte *Chara*, which have been studied in great detail. Our more recent work on algae indicates that the capacity to generate action potentials is prevalent among diverse groups of marine phytoplankton including coccolithophores and diatoms. The functional role of the action potential in these unicells remains elusive. However, using electrophysiological techniques we are now characterising the ion channels and currents that underlie the membrane conductance changes. Moreover, these approaches enable us to study the impact of toxins known to disrupt the function of excitable membranes on algal membrane transport processes.

Waves within waves: intracellular signalling during abiotic stress and polarized development in *Fucus* embryos

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The *Fucus* embryo experiences regular dramatic changes in its abiotic, particularly its osmotic environment. We have been using this system to study the interactions between intracellular signals in response to external stimuli and those involved in regulation of polarized development. Hyper- and hypo-osmotic treatments give rise to cytosolic calcium signals with patterns that vary with the strength and type of stimulus, imparting exquisite sensitivity to external osmotic fluctuations. In several cases, these calcium signals propagate through the cytosol as fast waves, in much the same way as calcium waves in animal cells, but so far not described for any other plant or algal cell. These waves have complex mechanisms of initiation involving both plasma membrane calcium-permeable channels and multiple, highly localized sites of calcium release from intracellular stores and uptake by mitochondria. The differential involvement of these pathways underlies the different observed patterns of calcium signals. We have also found a close spatio-temporal interaction between calcium signalling and reactive oxygen production. Some new approaches in dissecting the significance of cytosolic signals in relation to polarized development will be described.

The potential roles of plasma membrane redox activity in diatom ecophysiology

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A number of plasma membrane redox enzymes are able to transfer electrons from a cytosolic donor to extracellular acceptors. In plants this activity has been linked to a variety of fundamental physiological processes with both constitutive and inducible systems identified. Comparatively little is known about the roles of plasma membrane reductases, (PMR) in eukaryotic phytoplankton though there is evidence to suggest that it could be linked to carbon acquisition, nutrient sensing and possibly dissipation of excess photosynthetic energy. We have shown that marine diatoms, particularly large diatoms, have high constitutive PMR activity compared to chlorophytes and higher plants and that photosynthetic metabolism interacts with constitutive plasma membrane electron transport, (PMET), in these organisms. Recent work in our laboratory indicates that there may be a role for PMET in regulation of algal photosynthesis and maintenance of cellular redox balance. Work continues to determine whether O_2 is the external electron acceptor and the role that PMET may play in the biological generation of H_2O_2. Further studies will examine the long and short-term response of the PMET to nutrient and environmental factors.

Calcium influx pathways in the calcifying marine phytoplankton *Coccolithus pelagicus*

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The mechanism and pathway of delivery of Ca^{2+} to the intracellular calcifying compartment in coccolithophores is unknown. We are using a combined whole cell patch clamp analysis and electron microscopy approach to investigate this. Several ion currents have been characterised in the plasma membrane of the calicifying marine phytoplankton *Coccolithus pelagicus*. Of particular interest are two Ca^{2+}-permeable cation channels. Membrane depolarisation activates an outward current carried primarily by K^+. Tail current analysis reveals a reversal potential more positive than E_{K+}, indicating a moderate Ca^{2+} permeability. Another inward cation current, activated by smaller membrane depolarisations, is dependent on external [Ca^{2+}]. Both of these currents are reversibly blocked by Gd^{3+}, which typically blocks non-selective Ca^{2+} permeable channels in higher plants. These inward currents may act as the pathway through which the large sustained influx of Ca^{2+} from the external medium occurs. We are also investigating this *in vivo* using Ca^{2+}-sensitive dyes and confocal laser scan

ning microscopy (CLSM). A Pulse-chase approach using Sr^{2+} as a marker with subsequent spatial elemental mapping using electron microscopy combined with X-ray and EELS analysis is providing essential information on the transcellular route of Ca^{2+} transport.

Dimethyl sulphide production: do we really understand the contribution of the various marine phytoplankton groups?

Gill Malin and Michael Steinke

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Dimethyl sulphide [DMS $(CH_3)_2S$] is the dominant sulphur trace gas in seawater and provides the vital link in the global sulphur cycle between sulphur-rich marine waters and the relatively sulphur-poor terrestrial environment. DMS oxidises quite rapidly in the air and can lead to the formation of sulphate aerosols, which directly scatter radiation and also act as cloud condensation nuclei. Clouds also cool the Earth and so both processes have an important effect on climate. DMS is derived from the cellular precursor dimethylsulphoniopropionate (DMSP), a compatible solute found in some marine phytoplankton and seaweeds. Marine phytoplankton invest up 50% of their particulate sulphur and up to 20% of their cellular carbon in DMSP, so the quantity of carbon sequestered in DMSP and DMS in the seas and oceans means that these compounds also influence the global C cycle. Data gathered from laboratory and field studies by the DMS research community over the last 15 years or so, have led to the conclusion that the haptophyceae and dinophyceae are the major DMS-producing marine phytoplankton groups. Most attention has focussed on *Emiliania huxleyi* and *Phaeocystis sp.,* since clones of these are highly amenable to laboratory culture, and the natural blooms they dominate have provided convenient 'natural laboratories' for process-orientated studies. Some current modelling initiatives use such background data to define DMS production by different phytoplankton functional groups and in different biogeochemical provinces. In this talk we will briefly review the current DMS/P knowledge bank for marine phytoplankton, and then consider whether current assumptions are safe. We will examine where the important gaps in knowledge are and highlight areas that warrant further research.

Probing and characterizing the cell surface of live diatoms

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While diatoms are characterized by their highly ornate, silicified cell walls, another conspicuous feature of diatoms is their ability to secrete copious amounts of mucilaginous material or Extracellular Polymeric Substances that can come in several forms and perform several functions. We are investigating the biological, physical and chemical properties of the surface mucilages, including the adhesive mucilages, and the mechanisms of bioadhesion utilized by marine diatoms during the formation of fouling slimes. The formation of these mucilages and the mechanisms of diatom adhesion will be illustrated by video microscopy, showing the diversity and complexity of this activity. Atomic Force Microscopy (AFM) has been used to investigate the nanostructure and nanomechanical properties of diatom EPS, including the cell-substratum adhesive mucilage of live cells. My talk will highlight the capacity of AFM in elucidating the topography and mechanical properties of hydrated diatom EPS on a nanoscale, and demonstrate the usefulness of AFM for researchers interested in characterizing living surfaces.

The *Thalassiosira pseudonana* genome sequencing project: revealing the molecular secrets of marine diatoms

Chris Bowler

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Diatoms are a highly successful group of photosynthetic eukaryotes responsible for around 40% of marine primary productivity. In spite of their ecological importance the basic aspects of their cell biology remain largely unexplored. A major boost has been the recent completion of the first complete diatom genome sequence by the Joint Genome Institute in the USA, in a project funded by the US Dept of Energy and coordinated by Ginger Armbrust of Washington University. The sequence is from the centric diatom *Thalassiosira pseudonana*, and consists of a 33 Mb genome organized into 22 chromosomes. Gene finding softwares predict the presence of approximately 11,000 genes, many of which are unique to diatoms. In addition, our laboratory has generated 12,000 expressed sequence tags (ESTs) from the pennate diatom *Phaeodactylum tricornutum*, which have been annotated and organized into PtDB, a searchable EST database (http://avesthagen.sznbowler.com). Analysis of this enormous amount of annotated sequence information has revealed many surprises about the biology of diatoms. An overview of the major findings will be presented.

Benthic diatoms as indicators of nutrient loading in the River Wye

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The River Wye and several of its tributaries are Sites of Special Scientific Interest and a candidate Special Area of Conservation. The importance of the catchment for both nature conservation and fisheries was underlined by designation of the river downstream from Hereford as a 'sensitive area' under the terms of the Urban Wastewater Treatment Directive in 1994 as a result of which phosphorus stripping facilities have been installed at major sewage works. The Environment Agency has monitored benthic diatom assemblages in the river since the mid-1990s and the results of these studies will be presented in this talk. Despite

relatively low nutrient concentrations in the lower river as a result of nutrient stripping, diatom assemblages are still dominated by taxa typical of enriched conditions. One possible reason for this is that the relatively eutrophic River Lugg, which joins the Wye downstream from Hereford, is providing inocula of species favoured by high nutrient concentrations which are then able to establish in the lower river. The implications for other nutrient management programs will be discussed.

Early warning of toxic cyanobacterial blooms

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Toxic cyanobacterial blooms present a risk to recreational and potable water supplies. To facilitate the effective risk management of waterbodies, accurate and sensitive procedures are required to assess the cyanobacteria present and the cyanotoxins that can develop within a waterbody. A wide variety of methods is available that can successfully detect the toxins and the genes involved in the synthesis of these secondary metabolites. However, of these, only a limited number possess the sensitivity required for early warning. Using microscopic, antibody and DNA technologies, we have shown that the early detection of hepatotoxic microcystins is currently possible with single filaments of *Planktothrix* and colonies of *Microcystis* isolated from environmental waters. Other candidates for the early warning of cyanotoxins are the guanidine alkaloid hepatotoxic cylindrospermopsins and single filaments of cylindrospermopsin-producing cyanobacteria which can successfully be assessed for their capacity to produce this cyanotoxin. Of the methods being investigated, fluorescent *in situ* hybridisation (FISH) offers the possibility to combine both nucleotide- and antibody-based methods for both early warning and fundamental investigations into the production of cyanotoxins. This study was funded by the EU project TOXIC (EVK1-2002-00107).

