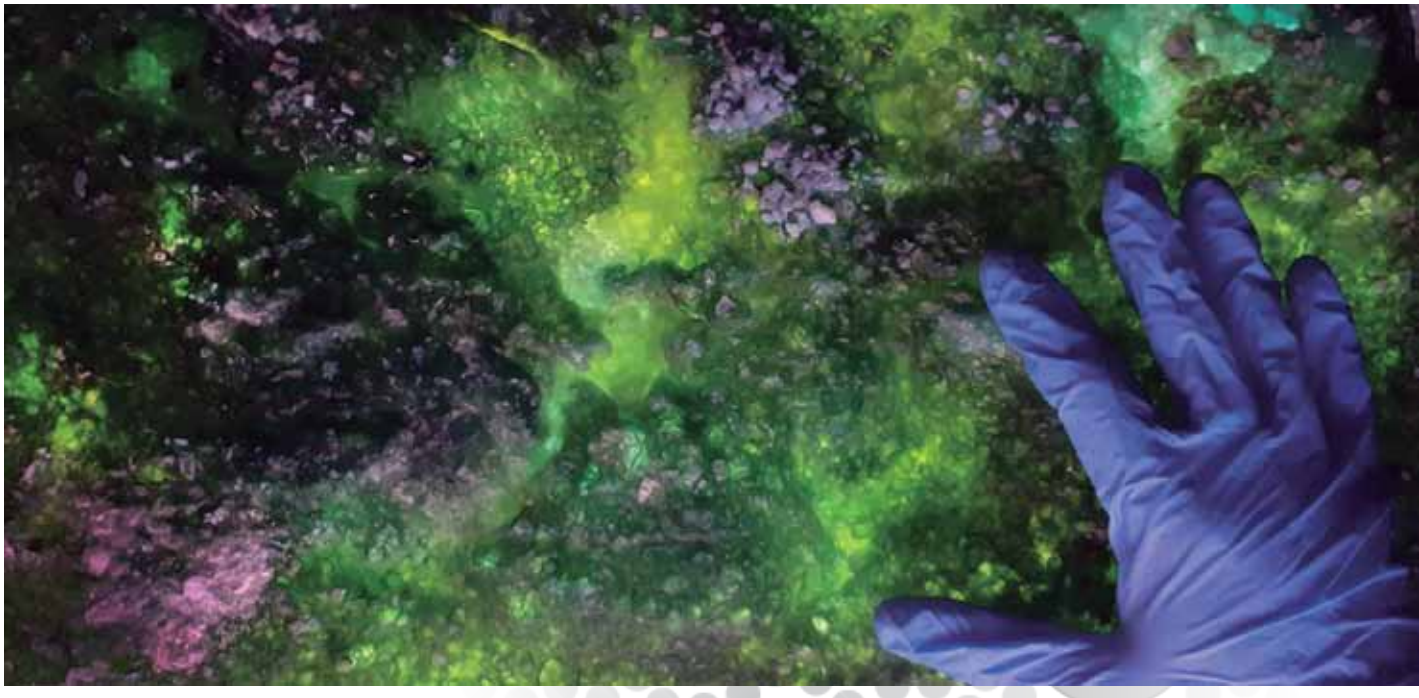
The Phycologist

The Newsletter of the British Phycological Society
Editor: Dr Amanda Burson
Homepage: http://www.brphycsoc.org/



BPS Project Reports

Annual General Meeting

Tripos and global warming

Number 102- Spring 2022

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2022
British Phycological Society

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Editorial

My sincerest apologies to all of our avid *Phycologist* readers for the tardiness of this Spring issue. The world's newest phycologist, my daughter, was supposed to arrive a couple of weeks after the deadline of this issue but instead she couldn't wait to see these articles and arrived three weeks early in mid-February (surprise!) She has thoroughly enjoyed looking at the beautiful pictures of algae and I especially look forward to showing her the Hilde Canter-Lund submissions.

Meanwhile, in this issue, we have some excellent articles, including an interesting discussion on the shapeshifting dinoflagellate genus, Tripos. Also, some exciting updates on previous Manton-prize-winning research as well this year's meeting winners. You'll also find more bursary and project reports now that field/lab work and traveling are starting back up. Thank you for your patience as your editor navigates her new job description as parent and I hope the wait was worth it for this issue!

Very best,

Amanda Burson

Remember - do keep sending in your contributions. Write to us with your phycological views, news, work events, or any matter you wish to share with readers of The Phycologist*. YOUR input is required; all relevant material will be considered (job adverts, science reports, book reviews, news items of topical interest, meeting announcements, research news, and suggestions for future articles are always welcome). Without YOU the newsletter would not exist.*

As a reminder, previous issues of *The Phycologist* can be downloaded at https://brphycsoc.org/the-phycologist-back-issues/

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Front cover picture: Close up of the large scale ELM architectural panel prototype. Credit Prantar Tamuli

Back cover: *Gigartina pistillata* from Thurlestone by Francis Bunker

70th British Phycological Society Winter Meeting Irene Manton Prize Winners

Winner Best Presentation Jaz Millar

Polar cryoconite associated microbiota is dominated by hemispheric specialist genera

School of Earth and Ocean Sciences, Cardiff University, millarjl@cardiff.ac.uk, @JazzedUpScience

I am incredibly honoured to be the recipient of this year's Irène Manton prize. This has not only boosted my confidence in my research and presentation, but in my place in the field of phycology.

My work has always centred around microbes and plants in extreme environments; from a school Nuffield Foundation Research placement working on the salt tolerance of the microalga *Dunaliella salina* (hosted by the Marine Biological Association) to the post-doctorate project I have just joined on ice adaptations of glacier algae (MicroLab @ University of Bristol, funded by the Leverhulme Trust). Working with these extraordinarily specialised organisms has given me a deeper appreciation of the diversity of life and the marvel of evolutionary adaptation.

Over my PhD I have been studying glacier surface ecosystems, of which algae are only one group of constituents. Cryoconite holes, supraglacial melt water depressions containing sediment and living microbes, contain a particular diversity of eukaryotic microalgae, Cyanobacteria, heterotrophic bacteria, fungi, protists and microanimals. Cryoconite holes are a refuge for biodiversity on glacier surfaces, allowing for the proliferation of organisms that perhaps would be less successful in the surrounding snow, ice and streams.

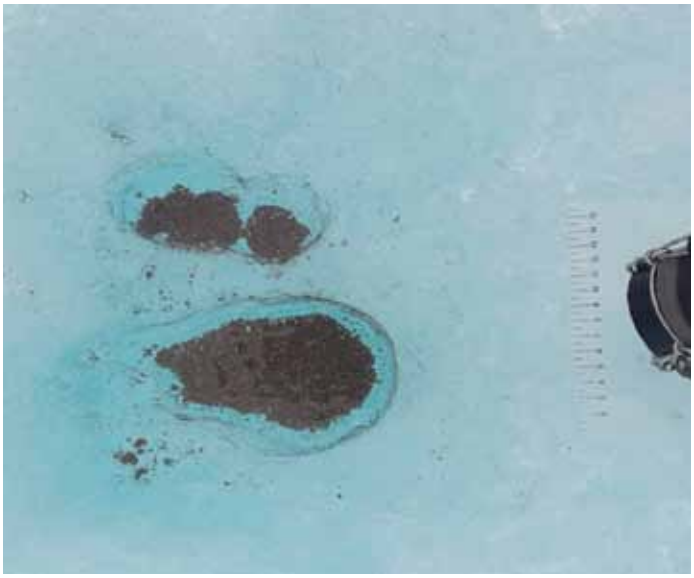


Figure 1.

During my presentation to the annual conference, I was able to present the diversity of cryoconite hole ecosystems across the polar regions, revealed by DNA metabarcoding. While this diversity of major groups was found in all locations, there was a dramatic difference between the cryoconite communities of the Arctic and those of the Antarctic. Although cryoconite is a global phenomenon, it is

Figure 2. Photo credit: Becky Peel

inhabited by regionally specific communities. One of the major contributors to this divide was the green algae. While the Arctic cryoconite holes were populated by *Chlamydomonas*, the Antarctic cryoconite holes were populated by *Pleurastrum*. We believe this dominance by one particular alga occurs when snow algae blooms are swept into neighbouring habitats by wind and meltwater.

The modern cryosphere makes up roughly 10% of the earth's surface and glacier surface ecosystems are an important contributor to the biogeochemistry of these regions. Even now, this is a significant portion of our global ecology. In the past, during larger glaciations, these supraglacial ecosystems were vital oases of life. Just preceding the Ediacaran dawn of animals, the Earth saw two 'Snowball Earth' global glaciations, each lasting tens of millions of years. It is likely that the warmer equatorial regions of this frozen planet were covered in cryoconite holes, snow and glacier algae, and other supraglacial communities that could flourish in a manner not possible in the dark, and possibly anoxic, ice covered oceans.

