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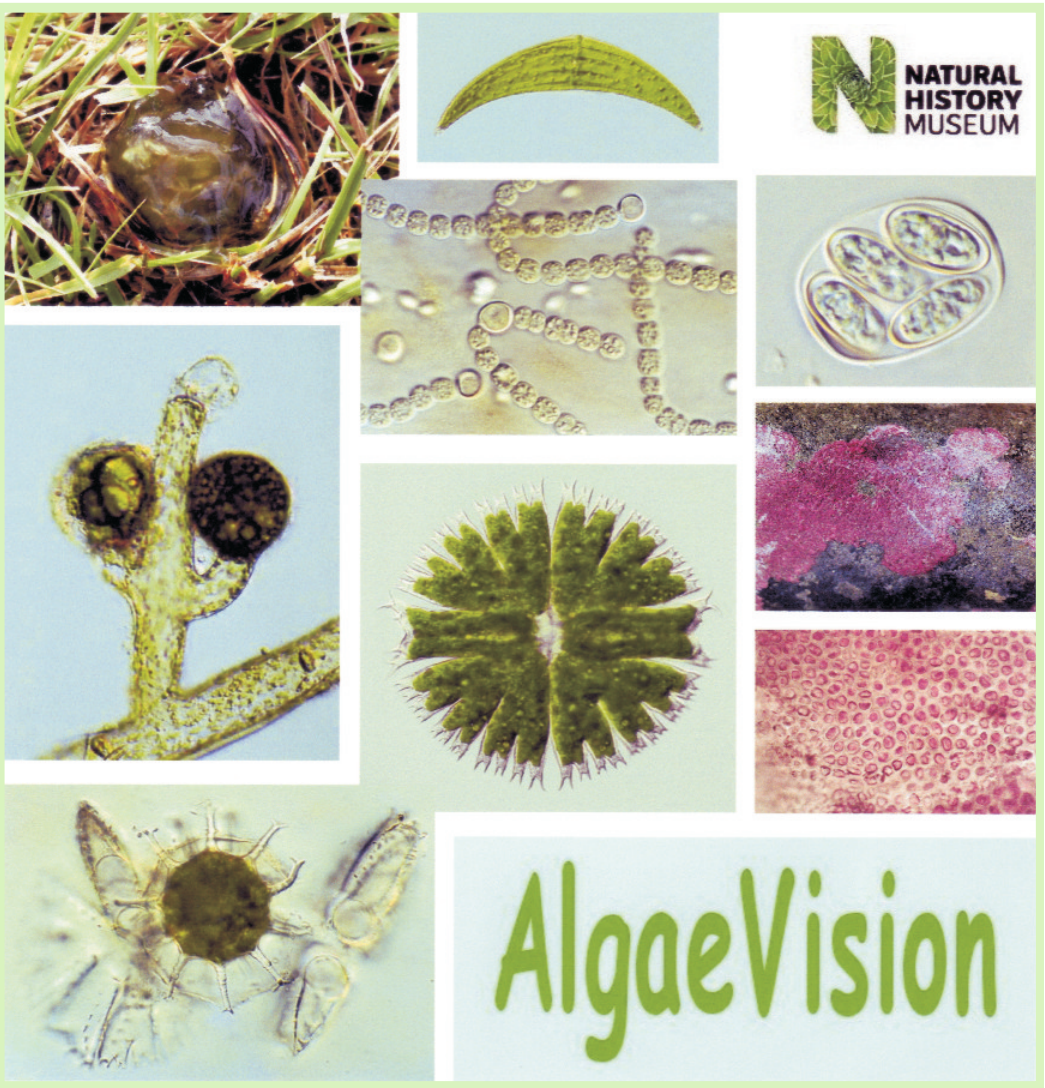

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In This Issue
-What's New-

This issue contains a number of contributions which happen to fall into a general theme of conservation and biomonitoring. Juliet Brodie and colleagues update on the progress they have made towards identifying Important Plant Areas (IPAs) for algae and, more specifically, they present a provisional list of marine seaweeds that are considered 'rare' and will contribute to nomination of algal IPAs and Red Data candidates. Dave John and Peter York announce the launch of the AlgaeVision website, an identification resource for freshwater and terrestrial algae hosted by the Natural History Museum. The importance of such resources along with identification courses to train the next generation of field ecologists is highlighted by Jan Krokowski. Finally Brian Moss gives a highly informative account of the EU Water Framework Directive, outlining the impacts of this legislation on management of aquatic ecosystems and the challenges to ecologists that its implementation poses.

Contents - *The Phycologist* -no. 68 Spring 2005

Background picture of *Fucus serratus* courtesy of F. Arenas.

FRESHWATER ALGAE IMAGE DATABASE

http://www.nhm.ac.uk/algaevision

The AlgaeVision website of images of freshwater and terrestrial algae of the United Kingdom will go live towards the end of April 2005. All major algal phyla are included apart from the Bacillariophyta (diatoms) and there are also some marine and brackish-water blue-green and haptophyte algae.

Fieldwork has been carried out in many parts of the UK to collect material and record photographically algal habitats, water blooms and macroscopic algal growths. Whenever possible only living algae have been photographed since preserved material can look very different with many crucially important diagnostic features lost or difficult to interpret. The material has been photographed to emphasise taxonomic characters that facilitate visual identification using various microscopical techniques including differential interference contrast microscopy. On some occasions digital image automontaging has been used to produce completely in-focus images from an electronically processed series of optical slices.

The website is intended to be a readily available reference source for those needing to identify freshwater algae. Each image entry is accompanied by the currently recognised binomial of the taxon, authority, a unique 8-digit code, magnification, collection details (where known), copyright and reference to pages where the taxon is described and illustrated in the *The Freshwater Algal Flora of the British Isles* (John, Whitton & Brook (eds) 2002, 3rd reprint April 2005). Almost half of the more than 1000 high colour images in the website were used in the CD-ROM photo-catalogue accompanying the Flora volume. Of the 180 genera and 350 species on the website the majority belong to one of the most taxonomically diverse groups of freshwater algae, the Chlorophyta.

The image website is to be regarded as a 'virtual collection' and is to be regularly updated and expanded. There is already a back log of new images and these will go into the first update (version 2) to be released later in the year.

If you have any comments on the image website (http://www.nhm.ac.uk/algaevision), please e-mail them to Peter York (p.york@nhm.ac.uk) or David John (d.john@nhm.ac.uk)

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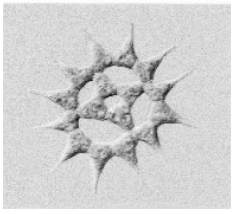

IMPORTANT PLANT AREAS FOR THE MARINE ALGAE: DETERMINING WHICH SPECIES ARE RARE

Juliet Brodie, Ian Tittley, David John & Mary Holmes

Following on from the earlier articles on Important Plant Areas (Brodie & John 2004a, b, c), we are now in the process of determining which species of red, green and brown marine algae are really rare and which might be candidates for a Red Data list. The information will contribute to the recognition of algal IPAs. As part of this process we have drawn up a list of species for which mapping records indicate that they occur at ten sites or less in Great Britain and Ireland. We have used two sources of maps: (i) those in Hardy & Guiry (2003); and (ii) those based on the collections in the herbarium at the Natural History Museum (BM). The initial list that resulted from this exercise included approximately half the British flora. The list has been refined by removing species that were known to be common but were under-recorded for one or other set of maps. The remaining species on this 'rare' species list are given in Table 1. These are species which on the evidence available appear to be restricted, uncommon, rare or extremely rare and their current status in Britain may need reassessment. Some of the species on the list may occur in very specific habitats that are rare in Britain. Other species may be rare because they are at the northern or southern limit of their distribution. Some of these species may be under-recorded, difficult to distinguish from other species or just hard to identify. A few require taxonomic investigation. There are also some alien species in the list. Each species has therefore been assigned one or more categories. The categories are used very generally, for example uncommon, rare or extremely rare species are treated as rare, and possibly or probably under-recorded species are treated as under-recorded.

Can you help?

If you have any comments on this list or information on distribution about any of these species we would be very pleased to hear from you. We would welcome labelled voucher specimens for any records. Please send your information to Dr Juliet Brodie by e-mail: **J.Brodie@nhm.ac.uk** or post: Natural History Museum, Department of Botany, Cromwell Road, London SW7 5BD, UK.

Acknowledgements

We are extremely grateful to Dr Yvonne Chamberlain, Mrs Linda M. Irvine and Professor Christine Maggs for their assistance with this list.

References

Brodie J. & John D. (2004a). Important Plant Areas: a draft list of important algal areas. *The Phycologist*, 66, 3-8.

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Hardy G. & Guiry M.D. (2003). *A check-list and atlas of the seaweeds of Britain and Ireland*. British Phycological Society, London.

Table 1. Provisional list of 'rare' marine red, green and brown seaweed species in the UK flora. R = rare; U = under-recorded; I = identification problems; T = taxonomic problem; L = localized; N = northern; S = southern; A = alien.

SPECIES	
RED ALGAE	
Acrochaetium battersianum G. Hamel	R
Acrochaetium minutum (Suhr) G. Hamel	U
Agardhiella subulata (C. Agardh) Kraft & M.J. Wynne	A
Aglaothamnion bipinnatum (P.L. Crouan & H.M. Crouan) Feldmann-Mazoyer	U, L
Aglaothamnion diaphanum L'Hardy Halos & Maggs	R
Aglaothamnion feldmanniae Halos	S
Aglaothamnion gallicum (Nägeli) Halos ex Ardré	U, S
Aglaothamnion priceanum Maggs, Guiry & Rueness	R
Aglaothamnion pseudobyssoides (P.L. Crouan & H.M. Crouan) Halos	R, S, U
Aglaothamnion tripinnatum (C. Agardh) Feldmann-Mazoyer	S
Anotrichium barbatum (C. Agardh) Nägeli	R, S
Anotrichium furcellatum (J. Agardh) Baldock	R, I, S, A
Antithamnion densum (Suhr) Howe	Not recorded from Britain
Antithamnion villosum (Kützing) Athanasiadis in Maggs & Hommersand	S
Antithamnionella foccosa (O.F. Müller) Whittick	R, N
Antithamnionella spirographidis (Schiffner) Wollaston	I, A
Antithamnionella ternifolia (J.D. Hooker & Harvey) Lyle	I, A
Apoglossocolax pusilla Maggs & Hommersand	R
Asterocolax erythroglossi J. Feldmann & G. Feldmann	R
Atractophora hypnoides P.L. Crouan & H.M. Crouan	R
Bornetia secundiflora (J. Agardh) Thuret	S
Callophyllis cristata (C. Agardh) Kützing	U, N
Calosiphonia vermicularis (J. Agardh) F. Schmitz	S
Ceramium cimbricum H.E. Peterson	R, U, T
Ceramium circinatum (Kützing) J. Agardh	R, I, S
Ceramium flaccidum (Kützing) Ardissone	U
Ceramium pallidum (Nägeli ex Kützing) Maggs & Hommersand	U
Ceratocolax hartzii Rosenvinge	N
Chondracanthus teedei (Mertens ex Roth) Kützing	S
Chondria coerulescens (J. Agardh) Falkenberg	S
Choreonema thuretii (Bornet) F. Schmitz	U
Chroodactylon ornatum (C. Agardh) Basson	R, U
Colacodictyon reticulatum (Batters) Feldmann	R, U
Colaconema caespitosum (J. Agardh) Jackleman, Stegenga & J.J. Bolton	U
Colaconema endophyticum (Batters) J.T. Harper & G.W. Saunders	U
Compsothamnion decompositum (J. Agardh) Maggs & L'Hardy-Halos	Not recorded from Britain
Compsothamnion gracillimum De Toni	R, U, I
Compsothamnion thuyoides (J.E. Smith) Nägeli	U
Corallina elongata J. Ellis & Solander	U, S, I
Crouania attenuata (C. Agardh) J. Agardh	R, S
Cruoria cruoriaeformis (P.L. Crouan & H.M. Crouan) Denizot	L
Cryptonemia seminervis (C. Agardh) J. Agardh	R, S
Dasya corymbifera J. Agardh	R, I, S
Dasya ocellata (Grateloup) Harvey	R., S
Dasya punicea (Zanardini) Meneghini ex Zanardini	R, I, S
Dermocorynus montagnei P.L. Crouan & H.M. Crouan	R, U
Drachiella minuta (Kylin) Maggs & Hommersand	R, U
Erythrocladia irregularis Rosenvinge	U
Erythrotrichia bertholdii Batters	R, U
Erythrotrichia investiens (Zanardini) Bornet	R, U, T
Erythrotrichia reflexa (P.L. Crouan & H.M. Crouan) Thuret ex De Toni	R, U, S
Erythrotrichia welwitschii (Ruprecht) Batters	U
Erythropeltis discigera v. *flustrae* Batters	R, U, I, S
Exilicrusta parva Y.M. Chamberlain	R, I, S
Gastroclonium reflexum (Chauvin) Kützing	R, S
Gelidiella calcicola Maggs & Guiry	U
Gelidium corneum (Hudson) J.V. Lamouroux	R, S
Gelidium maggsiae Rico & Guiry	Not recorded from Britain
Gigartina pistillata (S.G. Gmelin) Stackhouse	S
Gonimophyllum buffhamii Batters	U
Gracilaria bursa-pastoris (S.G. Gmelin) P. C. Silva	S
Gracilaria multipartita (Clemente) Harvey	S
Gracilariopsis longissima (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham	U, I
Grateloupia dichotoma J. Agardh	S
Grateloupia filicina v. *luxurians* A. Gepp & E.S. Gepp	R, A
Grateloupia turuturu Yamada	R, A
Haemescharia hennedyi (Harvey) K.L. Vinogradova & T. Yacovleva	R, U
Halosacciocolax kjellmanii S. Lund	R, U
Halymenia latifolia P.L. Crouan & H.M. Crouan ex Kützing	L
Helminthocladia calvadosii (J.V. Lamouroux ex Duby) Setchell	R
Holmsella pachyderma (Reinsch) Sturch	R, U
Hydrolithon boreale (Foslie) Y.M. Chamberlain	U
Hydrolithon cruciatum (Bressan) Y.M. Chamberlain	R
Hydrolithon samoense (Foslie) Keats & Y.M. Chamberlain	R, T
Hydrolithon sargassi (Foslie) Y.M. Chamberlain	T, S
Itonoa marginifera Masuda & Guiry	R
Laurencia pyramidalis Bory de Saint-Vincent ex Kützing	R, S
Leptophytum bornetii (Foslie) Adey	R
Leptophytum elatum Y.M. Chamberlain	R
Leptophytum leave (Strömfelt) Adey	N
Lithophyllum dentatum (Kützing) Foslie	Not recorded from Britain
Lithophyllum duckerae Woelkerling	Only one subfossil specimen in BM
Lithophyllum fasciculatum (Lamarck) Foslie	R
Lithophyllum hibernicum Foslie	Not recorded from Britain
Lithophyllum nitorum W.H. Adey & P.J. Adey	R
Lithothamnion lemoineae Adey	R, N
Lophosiphonia reptabunda (Suhr) Kylin	R, S
Meiodiscus spetsbergensis Saunders & McLachlan	R, T, N
Microcladia glandulosa (Solander ex Turner) Greville	R, S
Neevea repens Batters	R, U
Osmundea osmunda (S.G. Gmelin) K.W. Nam & Maggs	U
Osmundea ramossisima (Oeder) Athanasiadis	R, I
Osmundea truncata (Kützing) K.W. Nam & Maggs	R
Peyssonnelia armorica (P.L. Crouan & H.M. Crouan) Weber-van Bosse	R, S
Peyssonnelia atropurpurea P.L. Crouan & H.M. Crouan	S
Peyssonnelia immersa Maggs & L.M. Irvine	U
Phymatolithon brunneum Y.M. Chamberlain	R, S
Pikea californica Harvey	S, A
Plagiospora gracilis Kuckuck	U
Pneophyllum confervicola (Kützing) Y.M. Chamberlain	U
Pneophyllum coronatum (Rosanoff) Penrose	U
Pneophyllum limitatum (Foslie) Y.M. Chamberlain	U
Pneophyllum lobescens Y.M. Chamberlain	U
Pneophyllum myriocarpum (P.L. Crouan & H.M. Crouan) Y.M. Chamberlain	U
Polysiphonia ceramiaeformis P.L. Crouan & H.M. Crouan	R
Polysiphonia denudata (Dillwyn) Greville ex Harvey	R, S
Polysiphonia devoniensis Maggs & Hommersand	R, S
Polysiphonia foetidissima Cocks ex Bornet	R
Polysiphonia furcellata (C. Agardh) Harvey	R
Polysiphonia harveyi J. Bailey	U, A
Polysiphonia opaca (C. Agardh) Moris & De Notarius	R, S
Polysiphonia simulans Harvey	R, S
Polysiphonia subulifera (C. Agardh) Harvey	R, L
Porphyra drachii J. Feldmann	U, A
Porphyridium purpureum (Bory de Saint-Vincent) K. Drew & Ross	U, E
Porphyrostromium boryanum (Montagne) P.C. Silva	R, U
Porphyrostromium ciliare (Carmichael) M.J. Wynne	U
Pterosiphonia ardreana Maggs & Hommersand	R
Pterosiphonia pennata (C. Agardh) Sauvageau)	R, S
Pterosiphonia pinnulata (Kützing) Maggs & Hommersand	R
Pterothamnion crispum (Ducluzeau) NägeliR,	I, S
Pterothamnion polyacanthum (Kützing) Nägeli	R
Ptilothamnion sphaericum (P.L. Crouan & H.M. Crouan ex J. Agardh) Maggs & Hommersand	R
Rhodella maculata Evans	R
Rhodochorton concrescens K.M. Drew	R, U
Rhodophysema feldmanii Cabioch	Not recorded from Britain
Rhodophysema georgei Batters	R
Rhodymenia delicatula P. Dangeard	R
Sahlingia subintegra (Rosenvinge) Kornmann	U
Sarcodiotheca gaudichaudii (Montagne) Gabrielson	R, A
Scagelothamnion pusillum (Ruprecht) Athanasiadis	R, I
Schmitzia hiscockiana Maggs & Guiry	R
Schmitzia neapolitana (Berthold) Lagerheim ex P.C. Silva	R
Solieria chordalis (C. Agardh) J. Agardh	R, A
Spermothamnion strictum (C. Agardh) Ardissone	R
Stylonema alsidii (Zanardini) K. Drew	U
Titanoderma corallinae (P.L. Crouan & H.M. Crouan) Woelkerling, Y.M. Chamberlain & P. C. Silva	U
Titanoderma laminariae (P.L. Crouan & H.M. Crouan) Y.M. Chamberlain	R
Tsengia bairdii (Farlow) K.C. Fan & Y.P. Fan	R