Algal odour compounds: ecological and applied perspectives

Susan B. Watson

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Algal odour compounds (ALOCs) are not simply a question of aesthetics. They have major impacts on water, food and aquaculture industries, and consumer behaviour. They can signal treatment malfunction, algal outbreaks and/or hazards in source water, or profound changes in aquatic systems as a result of human activity. But despite extensive research, ALOCs remain largely unpredictable. The algal species, metabolites and mechanisms operate at different scales not resolved by classic models. Relatively few taxa have actually been characterized for ALOCs, while differences in species' growth, distribution and ALOC production mean odour sources are often untraced. Most importantly, little is known about the biological function(s) of ALOCs. Traditionally viewed as metabolic waste, an alternative view holds that some ALOCs are directly or indirectly involved in algal chemical ecology, which regulates their synthesis and release. This talk illustrates these points by focussing on two dissimilar ALOC groups associated with different levels of eutrophication.

In oligo-mesotrophic systems, fishy-smelling polyunsaturated fatty acid (PUFA) derivatives (PDVs) occur erratically. Chrysophytes, the most common source, exhibit a range of PDV biochemistry, nutritional strategies and ecology. PDV production is heightened at senescence, by disruptive treatment, and potentially, by herbivores. Some PDVs are recognized algal pheromones and toxins in marine systems; recent work suggests similar activity in freshwaters, where differences in PDV toxicity, grazer food selectivity and detoxification mechanisms may produce an apparent dichotomy in PUFA food value. In eutrophic systems two earthy/musty terpenoids (geosmin, MIB) are more problematic which differ markedly to PDVs in chemistry, ecology and treatment implications. They are synthesized by numerous terrestrial biota, but in aquatic systems are almost exclusive to (some) freshwater cyanobacteria. Their biological function is unclear, although their link with cyanotoxins has important socio-economic implications. They can provide potent signals of ecosystem dynamics, as exemplified by their recent outbreaks in the Great Lakes which accompany widespread shifts in transparency, nutrients and food webs, and highlight the roles of climate and large-scale water movement in the production and timing of odour events.

Dietary seaweeds and breast cancer prevention

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Seaweeds have been used for a variety of medical purposes including the folk use of seaweed tonics to treat cancer. Women in Japan have approximately one-third the rate of premenopausal breast cancer and one-ninth the rate of postmenopausal breast cancer as that reported for US or European women. As seaweed is a popular food in Japan, it seemed possible that dietary seaweed could function as a breast cancer preventive. *In vitro* and *in vivo* studies of seaweed extracts support this idea. Twenty-five healthy postmenopausal American women were randomized to 5 g/d of *Alaria esculenta* or placebo in a six-week double-blinded placebo controlled crossover clinical trial. A week of high isoflavone soy powder supplementation was added at the end of each treatment period. Our primary endpoints were changes in serum thyroid and oestrogen hormone levels, and changes in urinary excretion of iodine, estrogen metabolites, phytoestrogens, and melatonin metabolites. A small pilot study of 10 healthy volunteers randomized to a high fat breakfast with 5 g *Undaria* or 5 g placebo provided further evidence of possible mechanisms for the role of seaweed in breast cancer prevention. This work was sponsored by a grant from the Susan G. Komen Foundation.

Is there a symbiotic relationship between periphytic bacteria and the green alga *Ulva* (syn. *Enteromorpha*)?

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Periphytic bacteria are reported to affect the morphology of green algae such as *Ulva (*syn. *Enteromorpha)* through a symbiotic association. A bioassay has been developed, employing an axenic culture of *Ulva linza* (=*Enteromorpha linza*), to assess the effects of bacteria on growth and morphology of the alga. Cultures of periphytic bacteria from three species of *Ulva* were isolated and screened using denaturing gradient gel electrophoresis to remove replicates. Thirtyseven unique strains were obtained and their taxonomic affiliation identified from 16S rDNA sequences. The effects of these strains on growth and morphology of *Ulva* plantlets were then evaluated in the bioassay. Eleven strains caused a profound morphological change with long tubular appendages formed and 4 of these also increased growth. Effective strains were distributed across several bacterial taxa. Biofilms of effective strains were also used in settlement assays to investigate whether they stimulated spores to settle. Whilst biofilms of individual strains stimulated settlement, there was no correlation between those strains that stimulated settlement and those that caused changes in morphology/growth. Investigations are underway to determine the mechanisms by which these changes in morphology and growth occur. This work was funded under the NERC Marine and Freshwater Microbial Biodiversity Thematic Programme.

Relating biofilm biomass, community structure and stability to habitat characteristics

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Epilithic communities or biofilms, consisting of algae, protozoa and bacteria are key components in food web dynamics and nutrient cycling in rivers. Interactions between stream flow conditions and nutrient status may determine biofilm biomass and algal community structure, as species are selected according to their ability to acquire nutrients and/or withstand scour. Biofilm growth (chlorophyll-*a* concentration, algal species composition), water velocity, and nutrient concentrations (nitrate, ammonium, soluble reactive phosphorus) were monitored for 13 months in four streams with different habitat characteristics. High nutrient sites supported high biomass, as expected, though comparable biomass at a site with low nutrients was attributed to slow and steady water velocities. Unfavourable conditions at one site - low nutrient concentrations and fast, variable flow resulted in very low biomass. Algal diversity varied markedly over time at sites with highly variable water velocity compared to stable communities at sites with less variable flows. Classification of algae into functional groups according to morphological characteristics has produced evidence that specific types are selected depending on the nutrient status and flow regime of the stream. Data from this study is being used to develop a model to simulate biofilm algal community structure and biomass given varying hydrological and chemical conditions. This study is supported by a NERC CASE studentship.

Growth and photosynthesis during microphytobenthic biofilm development: an integrated optical approach in a tidal mesocosm

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The EU project BIOPTIS has developed rapid, non-intrusive, optical methods for biomass and photosynthesis determination. We have taken a tidal mesocosm approach in order to assess the reliability of these methods. Sediment from a well studied tidal flat was transported to the laboratory and installed in a tidal tank system. A MPB biofilm was grown on our simulated tidal flat over a period of 2 weeks. The specific aims of the study were; to follow the growth of the biofilm using optical methods, test whether *in-situ* measurements of photosynthesis using fluorescence correspond with measurements carried out on MPB slurries using both fluorescence and ^{14}C. We found that optical methods were an effective way to quantify the growth of the biofilm allowing the daily biomass specific growth rate of the biofilm to be estimated. Both *in-situ* and slurry measurements of photosynthetic parameters showed similar patterns during the growth period. We found a strong trend of decreasing maximum photosynthetic capacity per unit chlorophyll (P^B_{max}) throughout the growth period. This strongly correlated with daily biomass specific growth rates and was also related to changes in accessory pigments. The results will be discussed in relation to methodological issues and implications of the observed photosynthetic parameter changes to primary production on intertidal flats.

An extremely acid lake with a dense population of one species, *Dictyosphaerium pulchellum*. Why?

Haseeb Md Irfanullah and Brian Moss

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Delamere Forest Park Lake in Cheshire, UK is a shallow, acid lake (mean pH, 4) with very high phytoplankton growth (annual mean chlorophyll a, 275 μgl-1) and devoid of any significant cladoceran population. This apparently fish-less lake had been sampled on a biweekly basis for two years. *Dictyosphaerium pulchellum* was found to be the most dominant species comprising ca. 99% of the lake phytoplankton biovolume. Among other species, *Cryptomonas* sp. and *Monoraphidium griffithii* were also seen. Seasonal dynamics of these species in the lake will be presented. Possible roles of different variables in controlling such dynamics will be discussed. A lake enclosure experiment was carried out to reveal any effect of elevated pH on the lake phytoplankton community.

D. pulchellum maintained its dominance despite an increase in pH from 4 (ambient) to 6 and 8, however its contribution to the total phytoplankton biovolume decreased significantly in the final days of the experiment because of increased abundance of a *Chlamydomonas* sp. Species richness increased in all treatments, but a strong shift was observed among less abundant species. Possible influences of other chemical and biotic factors will be discussed, and scope for future work will be indicated.

Cyanophages from the Baltic Sea

Caroline Jenkins and Paul Hayes

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Cyanophages, bacteriophages that infect cyanobacteria, are found in association with their hosts in both marine and freshwater environments. We have isolated a collection of 30 lytic cyanophages from the brackish Baltic Sea that infect either the filamentous cyanobacterium *Nodularia* or the picoplanktonic cyanobacterium *Synechococcus*. We have also isolated, from plaques that appear spontaneously in lawns of stressed host cells, a collection of thirteen cyanophages that could be temperate, i.e. able to form stable lysogenic associations with their cyanobacterial hosts. Transmission electron microscopy has revealed that both the lytic and the potentially temperate cyanophages in our collection are members of either the *Cyanomyoviridae* or the *Cyanosiphoviridae*. The genetic diversity of these cyanophages was further investigated through the amplification and partial sequencing of a T4 g23 homologue (the gene that encodes the major capsid protein): this capsid protein-encoding gene is conserved among Baltic Sea and other marine cyanophage isolates. In this presentation we will discuss our findings and speculate as to whether cyanophage are important as vehicles promoting the transfer of genes between host lineages within cyanobacterial populations.