As the Snowball Earth melted, these microorganisms were distributed across the virgin terrestrial surface, and the deposited algae eventually gave rise to the first land plants in the subsequent Ediacaran period. My aim of my ongoing research is to better understand the *Zygnematophyceae* glacier algae, a close relative of modern land plants. I'm excited to focus in on this alga; to find out what adaptations allow it to succeed on ice surfaces, and to build up a picture of the evolutionary history of these organisms – from water, to ice, to land.

Figure 3. Photo credit: Chris Williamson

When thinking so far into the past, it is easy to forget the manifold connections between ourselves and these organisms in the present day. We will often tell the public that studying environmental microbiology advances everything from biotechnology to climate science, yet I find I rarely have the chance to engage with these fields directly. Therefore, it was a really valuable opportunity to be able to connect with researchers at BPS2022 who are making a difference, whether that's in the field of eutrophication, food production or climate-ecology studies.

I'd like to congratulate all of the presenters who attended the annual conference, not only on their fantastic posters and talks, but on carrying out such important and interesting work. I hope to meet many of you again at future events.

Winner Best Poster:

James Barrett

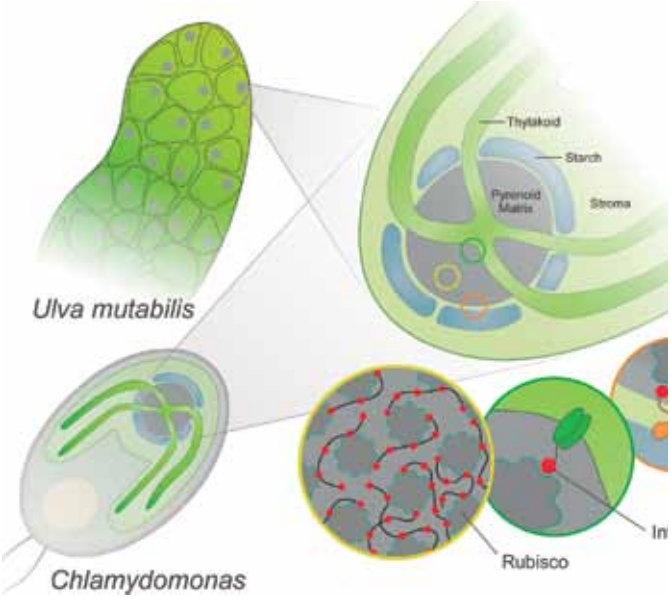
Dissecting the dynamic carbon-fixing organelle in *Ulva*

Department of Biology, University of York, Jb1725@york.ac.uk

The 70th British Phycological Society Winter Meeting was my first conference attendance with an opportunity to discuss a new venture for myself and the Mackinder lab – working in a macroalgae. I thoroughly enjoyed the oral and poster presentations, where I garnered great insights into the world of a range of micro- and macro-algal systems. With a background in molecular biology and biochemistry myself, it was fascinating to see the breadth of experience congregated virtually at the meeting and highlighted the value of interdisciplinary research and collaboration.

Suitably, the work presented in my poster represents a highly multidisciplinary, collaborative effort at "Dissecting the dynamic carbon-fixing organelle (pyrenoid) in *Ulva mutabilis*". It has long been known that the pyrenoids of micro- and macroalgae house the primary carbon-fixation enzyme Rubisco and enhance photosynthetic rates in CO2-limited environments.

Despite their abundance, the molecular details and dynamic nature of these enigmatic organelles has only recently been highlighted in the model alga *Chlamydomonas reinhardtii.* In this work we began to explore these aspects of the pyrenoid in the green macroalga *Ulva* through a combination of in vivo approaches headed up by Jonas Blomme (University of Ghent) and John Bothwell (University of Durham) and in silico, in vitro and structural approaches by myself at the University of York. Our results suggest that the pyrenoid of Ulva is held together by a similar set of Rubisco-interacting proteins as observed in *Chlamydomonas*, but that its dynamic properties differ slightly, likely due to its dependence on a higher salt tolerance as a product of its growth environment. Characterising the molecular details and dynamics of pyrenoids in diverse algae will continue to contribute to a wider goal of engineering functional counterparts in higher plants to increase crop yields.



I extend my thanks and congratulations to the organising committee who so seamlessly pivoted the conference to the virtual space in a matter of hours and provided a fruitful environment for discussions with attendees, for which I am also grateful. My thanks also go to my supervisor Luke Mackinder, and our collaborators Jonas and John who have so enthusiastically guided me through my first foray into the macroalgal world. I look forward to pursuing these and new collaborations to fruition and perhaps discussing our findings in person next year.

70th British Phycological Society Annual General Meeting

Swansea University

Via Gathertown

17:10-18:10, 5th January 2022

Meeting Agenda

1. Apologies for absence

2. Announcements

3. Approval of the Minutes of the 69th AGM, January 2021, Nottingham University

4. Matters arising

5. Reports from Officers and Committees

(*full reports are available at https://brphycsoc.org)

a. Secretary (Francis Bunker)

I have answered various queries from members and the public or passed them on the relevant Council / subcommittee members. These have been many and varied.

I have passed on notice of several events which may be of interest to members to Andy Davies and Sally Archer-Thomson for inclusion on the web site. Council meeting minutes and the BPS Operating Manual are now stored on the web site.

A notice advertising Council positions was drafted and sent to *The Phycologist* for publication in the autumn issue.

I liaised for renewal of BPS with a new company, Self Assured Underwriting Agencies Ltd recommended by our agent, Diane Howell of The Insurance Group. Documents have been uploaded onto the web site for Access by Council members.

b. *Treasurer (Nicky Slee)

The YE2019 accounts were transferred to our accountants, Paul Murray of LM Griffiths & Co Ltd on 16th February 2021. The YE2019 Trustees accounts and associated report were finalised the BPS Finance Subcommittee approved these in April 2021. This enabled the online annual return and The Report of the Trustees with the financial statements for the British Phycological Society (Charity Number 246707) to be submitted to the Charity Commission Website (CCW) on 22nd April 2021), a copy is attached. As the BPS accounts were up to date, this allowed the end of the Tax year to be changed to 30th March. The YE2021 accounts (18th month period) have been prepared by the Treasurer and independently examined by Paul Murray of LM Griffiths & Co. Ltd. on 17th December 2021. Members at the AGM are asked to approve:

1. Acceptance of the Prepared Accounts by members of BPS attending the AGM approve the accounts, then the YE02202 can be uploaded to CCW.

2. To elect Paul Murray of LM Griffiths & Co. Ltd as the Independent Examiners for the BPS YE accounts for YE2022.

c. Membership Secretary (Hilary Redden)

On 3 January 2022, the active membership of the Society was 470, this includes our current 12 Honorary Life Members. Total membership is 10 less than 2020.

Remaining steady at 26 %, members wanting a physical copy of the EJP by post rose by one to 124 in 2021. Membership percentages in each category stayed remarkably consistent from 2020 to 2021.

Student membership has dropped slightly from 35 to 32 % but considering the disruption to teaching over the year this has held up well. Ordinary membership without the journal has risen from 38 to 40% from 2020 to 2021.

Postal lists have been supplied to T&F for the EJP when requested this year. For members who miss issues, I request 10 extra copies to be held by T&F and they obligingly post one out when requested.

d. Student Representatives (Hannah Kemp and Eleanor Wood)

Continuing to monitor and actively post on the BPS social media accounts. Promote Hilda Canter-Lund competition and BPS video competition specifically the latter due to low number of entries this year. New student representatives are needed as current term is over.

6. Reports from the Editors and Webmaster

(*full reports are available at https://brphycsoc.org/)

a. *Joint Editors of the *European Journal of Phycology* (Chris Maggs and Juliet Brodie) and Editor in Chief of *Applied Phycology* (John Beardall) - presented by Chris Maggs and Juliet Brodie

Christine Maggs and Juliet Brodie have continued as joint Editors in Chief, with Kate Schoenrock-Rossiter as Editorial Assistant. Since June 2021, we have had one resignation as Associate Editor (Richard Dorrell) and two new AEs are likely to start soon.

The Journals Management Committee chaired by Graham Underwood has not met since the last Council meeting but we have raised concerns with the publishers about various aspects of the publishing process, including the offer of transfer to Applied Phycology. Some of these concerns have now been addressed.

Introduction of the new T&F submission portal in November 2020 has continued to cause problems for EJP intermittently, including a malfunction followed by failure of the portal for several days in late 2021.

b. Editor of *The Phycologist* (Amanda Burson)

Thank you to all the contributors to The Phycologist to date. A reminder that the deadline for the Spring 2022 issue is the 1st of March. This will be strictly enforced for this issue as the editor (Amanda Burson) is due to give birth on the 13th of March! Therefore, any submissions after the 1st of March will be included in the Autumn issue. Please note for BPS studentships and bursary payments a completed report for The Phycologist is required, so get them in early. Please remember to send images as separate files (ideally jpgs) to the text of the reports as this improves the resolution of your fantastic research pictures.

c. *Webmaster (Andy Davies)

This year, we have largely been maintaining the status quo of the website, with no major additions except the interactive voting for the Canter-Lund competition, which we felt was a success. The Education and Outreach Committee will continue to use that system this year. We have also created a Council area on the website, with file uploads and folder creation to allow for archiving materials. In total 32 news articles were published online, and we have two posted events for 2022.