BROWN ALGAE

Acrothrix gracilis Kylin R
Asperococcus ensiformis (Delle Chiaje) M.J. Wynne R
Asperococcus scaber Kuckuck R, U
Botrytella micromora Bory de Saint-Vincent R
Botrytella reinboldii (Reinke) Kornmann & Sahling R
Buffhamia speciosa Batters R
Chilionema hispanicum (Sauvageau) R.L. Fletcher R, U
Chilionema ocellatum (Kützing) Kornmann U
Choristocarpus tenellus Zanardini R
Cladosiphon contortus (Thuret) Kylin R
Compsonema microspongium (Batters) Kornmann R
Compsonema minutum (C. Agardh) Kornmann R, U
Compsonema saxicolum (Kuckuck) Kornmann R, U
Corynophloea crispa (Harvey) Kuckuck U?
Cylindrocarpus microscopicus P.L.Crouan & H.M. Crouan R
Cystoseira humilis v. *myriophylloides* (Sauvageau) J.H. Price & D.M. John R, S
Desmarestia dresnayi J.V. Lamouroux ex Leman U
Dichosporangium chordariae Wollney R, N
Dictyosiphon ekmanii Areschoug N
Dictyota spiralis Montagne U, I, S
Elachista stellaris Areshoug R, S
Felmannia irregularis (Kützing) G. Hamel U
Feldmannia lebelii (Areschoug ex P.L. Crouan & H.M. Crouan) G. Hamel R
Feldmannia paradoxa (Montagne) G. Hamel R, U
Fucus cottonii M.J. Wynne & Magne L
Fucus distichus Linnaeus N
Fucus evanescens C. Agardh R, N
Giraudia sphacelarioides Derbès & Solier R
Halothrix lumbricalis (Kützing) Reinke R, U
Haplospora globosa Kjellman R
Herponema solitarium (Sauvageau) G. Hamel Not recorded in Britain
Hinksia fenestrata (Harevey ex Berkeley) P.C. Silva R, N
Hincksia mitchelliae (Harvey) P.C. Silva U
Hincksia ovata (Kjellman) P.C. Silva R
Hincksia sandriana (Zanardini) P.C. Silva U
Hincksia secunda (Kützing) P.C. Silva U
Kuetzingiella battersii (Bornet & Sauvageau) Kornmann R
Kuetzingiella holmesii (Batters) Kornmann R
Laminaria longicruris Bachelot de la Pylaie N
Laminaria ochroleuca Bachelot de la Pylaie S
Laminariocolax aecidioides (Rosenvinge) Burkhardt & Peters U
Leblondiella densa (Batters) G. Hamel R
Leptonematella fasciculate (Rienke) P.C. Silva R
Liebmannia leveillei J. Agardh Not recorded in Britain
Mesogloia lanosa P.L. Crouan & H.M. Crouan R
Microcoryne ocellata Strömfelt R
Microspongium globosum Reinke R
Microspongium immersum (Levring) P.M. Pedersen R
Mikrosyphar polysiphoniae Kuckuck U
Mikrosyphar porphyrae Kuckuck U
Myriactula areschougii (P.L. Crouan & H.M. Crouan) G. Hamel U
Myriactula chordae (J.E. Areschoug) Levring U
Myriactula clandestina (P.L. Crouan & H.M. Crouan) Feldmann U
Myriactula haydenii (Gatty) Levring R, U
Myriactula stellulata (Harvey) Levring R
Myriocladia lovenii J. Agardh R
Myriocladia tomentosa P.L. Crouan & H.M. Crouan R
Myrionema corunnae Sauvageau U
Myrionema liechtensternii Hauck U
Myrionema magnusii (Sauvageau) Loiseaux R
Myrionema papillosum Sauvageau R, I
Padina pavonica (Linnaeus) Thivy S
Petalonia filiformis (Batters) Kuntze U
Petroderma maculiforme (Wollny) Kuckuck U
Phaeostroma pustulosum Kuckuck R, U
Phycocelis crouaniorum Athanasiadis R, U
Phycocelis foecunda Strömfelt R, U
Pilinia rimosa Kützing R
Pleurocladia lacustris A. Braun R
Pogotrichum filiforme Rienke U
Protectocarpus speciosus (Børgesen) Kuckuck ex Kornmann U
Pseudolithoderma roscoffense Loiseaux R, I, S
Punctaria crispata (Kützing) Batters R, S
Punctaria tenuissima (C. Agarh) Greville U
Scytosiphon dotyi M.J. Wynne R, U
Sorapion kjellmanii (Wille) Rosenvinge R, I
Sorapion simulans Kuckuck R, U
Sphacelaria caespitula Lyngbye R, N
Sphacelaria mirabilis (Reinke ex Batters) Prud'homme van Reine R
Sphacelaria nana Nägeli ex Kützing R
Sphacelaria racemosa Greville R
Sphacelaria rigidula Kützing U
Sphacelaria tribuloides Meneghini R
Sphaerotrichia divaricata (C. Agardh) Kylin R
Stictyosiphon soriferus (Reinke) Rosenvinge R, N
Stilopsis lejolisii (Thuret) Kuckuck & Nienburg ex G. Hamel R
Stragularia spongiocarpa (Batters) G. Hamel R
Streblonema breve (Sauvageau) De Toni R
Streblonema fasciculatum Thuret R
Streblonema helophorum (Rosenvinge) Batters R
Streblonema infestans (H. Gran) Batters U
Streblonema intestinum (Reinsch) Batters R
Streblonema myriocladiae (P.L. Crouan & H.M. Crouan) G.R. South & Tittley R
Streblonema parasiticum (Sauvageau) Levring R, U
Streblonema stilophorae (P.L. Crouan & H.M. Crouan) Kylin R, S
Streblonema tenuissimum Hauck Not recorded in Britain
Streblonema zanardinii (P.L. Crouan & H.M. Crouan) De Toni Not recorded in Britain
Strepsithalia buffhamiana (Batters) Batters R
Symphyrocarpus strangulans Rosenvinge R
Zanardinia typus (Nardo) G. Furnari S

GREEN ALGAE

Acrochaete heteroclada Correa & Nielsen U, T
Acrochaete operculata Correa & Nielsen U, T
Acrochaete repens Pringsheim U, T
Acrochaete wittrockii (Wille) Nielsen U
Blastophysa rhizopus Reinke R, T
Bolbocoleon piliferum Pringsheim U
Capsosiphon fulvescens (C. Agardh) Setchell & N.L. Gardner U, I
Chaetomorpha aerea (Dillwyn) Kützing U, I
Chaetomorpha crassa (C. Agardh) Kützing I, T
Characium marinum Kjellman R, U
Chlorochytrium cohnii E.P. Wright U
Chlorochytrium dermatocolax Reinke R, U, N
Chlorochytrium facciolae (Borzi) Bristol R, U
Cladophora aegagropila (Linnaeus) Trevisan U
Cladophora battersii Hoek R
Cladophora coelothrix Kützing R
Cladophora dalmatica Kützing R, U, I
Cladophora flexuosa (O.F. Müller) Kützing R, U, I
Cladophora prolifera (Roth) Kützing R, U, I
Cladophora retroflexa (Bonnemaison ex P.L. Crouan & H.M. Crouan) Hoek R, U
Cladophora vagabunda (Linnaeus) Hoek R, U, I
Codium adhaerens C. Agardh R
Codium bursa (Linneaus) C. Agardh R
Codium vermilara (Olivi) Delle Chiaje R, U, S
Derbesia marina (Lyngbye) Solier U, I
Derbesia tenuissima (Moris & De Notaris) P.L. Crouan & H.M. Crouan R, I
Entocladia leptochaete (Huber) Burrows R
Epicladia perforans (Huber) R. Nielsen I
Microspora ficulinae P.A. Dangeard R, U
Monostroma bullosum (Roth) Wittrock R
Ochlochaete hystrix Thwaites ex Harvey U
Ostreobium quecketii Bornet & Flahault U
Phaeophila dendroides (P.L. Crouan & H.M. Crouan) Batters U, T
Pilinia rimosa Kützing T
Prasiola calophylla (Carmichael ex Greville) Kützing
Prasiola crispa (Lightfoot) Kützing U
Prasiola furfuracea (Mertens ex Hornemann) Kützing U, I, N
Pringsheimiella scutata (Reinke) Höhnel ex Marchewianka R, U, I
Protomonostroma undulatum (Wittrock) K.L. Vinogradova R
Psuedendoclonium fucicola (Rosenvinge) R. Nielsen U, T
Pseudendoclonium submarinum Wille U, T
Pseudopringsheimia confluens (Rosenvinge) Wille R, U, I
Rosenvingiella polyrhiza (Rosenvinge) P.C. Silva U
Sykidion dyeri E.P. Wright R, U, I
Tellamia contorta Batters (incl intricata) U
Ulothrix implexa (Kützing) Kützing U
Ulva ralfsii (Harvey) Le Jolis R, U, T
Ulva rigida C. Agardh U, I
Ulvella lens P.L. Crouan & H.M. Crouan U
Umbraulva olivascens (P.L.J. Dangeard) E.H. Bae & I.K. Lee U, I, S
Urospora neglecta (Kornmann) Lokhorst & Trask R
Urospora wormskioldii (Mertens ex Hornemann) Rosenvinge U

Algae, the Water Framework Directive and Life: What should all it mean?

Sometimes, something good is wrapped up in opaque layers so that it is overlooked by most people. European Directives are often like this. Their language is stilted; their appearance is cold and plain; their font not exactly brimming with life. But they can be potentially revolutionary. The Water Framework Directive (it has a longer name but few use it and the reference number, 2000/60/EC, and the acronym, WFD, will do) is like this. In the next few decades it could entirely change the landscapes of Europe for the better.

Waters and their ecosystems, both fresh and marine, but particularly fresh for they are closer to the origins of the problems, have suffered immensely and unnoticed for the most part. They have been drained, dammed, embanked, overfished, regulated, polluted, canalised, acidified, salinated, eutrophicated, overabstracted and deoxygenated. Damaging floods affect some parts of Europe, desertification others. The WFD has been thirty years in discussion and attempts to solve many of these problems at a stroke.

Past approaches to water quality

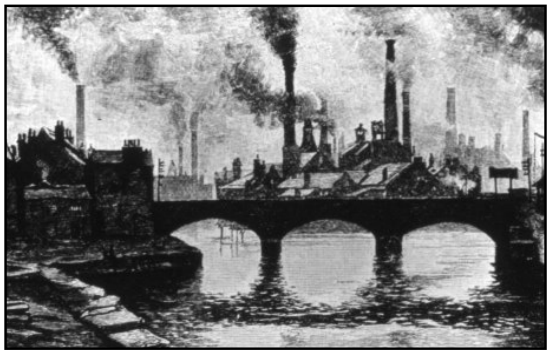
The UK took an early lead at the start of the twentieth century, following severe cholera outbreaks in the industrial cities, in establishing laws to control discharge of raw sewage into rivers. It was among the first to monitor the community of river invertebrates to supplement the chemical data on oxygen, biochemical oxygen demand and ammonia that were gathered. And it has progressively added legislation to limit discharge of poisons from the chemical and other industries. Its approach has been 'end of pipe', for point sources only, however. The regulations specify what can be discharged for discrete recognisable polluters like waste water treatment works and chemical factories. This has resulted in major improvements, announced annually by euphoric Secretaries of State for the Environment, in the symptoms of gross organic and toxic pollution and the water companies rejoice in the investment they have made in combating, by 2000 AD, problems that were defined a century ago.

What the UK (and most other EU member states) have not done, however, is to recognise that there are many more waters (streams, lakes, estuaries, coastal waters) than the larger rivers that are routinely monitored, that there are many other problems for natural waters than point source pollution of raw organic matter and toxins. The ways in which catchments are managed underlie these and a significant determinant is currently the agricultural industry and the market structures that puppeteer its daily operation. Diffuse pollution of trace organics and nutrients, river engineering, drainage of floodplains, reclamation of saltmarsh and mudflat, establishment of fish farms and overfishing are all agriculturally related to large extents and all hitherto have been largely ignored by the legislation. This is not surprising in a nation where land ownership is a mark of status and the right to use the land by individual will is deeply engrained.

The WFD as revolution

The WFD challenges this position. It says first that water must be managed as entire river basins, not just the wetted perimeters of rivers and lakes, and that the basins include the estuaries and coastal waters. Secondly it phases out entirely the discharge of a list of noxious substances, low concentrations of which have previously been tolerated. Thirdly it says that economic instruments must be used to safeguard water supply and quality. Water, when used in the private interest, must be paid for at its proper value and not regarded as a free good. Fourthly it requires the public to be consulted in the management of the river basins to a greater extent and earlier than at any time previously, And it also uses the term 'public' and not the horrible jargon of 'end users and stakeholder engagement' now bandied around by organisations of bureaucrats unaware of Hans Christian Anderson's tale of the emperors' clothes. But lastly, and crucially, it requires ecological quality to be the criterion for management, not water quality. There is a big difference.

Aquatic habitats, grouped by the Directive as rivers, lakes, transitional waters (an odd term for estuaries) and coastal waters, must first be arranged in typologies. This is just a pigeon-holing system that recognises that some lakes, for example, are based in hard rock, poorly weathered catch-



Top: Approaches to water monitoring in the UK until the advent of the Water Framework Directive have reflected the problems of the industrial revolution, not the realities of the late twentieth century.
Bottom: Llyn Bugeilyn , in mid-Wales, emerged as of good ecological quality in a recent pilot scheme.

ments and thus have different features from those on limestone or set in glacial drift; that some are big, some small, some deep, some shallow. For estuaries, some are well mixed, some wedged with layers of saline and freshwater passing side by side, some broad and some restricted. The typology has to rely on fixed, essentially geographical characteristics and not those that may be influenced by human activities that hence will be measures of ecological quality. It is in choice the latter that scientists should have their greatest influence.

The meaning of ecological quality

Ecological quality is to be based on a reference system and measured by many variables grouped into the hydromorphological, the chemical and the biological. The biological include phytoplankton, aquatic plants, macroinvertebrates and fish and estimates are that thirty to fifty different variables will have to contribute to the determination of ecological quality for each group of waters. For each ecotype (the term used for each pigeonhole in the typology) a reference standard of 'high ecological quality' has to be determined by finding existing sites, by palaeolimnology or by expert judgement. The latter will be the main approach for few if any sites of high ecological quality will exist in Europe and palaeolimnology is a limited tool. High ecological quality is defined as having negligible human influence. It is essentially pristine. A pristine upland river in the UK therefore will be one in which the catchment is covered by native forest, is completely unfarmed, has the native predators of wolf and brown bear as parts of the system, with their major influences on salmonid ecology and deer browsing of riparian communities, is liberally littered with forest debris from leaves to tree trunks and has vanishing concentrations of available nitrogen and phosphorus.

The high quality sites or sets of reference conditions are the yardsticks for estimation of the current ecological quality of existing sites on a scale of good, moderate, poor and bad. The only definition of any precision given in the Directive for these is that good quality is 'slightly' different from high quality. Much discussion will go into what 'good' means for it is a judgemental decision that has many political overtones. Environmental lobbies will point to the commonsense meaning of 'slight'. Governments and commercial lobbies will try to stretch it like legendary elastic of Marks and Spencer's knickers. The Directive, however, stipulates that definitions must be broadly the same across all member States and it requires that all habitats (subject to some justified derogations) shall be restored to good quality by 2015.

The challenge to ecologists

Thus there are interesting problems and exciting times for those of us involved in the ecology of marine and freshwater habitats. Defining quality is not easy. Deciding exactly what to measure within the stipulations of phytoplankton, aquatic flora, macroinvertebrates and fish is not trivial, not least because of the riders that composition, abundance, and for fish, age structure must be included. Even pristine ecosystems are not fixed entities with unchanging species lists and water chemistry. They operate within a range of conditions, most of which we do not know. They have general and fundamental features like nutrient parsimony, characteristic structure and diversity, resilience and connectedness that are not obviously measurable by a list of species or a set of chemical analyses, if at all. And even if they could reflect fundamental ecology, the sampling regimes specified by the Directive are unlikely to be able to reflect the natural variation in community and chemistry even over short periods.

There should now be a very healthy debate. Some advocate a continuation of current approaches. There are established methods using invertebrates to assess some aspects of river quality and standard surveys of river habitats. No doubt diatoms or seaweeds can be harnessed to produce further indices. The Environment Agency had to estimate last year, under the timetable for implementation of the Directive, the risk that habitats were failing to meet good quality and met with the difficulty that it has not yet decided what good quality means. The reason for this is that the UK Government is waiting for an agreement across Europe that it hopes will not set the standards very high. The Agency consequently set liberal standards for individual variables and used established approaches and indices to find that even then 95.5% of rivers and 82% of all water bodies in England and Wales would fail.

This conclusion is broadly in line with the experience of working ecologists and assessments of the state of Sites of Special Scientific Interest made in 2003 by English Nature, but legal opinion that a habitat must meet the good quality criterion in every respect to gain such status is ecological nonsense and probably will condemn some habitats to a lower status than they really have. One project to design a typology and ecological classification scheme for lakes run from the University of Liverpool found that compliance in around 80% of variables is about right. The alternative approach to monitoring is to abandon convention and design a monitoring scheme that uses the stipulated categories of chemical, hydromorphological and biological variables (phytoplankton, plants, invertebrates, fish) in a more creative way that reflects more the fundamental characteristics of high quality systems that in turn underlie the provision of goods and services from these systems on a sustainable basis. Fine taxonomic indices are unlikely to be of greatest value here but ones reflecting processes rather than composition may much more accurately reflect the needs and spirit of the Directive.

The Great Game

The next year or two, in which the monitoring systems will be set, will be exciting for ecologists and crucial to the ecosystems. If Government plays the game of minimising cost of implementation ('no gold plating' is the mantra of government departments), it will merely expand its existing approaches and achieve only large databases in metaphorically expanding filing cabinets. There may then be problems of acceptance by the more environmentally sophisticated member states. If it really wants to meet the challenge of environmental improvement for the good of society at large, it may need to listen carefully to the scientific community and build on modern concepts of what is important in ecosystems rather than sticking with the approach of 1912 and the understanding of 1950.

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Benthic diatoms and SEPA, Scottish Environment Protection Agency

Benthic diatoms are a significant component of aquatic ecosystems and can be used as a measure of general water quality, or a specific component of water quality such as eutrophication or acidification. The requirement for the monitoring of eutrophication fell under part of the Urban Waste Water Treatment Directive (UWWTD) and the Nitrates Directive and, as a result of such requirements, a Trophic Diatom Index, TDI was developed for the UK (Kelly et al., 2001). Recently, the requirement for monitoring of eutrophication and acidification is also inherent within the Water Framework Directive and the TDI continues to be one set of tools used by the Environment Agency of England and Wales and SEPA, Scottish Environment Protection Agency in the UK.

Benthic diatoms are sampled in order to produce representative collections of the (diatom) community indicative of water quality. Samples are cleaned using strong oxidising agents in order to prepare diatoms for identification and enumeration, and subsequent interpretation of water quality uses the TDI, which is based on the relative abundance of taxa. In SEPA, the TDI has been used as one of the tools to assess the trophic status of its rivers since the mid 1990s, and continues to be used to further develop requirements of the Water Framework Directive not solely in rivers but standing waters too (WFD-diatom projects DARES, Diatoms Assessing River Ecological Status and DALES, Diatoms Assessing Lake Ecological Status, http://craticula.ncl.ac.uk/DARES).

In response to requirements to ensure that benthic diatoms are accurately and precisely collected, prepared for enumeration, and enumerated, SEPA have held internal training courses for ecologists. The courses have been run by Dr Martyn Kelly, Bowburn Consultancy who developed the TDI. A recent TDI training course in February 2005 was attended by 11 SEPA ecologists. The first day of the two day course was aimed at staff with little or no experience of diatoms, concentrating on their main structural features used for enumeration, the use of the TDI, and progress with WFD-diatom related work. The second day was attended by staff that have undertaken diatom work in the past and that have undertaken training in the use of the TDI, and was used to further improve their diatom taxonomy. Such internal courses, together with external training courses as at Kindrogan Field Centre and the University of Durham help SEPA to recognise and correctly identify algae, as well as provide training in freshwater algal ecology. Links to the latter two training courses are provided from the BPS web page (http://www.brphycsoc.org/).

The training was extremely beneficial to SEPA by encouraging ecologists to get further training in diatoms, by highlighting possible errors, limitations and confusions in identification, but mainly by reassuring them that their current diatom identification has been accurate. The only internal negative feedback received concerned the size of the lunch – perhaps a warning to all who are due to hold meetings with SEPA.

Although the TDI is by no means a panacea to the interpretation of the assessment of ecological status of freshwaters as it does have its limitations, it is but one of a set of indices and methods which are used. Taxonomy is therefore very crucial to the work SEPA and others do, as without the correct identification all other related work will be useless. There is therefore a strong need to correctly identify taxa to species level to underpin work as part of the main ecological drivers, and I would envisage environment protection agencies continuing to build on their taxonomic skills and to build on their freshwater algal, including diatom expertise in particular.

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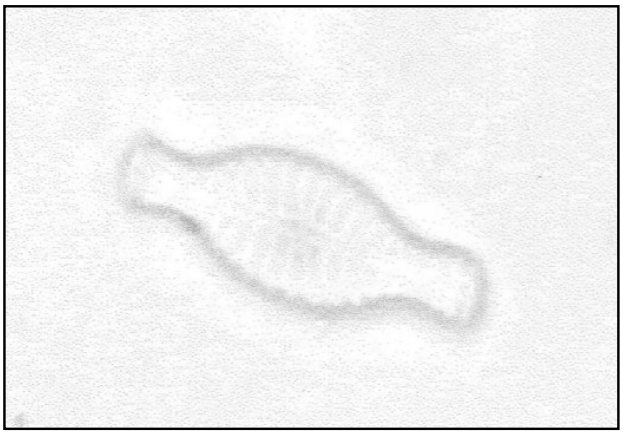

Name that diatom: a couple of diatoms encountered during the training course.

Fritsch Collection : Fritsch Notelets

The Fritsch Collection has, since Professor Fritsch began his 'scrap book' in 1912', collated algal illustrations indexed by group, genus and species of freshwater, terrestrial and brackish taxa; with a reference author card. From 1997, new additions have also been added to a searchable Author Citations Index and, in 2002, BPS Council awarded the Freshwater Biological Association a grant of £5000 to employ a casual worker to begin adding in the backlog of records.

We are delighted to announce that this partial database went online at the beginning of February and can be consulted in our new website **www.fritschalgae.info** by clicking on electronics index and search. We hope that you will use it and also provide us with your comments.