Do grazers behave in the way the functional group model predicts that they should?

Sara Marsham, Graham W. Scott and Michelle L. Tobin

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Algal morphology is thought to correspond to physiological and environmental factors such as stress and disturbance. A key disturbance exerted on algae is pressure from herbivores. Basing morphological characteristics on function allows algae to be classified into 'functional groups'. The functional group model proposed by Steneck and Watling (1982) combined algal species into seven functional groups, and suggested that susceptibility to grazing decreased hierarchically from functional group one to functional group seven. Based upon experimental manipulations, we present data to address the following questions: 1) does *Littorina littorea* demonstrate the predicted preference for algae from FG1 to FG7, and 2) does *L. littorea* consume all species within a group similarly. Together, these results can be used to evaluate the predictions of the functional group model. Results were collected by conducting edibility experiments, in which the amount of algae eaten was recorded, and attractiveness experiments, in which two-way choice tests were performed.

The cultivation of *Palmaria palmata* for aquaculture

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Palmaria palmata tetraspores have been settled onto Korean culture string in the laboratory; the survival rate of spores was 7% after 30 days. After a nursery period of one month, strings were transferred to longlines in Strangford Lough. After 3 months, the largest thalli were 20-70 cm long, and were harvested. This allowed smaller thalli to continue growing, and to be harvested at 45-day intervals over 3 months. On a commercial scale, a 100-metre long line would support 667 droppers, each 3 m long, and the total annual yield from four harvests would be 2.8 tonnes fresh weight. Further experiments have investigated the survival of spores from settlement to the on-growing phase in the sea, and the optimal spore density for maximising final yield. The influence of daylength on the induction of fertility in tetrasporophytes from the field has also been investigated. The significance of these results for extending the length of the cultivation season, and increasing the final yield of *Palmaria* will be discussed. This research is supported by the Northern Ireland Department of Education and Learning and Dolphin Sea Vegetable Company through a CAST award.

Using coralline algae as a biogenic archive

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Maerl forming species are calcareous red algae (Corallinaceae), which can become free-living due to fragmentation. The internal banding in maerl (rhodoliths) can provide a high-resolution biogenic archive, with particular use in reconstructing palaeoclimatic and palaeoenvironmental changes. Live and sub-fossil (4200 BP) samples of maerl have been analysed specifically for $\delta^{18}O$ and $\delta^{13}C$ using mass spectrometry. The sea-water temperature and salinity proxies (Ca, Mg, $\delta^{18}O$ and $\delta^{13}C$) are being validated using material grown in controlled laboratory conditions. Samples used are from Ireland, Britain, Canary Islands, Spain and Mexico. Other areas of investigation are internal banding, growth rates and PAM fluorometry studies of environmental constraints on maerl.

The work is supported by a studentship from the Department of Education and Learning for Northern Ireland.

Irene Manton FRS (1904-1988) - Legend and legacy

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The year 2004 marks the centenary of Irène Manton's birth. Her life spans the better part of the twentieth century and during this time she was at the forefront of one of the most important developments that affected microscopy since light microscopes were first introduced in the seventeenth century. Manton was by training a classical cytologist who worked on flowering plants and ferns. However, her need for better microscopes with greater resolution to observe chromosome substructure lead her to acquire a UV microscope and then an electron microscope. The latter opened up an opportunity to broaden her researches which she exploited to the full. Collaboration with phycologists, in particular Mary Parke FRS, lead to a major outpouring of papers containing seminal results. Irène Manton was a scientist of exceptional qualities. Apart from the sharpness of her intellect, she was an accomplished musician, linguist and a patron and collector of fine art. Her influence on phycological and fern research in particular, and biology in general, was considerable. This contribution takes a look at her life and career and reflects on her legacy.

Reassessing the systematic position of monoraphid diatoms

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The monoraphid diatoms are those diatoms in which a functional raphe system is present on only one of the two valves of a frustule. Traditionally such diatoms have been grouped in a single family or order, distinct from the biraphid diatom families or orders, although they exhibit variation in protoplast organisation and wall structure. Recently several new genera have been described for parts of *Achnanthes sensu lato*, but the systematic relationships of the new taxa have not been evaluated. We included a few monoraphid diatoms in a phylogenetic analysis of 50 diatoms that showed some conflicting combinations of protoplast and frustule characters. In addition we have studied valve morphogenesis in both biraphid and monoraphid diatoms. Evidence from cladistic analysis and morphogenetic studies independently indicate the derivation of monoraphid from biraphid taxa. This paper will summarize the findings that support the transfer of the monoraphid genus *Achnanthes* (*sensu stricto*) into the Mastogloiales. The implications for the systematic position of other monoraphid diatoms will be briefly discussed.

Is it possible to define what is meant by a species in the red algal genus *Porphyra (Rhodophyta)*?

Juliet Brodie

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Trying to define what is meant by a species is nothing new, but I have raised this question in relation to the red algal genus *Porphyra* for three reasons. The first concerns how a decision can be made to create a species based on empirical data. The second reason relates to the concept of a species and the many entries that are entered in the public databases, e.g. GenBank with perhaps no consideration of type or no type material available or a lack of verifiable specimens. The third reason is pragmatic in that we surely want to be able to identify species in the field. I am using *Porphyra umbilicalis* to start with to see if it possible to solve some of these issues. The approach is to obtain a mixture of sequence data as well as morphological observations from a wide range of specimens of what is considered to be this species, and on the basis of the data to consider the erection of a neotype to which future molecular data for this species can be referred. The range of morphological variation within what is ultimately defined as the species can then be described.

Using genetic markers to track invasions by the green seaweed *Codium fragile*

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The invasion of shorelines by algal exotics can alter ecosystems and threaten biodiversity. Determining the invasive tracks of marine exotics can prove troublesome due both to the occurrence of cryptic species, and to the lack of genetic diversity within the introduced populations. Genetic analysis of algal introductions, in particular, has to date been hindered by the absence of suitable molecular markers. The siphonous green alga *Codium fragile* ssp. *tomentosoides* is believed to have originated in Japan and has now spread along most of the world's temperate coastlines, often in association with aquaculture. To determine its invasion history and to reveal the organism's invasive tracks, we used high resolution chloroplast markers (chloroplast microsatellites) for the first time in seaweeds, in conjunction with plastid intergenic spacer sequences. Genetic diversity in populations in its native and non-native ranges was compared. Although there was limited genetic variation indicating a restricted genepool even in Japan, at least two separate introductions into Europe were revealed. Populations in the North Atlantic and the Mediterranean have most likely been founded from separate Japanese populations.

Heroic failure or new dawn? Image-based identification of microalgae

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A defensible estimate of species numbers in diatoms is c. 200,000, and evidence from several other microalgal groups indicate that current taxonomies are often 'coarse-grained' and do not discriminate sufficiently between biologically significant entities. However, making taxonomies more precise can make them difficult to use. Molecular methods offer one way around this prob-

lem and it has been suggested that sequence data could be used to 'bar-code' species for identification. However, this is currently unrealistic for many microalgae, because of rarity, poor sampling, recalcitrance in culture, or difficulty in obtaining sequences; furthermore, diatoms need to be identified when dead, for palaeoecology. The ADIAC and DIADIST projects were developed to make better use of morphological information, extracted without supervision from digital images, in classification and identification. Some new shape descriptors are highly sensitive and appear to surpass human visual capacity. DIADIST emulates traditional drawing in that a complex image is reduced to quantified, diagnostic essentials, which are then used for matching against a database of digitized drawings or photographs. DIADIST methods being developed can detect and represent striation patterns encouragingly well. Successful identification rates of > 95% in tests of ADIAC algorithms compare favourably with those achieved by experts. [EU, BBSRC funding].

Genetic structure of a North sea *Pseudo-nitzschia pungens* population

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Despite a marked increase in the number of studies of marine phytoplankton over the past couple of decades, knowledge of phytoplankton population structures and genetic diversities on a spatial or temporal scale is still very limited. Originally it was assumed that as a result of oceanic currents, phytoplankton must be widely dispersed and hence exhibit little genetic structure. This view has been seriously challenged by the few studies that have been conducted. These studies predominantly used isozymes and RAPDs to demonstrate that populations are in fact often heterogeneous and that isolates are related by geographic origin. Both isozymes and RAPDs have associated problems, and so for this study the more powerful and reliable technique of microsatellite analysis was chosen to investigate the genetic structure within a population of the marine pennate diatom *Pseudo-nitzschia pungens.* Using primers developed for six polymorphic microsatellite loci, we have genotyped 250 *P. pungens* clones from spring blooms in the North Sea in both 2002 and 2003, and approximately 150 clones from an autumn bloom in 2003. Here we present our latest results.

This work is supported by the NERC. Stefanie Kühn from the University of Bremen performed many of the *P. pungens* isolations.