The January annual renewal process has gone well again, as it did in the last two years. Most annual renewals went through without a hitch, however, several renewals failed due to members not having the correct credit card details on PayPal and some members having issues with their Direct Debits. This year no complaints were received.

Our visitor statistics remain strong with over 3000 unique visitors per month and are 9,000 higher for 2021 over 2020 (figure on BPS reports page). BPS Algal Records remains under the Webmaster's control, total visitor numbers during 2021 were less than half that of 2020 (> 20,000). We had one bug report, and I could not replicate the user error.

7. Elections and Council Vacancies (Francis Bunker)

Council vacancies for 2022 were advertised in the autumn issue of the *Phycologist*. The number of candidates put forward did not exceed the number of vacancies and so the following positions were filled: (see Table 1)

A vote of thanks is given to the following retiring members of Council for all the work they have done for the society: Mariana Olivera, Joe Taylor, & Mahasweta Saha.

Also to Graham Underwood who ends his term as Immediate Past President, Chair of Awards and Training Committee & Royal Society of Biology (RSB) Representative.

8. Hilda Canter-Lund Prize

Congratulations to winner of best presentation Jaz Millar and best poster James Barrett. Also congratulations to highly commended presentation by Benedikt Schrofner-Brunner and poster by Larisa Lewis.

Table 1. Council vacancies for 2022

Position	Tenure	Name	Proposed	Seconded
President Elect	2 years	Saul Purton (University College London)	Graham Underwood	Jane Lewis
Ordinary member	3 years	Suzanne McGowan (Netherlands Institute of Ecology, NIOO)	Graham Underwood	Francis Bunker
Ordinary member	3 years	Jo Wilbraham (Natural History Museum)	Juliet Brodie	Francis Bunker
Ordinary member	2 years	Jessica Adams (Aberystwyth University)	Hilary Redden	Francis Bunker
Ordinary member	2 years	Pippa Moore (Newcastle University)	Jason Hall-Spencer	Francis Bunker
Ordinary member	2 years	Esther Hughes (Natural England)	Francis Bunker	Jason Hall-Spencer
Overseas President	2 years	Line Le Gall (Paris Natural History Museum)	Christine Maggs	Francis Bunker

9. Subcommittee reports

a) Awards and Training Committee (Graham Underwood)

The A&T Committee oversees the BPS bursaries and awards programmes. It is Chaired by the Immediate Past President. All the current BPS Council Ordinary Members are member and help to judge applications (3 plus Chair look at each round of applications). In the award year 2021, twenty-eight applications were successful, totalling £31,240 of the nominal budget of £50,000. Awardees were from both the UK and overseas, reflecting the international composition of our membership. The COVID-19 pandemic has significantly affected the ability of members to attend conference and courses, but numbers of application for bursaries increased compared to the 2020 award year. Two new schemes, a COVID recovery scheme, and an Algae-Video bursary scheme ran in December 2021. The Algal-video scheme will continue in 2022. Council has agreed to increase the value of Project and Conference Bursary awards from 2022 to reflect increased costs and to increase the attractiveness of our awards.

Equal opportunities monitoring for Awards and Training applications was adopted in 2021. The majority of applicants (and awardees) self-identified as white, heterosexual, and female, but there was some diversity in our application pool. There was no evidence of differential outcomes considering ethnicity, sexual orientation and age. Success rates for applicants identifying as female was 80%, for applicants identifying as male 67%. The Society will continue to collect these EO data over future rounds

b) Biodiversity and Conservation Committee (Martin Wilkinson)

Courses and Field Meetings: Almost all field meetings and courses postponed owing to Covid. Online alternative to freshwater course not accepted. FBA lab being investigated for 2022 freshwater course.

Seaweed identification course postponed to 16-20 May 2022 at Plymouth Univ Lab. Introductory and advanced sessions planned.

Freshwater field mtg joint with Quekett Microscopical Society ran well. Hoping to organise another at Betws-y-Coed.

Seaweed field mtg at St Andrews postponed for second time but the generous offer of labs from St Andrews University remains in place for 2022. Dates await Covid developments.

Publications: British freshwater algal flora reprinted. £152 per copy. DVD no longer included but images now on CUP website, with link to AlgaeVision for 1500 more images. 2800 copies sold. An article detailing taxonomic changes since 2nd edition is being prepared.

Long awaited brown seaweed book, Brown Seaweeds (Phaeophyceae) of Britain & Ireland by Bob Fletcher, is now expected from Pelagic Publishing on 15 July 2022 at £55 per copy. In BPS 70th anniversary year, this completes the founders' aim of a biological flora of all British seaweeds. Reprints of the other seven parts, previously published over several decades, have been produced by Pelagic Publishing. As well as the author, Bob Fletcher, great thanks are due to Juliet Brodie for much help with this.

Juliet Brodie is collaborating with Ruth Nielsen on an English translation of Danmarks Havalger, which will be of great use for identification of some British seaweeds.

European charophyte flora expected May 2022 from Springer.

Seasearch Seaweed guide recently reprinted with some nomenclatural updates.

Charophyte Red List for UK: Welsh list published 2020. Scottish and English lists at advanced stage. Irish list about to be started. Independent molecular work at NHM on charophytes should help.

Seaweed Red List: A detailed report on vulnerable seaweeds submitted to JNCC. This Quinquennial Review requires IUCN approach for higher land plants to be followed. This is not useful because of data deficiency with seaweeds and different ways of recording from that with land plants. This committee will meet to review approaches to get round this early in 2022. It is important that we devise ways to collect appropriate data on smaller species rather than just relying on headline changes in dominant kelps and rockweeds.

Conservation actions: introduced for some species can cause problems with conservation of other species. There are no rules to help clarify such situations. B&C committee will watch out for examples of this.

Freshwater Biological Association: FBA has vacated Windermere Laboratory. Parts of their archive, which include very valuable algal data, are proposed to be rehoused at NHM. The Fritsch Collection and David Williamson's Desmid Card Index have already been moved to NHM.

Seaweed Harvesting: B&C Committee continues to watch reports of use of natural seaweed populations to ensure that best practice is used to both conserve the seaweed resource itself and its natural ecosystem. Although the Scottish Government prohibited any immediate, large-scale harvesting of wild kelp populations in response to public representations (including BPS) a few years ago, there remains a question mark over approval procedures for seaweed harvesting in Scotland which is being followed up.

Maerl Beds: are a matter of conservation concern and Francis Bunker is following a case where they have been damaged in Milford Haven.

c) Algal Outreach Committee (Martyn Kelly)

Outward-facing activities of the BPS in 2021 included the Hilda Canter-Lund competition, a joint field meeting with the Quekett Microscopical Club (QMC), performances at the Green Man Festival and a new scheme to encourage members to make short films. The Hilda Canter-Lund competition was fully online for the first time, using "plug-ins" that enabled photos to be uploaded and Outward-facing activities of the BPS in 2021 included the Hilda Canter-Lund competition, a joint field meeting with the Quekett Microscopical Club (QMC), performances at the Green Man Festival and a new scheme to encourage members to make short films. The Hilda Canter-Lund competition was fully online for the first time, using "plug-ins" that enabled photos to be uploaded and BPS members to vote for their favourites. A social media campaign run by our student reps led to the largest field of entries (75) in the history of the competition and the winners were Sophie Steinhagen and Gerd Günther.

After the 2020 Green Man Festival was cancelled due to Covid we had hoped that the 2021.

Festival would go ahead as planned. Eventually, the Welsh Government gave the go-ahead just a month before gates were due to open. A few stressful weeks followed but myself and Thomas Andrade eventually performed twice in the Festival's science tent, showing Susi Arnott's Slimeworld videos and also used one of the BPS's new training microscopes to explore the algae of the River Usk. We also learned some valuable lessons on the practicalities of putting on events at festivals that we hope to take forward into 2022. A few weeks after Green Man, a group of BPS and QMC members met at Malham Tarn Field Centre for a weekend of microscopy in the Yorkshire Dales, with a focus on the cyanobacteria and desmid communities of the area.

Finally, in early December, the first outputs from the new Video Bursary Scheme were uploaded to YouTube and TikTok. These short films were made by BPS members under the tutelage of a professional film maker (Susi Arnott) and provide us with some useful resources for raising the profile of algae. We hope that we can learn from this first exercise and that this will become a regular fixture in the BPS calendar in the future.

d) Algal Applications Committee (Gill Malin)

The remit of the Algal Applications Committee covers all aspects of applied phycology from biotechnology through to the use of algae as bioindicators and the production of algal biomass for inter alia biofuels, food, feed, nutritional supplements, and various high value products. The general subject area of Applied Phycology seems to be continuing to gain momentum – the programme for the BPS annual meeting reflects this very well with sessions on Sustainable Food Systems and Blue Carbon. BPS welcomes Corporate Members and information can be found on the website https://brphycsoc.org/corporate-membership/. The BPS membership also benefits from Annual Meeting support kindly provided by various algae-related businesses e.g. this meeting has had support from Barti, Membranology (a spin out company of Swansea University), VariconAqua, and the BBSRC network AlgaeUK, and Taylor & Francis who publish the BPS journals. We thank them all for their support! Given that the overall aim is to foster stronger connections between the BPS and the commercial companies, public agencies and regulatory bodies that use or consider algae in their work, we welcome your ideas and suggestions for working together at any time. For example this could range from a suggestion for a special session at a future BPS Annual Meeting, a one-off meeting focussed on an applied phycology topic or an event that would inspire and help with the training of the next generation of applied phycologists from amongst the BPS Student Membership.