Although the illustrations themselves are not web-searchable, they are available on microfiche from IDC, either complete or just for algal groups. The staff welcome visits to consult the originals and deal with enquires by mail and e-mail (**fritsch@ceh.ac.uk**). We are also able to supply some copy sheets.

We are now seeking further funding to complete the c. £30,000 project. Last year we were given desmid illustrations by the UK expert, David Williamson of Leicester, and told to use them to raise funds. Our first effort has been to design two sets of notelets, one being for more general interest. We would like to thank all those who supported this new venture at the Birmingham meeting in January as I took very few packs home, which was a grest start! Incredibly, one note has produced a very generous gift, of over £10,000, to support the project, over half-way but we still need to find the rest.

So, please keep supporting us by buying and using our notelets and - we do have further plans for 'David's Desmids'!!

Elizabeth Y Haworth

Obituary
Norman Ingram Hendey (1903-2004)

Norman Ingram Hendey died on 30 August 2004 in his 102nd year after a short period in hospital as a result of a fall. He was born in Lyndhurst on 31 January 1903 and, after the village school, he went to the King Edward VI Grammar School and then to Southampton University College (later Southampton University). At University he read mathematics, physics, chemistry and botany for two years. Norman then trained in pharmacy and for many years served as a pharmacist. In 1921 he started attending the meetings of the Southampton Natural History Society and at one of these meetings someone showed slides of diatoms under dark-ground illumination. Norman was captivated by the complexity and symmetry of the diatoms and this was the start of a study that was to continue until the end of his life. Unfortunately in 1921 there were no good books in English on diatoms but a friend lent Norman a copy of *A Treatise on the Diatomaceae* (van Heurck, 1896) and Norman was soon well and truly hooked on diatoms. He bought a second-hand microscope to help with his studies. In 1929 he was asked to assess the potenial of diatomaceous earth as a filter aid (Hendey, 1930) and for this work Norman consulted the literature and slides at the Natural History Museum in London and soon became known there for his detailed studies.

Because of his reputation Norman was asked by Dr Stanley Kemp, Director of Research of Discovery Investigations, to work up the samples taken in the Southern Ocean by the Research Ship 'Discovery.' This led to 'The Plankton Diatoms of the Southern Seas', which was published in the *Discovery Reports* (Hendey, 1937). The first comprehensive taxonomic work on the planktonic diatoms of the Antarctic in English, this has remained a standard reference book. The quality of the illustrations that Norman produced for this work is the envy of many diatomists.

In the Second World War, Norman joined Naval Intelligence. During his wartime travels Norman met a number of diatomists with whom he already corresponded and established strong friendships with many of them.

After the war he transferred to the Admiralty Research Laboratory at Portsmouth where he worked on fouling of surfaces immersed in the sea. While carrying out this work Norman made a full survey of the diatoms of Chichester Harbour and this led to another valuable publication (Hendey, 1951). In 1956 the Admiralty research was concentrated on the biological deterioration of stored materials such as timber, rope, canvas, fabric, and hydrocarbon fuels. The deterioration of these materials was costing the country millions of pounds annually and Norman was deeply involved in trying to prevent or control this wastage. He was the first to show that a fungus, *Cladosporium resinae*, found in stored jet engine fuel was responsible for the corrosion of the fuel tanks on aircraft (Hendey, 1964a), he was also the first to identify a fungal organism, *Myxotrichum deflexum*, responsible for the decay of the material used in life rafts (Hendey, 1966).

Norman Ingram Hendey.

Because of his expertise in organisms causing decay and corrosion in stored material Norman represented British interests at international meetings. While in America he met up with more of his diatom colleagues and became involved in the study of fossil diatoms as a source of dating geological samples. He also lectured on diatoms and attended meetings on red tides.

All this time he was accumulating information and records of the marine diatoms around the British Isles and in 1964 at the request of the Ministry of Agriculture and Fisheries published his monograph on the marine diatoms of the British Isles (Hendey, 1964b). This was an outstanding work. The taxonomic work was precise and accurate and once again the illustrations were outstanding. By this time Norman had perfected his method of producing the most amazing photomicrographs of the diatoms. This book is a standard reference book and is used all over the world. In 2004 I corresponded with a colleague in Spain and told him I had visited Norman and his reply was that the work by Norman was on his desk and was frequently consulted.

Later Norman became involved in the use of diatoms in forensic studies and the outcome of a number of important cases depended on the diatoms that Norman found in samples from the bodies.

Norman retired in 1968 and he and his wife moved to St Agnes on the North Cornish Coast. His retirement from official employment meant that he had more time for his study of diatoms, fossil, living and in forensic studies Eventually his sight began to fail but he had support in his diatom work from Patricia Sims at the Natural History Museum and with her he continued publishing scientific papers up to a couple of years ago (Sims & Hendey, 2002). He was a Fellow of the Royal Microscopical Society and Honorary Member of the British Phycological Society, the Queckett Microscopical Club and the International Diatom Society. In diatom taxonomy he established three new families of diatoms, described more than 100 taxa new to science and had 11 taxa named after him.

I first met Norman in the late 1950s at scientific meetings and in the early 1960s I visited him and his wife, Nellie, at Poole when he was carrying out his work on the deterioration of stored material. We met, of course, to talk about diatoms. When I was appointed to the Plymouth Laboratory of the Marine Biological Association, Norman became a frequent visitor. In 2003 we were invited to his 100th birthday party. At the end of May 2004 we were down in west Cornwall and arranged to call on Norman and his daughter, Janice. We arrived rather early for lunch and Norman was so delighted because he said we would have time to talk and we spent an hour discussing diatom taxonomy. The only sad note was that when we came to leave Norman gave me one of his hugs and with tears rolling down his face said, 'I don't expect I will see you again'.

Norman was a very determined worker and when he had made up his mind on any topic he was difficult to persuade otherwise, so much so that on some occasions he could appear to be obstinate. However, he was always extremely kind and helpful to me and I will miss him greatly.

A fuller obituary and list of publications will be published in *Diatom Research*.

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Van Heurck, H. 1896. *A Treatise on the Diatomaceae* (Translated by W.E. Baxter) Wesley and Sons, London xx + 558pp + 35 plates.

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Did you know Tony Fogg?

If so, I hope to hear from you. The next issue of *The Phycologist* will include contributions from of as many of his friends, students, colleagues and acquaintances as we can contact and wish to be involved. Words of appreciation, anecdotes, recollections would all be appropriate. If you have a photo we would be grateful if we could include it.

Please send your contribution to me at an address (preferably the email one) below. Photos attached to emails would be OK, as would airmailed non-digital ones which I would return immediately after scanning.

If you know of a potential contributor who may not have seen this notice please give me their address or tell them about the appeal.

The deadline for this section of the October issue is July 1st.

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The role of the Grants and Awards Committee

Before the Immediate Past President of the Society is finally put out to grass, he / she has the pleasant responsibility of chairing the Grants and awards committee for two years, and thereby giving away some of the Society's money. The aim of the committee is to support student attendance at scientific meetings and training courses, with the aim of fostering the scientific development of those students and encouraging their phycological endeavours. It also reviews proposals for summer projects that will utilize student "labour" to help push forward the research frontiers.

Because the Society seeks to help foster phycology in as many ways as possible, there are few rules. However, applicants must be members of the society, and after receiving support to attend courses or non-BPS meetings, they should contribute a small piece to *The Phycologist*, so that other members can see how the Society's funds are being used to support its aims. In the last year, we have supported students attending a number of different meetings in a variety of countries. In addition we try and hand over to the students a number of BPS leaflets to take to the respective meeting so that information about the Society reaches new audiences and encourages others to join.

We also of course support the attendance of student members to present a paper or poster at our own winter meeting. This of course means that the students have two opportunities to benefit financially, once simply by presenting, but secondly by competing for either the BPS poster prize or the Manton prize. Supervisors should remember to encourage their students to attend and present. The relevant information is on the web page and forms can be downloaded and submitted in either electronically or as hard copy. At present there a number of deadlines each year, depending on the type of funding. The application form with details is available on the Society website (http://www.brphycsoc.org/documents.lasso).

Eileen J. Cox
The Natural History Museum, London
January 2005

Into the pink!

In August 2004, due to the generous funding from the British Phycological Society travel award, I had the great pleasure of studying with Dr Yvonne Chamberlain at the Institute of Marine Sciences, University of Portsmouth. I am currently a doctoral student at the University of Hawaii studying the ecology and physiology of crustose coralline algae, an ecologically important but poorly characterized component of tropical Pacific reefs. I first met Dr Chamberlain when she came to Hawaii at the request of the Bishop Museum to review the taxonomy of their coralline algal collection and interact with University of Hawaii botanists, Drs Isabella Abbott and Celia Smith. While Dr Chamberlain was here, she led an all day workshop on coralline algal identification, which opened many eyes (from State agency people to myself) to the beauties and intricacies of *Hydrolithon* and other Hawaiian genera. Due to Dr Chamberlain's busy schedule, I was unable to pursue the interesting research questions I had for her on that short trip; she graciously sponsored me to study at Portsmouth the following summer to allow me the time needed to refine techniques and frame taxonomic concepts and questions.

To provide focus for my study, I brought samples that were collected during U.S. Fish and Wildlife – led reef surveys in American Samoa. These reefs are world renowned for their crustose corallines; islands such as Rose Atoll, a locale for Setchell's early studies, are pink from these corallines. As many of you may know, identification of crustose corallines is an involved process requiring many skills. These difficulties are further compounded by samples that come from areas like American Samoa, where there are no taxonomic keys available. Dr Chamberlain guided me through the entire process of identifying samples including: initial examination of the samples; decalcification; use of the freezing microtome; and finally, searching through the literature to come up with a positive identification. Dr Chamberlain shared many insights drawn from her extensive experience studying coralline taxonomy.

Despite the busy lab schedule, we found time for a trip to Kimmeridge to look at the local coralline flora. We even managed to squeeze in a tour of Stonehenge and Winchester Cathedral.

I am indebted to Dr Chamberlain for her warm hospitality and for committing time and effort to helping me The best part of the experience was that I gained not only a colleague, but a friend. Thank you, Yvonne! I also want to thank everyone at the Institute of Marine Sciences for their hospitality and support while I was there and BPS for their financial support, without which I would still be trying to distinguish between monomerous and dimerous morphologies!

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Cheryl Squair

Yvonne Chamberlain

XIth International Conference on Harmful Algal Blooms, Cape Town, South Africa

In November 2004, BPS awards gave us the opportunity to attend the XIth International Conference on Harmful Algal Blooms, in Cape Town, South Africa. This biannual event brought together approximately four hundred participants from nearly sixty countries, to address and exchange research findings on all aspects of toxic and harmful algae. The backgrounds of the delegates were diverse, ranging from research, to shellfish farming, to monitoring programmes.

The setting for the conference was the very impressive Cape Town International Convention centre. When we arrived we found our poster places amongst the three hundred spaces and put up the posters that we would be presenting on the Tuesday and Thursday evenings. These were entitled 'Morphology, Molecular Taxonomy and Toxicity of *Alexandrium peruvianum/ostenfeldii* of the Fal Estuary, UK' and 'Germination Dynamics of *Alexandrium minutum*'.

The conference began with a welcome from the organiser Grant Pitcher. The plenary speaker Pat Glibert gave the first lecture of the conference, on eutrophication and harmful algal blooms. This lecture really brought home the massive and continued shift in nitrogen based fertilizer to urea forms, and the potential impact of such a shift on the global expansion of harmful algal blooms.

There were in total seven plenary lectures, given in the mornings and afternoons prior to the lecture sessions, which demonstrated some very innovative science. This included Don Anderson's use of fibre optic microarrays for the detection and enumeration of harmful algae and Lincoln Mackenzie's SPATT (Solid Phase Absorption Toxin Tracking) technique that utilises the passive adsorption of micro-algal toxins onto sachets filled with synthetic sorbent resin. These sachets can be put out in the field and can provide a good simulation of toxin accumulation by filter feeders.

The lecture programme included sessions on taxonomy and systematics, biogeography and regional events, species and bloom detection, population dynamics, toxins and toxicity, allelopathy, monitoring, management and mitigation, public health-education and outreach, and ballast water. Since the lecture programme ran with parallel lectures, it was often difficult to choose which lecture to attend.

From both the lectures and posters there was a real scope of the 'old' to the 'new'. Ranging from Malte Elbrächter's discovery of Ehrenberg's late 18th century sketches on a species which may well be an *Alexandrium*, through to Alan Cembella's quest to find the gene encoding spirolide toxin biosynthesis in *Alexandrium ostenfeldii*. Collaborations between research institutes and scientists over a broad spectrum were plentiful and this was nicely demonstrated by three concurrent lectures, given by Monica Bricelj, Laurie Connell and Vera Trainer respectively. Their work described how recurrent toxic blooms have affected the softshell clam (*Mya arenaria*) populations from Atlantic North America, resulting in genetic adaptation to PSP toxins via natural selection of more resistant individuals. This work has led them to the recent discovery of a single mutation at the saxitoxin binding site in the clam that confers resistance to PSP toxins.

There was a chance to break from lectures mid week. In the morning, round table discussions were held, of which we attended 'detection and monitoring of HABS' and 'effects of HABs in the food chain'. That afternoon were the mid conference tours, and in our case the Township Tour. This was an opportunity to see a side of Cape Town we would otherwise not have been able to experience.

There were a number of social events organised, which gave us the chance to mingle with fellow participants. These included a cocktail party in the Cape Town aquarium on the Monday night, an African evening on the Wednesday night, and a banquet on the final evening, which at the latter two were plentiful amounts of food, drink and dancing. On the Saturday we were given the chance to accompany Claudio Maragoni on his sampling trip, for his study of *Pseudo-nitzschia* species in South Africa, which gave us the opportunity to see some Southern right whales near the coast. During our time in Cape Town we were also able to visit Table Mountain, the Kirstenbosch Botanical Gardens, where we admired the impressive Cape floral kingdom, and to tour Cape Point and see some penguins, baboons, ostriches and antelopes.

We would like to thank the BPS for financial support to attend this conference. Further support was provided by the University of Westminster and CEFAS. It was a fantastic opportunity to be able to meet the people whose work you read and admire, some who have dedicated their lives to the study of harmful algae. We are both nearing the end of our PhDs, so to be able to incorporate up to date research into our theses and take home constructive comments on our work is really worthwhile. Through the colleagues we have met, and friends made at this conference, we may well be able to collaborate in the future. Thank you BPS.

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Left, Eva Perez and face painter. Below, Muna Husain and Linda Percy.

Freshwater algae course 2005

Where and when?

Kindrogan Field Centre, Enochdhu, Blairgowrie, Perthshire, Scotland (near the tourist area of Pitlochry), 31 July - 6 August 2005.

What is the course about?

The course takes full advantage of the excellent range of aquatic and terrestrial habitats in this beautiful area of Highland Perthshire to provide a sound introduction to the recognition, identification and ecology of freshwater algae. Emphasis will be placed on the use of the microscope and taxonomic keys (print and electronic) for the identification to generic and species level and their ecological importance.

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

Field trips, on foot or by vehicle, will be varied, but not strenuous and will be complemented by laboratory work, illustrated talks and class discussion.

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

Who are the participants?

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

What is the full cost of the course?

The course costs £352.11 per person (approx € 499 or $664), which includes accommodation, all meals (please notify if you have any special dietary needs) and tuition. This is excellent value for money and costs significantly less than other algal courses on offer.

Who are the course tutors?

The course tutors, Dr Eileen Cox and Professor Elliot Shubert, have taught this course for the past eight years and have a wide ranging expertise on freshwater algae. Eileen and Elliot conduct research at The Natural History Museum, London, specialising in diatoms and green algae respectively. Eileen has published a key to live diatoms and Elliot has published a key to the non-motile coccoid and colonial green algae.

Is there support for students?

Yes, support for a student stipend is available from:
The British Phycological Society
http://www.brphycsoc.org/funding.lasso

The deadline for applications is 1 May 2005.

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

http://www.psaalgae.org/student/stugrants.html

The deadline for applications is 19 March 2005.

In addition, one outstanding student applicant may be eligible for a 'specialist course' British Ecological Society stipend. For more information and an application form:

http://www.britishecologicalsociety.org/grants/attendmeetings/index.php#specialist_course

Applications are due prior to 16 February 2005.

How do you get to Kindrogan?

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

Where can I find more information?

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

For a booking form:
http://www.field-studies-council.org/documents/leisure-learning/2005/bookingform.pdf

The Annual BPS Meeting - Plymouth, 5th-7th January 2006

The next BPS scientific meeting will be held in Plymouth and hosted jointly with the Marine Biological Association. The meeting will be extended to run over three full days and include a special symposium on *"Genomics in Phycology: Something for Everybody"* organised by Jim Callow (**j.a.callow@bham.ac.uk**) and Jeanine Olsen (**j.l.olsen@rug.nl**). A number of invited speakers will contribute to this special symposium providing both an information/teaching element and examples from developing algal genomics projects-including comparative, functional and ecological genomics, as well as proteomics and applied areas.

In addition, contributions from cell biologists and algal physiologists will be especially welcome, which will hopefully enable a further contributed session sponsored by the MBA during the meeting.

The accommodation will be in the Plymouth Moathouse hotel where very favourable rates have been negotiated. Scientific sessions will take place in the Sherwell Centre on the local University of Plymouth Campus. A preliminary programme will appear in the autumn edition of *The Phycologist* and **abstract submission deadline is therefore September 30th 2005**. The final registration and booking deadline will be November 15 2005.

The local organiser is Dr Alison Taylor (**arta@mba.ac.uk**) and further details on abstract submission and registration will be made available in the summer on the BPS website (http://www.brphycsoc.org/).

The 53rd Annual Meeting of the BPS, Birmingham, 5th-7th January 2005

The 53rd meeting was originally to be held at Nottingham University. However scheduling difficulties meant that the meeting needed a new host at short notice. Barry Leadbeater and Maureen Callow kindly agreed to step in and take on the task. The meeting was therefore run during 5–7 of January at Birmingham University.

The meeting was slightly shorter than usual and a main focus were the two special sessions on 'Pole to pole Phycology' and 'Conservation and Biomonitoring' (see articles in this issue). The first evening after dinner provided an opportunity for a wine reception and poster session. The BPS student poster prize was awarded to Stephanie Thompson (Birmingham) for her poster on the cell biology of *Ulva* zoospore settlement. A lengthy but productive Council meeting also took place the same evening, which thankfully had access to some of the reception refreshments!

The special symposia concluded on Thursday afternoon after which delegates were treated to The Presidential Lecture by Barry Leadbeater; 'A lifetime with flagellates: living by the rules'. Barry's talk centred on the mysteries, mechanics and morphology of choanoflagellates and he included some amazing video microscopy and modelling analysis of these organisms as they developed their intricate cell coverings of loricae. The rest of the evening was very much a social affair with a wine reception followed by the Society dinner. After dinner the evening was continued in the adjacent bar with a Ceilidh band providing music and delegates providing entertainment as they attempted to follow a variety of dances. During the evening, Graham Underwood surprised many and delighted us all with his energetic and impromptu solo morris performance.

The final morning of the meeting started well with parallel session of the Manton Prize and contributed papers, only to be interrupted by a lengthy fire alarm, requiring evacuation of the building. Nevertheless, once back in the building, the session chairs skilfully managed the timing of the remaining contributions so that the final lunch, Poster and Manton Prize presentations were not unduly delayed. The Manton session once again comprised a number of excellent talks by students, making judging a difficult task. The judges finally decided to split the award between Fiona Young and Eva Novak (see biographies in this issue), so congratulations go to them.

I am sure all those who attended will join me in thanking once again Barry, Maureen and their students for ensuring such a successful and enjoyable meeting.

Alison Taylor

Left, Graham Underwood. Right, members dancing.