Cryobanking: the need for accurate post-thaw viability assessment

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Most algal culture collections employ perpetual subculture to maintain their holdings. However, financial costs and concerns about genetic stability have increased interest in the use of cryopreservation techniques. A significant problem with the application of this approach is the determination of post-thaw viability levels. Colony formation; the standard technique, is suboptimal as many strains do not grow in or on agar, furthermore, morphologically complex and non-axenic strains present greater constraints. In this study, photosynthesis (O_2 evolving capacity) was investigated as a possible alternative viability assay. *Neochloris conjuncta*, an alga amenable to cryopreservation was used as a test strain and on employing an optimised assay viability data closely reflecting conventional pour-plate data. This observation was replicated for many simple unicellular green algae tested and reproducible, accurate viability data generated rapidly. However, problems were observed on assaying larger, more complex, freeze-recalcitrant algae. One significant problem identified was the possibility of oxygen release as a result of free-radical mediated injuries that could be misinterpreted as a sign of post-thaw viability. This work is currently ongoing, however, it is clear that although useful data can be generated using this approach, growth based assays remain the most accurate method of assessing post-thaw viability. This work was funded by the EU COBRA project (Contract No. QLRI-CT-2001-01645).

Algaebase: listing the World's algae

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AlgaeBase (http://www.algaebase.org) is a worldwide, web-searchable store of information on those organisms generally considered to be algae. Access to this information is free. The database was established in 1996 and at first only included seaweeds. Its main function at this time was as a catalog of the marine algae of Europe for the European Union-funded BioMar and European Register of Marine Species (ERMS) projects, and for the recently published (by the British Phycological Society) *Atlas and Check-list of the Seaweeds of Britain and Ireland* (Hardy & Guiry, 2003). The data are now being extended to cover all algae. Over 55,000 names, of which about half are presently accepted species names, are now included, together with the names of about 5000 genera, about 3000 common names, over 1000 pictures, and about 35,000 literature references. URL-based links from a number of other databases including the Species 2000 Annual Check-list, BIOSIS, GenBank, and Codes for Australian Aquatic Biota have been implemented. It is intended to initiate similar connections from new initiatives such as EuroCat, and a number of other global biodiversity databases. As part of a further EU-funded project, SeaweedAfrica (http://www.seaweedafrica.org), AlgaeBase is being completely rewritten as an SQL database with a browser-enabled interface, enabling access by taxonomic experts. AlgaeBase hopes thereby to continue to provide high-quality access to community-serviced data in the best traditions of the Internet.

The evolution of silicification in diatoms: inescapable sinking and sinking as escape?

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The silicified bipartite cell walls of diatoms (Bacillariophyceae) are produced in intracellular compartments from supersaturated silicic acid and are then externalized. The first fossil evidence of silicification is for marine planktonic centric diatoms from ~120 million years ago, so it is to these cells that we should look for early functions of silicification. The increased density resulting from silicification, internal or external, increases the sinking speed of cells; this can be partly or wholly offset in the marine environment by regulation of the protoplast solute composition. The initial selective significance for silicification presumably did not require externalization of silica, thus excluding many non-density related phenomena that may be very important roles of external silica today. Acclimatory and regulatory changes in silicification (relatively slow) and intracellular solute composition (relatively rapid) alter diatom cell density over periods of hours to days. Density changes resulting from changes in resource supply and, probably, parasitism, would move cells into more nearly optimal resource supply conditions, and remove parasitized, infective cells from surface populations of uninfected cells.

Microcystin quotas in cyanobacterial colonies and filaments

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Understanding of relations between bloom- and scum-forming cyanobacterial biomass and toxin concentrations is necessary to provide a sound foundation for the health risk management of cyanobacterial mass populations. Diversity occurs between types and concentrations of cyanotoxins and cyanobacterial genera, morphospecies and strains within species. We are using antibodies raised against the hepatotoxin microcystin-LR to quantify microcystins by ELISA, in individual colonies of *Microcystis* spp. and in *Plankothrix* and *Anabaena* filaments. Quantitative determination of microcystin content (quota) is possible, with a minimum detection limit (MDL) of 0.017 ng microcystin-LR equivalents per colony/filament. Using samples from over 25 freshwaters collected in 2002/3, we conclude that *M. aeruginosa* colonies most consistently showed a significant relationship between microcystin quota and colony size. Microcystin quotas below or slightly above the MDL were found with colonies of other *Microcystis* spp., principally *M. wesenbergii*, *M. flos-aquae*, *M. novacekii*, and *M. ichthyoblabe*. Filaments of *Planktothrix rubescens*, *Planktothrix agardhii* and *Anabaena flos-aquae* were both above and below the MDL. Single colony/filament ELISA provides a useful tool to investigate the origin and diversity of microcystin production in blooms and to help validate current Guideline Levels in the risk management of drinking and recreational waters which are based on colony/filament determinations.

DMS and related compounds during viral infection of *Emiliania huxleyi*: a secret weapon?

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Dimethyl sulphide (DMS) can influence climate and constitutes a major source of atmospheric sulphur. Its primary origin is dimethylsulphoniopropionate (DMSP) a compatible solute found in certain marine phytoplankton. DMS and acrylic acid are formed in equimolar amounts from DMSP when it is cleaved by isozymes known as DMSP lyases. It has been speculated that DMS can then be oxidised to DMSO possibly as part of an antioxidant cascade, or that DMSO is directly formed from DMSP via an undefined biosynthetic pathway in the cell. We studied axenic cultures of the phytoplankton *Emiliania huxleyi* and followed the production and fate of these compounds during viral infection. Concentrations of DMSO increased rapidly soon after the addition of viruses. DMS and acrylic acid production occurred simultaneously during the latter stages of the culture crash, although DMS concentrations were lower than those of acrylic acid indicating that a proportion of the DMS may have been converted to another compound. During a mesocosm study in Raunefjorden, Norway, seawater enclosures were enriched with inorganic nutrients stimulating the development of an *E. huxleyi* population. As the population declined a concomitant increase in virus-like-particles with a typical *E. huxleyi* virus flow cytometry signature were observed. In addition cell viability staining using SYTOX Green confirmed the presence of high numbers of compromised cells, indicative of viral infection in *E. huxleyi*. DMS concentrations increased in parallel with the appearance of the viruses and exhibited a good correlation with virus numbers ($R^2=0.85$, $p>0.05$) suggesting that DMS production was a result of the viral infection of *E. huxleyi*. Additional laboratory experiments have implicated DMS and acrylic acid in the reduction of infective virus titres and the possibility that these compounds could function as a defence against viruses will be discussed.

A hypothesis to explain the ecological distribution of chrysophytes

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Chrysophytes have a relatively wide ecological distribution but a rather poorly understood physiology. Recent work on the physiology of their photosynthesis suggests that all, or nearly all, freshwater chrysophytes are unable to make direct use of bicarbonate as a carbon source and rely on passive diffusion of carbon dioxide, in contrast to most other freshwater phytoplankton. Since in productive lakes the concentration of free carbon dioxide can be depleted nearly to zero, as a result of carbon uptake during photosynthesis, depletion of carbon dioxide may place an ecological limit on the temporal and spatial distribution of chrys-

ophytes. This hypothesis is explored using long-term temporal datasets, large-scale datasets and data on chrysophyte depth distribution. Upholding of the hypothesis would provide one of the clearest examples of how a physiological feature can control the distribution of organisms.

Continuous observation of phytoplankton physiology and productivity using fast repetition rate fluorescence during the 2003 spring bloom in the English lake district

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The dynamics of the 2003 phytoplankton spring bloom were observed throughout a six-week sampling period of Esthwaite Water in the English Lake District. Continuous fast repetition rate (FRR) fluorometry characterised phytoplankton physiology and productivity and revealed two distinct phases of the bloom. Chlorophyll *a* fluorescence (F_m) and PSII photochemical efficiency (F_v/F_m) increased throughout the first two weeks but subsequently crashed within three days. A secondary increase in F_m but not F_v/F_m was observed throughout the final three weeks. FRR measurements of PSII reaction centre-specific rates of light absorption (σ_{PSII}) were highest towards the end of both phases of the bloom. HPLC determinations of pigments from discrete water samples revealed that changes in F_m corresponded with changes in chlorophyll-*a* and that the first and secondary phases of the bloom were dominated by the accessory pigments fucoxanthin (diatoms) and alloxanthin (cryptophytes), respectively. Continuous monitoring of water column temperature indicates that these changes in phytoplankton physiology and community composition followed an increase in water column stratification throughout the sampling period. Chlorophyll-*a*-specific rates of gross oxygen evolution were subsequently estimated using the continuous FRR measurements under ambient light and compared with *in situ* changes in CO_2 (pH).

Lake development, meromixis and biological structure in the low Arctic of West Greenland

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The Søndre Strømfjord (Kangerlussuaq) area of West Greenland (66–67ºN 50–54ºW) contains a number of closed-basin oligosaline lakes (conductivity 2500-4000 μS cm^{-1}). The lakes have characteristic water chemistry that is the result of evaporative concentration over the last 7–8 K years. The limnology and ecology of these saline systems contrasts quite strongly with the other lakes in the region. Moreover, many of the oligosaline lakes have strong chemical stratification and appear to be meromictic. Saline, meromictic lakes in the Arctic are usually formed as the result of basin isolation following isostatic uplift in response to deglaciation, which traps seawater within the basin. The Søndre Strømfjord oligosaline lakes lie above the marine limit and are, therefore, atypical and are interesting from both ecological and palaeoclimatic perspectives. We have used a combination of contemporary limnological monitoring and surface sediment sampling to classify the lakes as well as analyses of sediment cores to provide long-term ecological trajectories. In this paper, we report on the interplay of long-term climate forcing and catchment processses on lake development and their effect on algal communities (diatom and chrysophyte microfossils and biomarkers of non-siliceous algae derived from HPLC pigment analysis). The relevance of these integrated palaeolimnological and contemporary monitoring studies to identifying the possible future response of algal dynamics to anthropogenic-induced climatic change and altered thermal stratification are discussed.