10. Federation Reports (* reports are available at https://brphycsoc.org/)

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

FEPS Website: https://www.facebook.com/FEPSalgae/

Next FEPS President: Prof Peter Kroth, University of Konstanz, Germany.

FEPS Publication: Feedback from the consultation of FEPS member societies has indicated that there is not a large interest in publishing a new phycological journal. The publication of the FEPS journal, Perspectives in Phycology, has been discontinued. It is planned to have discussion with the wider phycological community on future FEPS publication policy at the EPC8 meeting in Brest.

FEPS European Archive of Algal and Cyanobacterial Materials for Molecular Biology

Research (EURARCH): Progress continues on the construction of a database of collections of documented dried, archived algal and cyanobacterial materials throughout Europe, which are suitable and available for molecular biology and modern analytical biochemical analysis. Data on relevant collections from 64 herbaria and/or research groups have been obtained so far (from Belgium, the Czech Republic, Croatia, Greece, Italy, Macedonia, Poland, Spain and the UK) with further data awaited.

Discussions are in progress on the possibility of integrating the FEPS EURARCH database with that of the Distributed System of Scientific Collections (DISSCO) and EU infrastructures, whilst ensuring that the FEPS EURARCH retains high visibility on the FEPS website and ready access by FEPS members.

EPC8, the 8th European Congress, Brest, France, 2023: Feedback from the FEPS Council on the programme draft has been gathered and provided to the local EPC8 organisers.

It was pointed out that currently the only proposal for attendance is for this to be fully in person, with no option of online participation, whether by partial or full online attendance. FEPS Council has expressed concern about this and the matter is being pursued. It is being pointed out that many conferences are now providing some form of online participation (e.g. the International Seaweed Symposium also scheduled for 2023), and that online conference participation is consistent with the increasing wish to contribute to Climate Change mitigation efforts

b) Federation of European Microbiological Societies (FEMS) (Anne Jungblut)

FEMS council meeting and AGM was held online on the 3rd of September 2021. FEMS Conference on Microbiology to be held in Belgrade, Serbia, from 30 June to 2 July 2022: https://www.femsbelgrade2022.org/preliminary-programme. BPS special topic session "Diversity and ecology of aquatic phototrophic biofilms revealed interdisciplinary approaches and modern 'omics techniques" confirmed for the 10th Congress of European Microbiologists (FEMS2023, 9 – 13 July 2023, Hamburg, Germany). Invited speakers Graham Underwood (University of Essex, UK), Peter Kroth (University of Konstanz, Germany), Bente Bengtsson (University of Greifswald, Germany). FEMS offers grants for research and training, industry placement, meeting organizers, meeting attendance and FEM congress attendance: https://fems-microbiology.org/about_fems/network-and-activities/grants/.

c) Royal Society of Biology (RSB) (Graham Underwood)

The BPS is a full organisational member of the Royal Society of Biology (RSB). The RSB is a single unified voice for biology: advising Government and influencing policy; advancing education and professional development; and encouraging public interest in the life sciences. We receive various notifications of events and training, which are passed to Council member and Society members where appropriate. Events are mainly based in London. The BPS will remain a member of the RSB in 2022.

11. Future Annual meetings

University of Newcastle-Upon-Tyne, January 2023.

BPS Student Bursaries

70th Annual Meeting of the British Phycological Society

Submitted by Hannah Kemp

Department of Geography, University of Nottingham, hannah.kemp@nottingham.ac.uk

I am in the third year of my PhD with Envision DTP, based in the Geography department at the University of Nottingham and working in partnership with the National Trust. This was my 3rd BPS annual meeting and I continue to be amazed every year at just how varied the field of phycology is. I am very grateful to the BPS student bursary scheme for funding my ticket for this conference.

After being on the organising committee for last year's meeting "in" Nottingham, I can only imagine the hard work (and probably a fair amount of stress) the Swansea team had, moving the conference entirely online at the last minute due to the rising COVID cases pre-Christmas. However, they did a FANTASTIC job, alongside the Infohackit team of Lucy and Peter Moore-Fuller, in designing a virtual conference environment in the online platform, Gather Town. All in all, the meeting was attended by over 125 delegates, we listened to 39 talks, saw 19 posters, heard 4 keynote and invited speakers, and shared 1 public outreach lecture!

The start of the meeting saw us picking our cartoon avatars (some with fairy wings or top hats) to explore the virtual conference venue, followed by the presidential address from Jason Hall-Spencer given from Swansea itself. The special themes for this meeting were Blue Carbon and Sustainable Food Systems, alongside the General Phycology session. There were many really interesting talks, demonstrating the breadth of algal research, including its importance within industry, and in tackling big world problems such as food security and climate change. I was particularly impressed with the standard of the student presentations at this meeting. Jaz Millar was the deserving winner of the Manton prize for their talk titled '*Polar cryoconite associated microbiota is dominated by hemispheric specialist genera*'.

Prof Pippa Moore and Dr Dan Smale gave the BPS public lecture on spectacular kelps and the effect of climate change on these invaluable habitats. The lecture was attended by over 70 members of the public and has been viewed by another 140 on the BPS YouTube channel. Check it out here: https://www.youtube.com/watch?v=k6gC7nclvPU.

The poster session worked brilliantly in the Gather Town environment. The virtual poster hall allowed delegates to wander around posters and chat with the researchers about their work in real time. This was possibly one of the hardest aspects of a conference to emulate in a virtual setting – no drinks and nibbles?! However, some highlights for me were: talking to Sarah Read about toxic elements of *Cladophora*

and her Instagram algae outreach (@seaweeds_and_slimes); catching up on Eleanor Wood's research into biorefinery methods on the Rhodophyte *Porphyridium aerugineum*; and finding out about the dynamic carbon-fixing organelle in *Ulva* from the Manton prize poster winner James Barrett.

I also gave an oral presentation in the General Phycology session about my PhD research on nuisance macroalgae blooms that grow in shallow freshwater lakes. The need to understand and control blanket weed blooms is a pressing water management concern, due to the negative ecological and economic impacts these blooms often have on freshwater bodies. It was a great experience to be able to share some of the data I have been collecting over the last 12-months, as part of a limnological monitoring programme on the lake at the National Trust's Clumber Park, Nottinghamshire. My findings at Clumber indicate that nutrient rich water from the inflowing River Poulter provide the perfect prerequisite conditions for prolific blanket weed growth in the warm summer months. However, the dynamic movement and bloom formation of the macroalgae are likely be correlated with light availability – my next research steps!

Although we may not have been dancing a Cèilidh as is BPS tradition, it wouldn't be a BPS annual meeting without a "knees up". Not only did Peter and Lucy from Infohackit create the amazing online space for this conference, they also put together a devilishly hard quiz – I expected nothing less, having done one of their quizzes before! After 5 rounds involving deciphering songs from lyrics put through a thesaurus, matching the movie to its colour chart, and map reading maths, "The Good, the Bad and the Algae" took the prize (although they could have won with just their team name)!

Finally, I would like to extend a massive THANK YOU to the Swansea organising committee for putting together a brilliant annual meeting. Another thank you goes to the members of the BPS council; thanks to those members stepping down from roles and a welcome to those taking on new roles. I am really looking forward to *fingers crossed* seeing everyone in person and sharing the algae love in Newcastle 2023!

BPS Conference: Swansea via Gathertown

Submitted by Sophie Corrigan

Biosciences, University of Exeter, sc718@exeter.ac.uk, @SeaweedSoph

This year the British Phycological Society annual meeting was successfully hosted by the University of Swansea from the 4th to 7th January 2022. This year the conference was online, and hosted in a virtual reality called GatherTown where we could design our own avatars and interact with other participants in an online meeting space.