Pole to Pole Phycology

Unfortunately, Harvey Marchant was unable to attend the meeting so the polar phycology special session started with a brief overview of the peculiarities and similarities of algal communities in both Antarctic and arctic freshwaters given by Johanna Laybourn-Parry (Nottingham), one of the few people to have worked at both poles. Viv Jones (UCL) gave an overview of recent changes in lakes on Svalbard and in Siberia recorded in lake sediments together with some of the possible causal mechanisms. Her paper high-lighted the extent to which freshwater communities have changed over the last ~100 years throughout parts of the arctic. The session contained three more presentations with a palaeoecological focus, all based on work in SW Greenland, where there is a diverse range of lake types, from oligosaline to dilute freshwater systems. Suzanne McGowan (Nottingham) showed how two neighbouring oligosaline lakes had variable development trajectories during the Holocene due to lake-specific processes such as stratification, despite experiencing the same regional climate forcing. Sergi Pla (Queen's University, Kingston, Ontario), having wandered aimlessly around the Birmingham campus all morning, finally managed to find the lecture theatre in time to give us an overview of the factors controlling chrysophyte cyst distribution in lakes located along the Kangerlussuaq fjord of SW Greenland. John Anderson (Loughborough) presented Bianca Perren's work (University of Toronto) on recent changes in diatoms assemblages in SW Greenland, a part of the Arctic that is presently cooling, unlike the areas discussed by Viv Jones. While many lakes in SW Greenland show limited ecological change, there are clearly some that are changing, leading to questions about the dominant causal mechanisms underlying the observed changes. Kirsten Christoffersen (University of Copenhagen, Denmark) gave an overview of the phytoplankton assemblages in low to high Arctic lakes, based on a massive Nordic survey of more than 300 lakes. Despite the variability in the dataset due to the range of lakes sampled it was still possible to make broad generalisations, notably the dominance of flagellates. Karin Rengefors (Lund University, Sweden) returned to the final freshwater paper in the session where she discussed the seasonal variability of a number of small dinoflagellates in Anarctic lakes and their possible taxonomic affinities. Finally, there were two marine papers in the session; John Raven (Dundee) discussed in his own inimitable style the role of temperature in inorganic carbon acquisition in algae. Jeanine Olsen discussed the possible mechanisms influencing links between the Pacific and the North Atlantic with their implications for speciation and biogeography. The session provided us with a good introduction to the diverse nature of phycological research in the Arctic and Antarctic, as well as the fun and problems of working at high latitutudes.

John Anderson

The 53rd Annual Meeting of the BPS, Birmingham

Perspective on the Biomonitoring and Conservation Special Session

The first meeting of the British Phycological Society I attended was held back in 1996 in Lancaster, and I was going to ensure that the 53rd meeting of the BPS was going to be just as memorable. This was important for me because I was voted to Council of the BPS as recently as January 2004, and it was a real 'baptism of fire' being asked to organise one of the special sessions following my inaugural Council meeting. I was therefore keen to ensure that this meeting would be just as scientifically stimulating as previous ones. I very quickly panicked, but then got on with the arrangements.

It is not difficult for me to recount that arrangements for the special session on Biomonitoring and Conservation commenced as far back as January 2004. Initial efforts were aimed at running around and asking individuals if they would be willing to give presentations, and then checking their availability. A change in time for the winter meeting was unavoidable but luckily all the speakers were still able to make the new date. Arrangements continued for most of spring - by the summer of 2004 a tentative programme was laid out, and by October all abstract were received and a preliminary scientific programme was made available on the web and in *The Phycologist*. This seemed easy in comparison to arranging the running order and duration of talks, especially as this BPS winter meeting was also shorter than usual. Thanks should go to Jackie Parry for juggling this special session with the 'Pole to Pole' session.

My initial ideas for the special theme centred around the Water Framework Directive and perspectives on fresh and marine monitoring, and I was hopeful for a few talks from the environment agencies and other non-government organisations. None, however, were forthcoming from either the Environment Agency or Scottish Environment Protection Agency, and I guess with hindsight a shame, since discussions following the opening talk by Brian Moss could have been livelier had there been Environment Agency attendees. The other talks that followed also brought with them many lively and interesting discussions, and I thought that at times it would have been good to let them continue. Even though my background is all fresh water, I hoped to strike a balance between fresh and marine issues. Hopefully this was achieved, since people I spoke with afterwards said how much they enjoyed the session and how stimulating it was.

Organising the special session was very rewarding, being able to point it in a personal direction and towards your pet subjects. I would therefore recommend that if you have a special interest, area or a very topical issue you should suggest it to Council who may select it as a next special theme, and you may even get to organise it yourself.

There may have been problems with the accommodation, but it is easy to forget that without the quick intervention of Barry Leadbeater and Maureen Callow, the BPS may not have met at all for their 2005 winter meeting, which would have spared my meagre efforts in pulling the special session together. Many thanks therefore to all the organisers in Birmingham for another excellent winter meeting, and I would like to thank all the speakers and everyone else who participated and made this such a great session. Perhaps I will organise another special session in the future…perhaps!

Jan Krokowski, SEPA [Scottish Environment Protection Agency], 5 Redwood Crescent, Peel Park, East Kilbride, Glasgow, G74 5PP.
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Biomonitoring and conservation at the 53rd Annual Meeting of the British Phycological Society

The 53rd annual meeting of the British Phycological Society, held at the University of Birmingham, was attended by over 80 delegates from the international phycological community. On the second day of the meeting Jan Krokowski chaired a special session on Biomonitoring and Conservation. The session proved both intellectually stimulating and varied in its scientific content, including talks on freshwater, estuarine and coastal systems. Brian Moss opened the session with a talk on 'the Water Framework Directive and the bureaucratic mangle'. The talk provided serious food for thought, highlighting the disparity between the perception of ecological quality by professional ecologists and by the executive board of the Environment Agency. The following talks were tremendously varied in their scientific content. Lydia King and Martyn Kelly made presentations on the use of benthic diatoms to make inferences regarding water quality, in both standing and running waters. These presentations stimulated some lively discussion on the applicability and efficacy of these techniques. In what followed we heard about everything from methodological developments in the use of biosensors to identify pollutants to the genetic structure of phytoplankton populations. The assessment of long term change became a recurrent theme during the session, with John Anderson presenting on the value of palaeoecological methods in assessing long-term change, Stephen Maberly showing the use of long-term lake data to detect the effects of long-term changes in climatic forcing, and my own presentation highlighting the utility of ecological modelling as a tool for investigating and understanding long-term changes in water quality. The session concluded by returning to the subject of the first presentation of the day: the Water Framework Directive. A number of the final talks dealt with how the Water Framework Directive relates to estuarine and coastal ecosystems, specifically focussing on seaweed communities and macroalgal blooms.

Aquatic ecosystems are an essential human resource but the demands placed upon them can compromise their ecological status and conservation value as well as human goods and services. Overall, the special session was a valuable forum for the presentation of different viewpoints on the tools and approaches that can be used to preserve these fragile environments.

Stephen Thackeray
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Fiona Young
BPS Manton Prize 2005

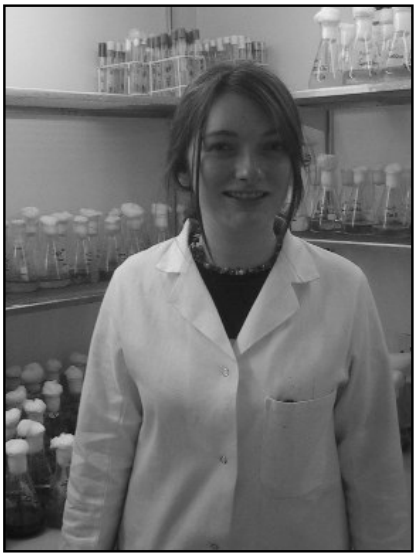
Born and brought up in Scotland, I first became interested in science after completing a woodland ecology project at school. Biology remained my favourite subject throughout my education and I decided to apply to the University of Glasgow to study microbiology. Although the course focused on medical microbiology and immunology, I was introduced to algae and protozoa as part of the marine microbiology component at the University Marine Biological Station Millport. Despite forming such a small part of my degree, I was sufficiently impressed as to undertake my Honours research project in Millport with Dr Fiona Hannah, looking at enumeration and culture methods for marine protozoa.

Having enjoyed this part of my degree, I decided to focus on marine and freshwater ecology and study towards a MSc. in the Biology of Water Resource Management at Napier University. During my Masters I gained theoretical and practical experience in a number of areas including water quality monitoring and toxicity assessment. For my research project, I chose to investigate the bacterial fish pathogen, ***Streptococcus iniae,*** at the FRS Marine Laboratory Aberdeen, with Dr Andrew Barnes. This project allowed me to use my experience in microbiological and immunological methods whilst still focusing on environmental issues. After my Masters, I decided (with the encouragement of my parents!) that it was about time I got a job, and worked for a year in a biotech company as a serology team member. Although I enjoyed the experience, I missed the daily challenges of conducting my own research project and applied to do my PhD at the University of Dundee with Professor Geoffrey Codd.

My research has focused on the immunological detection and investigation of microcystins. Microcystins are hepatotoxins produced by cyanobacteria, which can be harmful to both human and animal health. As part of my PhD, I have produced antibodies against two variants of microcystin, and have incorporated them in immunoassays for the detection of microcystins in the environment. A large part of my work so far has involved the immunological detection of microcystins within cyanobacterial cells, colonies and filaments - the more we know about their ultrastructural location, the better equipped we are to understand their production and natural function. My work has shown that most of the microcystin quota within a cell is localised in the thylakoid area. Potentially, this could indicate a role in light adaptation processes, although there is nothing to suggest that microcystins do not have an extracellular role.

On completion of my PhD, I would like to continue to work in scientific research, and would like to use the experience I have gained in both microbiological and environmental techniques.

I would like to thank the BPS and everyone involved in the Winter Meeting for an enjoyable few days in Birmingham, and for the funding which allowed me to attend.



Fiona Young (f.m.young@dundee.ac.uk)

Eva Nowack
BPS Manton Prize 2005

I was born in Muenster, Germany and was brought up in the outskirts of this city located in the centre of the flat, green Muensterland. My playground consisted of the fields and meadows surrounding our house, and it was here, since my early childhood, that I studied snails, grasshoppers and spiders.

After my time at school, where biology had always been one of my favourite subjects, I decided to study biology at the University of Cologne. It was a hard decision because there were so many other topics I would have liked to study as well, arts for instance or architecture. But I have never regretted my decision to study biology.

I made my first contact with algae at an excursion on limnic microalgae organised by Michael Melkonian in the Eifel, a locality to the south-west of Cologne. At that point in time algae, those tiny cells living in muddy puddles and slimy biofilms on the ground of cold lakes, seemed to me the most boring and irrelevant topic I could think of. I only decided to participate there because some friends of mine went, and because I preferred Michael Melkonian to the professor offering the alternative program. Well, it was in the progress of this excursion, that people convinced me to give up my negative attitude towards algae. Furthermore it was the stories of his life as researcher, and especially the description of the projects running in his biotechnology group, which Michael Melkonian offered to us in the evenings along with a glass of beer, that fascinated me. So I decided to ask Michael for a topic for a diploma thesis (equivalent to the English master thesis) the following year. Out of a few topics, that he offered me, I chose the development of a new culturing system for microalgae. I was fascinated by the idea, that I would have the possibility to prove my creativity and develop a new method, which would hopefully help to scale up algal culture collections significantly, a scientific challenge that had so far not been achieved successfully. At the BPS January meeting I presented the results of my thesis for the first time to a larger public. I was really grateful for the friendly atmosphere at the meeting and the interest that people showed for my work. In the end I would like to express my thanks to the BPS for the generous funding, which enabled me to attend, and to all those people engaged with the organisation of this pleasant event.

Eva Nowack, Botanisches Institut,
Universitat zu Koln, Germany

Stephanie Thompson – BPS Poster Prize 2005

From early childhood my birthday request was always to go to the seaside and when I was old enough I learnt to scuba dive in the local flooded quarries where helicopters were more common than fish! I went on to study Biology at the University of York where I was introduced to the joys of seaweed by a field course at Millport Marine Station. During my time at York, I took part in a conservation expedition to the Indonesian island of Buton, near Sulawesi to help with coral reef and rainforest projects and was able to dive in one of the most diverse areas for hard coral.

My plan had always been to specialise in Marine Biology so I then went on to study a Masters in Marine Environmental Protection at the University of Wales, Bangor. My research project was based in the Ria Formosa lagoon in Portugal where I investigated dissolved oxygen concentrations in relation to benthic habitats such as seagrass. I developed an interest in the fouling of marine organisms on submerged structures through conducting an Environmental Impact Assessment on the deep-sea disposal of oil rigs.

After applying for a research assistant position with the Callow group at the University of Birmingham who specialise in the adhesion of biofouling algae I was delighted to be offered a PhD. I am now in my second year of the project which is investigating the cell biology underlying the adhesion of algae and is a CASE project with the MBA in Plymouth. The main technique used has been confocal laser scanning microscopy to image fluorescent indicators in *Ulva* to study calcium and membrane dynamics. The results so far indicate that there is high membrane turnover at settlement and that calcium signalling may be involved. In Birmingham I am using fluorescent indicators to image cellular stress responses in diatoms in relation to hydrophobic and hydrophilic surfaces. My future aim is to patch clamp *Ulva* zoospores to investigate the presence of calcium channels in the plasma membrane. I would like to thank the BPS for this award and for organising such an interesting meeting; I enjoyed discussing my work with fellow phycologists.

Stephanie Thompson
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The 53rd Annual Meeting of the BPS, Birmingham

Abstracts

Oral Presentations

WEDNESDAY 5th JANUARY: POLE TO POLE PHYCOLOGY

IS GLOBAL CLIMATE CHANGE DRIVING CHANGES IN ANTARCTIC MARINE PHYTOPLANKTON COMMUNITY COMPOSITION?

Harvey J. Marchant

Australian Antarctic Division, Department of the Environment and Heritage.

Analysis of continuous plankton recorder (CPR) surveys, spanning nearly 50 years, provide strong evidence for changes in phytoplankton abundance and community composition in the north east Atlantic Ocean. A dramatic reduction in the extent of Antarctic sea-ice in the late 20th century has been reported as has a marked reduction in the abundance of krill and an increase in salp numbers. CPR surveys in the Southern Ocean have only been conducted regularly since 1997, a far too short a time to assess changes in the planktonic community. However several detailed studies of the phytoplankton (especially diatom) community structure and their abundance were undertaken in the 20th century. We are presently comparing these data with results from recent cruises. The distributions of cyanobacteria, Parmales and coccolithophorids are strongly temperature dependent although the latter is apparently also influenced by alkalinity. Despite problems related to interannual variability, preliminary evidence suggests changes in Antarctic marine phytoplankton communities on a decadal time scale.

WHAT CAN RECENT CHANGES IN DIATOMS FROM ARCTIC LAKES TELL US ABOUT GLOBAL CLIMATE CHANGE?

Viv J. Jones and Nadia Solovieva

Environmental Change Research Centre, University College London, 26 Bedford Way, London, WC1H 0AP, UK.

General circulation models predict that warming in the Arctic will occur more rapidly than elsewhere, and there is growing evidence from palaeoclimatic studies that unprecedented climate warming has already taken place in many parts of the Arctic during the twentieth century. Lake sediment records in these regions are especially useful in identifying the extent of warming. Here we examine results from the circumarctic and assess diatom-based evidence for climate change. We have obtained surface sediment and short sediment cores from over 50 lakes in the Pechora and Usa basins (Russia) and Svalbard which have been dated using a mixture of ^{210}Pb, Pu and SCP profiles. Diatom and chironomid analyses have been used to determine the extent and direction of recent change, and SCP profiles have been used to assess the timing and extent of pollution. Due principally to the high buffering capacity of the surface waters, there is no diatom evidence (through pH inference) for lake acidification. However, at many sites major changes in diatom assemblages have been found; at some sites changes occur earlier than the onset of industrial activity and the role of climate change is evaluated, however at other sites changes may be due to alkalisation effects of coal and cement dusts. Published results from other sites in the Arctic are examined to illustrate the extent and spatial patterns of warming in relation to climate models and instrumental records.

RELATIVE IMPORTANCE OF CLIMATE AND LAKE ONTOGENY IN REGULATING LAKE PRIMARY PRODUCTION AND COMMUNITY STRUCTURE IN TWO ARCTIC LAKES

Suzanne McGowan[1], Rene K. Juhler[2] and N. John Anderson[3]

[1]*School of Geography, University of Nottingham,* [2]*Geological Survey of Denmark and Greenland,* [3]*School of Geography, University of Loughborough.*

In the closed-basin lakes around Søndre Strømfjord (West Greenland), lake-water salinity is primarily determined by the balance between evaporation (E) and precipitation (P). Diatom-based sediment core reconstructions from these lakes show that there have been centennial- and millennial-scale shifts in lake-water conductivity (and therefore P:E balance), with an overall trend of increasing conductivity throughout the Holocene. We used Holocene sediment records from two such climate-sensitive lakes to assess the relative importance of climate (diatom-inferred conductivity), lake development (ontogeny) and lake-specific processes in determining primary producer abundance and community structure (inferred from sedimentary pigments). Variance partitioning analyses showed that the effects of lake ontogeny were most evident in the first ~1000 years of lake development, when filamentous cyanophytes were abundant. Conductivity was positively correlated with algal abundance on millennial timescales, likely caused by the increased colonisation of benthic habitats when lake levels lowered. However, lake biota responded differently to conductivity shifts as lakes aged, indicating a substantial interactive effect of lake ontogeny and conductivity. As lakes aged, periods of meromixis became more frequent (after ~1000 years BP), signifying a state change in biotic response to conductivity fluctuations once a threshold conductivity level had been exceeded. After this time, communities oscillated on centennial timescales between one composed of siliceous algae, cryptophytes and purple sulphur bacteria (indicating meromixis), and another composed of filamentous cyanophytes. Synchrony analyses suggested that photoautotrophs responded similarly among lakes ($r<0.75$) on longer timescales (10^3 years). However, lakes became asynchronous during periods of intense climate forcing and on shorter (10^2 year) timescales, when individualistic lake responses became more apparent. Together, these analyses suggest that although biotic response to climate may be predictable over millennia, predictions on timescales relevant to humans may be undermined by abrupt changes in ecosystem state and individualistic lake response during periods of intense climate forcing.

ENVIRONMENTAL FACTORS CORRELATED WITH CHRYSOPHYTE CYST ASSEMBLAGES IN LOW ARCTIC LAKES SOUTH-WEST GREENLAND, AND THEIR POTENTIAL FOR CLIMATE RECONSTRUCTION

Sergi Pla Rabes[1] and **N. John Anderson**[2]

[1]*Bioscience Complex, PEARL Queens University,* [2]*Department of Geography, Loughborough University.*

We analysed the relationship between chrysophyte cyst assemblages in surface sediment samples and limnological and geographical variables for 70 lakes located along Søndre Strømfjord in Southwest Greenland. Over 247 stomatocysts were identified, of these 153 were sufficiently abundant for use in statistical analyses. 8 stomatocysts were considered to be

new and are described formally. Canonical correspondence analysis (CCA) indicted that conductivity was the dominant variable explaining cyst distribution, reflecting the large conductivity gradient in lake water chemistry in this area. High conductivity lakes had distinctive cyst assemblages with lower diversity than low alkalinity lakes, where assemblages were similar to alpine, soft-water, lakes elsewhere. The high conductivity lakes, however, had cysts similar to other saline lakes elsewhere in the arctic. Additionally, pH, potassium, calcium, maximum depth, longitude, sulphate area and altitude explained significant amounts of variability of cyst assemblages. Longitude was the only geographical variable that explained cyst variability independently of other variables (i.e. had a unique effect), which suggests that the climatic gradient from the coast to the head of the fjord has an effect in terms of controlling cyst assemblages. Finally, as observed previously elsewhere, unornamented cysts usually showed a null response to environmental variables, which maybe indicate that they represent more than one species of chrysophyte or their development was incomplete. These results point to the potential of chrysophyte cysts for reconstructing palaeoenvironmental conditions in West Greenland.

ABUNDANCE AND COMPOSITION OF PHYTOPLANKTON COMMUNITIES IN 300+ ARCTIC, SUBARCTIC AND COLD TEMPERATE LAKES

Kirsten Christoffersen[1], Bjørn Faafeng[2], Paal Brettum[2], Torben Lauridsen[3], Frank Landkildehus[3], Erik Jeppesen[3], Jens Peder Jensen[3] and Susanne Amsinck[3]

[1]*Freshwater Biological Laboratory, University of Copenhagen, Denmark,* [2]*Norwegian Institute of Water Research, Norway,* [3]*National Environmental Research Institute, Denmark.*

The phytoplankton communities of more than 300 Arctic, Subarctic and cold temperate lakes from the Faroe Islands, the Norwegian west coast, Svalbard as well as East, West and North Greenland have been studied qualitatively and quantitatively to evaluate the impact of climatic differences. The study has been part of the Nordic NORLAKE project.

With a few exceptions the lakes are oligotrophic with no or minor glacial input and both deep and shallow lakes are included. Each lake was sampled once at a mid-lake station in July or August. Water from the phothic zone was integrated in the presence of a thermocline, the entire water column being integrated if the lake was not stratified. The data presented include the phytoplankton community structure, expressed as the biovolume of main groups identified from detailed taxonomic analyses. Multivariate analyses were used to examine the distribution of the main phytoplankton groups relative to a number of variables including total chlorophyll and fish as well as several physico-chemical variables such as TP, TN, temperature and conductivity.

Despite major variations within each of the studied regions it is apparent that the phytoplankton biovolume generally decreases in a western and northern direction (West Greenland being an exception, however). The main reasons seem to be decreasing nutrient availability, which is best described by the TN-concentration.