Dynamics of EPS production in benthic marine diatoms

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Microalgal biofilms play an important role in the ecology of many shallow water marine ecosystems. These biological communities are dominated by benthic, pennate diatoms. Pennate diatoms produce a number of different extracellular polymeric substances, EPS, (primarily polysaccharides) which form mucilages in the environment. These EPS differ in chemical composition, production patterns and abundance on mudflats. This paper will describe some of the latest data on the biochemical variability of different EPS types and fractions in culture and in natural biofilms, the rates of production of EPS components in culture and in natural environments, and the relationship between extracellular carbohydrate production, irradiance and photosynthesis and the possible fate of EPS in the marine environment.

ABSTRACTS of ORAL PRESENTATIONS

BRISTISH PHYCOLOGICAL SOCIETY ANNUAL MEETING

LANCASTER UNIVERSITY JANUARY 4–7 2004

Does food availability dictate *Littorina littorea* grazing habits?

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Steneck and Watling's (1982) functional group model advocates the combination of species of algae into seven groups based upon morphology and ecological function; the basic premise being that species within a group are assumed to react similarly to a stress or disturbance. All species within a group would be expected to be similarly susceptible to grazers. Previously we have shown that *Littorina littorea* demonstrates a significant difference in its consumption of functional groups, with a significant preference for FG2 (filamentous forms) over FG3 (foliose forms). Here we report the results of an experiment designed to test whether *L. littorea* actively choose their food.

Grazers were collected from two areas of a shore: one dominated by *Ascophyllum nodosum* and the filamentous alga *Polysiphonia lanosa* (but poor in *Ulva* [*Enteromorpha* type]), and one area dominated by foliose *Ulva* sp. (but poor in filamentous forms). Grazers from both areas were presented with *P. lanosa* and *Ulva* sp. as potential food in an investigation of their feeding preferences and choices.

Morph stability and distinctiveness in *Fucus spiralis*

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Fucus spiralis is an intertidal brown seaweed of the upper littoral zone found growing on rocky substrata on sheltered to moderately exposed shores. It exhibits great variation in morphology across its distribution range and several forms have been described. Here we present some of the results gained from a 12 month study of *in situ* populations of two morphs. Our aim was to investigate the physical persistence of the morphs, to compare their reproductive characteristics and to compare their mortality rates. Initially (February 2002) 25 plants were marked with numbered tags at each of eight sites (four per morph) and measurements of thallus length and frond width were made at approximately monthly intervals. New plants were tagged and measured each month to replace any lost during the intervening period. This data was used to calculate mortality rates. 10 unmarked plants from each population were removed each month for more detailed examination in the laboratory where the number of plantlets, number of dichotomies and reproductive status of the frond tips were noted.

First cloned lipoxygenase/hydroperoxide lyase from diatoms: a key enzyme providing for proposed chemical defence metabolites

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Diatoms are major contributors to phytoplankton blooms and serve the dominant plankton grazers, such as copepods, as important food source. Although regarded as a high-quality source of nutrition in recent years evidence has accumulated that certain

species can negatively affect the hatching success of copepod eggs. The effect was attributed to α,ß,γ,δ-unsaturated aldehydes, such as 2,4-decadienal, 2,4,7-decatrienal and (5*Z*,8*Z*,10*E*)-12-oxo-dodecatrienoic acid (12-ODTE). Here we report the first cloning, expression and functional characterization of a lipoxygenase (PtLOX1) from diatoms. The enzyme was identified from a *Phaeodactylum tricornutum* EST-library by sequence homology to lipoxygenases of higher plants. Sequence analysis shows that it exhhibits a unique domain structure compared to other known lipoxygenases, harbouring an additional N-terminal signal peptide which is presumably involved in crossing the plasmamembrane-derived membranes of the diatom chloroplast. PtLOX1 has a broad substrate tolerance with a preference for arachidonic acid and eicosapentaenoic acid. These fatty acids are transformed preferentially into the corresponding 12-hydroperoxy acids. In addition to this lipoxygenase activity the PtLOX1 also exhibits a hydroperoxide lyase and keto-acid forming activity releasing 12-ODTE, (2*Z*)-octen-1-ol and 12-keto-eicosatetraenoic acid from arachidonoic acid. Only a single enzyme is required for the two-step transformation of the valuable storage metabolite arachidonic acid into the α,ß,γ,δ-unsaturated 12-ODTE as a proposed defence metabolite.

Towards a revision of the taxonomy of the genus *Acrochaete* (Chlorophyta)

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Species assigned to the genus *Acrochaete* are microscopic, filamentous green algae that occur as epiphytes or endophytes on or in a wide range of macroalgal hosts. Identification has traditionally been made using morphological characters and this has been assisted in recent years by isolating species from their hosts and growing them in culture. Recent molecular studies on species of *Acrochaete* isolated from the red alga *Chondrus crispus* have highlighted the need for a revision of the taxonomy of the genus. They have also shown that species which are morphologically similar may not be closely related. This study aims to explore the diversity of these green algae and revise their taxonomy. Specimens will be isolated from a range of red algal hosts from which they are known to occur, including *C. crispus*, *Mastocarpus stellatus* and *Osmundea/Laurencia* species. Molecular work in conjunction with morphology will be undertaken to resolve species relationships.

Inducible defences in marine algae

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The phenomenon of induced chemical defences has been well studied in terrestrial systems but in the marine environment studies in this field are rare. Although this type of response has been reported in some brown algal species (i.e. *Ascophyllum nodosum, Fucus disticus*) these studies are merely small scale examples of a possible worldwide pattern. The current study, conducted at nine different study sites around the world, examines the response of a number of different marine algal species to different degrees of grazing. Using feeding assays to detect a response, the experiments set out to determine the effects of direct grazing, water borne cues and light on seaweed defences.

The properties of an S-layer protein that is expressed on the surface of Synechococcus WH8102 and is encoded by S-PM2 phage

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Cyanobacteria are responsible for a large proportion of the world's primary production in the oligotrophic regions of the ocean, of which *Synechococcus* and *Prochlorococcus* contribute up to 89%. Cyanophages infect cyanobacteria and can, therefore, potentially influence the primary production in these regions.

S-PM2 cyanophage is a marine phage that infects a number of strains of *Synechococcus*, including WH8102. S-PM2 carries a gene that could potentially encode a protein that is expressed on the surface layer (S-layer) of *Synechococcus* WH8102. The primary purposes of this work are to establish the role that this protein plays with respect to phage-host interactions and develop a suitable probe (using TA cloning methods and antibody manufacture) that would aid the quantification of infected cells in natural populations. In the past, mathematical models and calculated estimations have been used to quantify the proportion of infected cells in a natural population but the accuracy of these values is dubious.

It will be necessary to establish whether the S-layer protein gene is conserved in other cyanophage, by using PCR and Southern Blotting, and furthermore, if it is expressed in other strains of *Synechococcus*. The function of the protein will also be deduced with the use of DNA probes and model laboratory grazers as well as phage binding experiments. It would be an obvious benefit to the phage if it were able to give its host a competitive advantage over other cyanobacteria. One testable hypothesis is that the protein has some function in rendering the cell unpalatable to grazers whereas it may be possible that the protein could have an effect on the ability of other phage to bind to and superinfect the cell. The timing of gene expression and location of the S-layer protein are important parameters that could influence its function.

A probe, that could quantify the number of infected cells in a natural population, would highlight the impact that cyanophages have on cyanobacterial populations.

The tolerance of *Fucus vesiculosus* to environmental disturbance in different seawater salinities

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Fucus vesiculosus is a marine alga which extend even into the brackish Baltic Sea (distribution limit at approximately 4 ppt). This belt-forming alga is an important keyspecies in the Baltic ecosystem and forms breeding ground, shelter and food for a great amount of the macrofauna and fishes in the region.

The thallus of Baltic *F. vesiculosus* is much smaller than Atlantic *F. vesiculosus*. In the northern Baltic the plants even lack their oth-

erwise so characteristic bladders. The reason for this difference is the lower salinity in the Baltic. Few other macroalgae are able to survive this low salinity. In present study we examine possible differences between Baltic and Atlantic *F. vesiculosus* concerning tolerance to environmental disturbances, such as ultraviolet-B radiation (UV-B, 280-320nm) and pollution by the heavy metal lead ($PbCl_2$). Photosynthesis as oxygen evolution was measured. The results show that lead decreased the photosynthesis in all salinities, but most pronounced in high salinity. Similar results were obtained with UV-B radiation. Even before any addition of lead or UV-B the difference between Baltic and Atlantic *F. vesiculosus* was apparent, a much lower photosynthesis inside the Baltic than outside. The photosynthesis of *F. vesiculosus* apparently decreases with salinity. To summarise, results indicate that seawater salinity constitute an important factor for the photosynthesis of *F. vesiculosus*. The effects of UV-B and lead seem to be greatest in a higher salinity; *F. vesiculosus* outside the Baltic were more sensitive than Baltic *F. vesiculosus*.