Each day of the conference had a different theme, including General Phycology, Blue Carbon and Kelp, and Sustainable Food Systems, which was the session I presented my research in. I gave a talk entitled "Understanding the development and diversity of successional epibiont fouling communities on the cultivated kelp *Saccharina latissima*", which presented some of the research from my second and third PhD chapters. I am currently a third year PhD student at the University of Exeter and I work in close collaboration with the Marine Biological Association and Cefas. This research was conducted at an integrated seaweed and mussel farm in Cornwall with the Cornish Seaweed Company and West Country Mussels of Fowey farmers. We monitored the development and diversity of successional epibiont fouling communities on *Saccharina latissima* from the farm and compared its epibiont assemblages to neighbouring wild kelp populations. We found an increase in epibiont abundance and diversity on cultivated kelps over and beyond the course of the growing season, reaching an average of >6000 individuals per kelp in August 2020. Assemblages on cultivated kelps were dominated by amphipods, bivalves and bryozoans, which, despite their

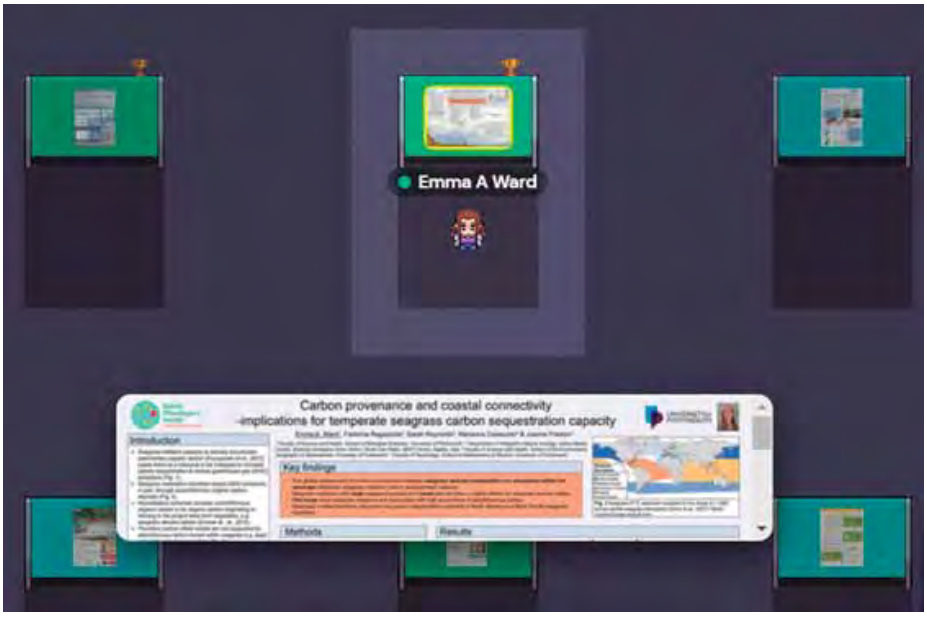
important roles in bioremediation and provisioning of food for higher trophic species, currently dictate the duration of the harvesting season, due to their detrimental effects on crop quality. Wild kelps hosted fewer epibionts comparably, but had a higher species diversity, due to a lower abundance of amphipods. Further work will investigate how macroalgal farms may be designed to maximise their habitat value potential, while optimising crop yield for farmers as a leading example of sustainable ecosystem-based aquaculture.

Despite not being able to meet in person, I thoroughly enjoyed the conference and thought the online format was excellently organised by the University of Swansea, especially given it was such a last-minute change for them to overcome. The talks were of an excellent standard and showed the great diversity of research into the algal world from the UK and beyond. I particularly enjoyed the online gallery, which shared photos and artwork from attendees. I am already looking forward to the next meeting in Newcastle!

Talking blue carbon and seagrass at the BPS Annual meeting

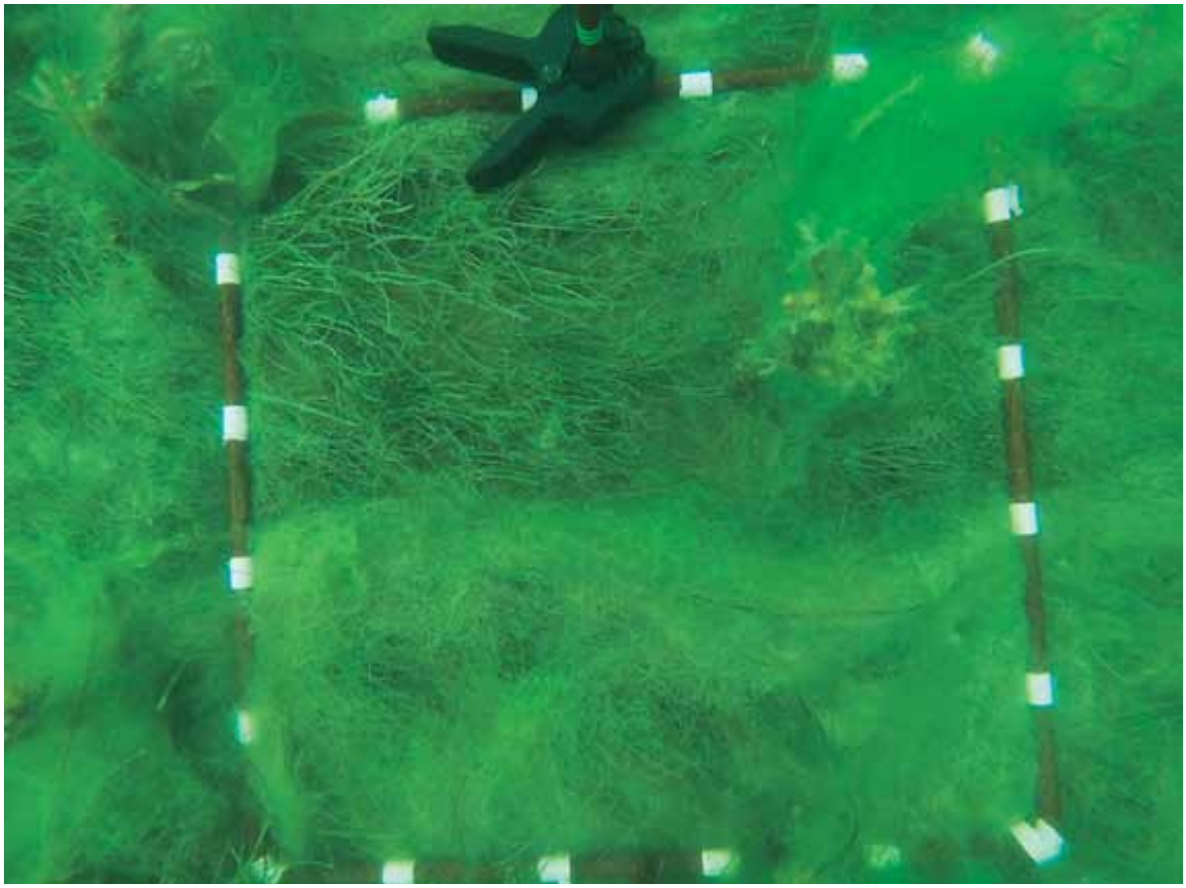
Submitted by Emma A. Ward

Institute of Marine Conservation, University of Portsmouth, emma.ward@port.ac.uk



I was particularly interested in attending the BPS annual meeting because of the planned blue carbon special session and, as such, for the opportunity to discuss with like-minded people about blue carbon science. Although my work primarily focuses UK seagrass habitats, it was great to engage in blue carbon discussions at BPS with others from a more algal perspective, as there were many synergies in thoughts behind the carbon accreditation process.

The gather town environment was a new conference experience for me, it was a great online environment for starting impromptu conversations, and I found it particularly effective during the poster sessions. I was presenting a poster titled 'Carbon provenance and coastal connectivity -implications for temperate seagrass carbon sequestration capacity'. This enabled me to showcase a global review and meta-analysis I had undertaken regarding



carbon provenance in seagrass sediments. This sparked some great conversations about some of the unknowns in blue carbon science such as accumulations rates, carbon provenance and permanence, things which seem to apply to both algal and seagrass UK carbon debates.

My poster focused on distinguishing patterns behind the proportions of autochthonous to allochthonous carbon globally in seagrass sediments. It found that seagrass meadows in the North Atlantic and North Pacific dominated by mid-range seagrass species, have the highest proportion of allochthonous carbon from adjacent habitats. Therefore, temperate seagrass meadows from within these bioregions such as the *Zostera* spp. dominated meadows found within the UK likely have a high affinity for allochthonous carbon from adjacent habitats. This demonstrates that having an awareness of their placement within the coastal landscape and adjacent habitats such as those dominated by algae and saltmarsh is important to seagrass carbon storage potential. This has made me think in a broader context, and the BPS annual meeting was great for widening my horizons to form discussions more focused on other habitats, namely algae.

I would like to thank the British Phycological Society for awarding me a student grant to attend the BPS annual meeting online. After having such an enjoyable experience at the online BPS meeting this year I am aiming to join the next annual meeting in person, where I can hopefully present some of my upcoming work; mapping seagrass beds and algal matts.

70th BPS AGM: An introduction to scientific conferences

Submitted by Bronwen Paxton

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As an MRes student, the 70th British Phycological Society Annual General Meeting was a fantastic introduction into the world of scientific conferences. I was welcomed to the society during the informal ice breaker where I was immediately put at ease. Despite my research focussing on seagrass, I quickly found common ground with other members early in their scientific careers.

The gather town environment was an excellent substitute to the in-person aspect of the conference and maximised interactions. I have suggested the interface be used within my university for online activities. I found the wide range of talks engaging and interesting to find out about the latest developments in research. I particularly benefitted from watching the presentation techniques, and how the science was being presented and communicated to an audience. I look forward to using the approaches and styles used and applying them to my own scientific communication. The Blue Carbon and Kelp Ecology session broadened my knowledge of the movement of carbon through other marine habitats.