The phytoplankton community biomasses are typically dominated by Chlorophyceae, Dinophyceae and Cryptophyceae; Cyanophyceae being significant in Norwegian lakes only, Chrysophyceae most frequently occurring in Greenland lakes. Further analyses of the data set reveal that there are interactions between phytoplankton community structure and the biological (zooplankton and fish) as well as physical-chemical conditions.

ARE THERE LATITUDINAL TRENDS IN INORGANIC CARBON ACQUISITION MECHANISMS IN MARINE ALGAE?

John A. Raven[1] and John Beardall[2]

[1]*Plant Research Unit, University of Dundee at Scottish Crop Research Institute, UK,* [2]*School of Biological Sciences, Monash University, Australia.*

Comparison of the nutrient element composition of surface seawater with the elemental composition of algae, e.g. the extended Redfield Ratio ($C_{106}N_{16}P_1Fe_{0.01}$), suggests that inorganic C should not generally be a constraint on marine photosynthetic primary productivity. However, most of the marine algae investigated have C concentrating mechanisms (CCMs), presumably related to the low diffusion coefficient of CO_2 in water as compared to air. The greater solubility of CO_2 in colder water, and the greater temperature dependence of the enzymic reactions involved in CO_2assimilation than of diffusion of CO_2, suggest that CCMs may have less selective significance in polar waters. However, studies on the characteristics of inorganic C acquisition of Antarctic marine micro- and macroalgae suggest that CCMs may be as common there as in lower latitudes, although the more negative values of $\delta^{13}C$ of marine phytoplankton at high southern latitudes might indicate a smaller dependence on CCMs in the Southern Ocean. Analyses of the resource constraints on primary productivity at different latitudes, and on the temperature dependence of the processes involved in inorganic C transport and assimilation, are used to examine the possible evolutionary utility of CCMs as a function of latitude, with mixed results. There is no clear evidence of latitudinal trends in the prevalence of CCMs in the ocean.

PACIFIC-ATLANTIC CONNECTIONS: A REEVALUATION OF THE TRANS-ARCTIC EXCHANGE

Jeanine L. Olsen and Wytze T. Stam

Department of Marine Biology, Centre for Ecological and Evolutionary Studies, University of Groningen, Biological Centre, 9750 AA Haren, The Netherlands.

The North Atlantic marine flora has traditionally been considered to have originated in the Atlantic as opposed to the Pacific (Dunton 1992) as is the case for animals. Lower intrusion rates have been attributed to poor dispersal capacities, unfavourable current regimes, lack of appropriate substrata and ice scouring. The greater richness of the Pacific has also been used as evidence for restricted interchange. Lindstrom (2001) reviewed the Arctic marine flora and concluded that this was probably not the case.

In this talk I will review what has been learned from phylogeographic studies in marine seaweeds and seagrasses, how hypotheses can be more soundly tested using newer methods and pose a number of new hypotheses about macro-scale dispersal between ocean basins and over the equator.

ENVIRONMENTAL CONTROLS ON DIATOM DISTRIBUTION IN LOW ARCTIC LAKES OF SOUTH-WEST GREENLAND

Bianca Perren[1] and **N. John Anderson**[2]

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Diatoms from the surface sediments of 62 lakes spanning the ice-free margin of West Greenland in the vicinity of Kangerlussuaq have been examined to quantitatively explore the Holocene development of the region in response to catchment development and climatic forcing.

TWINSPAN delineates 2 major clusters of lakes based on an ~800μS threshold between evaporatively enriched (high conductivity) and dilute (low conductivity) lakes. In this study, we are interested in the development and recent changes in the

more common group of dilute oligotrophic lakes (n=47) in the region. Canonical correspondence analysis (CCA) shows that most variables (12 out of 17) are statistically significant in their explanation of diatom variance. Most water chemistry variables are highly correlated, but of these variables, pH explains the greatest proportion of the diatom variance (axis 1). Lake depth (linked to the abundance of *Cyclotella* species) is most strongly correlated to the second axis. Our analyses suggest that the potential for the development of paleoecologically relevant models from freshwater lakes in West Greenland is strong and provides a nice complement to other paleoecological studies of evaporatively enriched lakes in the region (Ryves, et al, 2002; McGowan et al, 2003; Anderson and Leng, 2003). These data have thus been further used in the development of a diatom-based pH inference model (WA-PLS) for downcore lake stratigraphies in the region and in the exploration of recent trends and trajectories in lakes across the ice-free margin of West Greenland.

COMMUNITY COMPOSITION AND SEASONAL SUCCESSION OF DINOFLAGELLATES IN ANTARCTIC LAKES

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The dinoflagellate community composition and succession was investigated in three saline Antarctic lakes. These lakes are believed to have formed by isotonic rebound about 8,000 years ago, causing pockets of seawater being trapped in hollows, and thus forming lakes. The lakes investigated represent a gradient from brackish (4 psu) to saline (18 psu) water and ice-covered year round. We hypothesized that the species represented would be largely of marine origin. Our results suggest two major survival or successional strategies, cyst formation and disappearance from the pelagic zone during winter, or mixotrophic nutrition to allow survival in the water all year round. The species are similar to other marine dinoflagellate species rather than freshwater species. Presumably only the most physiologically robust species have adapted to living in oligotrophic lake environments, as species diversity is much lower than in the sea. The species were similar but not identical in the three lakes, suggesting local adaptations. These differences could be either phenotypic or genotypic differences due to rapid speciation. Here we present out preliminary result along with on-going investigations.

THURSDAY 6th JANUARY: CONSERVATION AND BIOMONITORING

THE WATER FRAMEWORK DIRECTIVE AND THE BUREAUCRATIC MANGLE

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The Water Framework Directive requires that aquatic habitats in Europe should be restored to 'good' ecological quality by 2015. 'Good' is defined as slightly different from conditions negligibly touched by human activities. The definition of 'slightly' is still being deconstructed but a greater problem lies in the disparity between what professional ecologists perceive as ecological quality and the more restricted view of the engineer/chemist establishment of the competent authority in England & Wales, the Environment Agency. This has enormous implications for the nature of monitoring, the conservation of freshwater habitats, the future of water management in the UK and the ultimate value of the Directive.

CAN DIATOMS BE USED AS A SURROGATE FOR PHYTOBENTHOS?

Lydia King[1], Martyn Kelly[2], Roger I. Jones[3] and Phil A. Barker[1]

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The Water Framework Directive requires the use of several indicators to assess ecological status, one of which is the phytobenthos. In lakes extant phytobenthos has not been studied extensively and the value of this community for water quality assessment is not known. However, many studies have been conducted on diatoms, often sampled as surface sediment during palaeolimnological investigations and their ecological preferences are comparatively well established. Here we re-evaluate a epilithon data-set collected in 1997/1998 in the English Lake District to see whether the inclusion of algae other than diatoms can provide better information than analysis of the diatom community alone by comparing the performance of transfer functions for total phosphorus, conductivity, calcium ion concentration and dissolved inorganic carbon concentration. The results indicate that, at the taxonomic level used here, transfer functions based on diatoms alone perform as well as those based on the whole phytobenthos community and therefore suggest that it might be possible to use diatom communities as proxys of the whole phytobenthos community. The limitation of this data set and further work required will be discussed. This work is part of the DALES programme funded by the Environment Agency.

USING DIATOMS TO ASSESS 'REFERENCE CONDITIONS' IN UK STREAMS AND RIVERS

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The Water Framework Directive (WFD) requires 'ecological status' to be assessed at all waterbodies as a ratio between the 'observed' condition of the waterbody and the condition that would be expected in the absence of significant human pressure. Establishing the natural state of waterbodies in those parts of the UK with a high population density is not an exact science and has nuances that extend into the realms of aesthetics as well as the politics of water management. The DARES project, funded by the Environment Agency and SNIFFER, is developing a diatom-based tool for assessing ecological status and are presently examining the criteria by which such reference sites might be identified. A preliminary desk-based screening exercise selected sites with good biological quality based on benthic invertebrates plus low nutrient concentrations. Benthic diatom samples from these sites are presently being analysed and a second screening stage will take place once these analyses are complete, based on the diatom assemblages themselves. The talk will focus on establishing objective criteria by which non-impacted sites may be recognised, and then will describe methods for assessing deviations from this reference state. These will include Bayesian Belief Networks, but ordination methods may also be useful as a first visualisation step.

SELECTIVE REAL-TIME TOXICITY MONITORING BY AN ARRAY CHIP BIOSENSOR EMPLOYING DIVERSE MICROALGAE

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In recent years, biosensors have been proposed as an alternative technology in the analysis of environmental perturbations.

By means of a new cell immobilisation technique a microalgal biosensor system for long-term operation was constructed. The signal of the biosensor was measured by a PAM chlorophyll fluorometer in terms of photosynthetic fluorescence induction. The simultaneous use of different algal strains was made possible through development of an array plate biochip (algal sensor chip: ASC) in conjunction with a fluorescence imaging technique.

To characterise the biosensor system, gaseous or water soluble toxicants were used in relevant concentrations: volatile organic compounds (VOC) or photosynthesis herbicides were detected within minutes by a concentration-dependent biosensor signal derived from different algal strains. Repeated exposure experiments revealed a reversible and reproducible signal of the biosensor during 30 days of operation.

Different sensitivities of microalgae to toxicants were employed to achieve selectivity of the biosensor. Methanol and formaldehyde were identified by a compound-specific response rate of two different *Klebsormidium* strains used. By the same method, a complex herbicide-specific response pattern was generated for each of five different herbicides (atrazine, simazine, diuron, isoproturon, paraquat) utilising the biosensor signals of nine microalgal strains. By means of response patterns the specific detection of herbicides was enabled.

Our study suggests that long-term and real-time identification of various environmental pollutants can be achieved using the algal sensor chip developed here. Further improvements of the system are both necessary and possible.

ANTHROPOGENIC CHANGES IN ALGAL COMMUNITIES: PALAEOECOLOGICAL PERSPECTIVES

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Questions about the role of anthropogenic activity in altering aquatic systems are difficult to answer for most systems because of the limited timescale of monitoring programmes. It is difficult to state objectively that sustained cultural disturbance is reducing biodiversity on the basis of most contemporary sampling, because we do not what conditions were prior to monitoring. In many cases, monitoring often started only with the identification of a problem, i.e. the situation prior to disturbance is unknown. Likewise, what justification is there for preserving a supposedly "natural" community, when "natural" has not been defined and the ecosystem may have high temporal variance, which monitoring cannot encompass. For algal communities in lakes, however, there is the possibility of using the sediment record to define rates of community turnover, species losses and immigration in a reasonably objective fashion. In this short review, I will illustrate the role of lake sediment records in extending the timescale of ecological change for a range of siliceous and non-siliceous algae, both in terms of community structure and species diversity. However, the sediment record is not perfect and some of its limitations (non-preservation, biased records, under representation of littoral communities) will be high-lighted. There is, however, a clear role for using palaeoecological methods in conjunction with contemporary monitoring and surveys to provide a more complete statement about the effect of cultural impacts on biodiversity. This overlap will also foster a better appreciation of the inherent temporal variability of aquatic ecosystems.

EFFECTS OF CLIMATE CHANGE ON CURRENT AND FUTURE BIOMONITORING AND CONSERVATION

Stephen C. Maberly and J. Alex Elliott

Centre for Ecology & Hydrology, Lancaster Environment Centre

Climate change is happening now and lakes can be very sensitive to its effects. Climate change can directly affect variables such as water temperature, have a more indirect effect on lake thermal-structure, and concentrations of oxygen and nutrients and potentially affect the lake through changed land-use in the catchment driven by socio-economic factors. This talk will explore some of the known current effects of weather and climate on lakes by analysing long-term records from the English Lake District. Evidence for the current effects of climate change on algal populations and lake characteristics, including higher trophic levels, will be presented. Examples will also be given of a second approach which uses lake models such as PROTECH to convert forecasts of future climates into forecasts of algal and lake performance. The sensitivity of lakes to climate change from a biomonitoring and conservation perspective will be assessed.

PROCESS-BASED MODELLING AS A TOOL FOR UNDERSTANDING WATER QUALITY ISSUES

Stephen J. Thackeray and J. Alex Elliott

Centre for Ecology and Hydrology, Lancaster Environment Centre

Phytoplankton can have direct and profound effects on water quality, therefore an understanding of the fundamental processes driving algal growth is of prime importance. PROTECH (Phytoplankton RespOnses To Environmental CHange) is a process-based model which has been created to precisely tackle these issues. In this presentation, we will describe some of the key ways in which the model has been applied to natural and artificial freshwater ecosystems. These topics will include the effect of artificial mixing and nutrient loading on algal populations and the effect of climatic change on algal biomass, with reference to meeting water quality targets.

THE GENETIC STRUCTURE OF PHYTOPLANKTON POPULATIONS

Paul Hayes

School of Biological Sciences, University of Bristol

The mass development of phytoplankton appears to occur through asexual reproduction, and yet the recent application of molecular methodologies reveals extensive genetic diversity within such populations. In this presentation I will review the current state of our knowledge regarding the genetic structure of phytoplankton populations and speculate about the nature of the selective forces that shape them. The presentation will draw on examples from both marine and freshwater environments and will encompass both eukaryotic and prokaryotic phytoplanktonic species. This work is supported by NERC.

MARINE AND FRESHWATER ALGAE - A CONSERVATION PERSPECTIVE

Catherine Duigan, Gabrielle Wyn, Paul Brazier and Bill Sanderson

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On a global scale algal biodiversity is important in the context of its functional, morphological and taxonomic diversity. Algae are the ecological foundation stones of many aquatic ecosystems. In the UK marine and freshwater algae are increasingly being recognised as key components of the national conservation resource. Particular species and communities are acknowledged as characteristic components of a number of marine biotopes, and permanent and seasonal freshwater habitats. The inclusion of algae as features of designated conservation sites brings a long-term monitoring and reporting requirement. Monitoring methods are currently being developed to address this need. Where algal taxonomic inventories are sufficiently developed it is possible to incorporate rare species into Red Data Books and Species Action Plans.

IMPORTANT PLANT AREAS FOR MARINE AND FRESHWATER ALGAE IN THE UK

Juliet Brodie[1], Dave M. **John**[1], Ian Tittley[1], Mary J. Holmes[2] and David B. Williamson[3]

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The Important Plant Areas (IPAs) programme is an initiative for assessing the nature conservation importance of plant sites in Europe. To designate important sites for marine and freshwater algae in the UK, it has been necessary to follow IPA criteria: A: the site holds significant populations of one or more species that are of global or European conservation concern, B: the site has an exceptionally rich flora in a European context in relation to its biogeographic zone; C: the site is an outstanding example of a habitat type of global or European plant conservation and botanical importance. Other criteria have also been used including historical baseline information and presence of nationally rare species or endemics. Members of the British Phycological Society suggested over 200 important marine and freshwater algal sites for IPA consideration. Some freshwater and marine sites are already 'priority threatened habitats' accountable under the EU Habitats Directive (e.g., chalk cliffs, maerl beds, blanket bog), and many are recognised Sites or Areas of Special Scientific Interest. Biodiversity action plans (BAPs) exist for a few marine algae and freshwater algae. Lists exist of supposedly rare/threatened marine algae, but there is currently no UK Red Data List for marine species. To ascertain sites of algal importance and species that might be considered rare, a consensus map based on herbarium specimens at the Natural History Museum (BM) was used in conjunction with Hardy and Guiry's (2003) *Atlas of the Seaweeds of Britain and Ireland*. For the freshwater algae there was sufficient information on desmids to prepare a provisional Red List. By comparing our list with European Red List desmids, it was possible to place important desmid areas in the UK into an international context. Improved data resources now allow a first assessment of the conservation status of UK algae. Using these resources together with information from conservation agencies and BPS members, first provisional identification of algal IPAs can be made.

SEAWEEDS AND THE EUROPEAN WATER FRAMEWORK DIRECTIVE

Martin Wilkinson[1], Emma Wells[2], Paul Wood[1], Clare Scanlan[3], Jo Foden[4] and Mike Best[5]

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The European Water Framework Directive (WFD) makes two advances for estuarine and coastal water monitoring. Firstly, it embraces Ecological Quality Standards which involve ecological measurements rather than just physical and chemical assessment of pollution. Secondly, it extends the range of organisms assessed beyond the benthic macrofauna traditionally used in the water industry to include seaweeds, among others. However, the ways in which the WFD specifies seaweeds should be used include some that are not appropriate, for example the presence of all sensitive species. This talk overviews the approaches being developed in the United Kingdom to use seaweeds in WFD monitoring and compares them with what the WFD proposes. These relate both to the intertidal and sublittoral on the open coast and to transitional waters (estuaries). In each case the approaches involve some aspect of community composition and the absence of nuisance macroalgal blooms. These are compared with approaches being developed in other European countries. In all cases the measures proposed are assessing ecosystem health in terms of community composition rather than process measurements. Some have criticised this, but it is suggested that this is an improvement on the previous narrow range of ecological monitoring.

OPPORTUNISTIC MACROALGAL BLOOMS AND THE WATER FRAMEWORK DIRECTIVE

Jo Foden[1], Clare Scanlan[2], Emma Wells[3], Paul Wood[4], Martin Wilkinson[4] and Michael Best[5]

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The EU Water Framework Directive (WFD) requires water bodies to be classified by their chemical and ecological status. Macroalgae are one of the biological quality elements to be used in defining the ecological status of a transitional or coastal water body. A key task in developing the classification system for surface water bodies is to identify appropriate reference conditions, i.e. those conditions found at pristine sites, undisturbed by anthropogenic activities. Calculating the extent of a quality element's deviation from reference conditions provides an ecological quality ratio used to classify water bodies as high, good, moderate, poor or bad.

The WFD suggests that the features of macroalgal communities to be be used for assessment of ecological quality should include taxon composition and abundance and presence of disturbance sensitive taxa. For blooms of opportunistic macroalgae (e.g. *Enteromorpha* spp., *Ulva* spp.) the proposal is to use abundance (estimated by a combination of spatial coverage and biomass) and adverse environmental effects, as indicators of ecological quality. This paper considers the criteria being developed to establish reference conditions and the degree of deviation from these conditions that defines each quality class. The crucial questions for the WFD are: to what extent opportunistic macroalgal blooms are naturally existent in pristine reference conditions and at what levels they have actual adverse ecological impact.

THURSDAY 6th JANUARY: PRESIDENTIAL LECTURE

A LIFETIME WITH FLAGELLATES: LIVING BY THE RULES

Barry Leadbeater

School of Biosciences, University of Birmingham.

The 'Flagellates' are an evolutionarily diverse group of protists whose cells are distinguished by the possession of one or more flagella. In spite of their heterogeneity, flagellates from different evolutionary lineages share many characters in common.

This is especially true of the cell coverings of free-living flagellates.

Cell coverings comprising individual units associated together to form a continuum are found in many chrysophyte, haptophyte and prasinophyte algae as well as in choanoflagellates, some aquatic fungi and some amoebae. However, in spite of much published work there is still uncertainty about how these coverings are constructed and what their function (which are probably various) may be. One group that has demonstrated the intricacy with which a cell covering is constructed and has revealed a possible function is the Choanoflagellida (choanoflagellates). Detailed analysis of a number of choanoflagellate species with loricae of different morphology has permitted a 'list of rules' (criteria) to be devised which when applied with rigour to all species has allowed an overall understanding of the method of construction and possible evolution to be deduced. It is also possible that conclusions drawn from the choanoflagelates will be applicable to understanding the mechanisms operating in other groups of protists.

FRIDAY 7th JANUARY: THE MANTON PRIZE

ESTABLISHING OPTIMUM CONDITIONS FOR THE CULTIVATION OF *PALMERIA PALMATA* IN THE SEA

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Cultivation of the edible red alga *Palmaria palmata* is being carried out due to the high demand for the product locally, in addition to an emerging national and international market. Experiments to optimise conditions for irradiance and nutrients provided to *Palmaria* tetraspores showed that 25 µmol m^{-2} sec^{-1} and full strength F/2 medium provided an optimum growth rate of 0.16 mm mm^{-1} day^{-1}. Sporeling survival following transfer to the sea after only 2 weeks of lab culture was high after 1 month, but plant length was lower than plants put out after 4, 6 and 8 weeks (7.2 mm compared with 19.5 mm). After 3 months, plants in all treatments had reached a similar length of approximately 52 mm. The growth rates of thalli after 9 months on labelled *Laminaria* stipes were not significantly different compared with those cultivated on long lines. Finally, AFLP of cultivated thalli with high growth rates has been compared with that of slower growing thalli to establish whether there are molecular differences which might be used to identify fast-growing strains.