The culture collection of algae and protozoa - an evolving service

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January 2004 forms a major landmark in the history of the Culture Collection of Algae and Protozoa (CCAP) with the relocation of the marine section (CCAP-M) to a new, purpose-built, facility at the Scottish Association for Marine Science (SAMS) at Dunstaffnage on the west coast of Scotland. The freshwater algae and the protozoan cultures (CCAP-F), currently based at the Centre for Ecology and Hydrology Windermere in Cumbria, will also be re-located to Dunstaffnage, thus re-merging the two sections of the Collection after a 17-year separation. CCAP-M research will continue to include molecular investigations into algae involved with harmful algal blooms and their associated bacteria. Frithjof Küpper, who joined SAMS as group leader in the autumn, will focus on algal models in inorganic biochemistry and chemical ecology, with special reference to biogeochemical cycles. It is also intended to extend the macroalgal part of the collection, in collaboration with Dieter Müller (Konstanz) and John West (Melbourne). CCAP-F research continues to focus on cryopreservation, especially related to the EU funded COBRA project, and also on protistan and cyanobacterial aquatic/ terrestrial ecology. The Collections' common catalogue is available in a searchable form on-line from the SAMS website www.sams.ac.uk and this will soon incorporate images of the CCAP strains.

The Fritsch Collection of Illustrations of Freshwater Algae

John W.G. Lund[2], John G. Day[1], E. Gina Devlin[1], Elizabeth Y. Haworth[2] and **Elaine B. Monaghan**[1]

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Traditionally used by researchers to assist in identification and for resolving taxonomic problems, the Fritsch Collection comprises sheets collating by species over half a million published figures and taxonomic entries on fresh- and brackish-water algae from worldwide distributions. The Collection contains floristic information from many papers, not only major works, which have been published from the eighteenth century to the present day. Constantly updated, it reflects the diverse and changing views that have been or are still held about the identification and taxonomy of many algae. Entries on the sheets are supported by a full author index, and a searchable computer database of citations entered into the Collection is being compiled. Its size and wide scope make the Fritsch Collection a valuable research tool, and its role as a source of data on morphology and taxonomy is being extended by its growing ability to provide other types of information, such as data relating to geographical distribution.

Sequence analysis of the genome of the marine cyanomyovirus S-PM2

Martha Clokie, Andy Millard, Annabel Cook and Nick Mann

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We have recently completed the sequencing of the genome of the lytic myovirus S-PM2. This phage infects a number of different strains of the marine cyanobacterium *Synechococcus*, which makes a significant contribution to the primary productivity of the oceans. The S-PM2 genome is circularly permuted, 196,280 base pairs long with a G + C content of 37.8%. Glimmer and GeneMarkS were used to predict putative open reading frames and 241 potential protein-encoding ORFs and 25 tRNA genes were found. The putative proteins were translated from the nucleotide sequence and BLAST searches were performed. More than half of the predicted proteins have no similarity with any protein sequence currently in the databases. There are several extremely large proteins including one of 3339 aa. Amongst those S-PM2-encoded proteins with homologues in the databases many are related to well-characterised proteins from other phages, for example structural proteins associated with capsid, tail and neck. There is an element of conservation of gene order between some of the genes that encode structural proteins in S-PM2 and phage T4. The genome also encodes proteins with a high degree of similarity to those of host *Synechococcus* and *Prochlorococcus* strains. One surprising and extremely interesting observation is the presence of genes (*psbA* and *psbD*) encoding the photosynthetic proteins D1 and D2. These are key proteins in the reaction centre of photosystem II of all photosynthetic organisms. The phage *psbA* gene aligns very well with the host homologue, suggesting that it has been acquired by horizontal gene transfer. The phage version, however, contains a 212 bp region that has the characteristics of a self-splicing intron. Under normal growth conditions D1 is one of the most rapidly turned over proteins in *Synechococcus* and this turnover is required for continued photosynthetic activity. For the virus to express this protein itself, would allow the host to continue to photosynthesize and thus the energy for S-PM2 replication would continue to be produced for a longer period and more progeny would be produced.

The fjordlands of southern Chile: distribution and biogeographical affinities of its marine algal flora

David M. John and Maria Eliana Ramirez

Department of Botany, The Natural History Museum, London, UK and Museo Nacional de Historia Natural, Santiago, Chile

Until recently the marine algal flora of the remote and relatively inaccessible fjordlands of the Patagonian region of southern Chile was virtually unknown. The fjordlands extend from Isla Chiloe (43ºS) to Tierra del Fuego and includes the Laguna San Rafael National Park (LSRNP). Marine algae were collected over a 5-year period (1998-2003) at almost 250 sites within the LSRNP, the Chonos Archipelago to the north and the Katalalixar region to the south. Sites ranged from fully marine and wave-exposed in the Gulfo San Esteban to wave-sheltered and low salinity in the Laguna San Rafael where they are influenced by its calving glacier. Within this coastal area of the Aysén region (42-49ºS) lies the ill-defined boundary of two marine zoogeographical provinces: the northerly Peruvian and the southerly Magellanic. Of the more than 140 species of algae known from Aysén, about 18% occur only to the south, 37% only to the north, 43% are common to both north and south of the region, and 2% are endemic to it. Most species are at the limit of their distribution in Aysén thus lending support to the view that the region is transitional between two biogeographical provinces. An analysis of algal distribution patterns demonstrates salinity and wave-exposure to be key ecological factors.

The use of cryopreservation to develop a european scientific and biotechnological resource: the COBRA project

John G. Day[1], E.E. Benson[2], K. Harding[2], B. Knowles[2], M. Idowu[2], D. Bremner[2], S. Watt[2], L. Santos[3], F. Santos[3], T. Friedl[4], M. Lorenz[4], A. Lukesova[5], J. Elster[6], J. Lukavsky[6], M. Herdman[7], R. Rippka[7], H. Hedoin[8] and T. Hall[8]

[1]*CCAP, Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban, Argyll, UK;* [2]*University of Abertay Dundee, Dundee,UK;* [3]*Dept Botânica, Univ Coimbra, Coimbra, Portugal;* [4]*SAG, Albrecht-von-Haller-Institut für Pflanzenwissenschaften, Univ Göttingen, Göttingen, Germany.* [5]*Inst Soil Biology CAS, Ceske Budejovice, Czech Republic;* [6]*Inst Botany CAS, Trebon, Czech Republic;* [7]*Inst. Pasteur, Paris, France;* [8]*AQUAARTIS, St Herblain-cedex, France.*

Microalgae and cyanobacteria have significant biotechnological potential; however, one constraint on their exploitation is that they are generally maintained by routine serial subculture. This approach can not guarantee the stability of the strain and loss of attributes, including the production of pharmacologically active compounds, or even loss of the culture itself can occur. COBRA (The COnservation of a vital european scientific and Biotechnological Resource: microAlgae and cyanobacteria) is the acronym for a European Union, RTD Infrastructures project (Contract No. QLRI-CT-2001-01645). This project has the objective to develop a physical, and virtual European Biological Resource Centre based on existing algal culture collections. COBRA's central aim is to apply cryopreservation methodologies to currently 'preservation recalcitrant' strains of microalgae and cyanobacteria, organisms that, to date, have proved difficult to conserve using cryogenic methods. In addition, molecular and biochemical stability tests are being developed to ensure that the equivalent strains of microorganisms supplied by the culture collections will give high quality and consistent performance. Fundamental and applied knowledge of stress physiology form an essential component of the project and this is being employed to assist the optimisation of methods for preserving a wide range of algal diversity. COBRA's 'Resource Centre' utilises Information Technologies (IT) and Knowledge Management practices to assist project coordination, management and information dissemination and to facilitate the generation of new knowledge pertaining to algal conservation.

Morphological and allozyme variation across a *Fucus spiralis* and *F. vesiculosus* contact zone?

Graham W. Scott[1] and Michelle L. Tobin[2]

[1]*Department of Biological Sciences and* [2]*SCCS, University of Hull, UK.*

Fucus spiralis and *Fucus vesiculosus* are thought to hybridise in situ. It would be expected that the products of these hybridisations should demonstrate a morphology and allozyme complement that is in some ways intermediate between the two species types. The incidence of hybrid type plants should also be highest in those situations where the populations of the two species are in close contact on the shore. We present data relating to a survey of morphology and allozyme complement of plants collected across such contact zones at two shores on the Isle of Cumbrae, Scotland.

An interactive CD-Rom for identifying freshwater diatoms

University of Newcastle; Natural History Museum; Royal Botanical Garden Edinburgh; University College London; Bowburn Consultancy and Environment Agency

Diatoms are photosynthetic unicellular organisms. They are found in most aquatic and semi-aquatic habitats and are of great ecological importance because they form an important part of the base of the food web. Ecologists have long made practical use of diatoms by collecting and analysing individual species and community data to determine the quality or condition of aquatic habitats. Diatoms are excellent environmental indicators as they are ubiquitous and taxa are differentially sensitive to pollution and other pressures.

Biologists and ecologists in the Environment Agency have used benthic diatoms as part of the monitoring toolkit since approximately 1996, used initially to prepare cases for the designation of 'sensitive areas', to meet the needs of the Urban Wastewater Treatment Directive (UWWTD). Diatoms have also been used in assessment studies of lakes and rivers in relation to conservation criteria and to detect impact and amelioration of acidification. Links are currently being investigated between nutrients and diatoms in estuaries (University of Essex).