I presented a poster based on my research for my MRes course entitled "*Assessing the Blue Carbon Potential of Seagrass Restoration in the UK*". I spoke about my progress within the Solent Seagrass Restoration Project, where

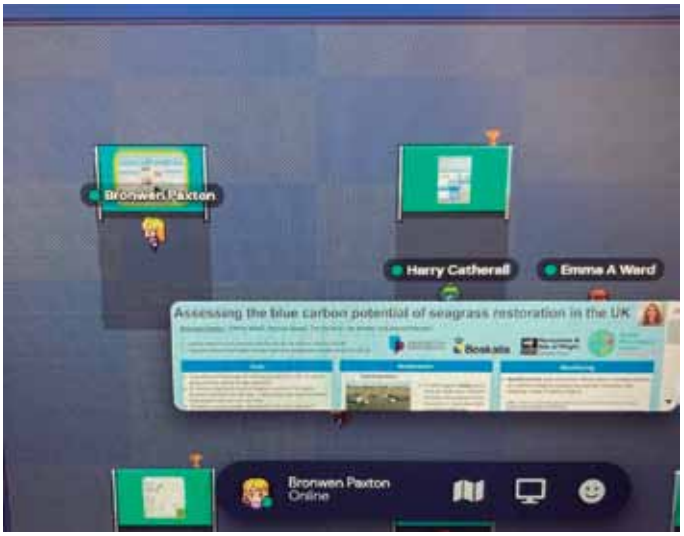

Figure 1. The Gather Town poster session environment

21,000 *Zostera noltii* seeds have been planted in a degraded intertidal mudflat in Farlington Marshes. The seeds were rotted from existing blades sourced locally and processed at the Institute of Marine Sciences, Portsmouth. The processed seeds were bagged in degradable Hessian and deployed in December 2021 at two sites. These restoration sites will be monitored in Spring and Summer to assess growth. With the aim of successful restoration, the carbon capture potential of the developing seagrass will be assessed during summer 2022. I will then investigate the applications of this potential in climate change mitigation. I enjoyed discussing my research with like-minded people who shared an interest and drew parallels with algal blue carbon. The online poster session provided me with a great introduction to presenting at conferences and building confidence.

I am grateful for the generosity of the British Phycological Society for awarding me a grant to attend the BPS Annual meeting. I hope to attend the 2023 Annual meeting and look forward to discussing my completed research in person.

Figure 2. The completion of a baseline survey of a reference seagrass meadow (high intertidal zone pictured) to be compared to the restored seagrass.

Figure 3. Hessian bags filled with 15/30 seeds of *Zostera noltii* ready for planting. The hessian bags prevent predation from crabs and will eventually degrade.

Are non-cosmopolitan species of the coastal, Dinoflagellate genus *Tripos* better monitors of global warming than cosmopolitan species?

Submitted by Michael W. Marshall

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The aim of this study was to examine the proposal [1,2] that the sensitivity of the *Tripos* genus to sea surface temperature (SST) makes it a relevant genus for monitoring the effects of global warming and its potential devastating effect on algal blooms, biodiversity, and water masses. There is an established biogeographical distribution associating different *Tripos* species with different oceanic SSTs [3,4,5,6,7,8,9], despite there being extensive intra-species morphological variability. One key temperature-dependent biogeographic analysis [4] divided the North Atlantic and adjacent seas into six biogeographical zones (from Arctic to Warm/Tropical, a 2 °C to 30 °C range) and concluded that mean SST was the most important factor in species zonal distribution. Also five "cosmopolitan" species were identified [4], three of which - *T. furca, T. fusus* and *T. muellerii* - are known to cause serious ecosystem stress by forming harmful (discolouration and hypoxic), algal blooms.

As global warming causes SST to rise, "non-cosmopolitan" warm/tropical Tripos species could be expected to expand their biogeographical range into higher latitude, colder waters. To test this hypothesis a diversity analysis was carried out within and between Tripos species at different latitudes from 2010 to 2019 inclusive, over a SST range of ca.15 °C and at 49 different coastal locations in four countries: the high latitude, cold/temperate waters of Chile and Scotland's west coast; and the low latitude, warm/tropical coastal waters of Belize and Thailand. A sub-surface, 53 µm mesh, plankton net, (filtering c.5 cu. m. of water at each site) was towed in optimal growth seasons and at similar times of day. SST was measured using a temperature and a bucket and it was well correlated with the average SSTs that have been recorded at the sites over several years [10]. Mature cells were identified from unstained photomicrographs, classified into one of their temperature-dependant, six biogeographical Groups [4,8], and cell width, length and antapical horn span (but only in cells where the antapical horns curved towards the apical horn) were carefully measured. Cell width is the most reliable of all these measurements as broken horns, undulating focal planes and cell debris compromise span and length measurements.

As found for oceanic waters species, diversity increases with increased coastal SST, however, non-cosmopolitan species from the cold/temperate coastal waters of Chile (21 sites, 10 species) and the west coast of Scotland (16 sites,

Table 1a: *T. furca* var *eugrammus*

*Statistically significant difference (P<0.05; two-tailed, unpaired t-test) between mean cell body width in between sites at 18.4 °C and 14.4 °C. Assuming a linear relationship there is a 2.3% fall in mean cell body width per 1°C increase in SST.

**The average of the tropical cell body widths compared to the Scottish mean cell body width gives, for a 15°C SST range, a 1.96% fall per 1 °C increase in SST - a similar result for a 4°C SST range within Chilean waters. There is also appears to be an inverse relationship between cell length and SST. A similar inverse relationship between cell width and SST probably exists in cosmopolitan species, but non-cosmopolitan cells are easier to measure as they are less variable, more abundant and robust, and less liable to sampling damage than the more flamboyant cosmopolitan species.

Region	Sites: Lat. Long.	Body width (µm)	Cell length (µm)	SST (°C)
Temperate/Cold	**Chile (actual sites)**			
	30 13.2S 71 30.6W	44.80±3.96 (n=5) *	229.55±16.27 (n=20)	18.4
	39 14.0S 73 46.4W	49.45±4.06 (n=11)	234.36±14.42 (n=11)	15.4
	41 50.7S 73 20.7W	49.50±3.73 (n=15) *	232.50±16.06 (n=6)	14.4
	Scotland			
	55.52.04N 05 23.25W	42.23±4.82 (n=40) **	224.93±34.17 (n=40)	13.5
Tropical	**Belize/Gulf Honduras**			
	17 29.32N 88 10.04W	27.53±5.33 (n=21) **	166.14±45.11 (n=21)	28
	Thailand			
	07 50.51N 98 28.30E	32.14±2.60 (n=14) **	203.79±12.79 (n=14)	29

Table 1b: *T. fusus*

At a SST of ca. 14°C the average of all Chilean body widths is 26.37 µm, similar to the Scottish widths of 25.85 µm. Averaging Belizean and Thai width means gives 19.61 µm and when compared to a mean Scottish cell body width of 25.85 µm gives an average fall of 1.61% mean cell body width per 1 °C increase in SST. Cell lengths are more difficult to compare as cells are long, spindly and easily broken.

Region	Sites: Lat. Long.	Body width (µm)	Cell length (µm)	SST (°C)
Temperate/Cold	**Chile (actual sites)**			
	41 50.7S 73 20.7W	26.57±2-30 (n=7)	312.14±13.89 (n=7)	14.4
	42 36.1S 73 23.1W	25.83±2.72 (n=8)	285.38±22.61 (n=8)	14.4
	42 43.4S 73 29.3W	28.33±3.98 (n=6)	307.00±39.97 (n=6)	14.4
	42.37.5S 73 13.5W	24.75±1.71 (n=4)	323.00±25.31 (n=4)	14.4
	Scotland			
	55.52.04N 05 23.25W	25.85±4.14 (n=62)	399.53±42.07 (n=62)	13.5
Tropical	**Belize/Gulf Honduras**			
	17 29.32N 88 10.04 1W	20.63±2.75 (n=6)	532.91±104.20 (n=6)	28
	Thailand			
	07 50.51N 98 28.30E	18.59±2.24 (n=27)	376.52±47.77 (n=27)	29

Table 1c: *T. muellerii* var *atlanticum*

Chilean cell body width appears to be falling over a over ca. 4°C SST rise 4°C. Scottish and Chilean cell widths were similar at ca. 4°C SST. Scottish mean cell body width compared to Belizean over a 15 °C increase in SST range, gives a 0.7% drop a percentage fall, but less than that obtained for *T. furca* and *T. fusa*. Note: *T. muellerii* is a large cell with very variable morphology, also length and span measurements are subject to error as its apical horns are long, delicate, and easily broken.