THE IMPACT OF SEAWATER SALINITY ON PHOTOSYNTHESIS BY THE MARINE ALGA *FUCUS VESICULOSUS*

Charlotta A. Nygård[1], Matthew J. Dring[2] and Nils G.A. Ekelund[1]

[1]*Mid Sweden University, Sundsvall,* [2]*Queens University, Belfast*

Fucus vesiculosus is one of the few marine algae that penetrates into the Baltic Sea. Possibly because of the low salinity, the plants are smaller than in the Atlantic, and also lack the characteristic bladders of Atlantic plants. In addition to these morphological differences, the photosynthesis is affected by the low salinity. To examine these differences, the photosynthesis of plants from regions of different salinity was measured under different conditions of salinity, nutrient concentrations and UV-radiation. *F. vesiculosus* exhibited lower photosynthetic rates in the Baltic Sea than in more marine waters, such as the Atlantic. The photosynthesis of Baltic *F. vesiculosus* increased following transfer to a higher salinity, but Atlantic *F. vesiculosus* died shortly after the reciprocal transfer into Baltic water. At a high nutrient concentration, the tolerance to a low salinity increased for the Atlantic plants. Atlantic *F. vesiculosus* displayed their maximum photosynthesis and growth at 20-35 psu, but the Baltic plants reached a maximum at 10 psu (no further increases in a higher salinity). The Baltic plants showed a lower tolerance to high PAR as well as UV-radiation. This may be related to their depth distribution, since *F. vesiculosus* is subtidal inside the Baltic but intertidal outside. It seems that Baltic *F. vesiculosus* experience chronic photoinhibition whereas Atlantic plants experience dynamic photoinhibition.

VARIABILITY IN *FUCUS SPIRALIS* L.

Jane Pottas[1], Graham Scott[2] and Sue Hull[1]

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Previous investigations of phenotypic variation in *F. spiralis* have identified and described differences in morphology and chemical composition between two forms of this species – *F. nanus* and *F. spiralis*. Here I describe the results of a more extensive study to explore the persistence of their distinctive morphologies and an analysis of enzyme phenotypes determined through cellulose acetate based comparison of allozyme production.

TOWARDS A REVISION OF THE TAXONOMY OF THE GREEN ALGAL GENUS *ACROCHAETE* (CHLOROPHYTA)

Barbara Rinkel[1], Juliet Brodie[1] and Paul Hayes[2]

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A revision of the taxonomy of microscopic green algal endophytes currently assigned to the genus *Acrochaete* is being undertaken using a combination of morphological and molecular techniques. Green algal endophytes have been isolated into culture from around the UK and from a range of algal hosts, including the red algae *Chondrus crispus, Mastocarpus stellatus, Dumontia contorta, Osmundea pinnatifida, Osmundea hybrida* and *Osmundea osmunda*, and the brown algae *Chorda filum* and *Fucus serratus*. Preliminary results based on sequence data of the ribosomal DNA ITS2 region confirm recent findings that the green endophytic algae are more diverse than traditionally thought at the intra- and inter-specific level and that some morphologically similar species belong to different genera. Furthermore, some species are host-generalists, whereas others appear to be host-specialists. The relationship of these endophytic green algae to the type of *Acrochaete*, *A. repens*, is being explored, and to provide further taxonomic resolution, analysis of sequence data of regions of the plastid genome is being undertaken.

COMMUNITY COMPOSITION AND DYNAMICS OF MACROALGAE IN BEDROCK STREAMS OF THE SOUTHERN HIGHLANDS, NSW, AUSTRALIA

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Macroalgae are an important part of freshwater systems, but in Australia they are all too often considered only as habitat or food for macroinvertebrates! Their ecology is particularly poorly studied – we really have no idea why they grow where they do. Their distribution at first appears to be whimsical, with seemingly similar sites having vastly different floras, and with populations changing dramatically from season to season in some cases. Surveys of bedrock streams in the Southern Highlands of NSW have indicated that substrate heterogeneity and light levels may play an extremely important role in structuring algal

communities. Large differences in community composition are seen between sites in the same stream separated by only a few hundred meters. Species numbers can vary from 2 in one site to 10 in a site 500 metres upstream, and distribution across a site can also vary considerably. Detailed measurements of substrate texture and canopy cover, along with field experiments, have provided an indication of the relative and combined effects of substrate heterogeneity and light on community composition. This work has been supported by as Australian Research Council grant.

DIATOM MOTILITY IN RESPONSE TO LIGHT

Deirdre McLachlan[1,2], Richard Geider[1], Colin Brownlee[2], Alison Taylor[2] and Graham Underwood[1]

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Epipelic, biraphid diatoms move, en masse, onto the surface of the mud during daytime tidal emersion, eventually descending back into the mud in advance of dusk or tidal immersion. Environmental entrainment is important in the maintenance of these rhythms, as they only persist for a few days in controlled laboratory conditions. There are a number of stimuli that could be utilised by diatoms, with light being one of the most obvious candidates. The current work has started to separate the various types of photomovement, in order to determine their contribution to the overall behavioural response. *Cylindrotheca closterium* and *Navicula perminuta* were used as test organisms in experiments to determine responses to light intensity (phobic and kinetic responses) and light direction (tactic response).

ACUTE-TOXICITY EFFECTS OF THE DIATOM-DERIVED TOXIN, DECADIENAL, ON THE BRINE SHRIMP *ARTEMIA SALINA* IN THE PRESENCE OF SUB-LETHAL CONCENTRATIONS OF DISSOLVED COPPER

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Some marine diatoms and other microalgal species produce toxic oxylipins in response to cell damage that may occur during ingestion by herbivores such as copepods. These oxylipins, notably unsaturated aldehydes and oxo-acids, can reduce the reproductive success of aquatic invertebrates both by direct effects on gametes, embryos or larvae or alternatively via the parental diet. Effects have been reported on sperm motility and fertilisation success, cell division and embryonic and larval development and subsequent survival. There is considerable variation in the particular oxylipins produced, both between and within diatom species, with concomitant variations in toxicity. Diatoms possessing such chemical defence may be the dominant species in coastal algal blooms providing ample opportunity for grazers to be affected by the natural toxins. Sensitivity to diatom toxins may be further increased by the presence of a cocktail of anthropogenic pollutants within the coastal system.

This study reports on the combined effect of sublethal concentrations of dissolved copper upon the acute-toxicity of diatom aldehydes to larvae of the brine shrimp *Artemia salina*. The 48h LC_{50} value of decadienal of 26μM decreases by over a third to 16SymbolM in the presence of 1SymbolM of dissolved copper. There is, therefore, clear evidence of a highly synergistic effect of this common heavy metal pollutant on the acute-toxicity of a diatom-derived aldehyde. This work is funded by an NERC studentship to RLT.

UNICELLULAR ALGAE AND CYANOBACTERIA ASSOCIATED WITH EPIPHYTIC COATINGS ON ORNAMENTAL HOUSE PLANTS IN GREENHOUSES

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A serious phytopathological problem was observed on leaves of house and other ornamental plants in several commercial greenhouses in central and southern Greece, at least for the last five years. Plants of various species, including *Dizygotheca elegantissima*, *Ficus europa*, *F. lyrata*, *F. Benjamina*, *Schefflera actinophylla*, *Philodentrum burgundii*, *Gardenia jasmisnoides*, *Yucca gloriosa*, *Camellia japonica, Adiantum raddianum*, show on their leaf surface, mainly the upper, areas of various sizes covered with green epiphytic growth in the form of coating. The symptoms were more prevalent under conditions of indirect light and high relative humidity, especially under mist propagation. Since the initial microscopic observations of such coatings indicated the presence of unicellular algae, isolations were performed in Bold's Basal (BB) medium supplemented with vitamins. The petri dishes were placed under RT conditions (20-25 ^{o}C) and under indirect natural daily illumination to avoid phototoxicity. Those isolations gave: a) green colonies of a unicellular alga in their majority, with an initial identification as *Choricystis minor* (Chlorophyta), and darker green colonies which resulted in irregular dense bacterial clusters with an initial identification as *Aphanothece saxicola* (Chroococcales, Cyanobacteria), and b) green and white netlike flat growth of thin threads with the occurrence of small whitish sphaerical sporophores with cracked surface, on thin, colored stalks, full of dark brown spores (two isolations). The fungicide flusilazole (10 ppm) was successfully used in the BB medium to suppress fungal growth, indicating the presence of an ergosterol containing fungus which might be a partner of a lichen. In the absence of the fungus the green appearrance of the culture was greatly affected, and only small colonies of pink, cream or green color were obtained; the organisms are under identification. To our knowledge, this is the first report of an epiphytic alga and cyanobacterium causing plant damage.

IMMUNO-GOLD LOCALISATION OF MICROCYSTINS IN CYANOBACTERIAL CELLS, COLONIES AND FILAMENTS

Fiona M. Young, Sabine U. Gerbersdorf, Calum Thomson, James S. Metcalf and Geoffrey A. Codd

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Although detailed investigations have been made into the structure and toxicity of microcystins (potent hepatotoxins and tumour-promoters) of cyanobacteria, little is known about their ultrastructural location and possible function(s) in cyanobacterial cells. We have localised the microcystins in laboratory cultures of unicellular and filamentous cyanobacteria by immunogold labelling using antibodies raised against microcystin-LR. Cells were prepared for electron-microscopy (EM) using cryosectioning rather than more traditional preparative methods which involve ethanol dehydration. Ethanol, an effective solvent for the extraction of microcystins for chemical analysis, extracted these toxins from *Microcystis* PCC 7806 and a colony-forming laboratory strain of *Microcystis* (*Microcystis* EBRO) during ethanol-based dehydration for EM. Immuno-gold-localised microcystins were quantified in defined cell compartments of cryosectioned cells of *Microcystis* PCC 7806, *Microcystis* PCC 7820, *Microcystis* EBRO and a laboratory strain of *Planktothrix rubescens*. Pre-immune serum and a mutant of *Microcystis* PCC 7806 which does not produce microcystins, were used as controls. Varying densities of specific labelling were found in the

cytoplasm and all major inclusions of cyanobacterial cells, although specific labelling was preferentially associated with thylakoids and round the periphery of polyphosphate bodies. All cells within colonies of *Microcystis* and in filaments of *Planktothrix* were found to be specifically labelled for microcystins. This is the first demonstration of specific immuno-gold labelling of these toxins within *Microcystis* colonies and *Planktothrix* filaments. By gaining information on the localisation of microcystins within cells, colonies and filaments, we will be better able to understand the production, fates and functions of cyanobacterial toxins.

THE 96-WELL MEMBRANE-MICROTITER PLATE SYSTEM: A NOVEL APPROACH IN THE CULTIVATION OF MICROALGAE

Eva C.M. Nowack and Michael Melkonian

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Algae have a prominent position in the living world in terms of their ecological importance and genetic diversity. Algal culture collections aim to preserve this diversity and make it available to the scientific community and to industry. Although considerable progress has been made in recent years in the cryopreservation of algae, to maintain their strains, collections still mostly rely on the serial transfer of individual strains from suspension or agar cultures. This approach is both labor and cost intensive and severely limits the holdings of all major collections.

Here, we present a novel system for the growth and maintenance of microalgae which will hopefully overcome some of the current limitations. The system is based on a 96-well microtiter plate system in which a solute-permeable membrane constitutes the bottom of each well. Algal strains are immobilized on the membranes and are provided with culture medium through contact with wet layers of porous glass fiber located beneath the membranes. The configuration effectively separates culture medium from algal cells and allows the periodical simultaneous exchange of the culture medium from 96 strains in less than a minute without the need to transfer the algae. If necessary, algal strains can also be transferred using multi-channel pipettes. We show that a large variety of microalgal strains including delicate flagellates can be reliably grown together in the system over long (>100 days) periods of time without cross-contamination and under axenic conditions.

As any array system, the membrane-microtiter plate system is also amenable to high-throughput and massively parallel applications increasingly sought after in algal bio- and environmental technology.

DEVELOPMENT OF BLOOMS OF OPPORTUNISTIC GREEN ALGAE (oga) IN STRANGFORD LOUGH, NORTHERN IRELAND, AND ITS ASSESSMENT BY REMOTE SENSING

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Green tides dominated by green algal genera like *Ulva*, *Cladophora* and *Chaetomorpha* can form free floating mats in shallow waters and/or attached large mats on soft intertidal sediments. Field and laboratory studies at several sites in Strangford Lough during the summer and autumn of 2002 and the spring of 2004 show the biological and physiological characteristics of the rapidly growing blooms of attached green algae dominated by *Ulva* sp. (incl. forma *Enteromorpha* spp.). The highest OGA biomass in different sites ranged from 276 g dwt m^{-2} to 820.90 g dwt m^{-2}. The absorbance ratios 436:460 nm and 681:658 nm were correlated with physiological changes, and the reflectance ratio 690:540 nm permitted discrimination between OGA and *Zostera noltii* on sand flats. Ratios of reflectance at 935:690 nm appeared to be correlated with the amount of biomass present.

The results may permit the stage of bloom development and the balance between OGA and seagrasses to be determined by remote spectral techniques

FRIDAY 7th JANUARY: CONTRIBUTED PAPERS

EARLY WARNING OF CYANOBACTERIAL BLOOMS AND TOXINS: AIMS AND APROACHES

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Cyanobacterial blooms and their toxins are worldwide phenomena, as documented by proactive research, and reactive investigations after animal and human poisoning episodes. Guideline Values of both an advisory nature, and as legal instruments in some countries, have been derived from research into: (i) the toxicity and abundance of cyanobacterial blooms and toxins; (ii) actual and likely exposure levels; (iii) known adverse health outcomes. Derivation of these Guideline Values for the protection of drinking- and recreational water quality and health have also required the application of analytical methods of necessary sensitivity and specificity.

The range of applicable methods (e.g. fluorimetric, chromatographic, immuno- and molecular biological for the early detection, identification and quantification of potential and actual toxigenic cyanobacterial cells and of their toxins, is increasing. For example, minimum detection limits now permit the detection of genes for microcystin production, and the microcystins themselves, using single colonies of *Microcystis* or filaments of *Anabaena*. These procedures are candidates for incorporation into early warning systems to detect cyanobacterial blooms and toxins in waterbodies used as drinking water sources and recreation, and for the monitoring of water treatment processes.

Resources, necessary operating skills and operation times are compared for available methods. However, whilst the available methods can be carried out in central laboratories, few are so far suitable for lake-side or on-line use. For early warning systems to be useful, the detection methods for cyanobacterial cells, DNA or toxins need to supported by the following: (i) appropriate sampling methods, (ii) rapid transportation (if not to be performed on-site), (iii) rapid interpretation and reporting of results, and (iv) a decision-making system to identify actions based on the environmental data obtained. Experiences with some of these requirements are presented.

ANALYSIS OF MICROCYSTIN TOXINS IN SEDIMENTS AND OVERLYING WATER IN SCOTTISH AND THAI WATERBODIES

Rattapoom Prommana[1], Louise F. Morrison[2], Marianne Reilly[2], James S. Metcalf [2] and Geoffrey A. Codd[2]

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The analysis of cyanobacterial toxins in lakes and reservoirs has so far focused on the determination of these substances in the water column. Examples are presented of concentrations of microcystins in cyanobacterial scums, in filtered planktonic cyanobacteria in the water column and in the filtered water from locations in Scotland and northern Thailand. Sediments have been neglected as sites, or sinks, of cyanobacterial toxins, although the sedimentation (and over-wintering) of potentially toxigenic genera, e.g. *Microcystis* and *Anabaena*, has been well investigated. Sediment from Loch Rescobie, Scotland, collected in August 2004 during a toxic, *Microcystis*-dominated cyanobacterial bloom, contained: *Microcystis*, *Staurastrum*,

Pediastrum, *Trachelomonas* and diatom species. No microcystins were detected by HPLC (minimum detection limit, 80 nanograms per gram wet weight) after aqueous dilution, vigorous stirring, and concentration of the filtrate. However, sorption occurred after spiking wet Loch Rescobie sediment samples with purified microcystin-LR (%sorption after spiking: 100% at 1ug per ml, 35% at 2ug per ml and 40% at 3 ug per ml). The microcystin contents and sorption characteristics of Thai waterbody sediments of differing texture and organic matter, and progress on extraction methods to optimize microcystin recovery will be presented. We also discuss the possible biological significance and fates of cyanobacterial toxins in sediments.

EAT POISON TO BREED: HOW ALGAL TOXINS INCREASE THE REPRODUCTIVE POTENTIAL OF *DAPHNIA PULEX*

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Daphnids are the dominant zooplankters in freshwater lakes, and in turn represent key food items for fish. Herbivore secondary productivity in aquatic systems is highly dependent upon the quantity and quality of the available algal diet. A number of freshwater algae produce toxins, the most thoroughly documented toxins being the cyanotoxins. A new class of toxins has recently been described from marine and aquatic diatoms, synurophytes, chrysophytes, cryptophytes, dinoflagellates and prymnesiophytes. The toxins, polyunsaturated aldehydes (PUAs), are produced by algal cells during grazing and have been documented to severely reduce the reproductive success of marine and freshwater copepods. Exposure to PUAs results in reduced egg production, hatching success and larval fitness. In contrast to copepods, Daphnids responds quite differently. PUA exposure increases egg production and hatching success with little or no apparent detrimental effects on the offspring. We have found that larvae produced from mothers pre-exposed to PUAs are highly resistant to further toxin exposure, to the point whereby growth is higher in the presence of PUAs than without. This trend continues down through subsequent generations. We investigated whether biochemical detoxification pathways may be allowing the Daphnids to thrive in such toxic environments. The application of specific detoxification pathway chemical inhibitors indicates that both cytochrome P450 and glutathione-S-transferase enzymes are functional in detoxifying PUAs in *Daphnia pulex*. The response is seen as a further increase in reproductive output. We suggest that *D. pulex* increases fecundity as a response to stress. In this fashion, ingestion of PUA producing algae may increase grazer standing stock rather than reducing it. This work was supported by an NSERC postdoctoral fellowship.

GROWTH OF PLANKTONIC DIATOMS UNDER THE ICE IN LAKE BAIKAL

Chris Gibson[1] and Tammi Richardson[2]

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Lake Baikal in Siberia is the largest and deepest body of freshwater in the world. In winter, it is covered with ice which can be up to one metre thick. In spite of this, a rich planktonic diatom flora develops under the ice. The species are large in size and have fast sinking rates. How do they stay in the water in the absence of wind mixing? The physics of water at low temperatures means that as the sun warms the layer just below the ice, it sinks, creating a surface mixed layer. The depth of this layer is critical to the development of the plankton. If the layer is too shallow, cells do not stay afloat but if it is too deep, the quantity of light received by the cells is insufficient for net growth. We grew the diatom *Aulacoseira baicalensis* in the laboratory at temperatures near freezing and obtained a set of growth curves at different combinations of light and temperature similar to those found under the ice in Baikal. This information together with field measurements of light and cell sinking rates in the lake itself, were used to develop a model allowing us to explore the interplay between light, temperature and mixing depth. The model illustrates the forces at work and defines the conditions in which growth under the ice can proceed.

REASSESSING DIATOM CELL ULTRASTRUCTURE: UNLIKE MANY RAPHID DIATOMS *CRASPEDOSTAUROS* **(BACILLARIOPHYTA) HAS A WELL-DEFINED DIATOTEPUM**

Eileen J. Cox and Gabrielle M. Kennaway

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The presence of an additional organic layer (diatotepum) that is deposited between the plasmalemma and the silica cell wall after the frustule has been formed has long been known for some centric diatoms but its occurrence in raphid diatoms is poorly documented. Ultrastructural studies of *Craspedostauros australis*, a raphid pennate diatom, revealed the presence of a well-defined diatotepum that attaches firmly to the siliceous valves along the raphe slit, and also to the inner projections of the girdle bands, but lies some distance from the valve face and mantle. It does not occlude the raphe slit, nor does it link the epi- and hypocingula. The protoplast does not appear to be anchored within the diatotepum and the plasmalemma is often rather irregular. Closer examination of other raphid diatoms also showed the presence of diatotepa, although these were more closely associated with the entire inner surface of the valve. We will describe the cell ultrastructure in more detail and discuss the implications of the observed variation within and between raphid and centric diatoms.

HALOCARBONS, ANTHROPOGENIC AND BIOGENIC SOURCES: AN INTEGRATED REVIEW

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Anthropogenic halocarbons have a considerable impact on the environment, are responsible for the decline of stratospheric ozone and act as Green house gases. Since their use has been regulated by the Montreal and Kyoto Protocol, the natural production has been the focus of researchers. The ocean is a natural source of halocarbons and the amounts produced, mainly by algae, biogenic volatile halogenated organic compounds (VOHCs), can be higher than anthropogenic production. The present review provide wide information about halocarbons produced by marine biogenic sources of VOHCs, including fluxes and concentration by natural and anthropogenic sources, properties, ozone depletion reaction induced by UV radiation and effects and live span of different halogen-free-radicals. The emphasis will be set on micro and macroalgae production.