The Water Framework Directive (WFD) demands that Member States will be required to achieve 'good surface water status' and 'good groundwater status'. The Ecological quality is

assessed by considering biological, hydromorphological and physico-chemical elements. The biological elements for most of the waterbody types include aquatic flora - phytobenthos (diatoms are currently being considered as the surrogate group) and macrophytes, invertebrates and fish. Diatoms will play an increasingly important role in the monitoring of ecological status of river, lakes and coastal and transitional waters. 'Phytoplankton' is another biological element specified by the WFD where identification of diatoms will be essential. Diatom monitoring will also have a role within the Habitats Directive in relation to conservation criteria and environmental impact assessment work.

The absence of good English language identification tools is a major impediment to diatom studies in a practical context. The correct identification is imperative. Whilst there are both beginners' guides and specialist taxonomic works (usually in languages other than English), there is no practical and comprehensive diatom flora for the British Isles. Diatoms were omitted from the recent Freshwater Algal Flora of the British Isles. Over 2000 diatom taxa have been recorded from UK freshwaters (approximately 40% of the entire freshwater algal flora) and production of a comprehensive flora has been further complicated by an ongoing debate about the basis by which diatom genera and species are determined.

The development of an interactive key using LucID software (earlier versions), for blue-green algae (R&D project E1-011) and the key for green algae (R &D project E1-096), has provided a detailed understanding of the LucID software and specialisms involved. This diatom key will use this software (or build on it).

Preliminary observations on the trichogynes of two species of *Porphyra* (Bangiales, Rhodophyta) from Britain

Mary J. Holmes[1] and Juliet Brodie[2]

[1]*School of Science & the Environment, Bath Spa University College, Newton Park, Bath, BA2 9BN;* [2]*Department of Botany, The Natural History Museum, Cromwell Road, London, SW7 5BD.*

The trichogyne is the female receptive organ in the red algae that serves as a specialised site for male gametes. There are several studies that have examined trichogynes in the Florideophycidae, but very few in the Bangiophycidae. This study provides for the first time preliminary cytological observations on the trichogynes of two species of *Porphyra* from Britain, *P. dioica* Brodie & L. Irvine and *P. leucosticta* Thuret in Le Jolis. In both species of *Porphyra*, trichogynes were found at each end of the female gametangium and were observed immediately before fertilisation. They disappeared shortly after the first division of the zygotosporangium. The trichogynes of *P. dioica* were long, thin and often hook-shaped, extending beyond the thallus surface, whereas in *P. leucosticta*, the trichogynes were short, broad and slightly curved, with little extension seen beyond the surface of the thallus. These observations on the morphology of the trichogyne in *Porphyra* are explored with respect to providing useful characters with which to distinguish between species.

The development of algal fouling communities on sea scallop aquaculture nets in Newfoundland

Derek Mouland and **Alan Whittick**

Department of Biology, Memorial University, Newfoundland, Canada.

Biofoulding of aquaculture nets causes hydrodynamic loading leading to increased drag and their potential loss. The concomitant occlusion of the mesh restricts water flow and reduces both plankton availability to filter feeders and the flushing of waste products. As part of a study of biological control of fouling, its development on pearl nets, used in the culture of the sea scallop *Placopecten magellanicus,* was followed over a two-year period at a farm located in Charles Arm, Bonavista Bay on the north coast of Newfoundland. Virtually all the fouling was algal or cyanobacterial, with over 80 species of the Chlorophyta, Phaeophyta Rhodophyta and Cyanobacteria, together with some colonial diatoms, being recorded. All were common components of the local epilithic and epiphytic flora. Biomass per net was approximately 1kg wet weight of algae after 12 months growth, and did not increase thereafter. Initial growth rates were higher in the shallow samples, but after two years no differences in biomass were found with depth. Multivariate analysis, TWINSPAN and DECORANA, showed rapid change in species composition during fouling development, but after 12 months growth the communities had stabilized, with some seasonal changes in composition being recorded.

Website database of images of freshwater algae: a virtual collection and identification tool

Peter V. York and David M. John

Department of Botany, The Natural History Museum, London, UK.

A website of images and habitats of UK freshwater algae is currently being developed at the NHM and will be available on line during 2004. It will enable users to readily compare living algae, viewed under the light microscope, with more than 1000 high quality colour images of over 150 genera and 300 species in all major 'algal' phyla other than the diatoms. Sometimes crucially important diagnostic features are not visible or lost when alga is preserved. Included are many harmful and nuisance algae that give added value to the database of images. Fieldwork has been carried out in many parts of the UK to collect new material and record photographically algal habitats, water blooms and macroscopic algal growths. A variety of microscopic techniques have been used to photograph most of the material in which taxonomically important features have been enhanced. Digital image automontaging has been used to produce completely in-focus images from an electronically processed series of optical slices. Accompanying the images is the currently recognised name of the alga, authorities, its unique 8-digit code, magnification, collection date, site details and pages where the species is described and illustrated in the 'The Freshwater Algal Flora of the British Isles' (John et al., 2002, reprinted May 2003).

Seaweeds of the British Isles Volume 1 3B - The Bangiophycidae

Juliet Brodie, Linda Irvine and Jenny Bryant

Natural History Museum, Department of Botany, Cromwell Road, London, SW7 5BD, UK.

The production of the final part of the Rhodophyta volume in the series *Seaweeds of the British Isles* involved the use of a wide range of algal material and a variety of techniques. The project required fieldwork and observations of the algae in culture but of particular note is the realisation of the importance of herbarium specimens and permanent microscope preparations, including type material, held at the Natural History Museum and elsewhere. It has been possible to make detailed studies of the vegetative and reproductive morphology of many of these specimens, to interpret the earlier literature, and indeed to obtain molecular data from some individuals, including material that was over 100 years old. This work clearly illustrates the immense value of the collections resource held at the Natural History Museum and in other institutions worldwide. It also demonstrates the need for maintaining and enhancing these collections professionally, taking into account any advances in curatorial techniques and algal taxonomic research.

A friendly and fast procedure to PCR amplify plastid genes in spores of *Porphyra*

Marina Morabito, G. Genovese and G.M. Gargiulo

Department of Botanical Sciences, University of Messina, Italy.

Nowadays, molecular biology has become an important aspect of several research trends in phycology, including systematics, population genetics and phylogeny, and protocols to improve reliability of its techniques are needed. As for economic seaweeds, discrimination among natural populations is essential because the quality of products is species specific. In recent years, PCR protocols on living algal cells have been developed, mainly involving amplification of ribosomal genes (nuclear multi-copies genes), but were also performed to amplify a short fragment of a plastid gene. They were successful on unicellular algae, from thousands of cells to even a single cell, and on small pieces of tissue (several hundreds of cells) from macroalgae. We developed a friendly and fast protocol to PCR amplify the plastid *rbc*L gene, using 5-10 monospores of *Porphyra*, the most economically valuable genus of Rhodophyta. The principal advantage of such a technique is the possibility of investigate a small and genetically homogeneous set of cells and to reduce the risk of both biological and chemical contamination. Moreover, we developed this technique to amplify *rbc*L gene because of the huge amount of such sequence data deposited in molecular biology databases and their utility as molecular markers in taxonomic studies.

Sources of inorganic carbon for photosynthesis by freshwater filamentous algae

Troels Andersen[1] and **Stephen Maberly**[2]

[1]*Institute of Biology, University of Southern Denmark;* [2]*CEH Windermere, Ambleside, UK.*

Filamentous algae comprise a number of taxonomic groups, are common components of most freshwaters and have been suggested to be involved in changes in macrophyte abundance in response to changed nutrient loading, yet little is known of their physiology. To start to redress that imbalance, freshly-collected material from 32 lakes of a range of alkalinities and trophic state were collected in autumn 2003 from the English Lake District and Yorkshire Dales, and their ability to use bicarbonate tested using pH-drift at standard conditions. Two rhodophytes appeared unable to use bicarbonate. In contrast species of *Spirogyra*, *Oedogonium* and *Cladophora* were all able to use bicarbonate. Ability to deplete inorganic carbon increased with site alkalinity because of increasingly effective bicarbonate uptake. In addition, species of *Bulbochaete* sp. and *Zygnema* sp. used only CO_2 as their inorganic carbon source at low alkalinities, but changed to HCO_3^- use when collected from lakes with higher alkalinity. *Zygnema* sp. from Lake Hampen, Denmark, increased their rate of photosynthesis about 2-fold from atmospheric CO_2 to ten-times atmospheric CO_2 and this is consistent with their increased growth rate in enclosures in the lake at these CO_2 concentrations, suggesting possible changes in lake flora in response to climate change.

Cell connections in colonial algae revealed by SEM

Elzbieta Wilk-Wozniak[1] and **Elliot Shubert**[2]

[1]*Freshwater Institute of Biology, Krakow, Poland;* [2]*Department of Botany, The Natural History Museum, London*

Samples were collected from various reservoirs in Poland and were enriched with nutrient medium. Mixed cultures were examined with the SEM for morphological features. One species of *Coelastrum* had 'arm-like' structures connecting the cells. *Desmodesmus* spp. have a warty layer joining the four cells together and at the cell-cell region the warts were arranged in a 'zip-like' configuration. *Aulacoseira granulata* showed interlocking spines. *Woronichinia naegeliana* was held together with microfibril-like material. These examples illustrate that algal cell connections were intricate as revealed with the SEM.