Sites: Lat. Long.		Body width (µm)	Cell length (µm)	Cell span (µm)	SST (°C)
Temperate/Cold	**Chile (actual sites)**				
	30 13.2S 71 30.6W	73.33±6.04 (n=20)	229.55±16.27 (n=20)	163.00±11.34 (n=20)	18.4
	39 14.0S 73 46.4W	76.47±4.46 (n=19)	227.26±24.89 (n=19)	154.00±44.75 (n=16)	15.4
	41 50.7S 73 20.7W	76.33±7.13 (n=15)	220.73±11.15 (n=15)	146.60±12.97 (n=15)	14.4
	41 39.1S 73 01.6W	75.30±4.90 (n=10)	196.90±13.25 (n=10)	172.00±10.49 (n=10)	13.7
	Scotland				
	55.52.04N 05 23.25W	74.87±5.18 (n=60)	217.52±22.07 (n=60)	153.78±15.43 (n=55)	13.5
Tropical	**Belize/Gulf Honduras**				
	17 29.32N 88 10.04W	67.00±6.86 (n=36)	222.30±25.39 (n=33)	172.21±11.60 (n=19)	28
	Thailand				
	07 50.51N 98 28.30E	55.00 (n=1)	271.00 (n=1)	173.00 (n=1)	29

7 species) were not readily classified into discrete, biogeographical groups - classification ranged from Groups 1-6 - Arctic to Tropical. Similarly in the coastal, tropical waters of Belize (9 sites, 27 species) and Thailand (3 sites, 16 species) biogeographical group classification ranged from Groups 3-6 - Intermediate to Tropical/Warm. The temperature range of each of the six groups is large (2 to 20 °C) compared to the small changes of SST (1.2 to 3.2 °C) due to global warming that are predicted to occur by 2100 [11] Thus the temperature-dependent biogeographical distribution of coastal, non-cosmopolitan species of the *Tripos* genus, is probably not sufficiently stenothermic to be an effective biological monitor of global warming, unlike, as proposed here, the more eurythermal, cosmopolitan species T. *furca, T.fusus, and T. muellerii*. In cold, high latitude waters these cells are large and more robust compared to those in lower latitude, warmer waters (Fig. 1) and, as shown in the following Tables 1a-c, their cell width, the most reliable of cell measurements, is inversely correlated with an increase in SST. Tables 1a-c give a summary of mean of cell body width, length and, where appropriate, span, along with standard deviations (±SD) and observation numbers (n) for the four countries and the latitude and longitude of their respective sampling sites.

In conclusion Tables 1a-c show that, paradoxically, the coastal, [cosmopolit] species are probably best for monitoring global warming as they are more abundant, robust, easily identifiable, least variant, exhibit visual changes in temperature-dependent cell morphology and show a quantifiable, inverse correlation between SST and cell body width. The relationship is most marked and quantifiable in *T. furca* var *eugrammus* and *T. fusus* and similar to results for cell volumes (2.5% °C -1) found in protists [12]. The relationship is irrespective of a climate induced increase in SST having either a direct or indirect effect on cell body width, but does not rule out that an increase in SST will not trigger measurable phenotypic plasticity and/or adaptive evolutionary changes.

References:

1.Tunin-Ley, A., & Lemee, R. (2013) Microorganisms, 1, 58-70.

2. Hays, G. et al. (2005) Trends Ecol. Evol., 20 (8), 337-344.

3. Sournia, A. (1968) Vie et Milieu, 18, 375-499.

4. Dodge, J., & Marshall, H. (1994) J. Phycol., 30, 905-922.

5. Gómez, F. (2005) Acta. Bot. Croat.., 64, 129-212

6. Semina, H., & Levashova, S. (1993) Int. Rev. ges. Hydrobiol. Hydrogr. , 78, 243-262.

7. Marshall, M. W. (2016) Harmful Algal News, 53, 12-13.

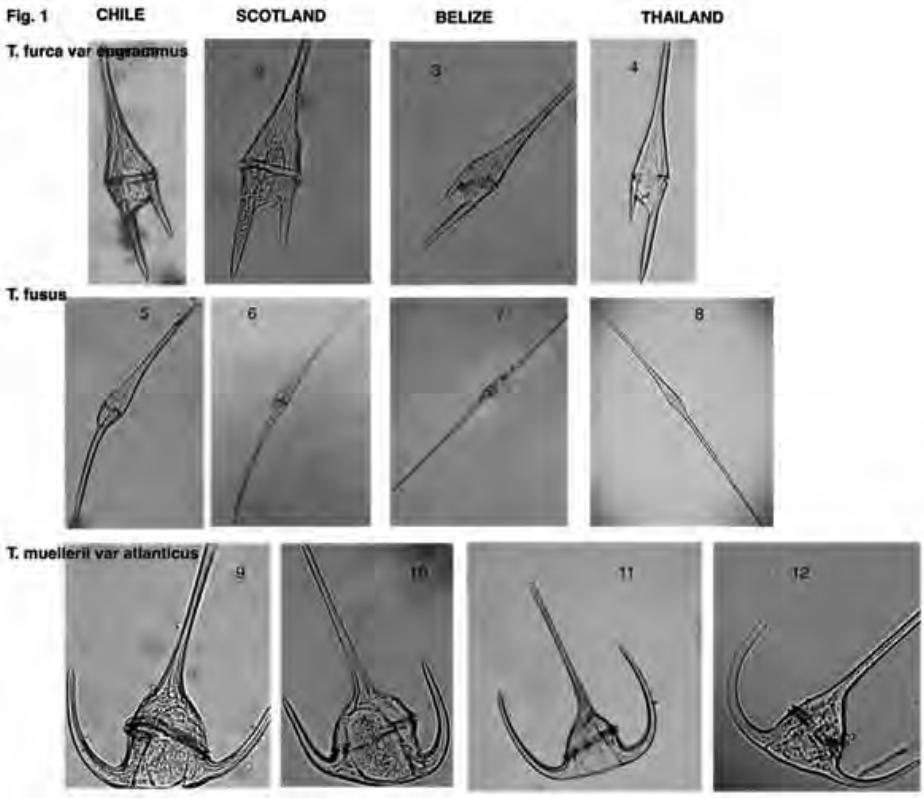
8. Hallegraeff, G. et al. (2020) *Tripos* dinoflagellates as indicators of Australian marine bioregions. State and Trends of Australia's Ocean Report. Internet: www.imosoceanreport.org.au.

9. McDermott, G., & Raine, R. (2006). The Dinoflagellate genus *Ceratium* in Irish Shelf Seas. Martin Ryan Institute, Galway. viii + 1-86.

10. Internet site: https://www.seatemperature.org

11. Genner, M. J., Freer, J. F. & Rutterford, L. A. (2017). Biological Response to Ocean Warming. www.gov.uk/go-science

12. Atkinson, D. et al. (2003) Proc. R. Soc. Lond. B. (270) 2605-2611



BPS Funded Research

Molecular identity and systematics of foliose monostromatic green algae in the Baltic Sea

Submitted by Dr Sophie Steinhagen
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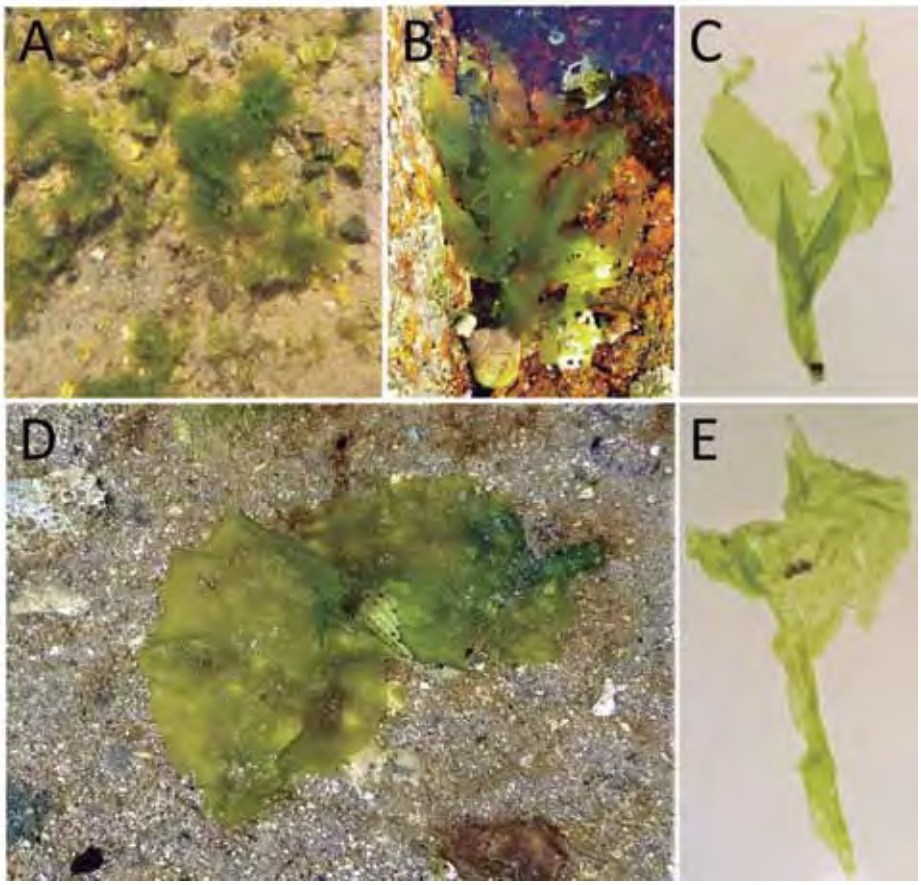
Green algae of the orders Ulvales and Ulotrichales are main components of the benthic flora of the Baltic Sea region. Several species encompass a high tolerance towards abiotic factors, such as salinity, and occur in the high salinity waters of the Skagerrak as well as in the innermost parts of the Baltic Sea where the salinity nearly reaches freshwater state.