VOLATILE ORGANIC HYDROCARBONATED COMPOUNDS PRODUCED BY *DUNALIELLA TERTIOLECTA* **(BUTCHER) AT DIFFERENT STAGES OF CULTURE PERIOD**

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The production of volatile halocarbonated compounds was studied in cultures of *Dunaliella tertiolecta* (Butcher) strain Conc.006, at three different stages of growth. Axenic cultures of *D. tertiolecta* were grown in triplicate at an ionic strength of 0.5 M of NaCl in Johnson (J/1) culture medium under the following laboratory growth conditions: 24 hour photosynthetic active radiation (PAR) provided by a fluorescent 40 W lamp combined with a 100 W incandescent lamp under a photon flux density of 200 μmol * m^{-2} * s^{-1}, at 20 ± 1°C at pH 7.5.

Volatile Organic Halocarbonated Compounds (VOHCs) production was detected by using the head space incubation and automated sampling technique, coupled to a GC-MS system. Cell numbers, doubling times and relative growth rate were calculated over a 14 day period of culture. During this period *D. tertiolecta* released from 7 to 10 different VOHCs, with the following compounds being detected and analyzed; CH_3I, CH_3Br, $CHCl_3$, CH_2I_2, CH_2Cl_2, CH_3CH_2Br, CH_2ClBr, CH_2ClI, CH_3CH_2I, $CH_3CH_2CH_2I$ and C_4H_9I. The VOHCs species produced by *D. tertiolecta* changed over the time, increasing its diversity at the late stages of the culture. The production rate of VOHCs ranged from 0.3 to 19.21 $\mu g^{-1}*L^1*10^6$cell* min^{-1}.

Furthermore, during early stages of cultures (lag phase), the released compounds were VOHCs of short chains, whereas at the latest phases of culture, *D. tertiolecta* produced longer chains and more complex molecules of VOHCs. The study allowed us to conclude that only one strain of microalga may have a severe impact by releasing a large diversity of VOHCs to the atmosphere and consequently, contribute to the depletion of the ozone layer. These results have been analyzed in detail in the present study, since the free halogen radicals of biogenic origin will induce the conversion of O_3 into O_2 and will remain at the atmosphere for long and variable periods of time, before they become inactive.

NATURAL PRODUCTION OF VOLATILE ORGANIC HALOCARBONATED COMPOUNDS, RELEASED BY *ULVA RIGIDA, MAZZAELA LAMINARIODES* AND *LESONIA NIGRECENS*

Jorge Muñoz[1], Stephen Mudge[2], Rodrigo Loyola[1], Claudio Bravo-Linares[2] and Marcelo Peralta[1]

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The effect of short periods of desiccation on the production of volatile halocarbonated compounds (VOHCs) was studied in *Ulva rigida*, *Mazzaela laminarioides* and *Lesonia nigrecens.* The samples were obtained in Cocholgüe 36°, 35' S; 72°, 58' W, close to the north end of Concepción Bay, Central Chile. Samples were taken and maintained in plastic bags with seawater in a cooler container during a 40 minutes journey to Laboratory. In laboratory samples of each species were washed and cleaned with sterile Johnson (J/1) culture media 0.5 M NaCl. Afterwards, samples were place in separated small aquarium with sterile Johnson (J/1) culture media 0.5 M of NaCl, under the following laboratory growth conditions: 24 hour photosynthetic active radiation (PAR) provided by a set of fluorescent 40 W lamps combined with a 100 W incandescent lamp under a photon flux density of 200 μmol * m^{-2} * s^{-1}, at 20 ± 1°C at pH 7.5.

Volatile Organic Halocarbonated Compounds (VOHCs) production was determined for each species of macroalgae, by placing and incubating 1gr of fresh fronds tissue in 20 mL head space vials. Each vial used was new and sterile and were previously flushed with nitrogen and helium ultra pure. The head space incubation and automated sampling technique was coupled to a GC-MS system. The effect of desiccation, on the progressive production of VOHCs over a period of 0 to 160 min. During the incubation time, gas samples of 2 mL were taken by the head space autosampling system and injected to the GC-MS system. Samples were taken at 5, 40, 80, 120 and 160 min at room temperature (20 +/-1°C). Each determination was made in triplicate

Results for *Ulva rigida* showed that this alga can produce the following VOHCs $CHBrCl_2$, CH_2Br_2, CH_2I_2, CH_3I, *Mazzaela laminarioides* CH_2Cl_2, $CHBrCl_2$, CH_2Br_2, CH_2I_2, CH_3I and *Lesonia nigrescens* produced the following VOHCs; $CHBrCl_2$, CH_2Br_2, CH_2I_2, CH_3I. The rate of VOHCs for the three species ranged from 33 to 639 $\mu gr^{-1}*gr^{-1}$ of algal fresh weight tissue. The evolution and progress of each algal species followed different of patterns VOHCs production, during the incubation-desiccation period.

These species of seaweeds are mainly intertidal and they are present along the Chilean coast. Furthermore, they are exposed to the atmospheric gas phase for long periods, according to the tidal cycle. Hence, these results may contribute towards the development of a model that may calculate the total estimate of each macroalgae production to the atmosphere. This is of particular importance for the Southern Hemisphere spring and summer season, since, the Antarctic/Austral Ozone hole(s) has already reached central Chile region, along with New Zealand, Australia; just to mention some regions. UV light catalyzed the reaction that release-free halogen radicals will induce the conversion of O_3 into O_2, following the subsequent global effects.

THE OXIDATIVE BURST IN MARINE ALGAE – MULTIPLE FUNCTIONS IN DISEASE RESISTENCE, BIOFILM CONTROL AND HALOGEN METABOLISM

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The oxidative burst was initially discovered as a burst of increased respiration of macrophages during phagocytosis in the 1930s. It was later recognized that this served a massive and rapid release of active oxygen species for the targeted killing of pathogenic microorganisms. In the early 1980s, a similar reaction was found in higher plants, where it constitutes a similarly central element of inducible defense reactions.

The last few years have seen the first such findings in marine algae. Studies in *Laminaria digitata* have shown that an oxidative burst can be triggered within seconds of the recognition of oligomeric degradation products the main brown algal cell wall carbohydrate, alginate, resulting in near-millimolar hydrogen peroxide concentrations in the algal apoplast which are sufficient to control the growth of alginate-degrading, bacterial biofilms on the thallus surface. Furthermore, the oxidative burst seems to constitute a first event in the defense against pathogenic endophytes (e.g. *Laminariocolax*). The burst of active oxygen species is concomitant with a release of accumulated iodine and an increased emission of volatile halocarbons. The oxidative burst seems to play a similarly central role in other macroalgal systems such as the defense of *Chondrus crispus* (Rhodophyceae) against the green algal endophyte *Acrochaete operculata*, control of bacterial biofilms by *Gracilaria conferta*, and the wound plug formation of the unicellular green macroalga *Dasycladus vermicularis*.

PLASMA MEMBRANE ELECTRON TRANSPORT AND REACTIVE OXYGEN PRODUCTION IN THREE MARINE *THALASSIOSIRA* SPECIES

Margaret Davey[1], Angie Milne[2], Richard Geider[3] and Alison Taylor[1]

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Marine diatoms studied exhibit high constitutive rates of potassium ferricyanide reduction (FCR) believed to be mediated by plasma membrane reductase enzymes. This level of electron transport to this artificial electron acceptor is unlikely to occur under natural conditions, but maybe indicative of maximum potential rates. We are testing the hypothesis that the plasma membrane electron transport (PMET) in these diatoms could play a role in cellular energy balance, moreover the natural external electron acceptors need to be identified. Our work indicates that the FCR activity observed is not due to a single plasma membrane reductase enzyme. Preliminary experiments also suggest that molecular oxygen is a likely candidate for at least one of the natural electron acceptors of the PMET. The consequent generation of reactive oxygen species by reduction of oxygen at the plasma membrane has a number of implications with respect to the known range of functions of ROS in plant and animal cell signalling defence and repair. The potential role(s) and function of the PMET in these diatoms will be discussed. This work is supported by NERC.

The 53rd Annual Meeting of the BPS, Birmingham

Abstracts

Poster Presentations

1) ANTARCTIC MARINE PROTISTS

Fiona J. Scott and **Harvey J. Marchant**

Australian Antarctic Division, Department of the Environment and Heritage.

The book, *Antarctic Marine Protists*, is to be published in early 2005. Marine planktonic protists account for over 90 percent of all living organisms in the ocean. They constitute the base of marine food webs, contribute about half of global primary production and play a key role in biogeochemical cycling. *Antarctic Marine Protists* is a comprehensive guide to the protists that live in the surface waters and sea-ice south of the Antarctic Polar Front. More than 550 organisms are described and illustrated with over 1300 light and electron micrographs and drawings. The literature on Antarctic marine protists is widely scattered in journals and specialized texts. Until now there has been no single resource that draws this information together to enable non-specialists to readily access the literature on these fundamentally important organisms. A bibliography of more than 1000 entries and a glossary will make this book an indispensable resource for marine biologists.

2) AN EVOLVING ROLE FOR CCAP, A TRADITIONAL BRC

F.C. Küpper, C.N. Campbell and J.G. Day

Culture Collection of Algae and Protozoa (CCAP), Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Dunbeg, Argyll, PA37 1QA, UK.

The Culture Collection of Algae and Protozoa (CCAP) is one of the oldest collections in the world, having evolved from the personal research collection of Prof. EG Pringsheim of the German University of Prague in the 1920s to today's major service collection. After 17 years of being co-located on two sites it has been reunified recently to a world-class custom-built facility near Oban in Scotland. CCAP is a unique collection with representatives from a very broad phylogenetic diversity being maintained, including isolates from freshwater, marine and terrestrial habitats. It also includes numerous strains which cannot be maintained by long-term preservation techniques (lyophilization, cryopreservation).

Besides being a Service Collection, it underpins interdisciplinary research at SAMS ranging from ecological studies to natural product discovery. The CCAP is a platform from which a number of national and international projects have been developed including: the COBRA project www.cobra.ac.uk, AlgiNet thematic network www.algi-net.org, Harmful Algal Bloom (HAB) network, as well as biodiversity and bioprospecting projects. The CCAP has become a hub of research and service activities. On-going collaboration and underpinning activities in the European Centre for Marine Biotechnology (ECMB) at SAMS and elsewhere will ensure the long-term sustainability and scientific vigour of the CCAP.

3) ALGINET (MICROALGAE AS CELL FACTORIES FOR CHEMICAL AND BIOCHEMICAL PRODUCTS): THE DEVELOPMENT OF A EUROPEAN ALGAL DATABASE

J.G. Day[1], **F.C. Küpper**[1], C.N. Campbell[1], T. Friedl[2], I. Probert[3], S. Flanders[4] and M. Pullinger[5]

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There are many centres of excellence throughout Europe specialising in microalgal research. However, whilst interesting results and innovations are regularly generated, commercialisation of these results has not been particularly successful. The AlgiNet (Microalgae as Cell Factories for Chemical and Biochemical Products) thematic network, which is funded by the European Union (Contract No. QLRT-2001-02132) aims to carry out a program of technology transfer to end-users involved in microalgal biotechnology. There is clearly a need for a body to help co-ordinate European research and to make recommendations for its future direction. This thematic network aims to achieve this by bringing together experts from across Europe: academics, industrialists, end-users and SMEs (see www.algi-net.org/ for further details).

One Work Package (WP) of the project aims to improve access to biological resources i.e. algal cultures. At present there is no definitive list that contains all the information available on European phycological resource centres. WP 2 of the Algi-Net project is collating information about European algal collections from various sources, with the objective of cataloguing the information in a searchable on-line database. This will effectively provide a "one stop shop" for users and potential users of microalgal cultures. This paper outlines the development and population of this database.

4) THE COBRA PROJECT: THE DEVELOPMENT OF A PAN-EUROPEAN SCIENTIFIC AND BIOTECHNOLOGICAL RESOURCE

J.G. Day[1], **F.C. Küpper**[1], E.E. Benson[2], K. Harding[2], B. Knowles[2], M. Idowu[2], D. Bremner[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] and T. Hall[8]

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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, started in November 2001, is in the process of developing a pan-European Biological Resource Centre based on existing algal culture collections. The COBRA project's central aim is to apply cryopreservation methodologies to microalgae and cyanobacteria, organisms that, to date, have proved difficult to conserve using cryogenic methods. In addition, molecular and biochemical stability tests have been developed to assess the stability and viability of cryopreserved material and strains maintained by conventional serial sub-culture. The objective is to ensure that the equivalent strains of microorganisms supplied by the culture collections 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.

5) OPPORTUNISTIC MACROALGAL BLOOMS AND THE WATER FRAMEWORK DIRECTIVE

Jo Foden[1], Clare Scanlan[2], Emma Wells[3], Paul Wood[4], Martin Wilkinson[4] and Michael Best[5]

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The EU Water Framework Directive (WFD) requires water bodies to be classified by their chemical and ecological status. Macroalgae are one of the biological quality elements to be used in defining the ecological status of a transitional or coastal water body. A key task in developing the classification system for surface water bodies is to identify appropriate reference conditions, i.e. those conditions found at pristine sites, undisturbed by anthropogenic activities. Calculating the extent of a quality element's deviation from reference conditions provides an ecological quality ratio used to classify water bodies as high, good, moderate, poor or bad.

The WFD suggests that the features of macroalgal communities to be be used for assessment of ecological quality should include taxon composition and abundance and presence of disturbance sensitive taxa. For blooms of opportunistic macroalgae (e.g. *Enteromorpha* spp., *Ulva* spp.) the proposal is to use abundance (estimated by a combination of spatial coverage and biomass) and adverse environmental effects, as indicators of ecological quality. This paper considers the criteria being developed to establish reference conditions and the degree of deviation from these conditions that defines each quality class. The crucial questions for the WFD are: to what extent opportunistic macroalgal blooms are naturally existent in pristine reference conditions and at what levels they have actual adverse ecological impact.

6) MACAROALGAE SPECIES RICHNESS AND COMPOSITION WITHIN THE EU WATER FRAMEWORK DIRECTIVE

Emma Wells[1], Paul Wood[2], Martin Wilkinson[2], Clare Scanlan[3], Jo Foden[4] and Michael Best[5]

[1]*Wells Marine Surveys, Norfolk,* [2]*School of Life Sciences, Heriot-Watt University,* [3]*Scottish Environmental Protection Agency, Aberdeen,* [4]*Centre for Environment, Fisheries and Aquaculture Science, Lowestoft,* [5]*Environment Agency, Peterborough.*

The EU Water Framework Directive requires the protection and classification of water bodies using chemical and ecological quality objectives. One of the biological components suggested for the classification of transitional and coastal waters is the composition of macroalgae. For this particular macroalgae component the directive states that for reference conditions the taxonomic composition should correspond totally or nearly totally with undisturbed conditions with all sensitive taxa present. As species richness remains broadly constant in the absence of environmental alteration this was proposed as an ideal measure of quality rather than using the detailed listing of species present. Therefore, the WFD requires information on the level of macroalgae species richness to be expected under different situations in order to set an ecological quality standard from which any deviation may be measured and used to classify water bodies as high, good, moderate and poor.

The identification of intertidal seaweed species requires high levels of taxonomic expertise. Therefore, a tool is being developed that may be used by less experienced persons to assist with the classification of water bodies. This tool utilises an alternative means of recording qualitative species data, which is to implement the use of a reduced species list (RSL) whereby the number of species from the RSL will be in proportion to total species richness. The list is composed of species (approximately 70) that are present most frequently on a variety of rocky shores within a geographical area. Additional measurements have been incorporated using the RSL including the proportion of green and red species and an Ecological Status Group ratio. The tool also utilises basic shore descriptions to allow for natural variations to be considered. The tool aims to fulfil the requirements of the WFD by enabling less experience algal taxonomist to classify areas of coastline with the assistance of detailed and specially adapted sampling methodologies and identification guides.

7) HOW USEFUL ARE UPPER ESTUARINE MACROALGAE IN ECOLOGICAL QUALITY CLASSIFICATION OF ESTUARIES?

Martin Wilkinson and Paul Wood

Heriot-Watt University, Edinburgh

Estuarine macroalgae encompass red, green and brown seaweeds but also macroscopic mats of colonial diatoms, cyanobacteria and *Vaucheria* spp. The distribution of macroalgae, going upstream into estuaries, involves a large reduction in species richness, the selective attenuation of the two most common seaweed groups on the open coast (red and brown), and a sharp limit where large perennial algae (usually fucoids) give way to domination by mat-forming filamentous algae. This general pattern is known from many countries. This poster presents the results of over 30 years sampling of over 200 sites in the upper reaches of a wide range of estuary types in the British Isles. Very few species are found in each estuary relative to the open coast and those present are drawn from a very small pool of species. It is proposed that the intensely physical environment of estuaries results in a widely tolerant community of few species which varies only slightly with anthropogenic influences, reducing any value for pollution monitoring based on total species composition. Over the last 30 years some estuaries have recovered dramatically from pollution and this has

been accompanied by upstream spread of fucoids. The potential use of fucoid penetration of estuaries as a quality assessment tool is reviewed on the basis of a range of examples over 30 years. Problems arise in terms of whether or not the estuarine *Fucus ceranoides* is present and other possible causes of fucoid change such as long term salinity variations.

8) ORGANIC INCLUSIONS IN LACUSTRINE DIATOM FRUSTULES AS A HOST FOR CARBON AND NITROGEN ISOTOPES

Lydia King[1], Phil A. Barker[1] and Jon Grey[2]

[1]*Lancaster Environment Centre, Lancaster University, LA1 4YB, UK,* [2]*Dept. of Physiological Ecology, Max-Planck-Institut fuer Limnologie, Postfach 165, 24302 Ploen, Germany.*

Stable isotope ratios of C (δ13C) and N (δ15N) measured on bulk sedimentary organic matter traces temporal productivity changes, but they are also influenced by the material source, dissolution during sedimentation and post-depositional diagenetic alteration. An alternative host, already being studied by oceanographers, are organic inclusions preserved within sedimentary diatoms. These should provide a better record of lake water C and N conditions, but several hypotheses need testing before the method can be applied to freshwater lake cores. Preliminary data are presented comparing the isotope ratios of the inclusions, total diatom organic matter, and other elements of contemporary periphyton communities.

9) THE EFFECTS OF SALINITY, N:P RATIO AND WATER MOVEMENT ON THE VALVE MORPHOLOGY OF *N. FRUSTULUM* (KÜTZING) GRUNOW

R. Trobajo[1,2], E.J. Cox[1] and X.D. Quintana[2]

[1]*Dept. of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, UK,* [2]*Institute of Aquatic Ecology, University of Girona, Campus de Montilivi, E-17071 Girona, Catalonia, Spain.*

Nitzschia frustulum (Kützing) Grunow is a widely distributed diatom taxon and very common in different types of habitats. It presents a wide range of variation in length, width and shape. The morphological variation of *N. frustulum* was studied in a culture experiment using specimens isolated from a Mediterranean salt marsh, where environmental conditions fluctuate over a wide range. The effect of three environmental variables on valve morphology was tested in a factorial design: salinity (0.5, 7.0, 17.5‰); N : P ratio (6.5:1, 16:1, 32:1) and water movement (movement / no movement). Salinity is the main factor affecting length, width and fibula density, but changes in N : P ratio and water movement also affect fibula density and width, respectively. Stria density is the most stable character studied. Short and wide valves were observed in all salinity treatments. The results corroborate the conspecifity of *N. frustulum* and *N. inconspicua*, formerly considered characteristic of N. *inconspicua*, a species limited to freshwater.

10) DO MACRO-ALGAL FUNCTIONAL GROUPS FACILITATE COMMUNITY COMPARISON BETWEEN GEOGRAPHIC REGIONS?

Michelle Tobin[1], Graham Scott[2] and Colin Bates[3]

[1]*Scarborough Centre for Coastal Studies, University of Hull,* [2]*Department of Biological Sciences, University of Hull,* [3]*Dept. of Biology, University of New Brunswick, Canada.*

The Functional Group (FG) approach as described by Steneck and Dethier (1994) suggests that algal species having similar morphology (i.e. from the same functional group) should exhibit a similar response to environmental variables. This offers a potential advantage when describing and interpreting community structure since species have been suggested to be too 'noisy' to identify predictable variation. One potential application of the FG approach is in the investigation and interpretation of the effects of environmental impact upon algal assemblages which share few (if any) species in common. Generalising across geographic regions is often difficult due to species variability. However if classification at the FG level is used it may be possible to identify similar responses to environmental impact from a wide range of algal assemblages. Using data collected from surveys carried out independently in two different geographic regions (NW and NE Atlantic) we present the results of a study to compare algal assemblages experiencing different levels of anthropogenic impact and wave exposure with a view to assessing the usefulness of functional groups in interpreting community structure.