The British Phycological Society

Registered Charity no. 246707

Annual Report for the year ended 30 September 2003

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:	Dr B.S.C. Leadbeater	Hon. Treasurer:	Professor L.E. Shubert
Vice President:	Professor M.D. Guiry	Hon. Eds (*Eur. J. Phyc.*):	Dr C.A. Maggs
Overseas President:	Dr Jeanine Olsen		Professor M.J. Dring
Immediate Past President:	Dr E.J. Cox	Hon Eds (*The Phycologist*):	Dr Alison R. Taylor
Hon Secretary:	Dr Jackie Perry	Webmaster:	Professor M.D. Guiry
Hon. Membership Sec.:	Dr Graham Scott		

Ordinary Members:

Dr M. Callow	Dr D.M. John	Dr G.J.C. Underwood
Dr R. Forster	Dr S.C. Maberly	Dr T. Wiedemann
Dr P. Hayes	Dr D. Stengel	

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

This is the third Annual Report presented by the current Hon. 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 annual winter meeting and AGM were held at the National University of Ireland, Galway. The standard of presentations was very high and congratulations go to Jenny Waring, who was the Manton Prize winner, and Mary Holmes and Robert Wilkes, who received the annual Poster Prize. Ten student members received support to attend this meeting from the Scientific Meetings Fund (SMF) (thirteen in 2002). Four students were supported with a stipend to attend the specialist freshwater algae courses in Durham or Scotland. Unfortunately, this past year, no Summer Bursaries were awarded to students and no support was given to students to travel to professional meetings to present their research findings, because no student applied. More encouragement should be given to students by their supervisors to take advantage of these BPS sponsored opportunities.

Honoraria were paid to some officers for whom it was felt the time commitment of the positions was exceptional. The Hon. Membership Secretary, Hon. Secretary and Hon. Editor of *The Phycologist* each received £750, the Hon. Treasurer received £1,000, and the Hon. Editors of the *European Journal of Phycology* received a total of £1,500 and will show on the next financial year statement.

The Society's financial situation remains good. The Scientific meetings Fund was topped up to a total of £25,000. This amount will allow the fund to support students with Travel Awards, Summer Bursaries and Summer Field Courses from the interest it receives.

The Journal has continued to perform well financially. The balance to the Society from Volume 37 was £15,882.12 (£17,477.67 for Volume 36). However, with our new publisher, Taylor & Francis, we are guaranteed an annual income of £25,000.

The British Phycological Society

Statement of financial activities for the year ended 30 September 2003

	Note	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2003 £	Total 2002 £	
Income and Expenditure							
Incoming Resources							
Subscriptions		13,924.70			13,924.70	17,841.50	
Surplus from Journal		15,882.12			15,882.12	17,477.67	
Atlas Book		2,288.00			2,288.00	0.00	
Goodwill Payment T&F		0.00			0.00	10,000.00	
Auction proceeds		0.00			0.00	905.00	
Miscellaneous (mouse mats)		173.67			173.67	0.00	
Cash returned		0.00			0.00	290.50	
Interest		1,685.67		208.12	1,893.79	3,516.37	
Total Incoming Resources		33,954.16	0.00	208.12	34,162.28	50,031.04	0.00
Resources Expended							
Grants, studentships & awards	2	4,400.00	1,380.55	250.00	6,030.55	7,241.20	
Publications expenditure	3	26,066.92			26,066.92	22,610.93	
Meetings & Committee Expenses	4	8,905.00			8,905.00	8,346.07	
Administration Costs	5	3,663.76			3,663.76	13,480.13	
Publicity - brochures, labels	6	0.00			0.00	152.63	
		43,035.68	1,380.55	250.00	44,666.23	51,830.96	0.00
Net Incoming (Outgoing) Resources for the Year		(9,081.52)	(1,380.55)	(41.88)	(10,503.95)	(1,799.92)	
Fund at 1 October 2002		34,790.69	25,000.00	5,985.97	65,776.66	67,576.58	
Transfer (General to SMF)		(1,380.55)	1,380.55		0.00	0.00	
Fund at 30 September 2003		24,328.62	25,000.00	5,944.09	55,272.71	65,776.66	0.00

The British Phycological Society

Balance Sheet as at 30 September 2003

	Note	2003 £	2002 £	
Current Assets				
Debtors	8	1,815.00	2,500.00	
Short term deposits		69,650.20	67,229.96	
Cash at bank		4,312.83	10,946.70	
		75,778.03	80,676.66	
Liabilities: amounts falling due within one year	9	20,505.32	14,900.00	
Net Assets		55,272.71	65,776.66	
Funds	10			
Unrestricted		24,328.62	34,790.69	
Restricted		5,944.09	5,985.97	
Designated		25,000.00	25,000.00	
		55,272.71	65,776.66	0.00

Signed on behalf of the British Phycological Society

Prof L. Elliot Shubert
Hon. Treasurer

The British Phycological Society

Notes to the accounts for the year ended 30 September 2003

1 Accounting Policies

The accounts have been prepared in accordance with applicable Accounting Standards and the SORP - Accounting and Reporting by Charities issued in October 2000. 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 2003, 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 2003, 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 2003 £	Total 2002 £
2 Grants, Studentships & Awards					
Travel awards for 2003 Winter Meeting		1,230.55		1,230.55	2,081.20
Awards for courses, travel, Summer Bursary	1,400.00			1,400.00	4,285.00
Manton Prize			250.00	250.00	250.00
Poster prize at Winter Meeting		150.00		150.00	125.00
Meeting Sponsorships	3,000.00			3,000.00	500.00
	4,400.00	**1,380.55**	**250.00**	**6,030.55**	**7,241.20**
3 Publications expenditure					
Journal	9,018.00			9,018.00	9,855.00
Hon. Editor's Honorarium				0.00	2,256.11
E.J.P.Management Committee	254.80			254.80	192.50
The Phycologist	10,829.67			10,829.67	10,307.32
Jubilee Book	3,676.45			3,676.45	0.00
Atlas Book	2,288.00			2,288.00	0.00
	26,066.92	**0.00**	**0.00**	**26,066.92**	**22,610.93**
4 Meetings & Committee Expenses					
Council Meetings	1,271.90			1,271.90	2,777.76
Flora (Mapping) Committee Expenses	11.17			11.17	652.82
BPS Meeting 2002	6,821.93			6,821.93	4,915.49
BPS meeting 2004	800.00			800.00	0.00
	8,905.00	**0.00**	**0.00**	**8,905.00**	**8,346.07**
5 Administration Costs					
Executive expenses	94.49			94.49	280.70
Subscription to Institute of Biology				0.00	120.00
Public liability insurance	367.50			367.50	157.50
Independent Examiner's Fee	833.75			833.75	470.00
Credit Card Charges	440.58			440.58	527.05
Bank charges	76.16			76.16	54.00
Returned cheque, c.c. returned				0.00	3,606.00
Executive Honoraria		0.00		0.00	2,310.00
Website expenses				0.00	675.63
Special Projects (Fritsch Collection)				0.00	5,000.00
Special Projects (Mouse Mats)	1,453.83			1,453.83	0.00
Miscellaneous	397.45			397.45	279.25
	3,663.76	**0.00**	**0.00**	**3,663.76**	**13,480.13**
6 Publicity					
Jubilee, Labels, BPS Brochure				0.00	152.63
	0.00	**0.00**	**0.00**	**0.00**	**152.63**

The British Phycological Society

Notes to the accounts for the year ended 30 September 2003 (*continued*)

Reimbursment of Council members' expenses

7 Thirteen (2002: Ten) Council members received £1,271.90 (2002: £3250.96) 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.

	Debtors	2003 £	2002 £
8	Interest receivable	1,815.00	2,500.00
		1,815.00	2,500.00
	Liabilities: Amounts falling due within one year		
9	Accruals	646.25	400.00
	Provisions for the Journal and the Phycologist	19,859.07	14,500.00
		20,505.32	14,900.00

10	Analysis of Net Assets between Funds	Unrestricted Funds £	Restricted Funds £	Designated Funds £	Total Funds £
	Fund balances as at 30 September 2003 are represented by				
	Current assets	44,833.94	5,944.09	25,000.00	75,778.03
	Current liabilities	(20,505.32)			(20,259.07)
	Total Net Assets	24,328.62	5,944.09	25,000.00	55,272.71

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 2003, which are set out on pages 2 to 4.

Respective responsibilities 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 responsibility to:

* examine the accounts (under section 43 (3) (a) of the 1995 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 unusual items or disclosures in the accounts, and seeking explanations from the Council Members concerning any such matters. The procedures undertaken do not provide all the evidence that would be required in an audit, and consquently we do not express an audit opinion on the view given by the accounts.

Independent examiner's statement:

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

* to keep accounting records in accordance with section 41 of the 1993 act and;
* to prepare accounts which accord with the accounting records and comply with the accounting requirements of the 1993 Act;

have not been met.

Flanigan Edmonds & Bannon
Chartered Accountants and Registered Auditors
Belfast, Northern Ireland
23 December 2003

2004
British Phycological Society

Council Officers (January to January)

President
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STOP PRESS

At the time of going to press we are saddened to learn of the untimely death on Friday March 5th, 2004 of Tony Chamberlain (Dr AHL Chamberlain, University of Surrey) after a long illness. We offer our sincerest condolences to Tony's wife, Helen, and his two daughters, Claire and Jo. A full obituary will appear in the September issue of *The Phycologist*.