11) ABILITY OF DIFFERENT ALGAL SPECIES TO TAKE UP HEAVY METALS FROM WASTEWATER: A REVIEW

Loredana Brinza [1,2], Matthew J. Dring[2] and Maria Gavrilescu[1]

[1]*"Gh. Asachi" Technical University of Iasi, Faculty of Industrial Chemistry, Department of Environmental Engineering, Bd. D. Mangeron 71 A, 700050, Iasi, Romania,* [2]*Queen`s University Marine Laboratory, The Strand, Portaferry, Co. Down, BT22 1PF, Northern Ireland, United Kingdom.*

This paper reviews some practical aspects of the application of algal biomass for the biosorption of heavy metals from wastewater. The ability of different algal species to remove metals varies with algal group and morphology, with the speciation of specific metals and their competition with others in wastewater, and with environmental or process factors. The scattered literature on the uptake of heavy metals by both living and dead algal biomass - both macroalgae and immobilized microalgae - has been reviewed, and the uptake capacity and efficiency of different species, as well as what is known about the mechanisms of biosorption, are presented. Data on metal uptake have commonly been fitted to equilibrium models, such as the Langmuir and Freundlich isotherm models, and the parameters of these models permit the uptake capacity of different algal species under different process conditions to be compared. Higher uptake capacities have been found for brown algae than for red and green algae. Kelps and fucoids are the most important groups of algae used for biosorption of heavy metals, probably because of their abundant cell wall polysacchrides and extracellular polymers. Another important practical aspect is the possibility of re-using algal biomass in several adsorption/desorption cycles (up to 10 have been used with *Sargassum* spp), and the influence of morphology and environmental conditions on the re-usability of algal tissue is also considered.

12) DEVELOPMENT OF A MARINE MACROALGAL BIOASSAY FOR METAL POLLUTION IN SEAWATER

Dagmar B. Stengel, Liam Morrison and Hans Baumann

Environmental Change Institute, Martin Ryan Institute and Department of Botany, National University of Ireland, Galway.

Macroalgal metal accumulation from seawater varies due to species-specific differences in growth patterns and biochemical composition, as well as local environmental conditions. Despite this potential variability, marine macroalgae have been used widely as biomonitors in the past, since tissue metal concentrations are generally correlated with bioavailable metal concentrations in seawater. In this project, the application of macroalgae as biomonitors and biosensors was evaluated, and a bioassay using *in vivo* chlorophyll fluorescence developed.

Spatial and temporal variation in tissue concentrations was determined in selected biomonitors (brown algae in particular), and the efficiency of applying seaweeds in active biomonitoring was assessed using transplantation techniques. With the exception of algae collected from some contamination hotspots, tissue metal concentrations in plants from a range of

sites along the Irish coast were near background levels. Concentrations differed greatly between algal species and thallus parts, but were similar within ecological form-functional groups. Variation within plants was mainly due to seasonal and tissue-specific metabolic activity.

Pulse amplitude modulated (PAM) chl *a* fluorescence, measuring *in vivo* responses of photosystem II, was used to assess the toxicity of Cr, Zn and Cu in selected species of local macroalgae. Species suitable for use in bioassays were screened and selected according to their physiological stability under a range of environmental conditions while maintaining a high sensitivity to small fluctuations in metal concentrations in artificial media and natural seawater. The sensitivity of PAM fluorescence to metal toxicity was comparable to results of traditional physiological bioassays such as O_2-evolution, spore release and germination, however fluorescence measurements were considerably faster and less labour-intensive.

13) THE ECOLOGICAL EFFECT OF HEAVY METAL POLLUTION ON SEAWEED ASSOCIATED INVERTEBRATE COMMUNITIES ON THE NORTHEAST COAST OF ENGLAND

Kevin Linnane, Jeremy C. Thomason and F. Gavin Hardy

School of Biology, University of Newcastle upon Tyne

The Northeast coast of England has been subjected to severe heavy metal pollution from a variety of inputs over the past few centuries i.e. coal mining in Northumberland and Durham, shipbuilding and the production of iron and steel around the Tyne and Wear estuaries and petrochemical industries around the mouth of the Tees. Although mining and shipbuilding in the area has now ceased and many of the other industries have been scaled down, the problem of heavy metal pollution is still a significant problem. Heavy metals are particularly dangerous in enclosed water bodies such as the North Sea where dispersion of these persistent metals can take a very long time. Many algal species are known to accumulate heavy metals and this study sets out to determine the ecological effect that this type of contamination has on the associated macro invertebrate communities. This presentation describes work that is currently in progress. Samples of nine different species of algae were collected from 10 sites along the northeast coast of England, ranging from clean to chronically polluted, and invertebrate communities were quantified and compared. These results will then be correlated with the heavy metal loads of the seaweeds.

14) *EUCHEUMA* FARMING IN ZANZIBAR BROADCAST SYSTEM: AN ALTERNATIVE METHOD FOR SEAWEED FARMING

Elisabeth Lundsør

Institute of Biology, University of Bergen, Norway

Different species of the red algae *Eucheuma* and *Kappaphycus* have been cultivated on the reef flats on the east coast of Zanzibar, Tanzania, since they were successfully commercialized in 1989. The local people, mainly women, at their own independent farms, grow the seaweed. *Eucheuma* and *Kappaphycus* are of commercial interest for different international companies due to their high content of carrageenan. Carrageenan is used for thickener and emulsifier in different food and cosmetic products. This study investigates whether an alternative farming method, the "broadcast method", can contribute to better growth and yield of the harvest. It concludes that implementation of this method will able the farmer to increase the production but the cost of the equipment needed is high.

15) POLYCULTURE OF RAINBOW TROUT *ONCORHYNCHUS MYKISS* AND RED ALGA *CHONDRUS CRISPUS* IN THE INNER DANISH WATERS

Susan Holdt, Flemming Moehlenberg and Karl Iver Dahl-Madsen

Department of Ecology and Environment, DHI Water & Environment, Denmark

The Danish aquaculture production has been stagnating and left behind the increasing world production for the last 15 years due to the stringent Danish legislation. This legislation was lifted after the Danish marine farming committee published a report that recommended an active development of marine environmentally efficient fish farming in Denmark. The committee recommends among other things that research with polyculture (seaweed or mussels) should be carried out to document the bioremediation of nutrient waste.

DHI-Water & Environment has as research and consulting company taken the challenge to produce the native red algae *Chondrus crispus* near fish farms in the temperate Danish inner waters. The nutrient released from the *Oncorhynchus mykiss* production will be converted into a valuable product, carrageenan, and furthermore the fish production can be increased.

Pilot experiments near marine fish farms in summer 2004 indicate that grow out of *C. crispus* is possible near *O. mykiss* cages in the temperate inner Danish waters. However further investigations are needed and the handling process should be reduced by the use of ropes with settled spores, to scale up the production.

16) DOES ALGAL MORPHOLOGY DICTATE *LITTORINA LITTOREA* GRAZING HABITS?

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

[1]*Scarborough Centre for Coastal Studies, University of Hull,* [2]*Department of Biological Sciences, University of Hull.*

One premise of Steneck and Watling's (1982) functional group model is that algal susceptibility to grazing will decrease hierarchically from functional group one to functional group seven, based upon morphological characteristics. A second is that all species within a functional group will 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 functional group two (filamentous forms) over functional group three (foliose forms); and that species within some groups are consumed in different amounts. Based upon experimental manipulations, data will be presented to show if these preferences are the same when morphology is removed as a factor affecting feeding preference. *L. littorea* were presented with both whole plants and homogenates of algae in agar in edibility experiments, in which the amount of algae consumed was recorded.

17) PHYLOGENETIC AFFINITIES OF TWO EUKARYOTIC PATHOGENS OF MARINE MACROALGAE, *EURYCHASMA DICKSONII* AND *CHYTRIDIUM POLYSIPHONIAE*

Frithjof C. Küpper[1,2,3], Ingo Maier[1], Dieter G. Müller[1], Susan Loiseaux-de Goër[2] and Laure Guillou[4]

[1]*Dept. of Biology, Faculty of Sciences, University of Konstanz, D-78457 Konstanz, Germany,* [2]*UMR 1931 CNRS-Goëmar, Station Biologique, Place G. Teissier, BP 74, F-29682 Roscoff, France,* [3]*Culture Collection of Algae and Protozoa, Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban, Argyll, PA37 1QA, Scotland, UK,* [4]*UMR 7127 CNRS et Université Pierre et Marie Curie, BP 74, 29682 Roscoff, France.*

The 18 S rRNA genes of *Eurychasma dicksonii* and *Chytridium polysiphoniae*, pathogens of brown algae, were sequenced and used to clarify their phylogenetic affiliations. *E. dicksonii* is consistently placed at the basis of the Peronosporomycota (Oomycota) with high bootstrap support. Nevertheless, its sequence is clearly separated from other terrestrial and freshwater Oomycota. The closest related marine group is a clade entirely composed of environmental sequences of free living plankton organisms. The genus *Chytridium* usually forms a clade that includes several other genera (alongside the clades of *Monoblepharis*-, *Rhizophydium*-, *Lacustromyces*-, *Nowakowskiella*-, *Neocallimastix*- and *Spizellomyces*-like organisms) within the Chytridiomycota, one of the principal lineages of the Eumycota. Interestingly, our sequence of *C. polysiphoniae* differs drastically from other sequences of the genus *Chytridium*, forming a novel clade of the Chytridiomycota, that also includes environmental sequences from water and soil samples. Consistent with these phylogenetic affiliations, *C. polysiphoniae* has a chitin cell wall, whilst *E. dicksonii* has cellulose instead. Altogether, these results suggest that *Eurychasma* and *Chytridium* may become interesting model organisms as the currently only culturable and morphologically known representatives of a poorly understood aquatic biodiversity, pointing out the necessity to include marine representatives for phylogenetic studies of the Oomycota and Chytridiomycota.

18) SCREENING OF TURKISH ISOLATES OF CYANOBACTERIA AND ALGAE FOR ANTIBACTERIAL AGENTS

Fatma Gurbuz[1], Hatice Aloglu[2] and Aynur G. Karahan[2]

[1]*Suleyman Demirel University,Department of Biological Sciences Isparta,Turkey,* [2]*Suleyman Demirel University,Department of Food Engineering, Isparta,Turkey.*

Algae and cyanobacteria are receiving increasing attention as sources of biologically active compounds. Cyanobacteria, for example, produce over 120 natural products which can be classified as biotoxins. Several algal and cyanobacterial secondary metobolites have potential as anticancer, antibacterial, antiviral and antifungal agents. Cyanobacteria have been identified as one of the most promising groups of microbes from which to isolate biochemically active compounds

In this study, strains (*Synechococcus sp.*, *Oscillatoria* sp.) and an isolate of *Spirogyra* sp. were investigated to search for antimicrobial compounds. The strains were cultivated in BG11 and modified SAG media and were illumunated at 4000 lux light intensity on a 16h/ 8h light and dark cycle.

Cultures were harvested by centrifugation, washed with 0.10M HCl and rinsed three times with deionised water. Extractions were carried out using methanol, ethylacetate, and ethanol. The extracts were stored at –20^{o}C before use. Lipophilic and hydrophilic extracts were screened for antibiotic activity against Gram positive bacteria such as *Staphylococcus aureus* and *Bacillius subtilus,* and Gram negative bacteria such as *Yersinia enterocolitica*, *Escherichia coli* and *Pseudomonas aeruginosa*. Bacterial strains were inoculated into nutrient broth and incubated for 16-18h at 30-37^{o}C. At the end of incubation period, a standard quantity of suspension of the respective organisms was plated onto Petri dishes containing nutrient agar.The inhibition of bacterial growth was determined by disc diffusion technique for the organic extracts and well diffusion technique for the water extracts by measuring the diameter of incubation zones after incubation of 16 h.

No inhibition of bacterial growth occurred with aqueous extracts of the cyanobacteria or green alga. Organic extracts of *Spirogyra sp.* showed a low inhibition of growth of bacterial strains, although *E. coli* was unaffected. *E. coli* was not inhibited by organic extracts of the cyanobacteria, but these showed medium to strong inhibition of the growth of the other test bacteria.

19) CELL BIOLOGY OF SETTLEMENT AND ADHESION PROCESSES OF *ULVA* ZOOSPORES

Stephanie E.M. Thompson[1,2], Colin Brownlee[2], James A. Callow[1] and Maureen E. Callow[1]

[1]*School of Biosciences, University of Birmingham,* [2]*Marine Biological Association of the UK, Plymouth.*

The recruitment of many marine algae involves the settlement of motile zoospores onto a substratum via the exocytosis of vesicles containing adhesive, which forms an adherent pad. It is known that settlement is an active process involving the detection of various cues. However, at present information on the cellular mechanisms behind spore adhesion is lacking. The work presented is an initial attempt to determine the cell biology behind the mass exocytosis occurring at settlement in *Ulva* (syn. *Enteromorpha*) zoospores. The membrane labelling fluorescent dye FM 1-43 was used to follow membrane recycling at settlement. In swimming zoospores dye labelled only the plasma membrane however upon settlement dye was rapidly internalised (within one minute) indicating high membrane turnover. The internalised dye was focused into a spot separated from the plasma membrane indicating that an endosomal compartment may be involved in membrane recycling. It is believed that this is the first demonstration of endosomes being involved in vesicle recycling in algae. Future work will focus on establishing the signalling pathways involved in adhesion through patch clamping and use of fluorescent calcium indicators to investigate the roles of plasma membrane channels and calcium. This work is supported by BBSRC and the Marine Biological Association of the UK.

20) MODELLING BIOFILM COMMUNTIES IN RIVERS: THE INFLUENCE OF NUTRIENTS AND FLOW ON ALGAL BIOMASS AND COMMUNITY STRUCTURE

Jo Moodie[1], Alex Elliott[3], Keith Beven[2] and Jackie Parry[1]

[1]*Department of Biological Sciences, The Lancaster Environment Centre, Lancaster University, Bailrigg, Lancaster, LA1 4YQ.* [2]*Department of Environmental Sciences, Lancaster University, Bailrigg, Lancaster, LA1 4YQ,* [3]*CEH Lancaster, Library Avenue, Lancaster University, Bailrigg, Lancaster.*

Attached algal communities (biofilms) play a fundamental role in food web dynamics and biogeochemical cycling in streams. Biofilm biomass and community structure are directly influenced by chemical (nutrient) and physical (flow) factors; thus changes in environmental conditions can be indicated by changes in biofilm structure. A process-based model, written in FORTRAN 77 was used to simulate biofilm community development under varying chemical and hydrological conditions, and was validated against data from a two-year field study. The modelled community consisted of ten diatom species representing five functional groups. The functional groups were defined by morphological characteristics (surface area, volume, maximum linear dimension), thought to determine resource acquisition ability and growth rates. Species-specific growth rates are calculated according to the resource (nitrogen, phosphorus, light) that is in the most limiting supply. Initial simulations, based solely on growth rate and substrate surface area taken up per cell, showed reasonable agreement with field data in terms of the relative biomass of each functional group. Experimental work is underway to parameterise a species-specific function to estimate the biomass lost per day due to erosion by flow. Single-species biofilms are grown in flow cells and subjected to increases in velocity to quantify the resistance of the species to high flow, and to determine the velocity required to dislodge significant numbers of cells from the substrate. This data will be used to augment the existing model and to improve the agreement between model output and field data. This study is supported by a NERC-CASE studentship.

The British Phycological Society

Registered Charity No. 246707

Annual Report for the year ended 30th September 2004

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:	Dr M.L. Tobin
Vice President:	Professor M.D. Guiry	Hon. Eds (*Eur. J. Phyc*):	Professor M.J. Dring
Overseas President	Dr J. Olsen		Dr E.J. Cox
Immediate Past President:	Dr E.J. Cox	Hon. Ed. (*The Phycologist*):	Dr A.R. Taylor
Hon. Secretary:	Dr J.D. Parry	Webmaster:	Professor M.D. Guiry
Hon. Membership Sec:	Dr G.W. Scott		

Ordinary Members

Dr F. Küpper	Dr D.M. John	Dr G.J.C. Underwood
Dr R. Forster	Dr S.C. Maberly	Dr T. Wiedemann
Dr J. Krokowski	Dr D. Stengel	Miss C. Blake

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

This is the first 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 University of Lancaster. The standard of presentations was very high and congratulations go to Katrina Marshall who was the Manton Prize winner, and Thomas Wichard, who received the annual Poster Prize. Nine students received support to attend this meeting from the Scientific Meetings Fund (SMF) (ten in 2003). The auction raised £295.84 and thanks must go to Professor Elliot Shubert for his enthusiasm and efforts. Two students received stipends for the summer bursary programme (allowing promising young graduates to undertake research), and one student was supported to attend a freshwater algal identification course at Durham. Four students were supported to attend international meetings to present their research findings. This is an improvement on last year and supervisors are urged to encourage their students to continue 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. Honoraria presented in the 2003 financial report are shown on this year's financial report. For the current year, the Hon. Membership Secretary, Hon. Secretary and the Hon. Editor of *The Phycologist* each received £750, the Hon. Treasurer received £1000 (shared between the current and previous post holders) and the Hon. Editors of the *European Journal of Phycology* received a total of £1500.

The Society's financial situation remains good. The Scientific meetings Fund was topped up to a total of £25000 to allow the Society to support students with Travel Awards, Summer Bursaries and Summer Field Courses from the interest it receives.

Due to problems in the transfer of the account to the new Hon. Treasurer it was not possible to process all of the 2004 membership payments by the end of the financial year. Delayed payments for 2004 will show on the next financial year statement.

The Journal has performed reasonably well financially and whilst subscriptions were lower the balance to the society from Volume 38 was £20,000 (£15,882.12 for Volume 37) due to the current guaranteed annual income of £20,000 from the publishers, Taylor and Francis.

Finally the I would like to offer thanks on behalf of the Society for the efforts of Professor E. Shubert in his role as Hon. Treasurer over the last three years. In addition I would like to thank all council and society members for their patience and support during the change over period this financial year.

The British Phycological Society

Registered Charity No. 246707

Statement of Financial Activities for the Year ended 30th September 2004

	Note	Unrestricted General £	Designated S.M.F. £	Restricted Manton £	Total 2004 £	Total 2003 £	
Income and Expenditure							
Incoming Resources							
Subscriptions		7,523.00			7,523.00	13,924.70	
Surplus from Journal		20,000.00			20,000.00	15,882.12	
Atlas Book		1,704.50			1,704.50	2,288.00	
Auction proceeds		295.84			295.84	0.00	
Miscellaneous (mouse mats)		0.00			0.00	173.67	
Interest		2,144.62			2,144.62	1,893.79	
Miscellaneous (Jubilee A/C Transfer)		7.82			7.82	0.00	
Total Incoming Resources		**31,675.78**	**0.00**	**0.00**	**31,675.78**	**34,162.28**	0.00
Resources Expended							
Grants, studentships & awards	**2**	4,850.00	1,497.65	250.00	6,597.65	6,030.55	
Publications expenditure	**3**	6,464.51			6,464.51	26,066.92	
Meetings & Committee Expenses	**4**	558.01			558.01	8,905.00	
Administration Costs	**5**	8,737.89			8,737.89	3,663.76	
Reduction in provision for newsletters		(8,214.68)			(8,214.68)	0.00	
		12,395.73	**1,497.65**	**250.00**	**14,143.38**	**44,666.23**	0.00
Net Incoming (Outgoing) Resources for the Year		**19,280.05**	**(1,497.65)**	**(250.00)**	**17,532.40**	**(10,503.95)**	
Fund at 1 October 2003		24,328.62	25,000.00	5,944.09	55,272.71	65,776.66	
Transfer (General to SMF)		(1,497.65)	1,497.65		0.00	0.00	
Fund at 30 September 2004		**42,111.02**	**25,000.00**	**5,694.09**	**72,805.11**	**55,272.71**	0.00

The British Phycological Society

Balance Sheet as at 30 September 2004

	Note	2004 £	2003 £
Current Assets			
Debtors	**7**	1,652.25	1,815.00
Short term deposits		71,853.24	69,650.20
Cash at bank		11,690.26	4,312.83
		85,195.75	75,778.03
Liabilities: amounts falling due within one year	**8**	12,390.64	20,505.32
Net Assets		**72,805.11**	**55,272.71**
Funds	**9**		
Unrestricted		42,111.02	24,328.62
Restricted		5,694.09	5,944.09
Designated		25,000.00	25,000.00
		72,805.11	**55,272.71** 0.00

Signed on behalf of the British Phycological Society

Dr Michelle Tobin
Hon. Treasurer

2005
British Phycological Society

Council Officers (January to January)

President
Professor Mike D. Guiry (2005-2007)
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