However, the identification of certain green macroalgal genera is notoriously difficult due to their morphological instability, which is attributed to variation in salinity, nutrient concentrations, and bacterial associations, as well as to an elevated tendency for mutagenesis.

Especially monostromatic green algae (consisting of a single cell layer) are poorly known in the Baltic Sea region and molecular investigations on their taxonomy, and thus systematic studies are widely lacking. Two species of the genus *Monostroma* were previously reported to occur in the Baltic Sea: the cosmopolitan *Monostroma grevillei* (Thuret) Wittrock and a proposed endemic species, *Monostroma balticum* Wittrock.



Overview about the morphology of selected monostromatic green algae of the Baltic Sea. A-B) Shows wild populations of *Monostroma grevillei* and C) a close-up of a single thallus. D-E) shows monostromatic thalli of *Ulva intestinalis*, which are morphologically overlapping with *M. grevillei* and *Monostroma balticum*.

M. balticum is currently only known from the Baltic Sea basin. However, previous studies have highlighted the unclear taxonomic status of this species, and some studies consider it an ecotype of the cosmopolitan species *M. grevillei* or a monostromatic growth form of an *Ulva* spp.. *M. balticum* is described free-floating and is found typically later in the season in the Baltic Sea, often producing abundant mass accumulations, in contrast to the early-season substrate-attached *M. grevillei*. Micromorphological characteristics are very plastic in both taxa and in practice very difficult to use in specimen identification. However, based on growth form and phenology, field phycologists in the region acknowledge the two taxa traditionally as distinctly different.

Until date, no molecular evidence exists of *M. balticum*, and the morphological characteristics distinguishing this species from *M. grevillei* and similar species are dubious at least. An exact identification of *M. balticum* gets further complicated by the absence of a clearly designated type specimen. Despite the absence of a type voucher, the existence of many exsiccates – which have been sent to different herbaria worldwide by the species author Wittrock himself – could yield first insights into the unclear taxonomy of *M. balticum*. Using museomics we aim to verify the identity of the taxon initially described by Wittrock, and if necessary, a molecularly confirmed lectotype could be designated among these specimens.

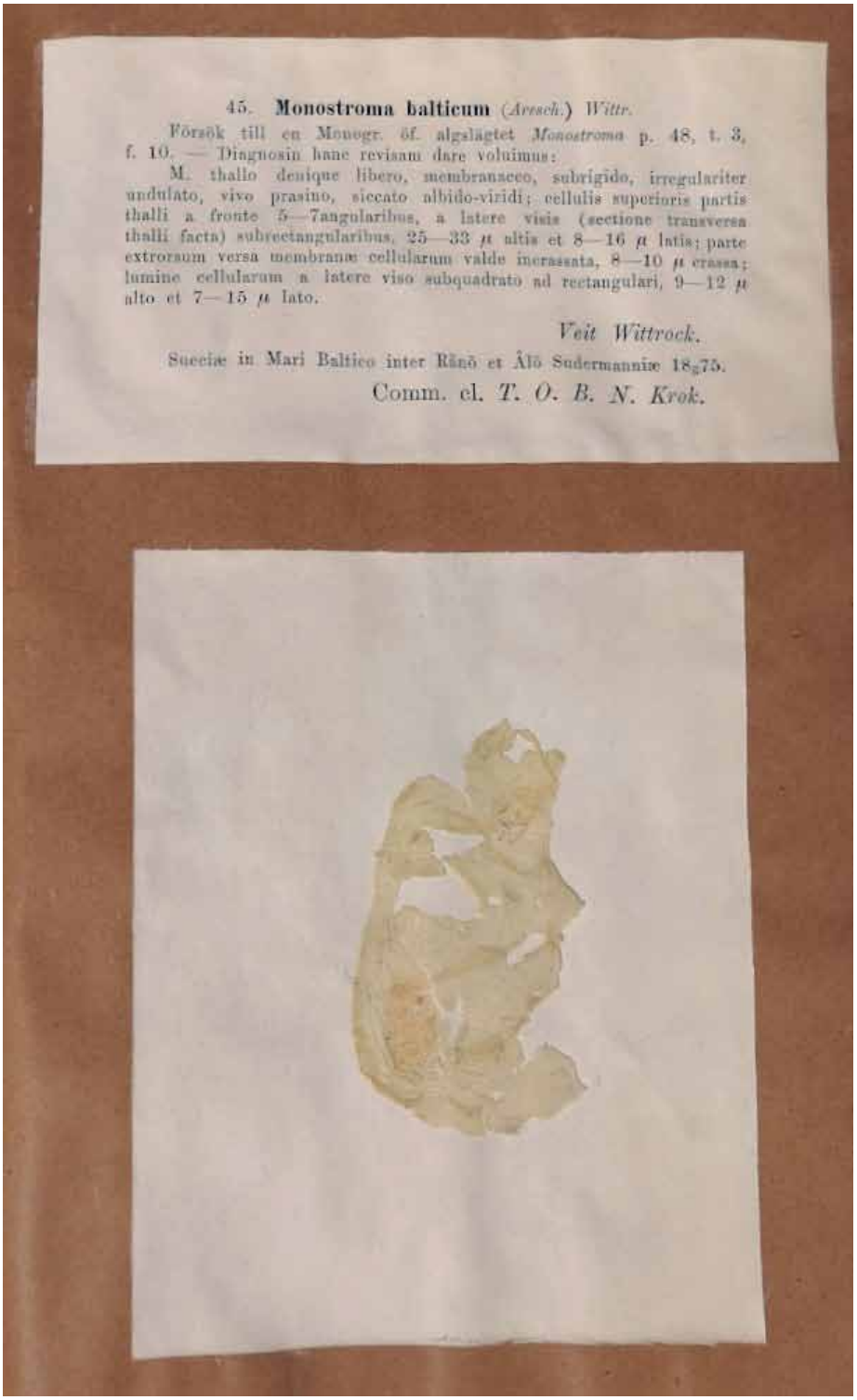
In a collaborative effort, researchers from the University of Gothenburg (Dr. Sophie Steinhagen) and from the University of Helsinki (Niko Johansson, Dr. Jaanika Blomster) aimed to assess the biodiversity of foliose monostromatic

green algal species of the Baltic Sea, and clarify the unclear taxonomic status of the allegedly endemic *M. balticum.*

Therefore, a sample set of recent specimens collected along the whole salinity gradient of the Baltic Sea in 2019/2020 was used in a DNA barcoding approach, which allowed for the molecular identification of the collected specimens. With the COVID 19 recovery award of the BPS we were furthermore able to circumvent the strong travel restrictions, which limited sampling efforts of fresh material in 2021, and a collection and molecular analyses of valuable herbarium specimens was supported by covering costs for Next Generation Sequencing (NGS) efforts.

With the combination of morphological and molecular data we were able to verify the presence of *M. grevillei* in the Baltic Sea region (as low as a salinity of 5 PSU). As already suggested in the literature, *M. grevillei* was predominantly found in spring and only rarely in early summer. Even though our sampling was performed at a large geographic scale, spanning the whole Baltic Sea region and including samplings at different seasons along the Swedish, Finnish, and German coasts, genetic evidence of *M. balticum* is still lacking. Notably, monostromatic individuals collected in spring from the Baltic proper were molecularly identified as *M. grevillei*, whereas individuals collected during summer with a similar monostromatic morphology, were allocated to *Ulva intestinalis* using DNA barcoding. First results therefore hint towards a mis-application of the name *M. balticum* towards morphologically similar species within the same genus but show also an overlap with aberrant morphotypes of species from other genera, such as *Ulva*.

Currently, we apply a NGS approach to be able to retrieve genetic data from historical *M. balticum* vouchers collected by Wittrock and other renown phycologists – such as Häyren, Ravanko and Elfving – whose extensive algal collections contribute a valuable resource to today´s biodiversity studies and are helpful in revealing taxonomic relations. With the help of full plastid genome sequencing we are aiming to be able to close the knowledge gap and reveal the systematics and taxonomic relations of *Monostroma balticum.*


45. **Monostroma balticum** (*Areschoug*) *Wittr.*

Försök till en Monogr. öf. algslägtet *Monostroma* p. 48, t. 3, f. 10. — Diagnosin hanc reviam dare voluimus:

M. thallo demique libero, membranaceo, subrigido, irregulariter undulato, vivo prasino, siccato albido-viridi; cellulis superioris partis thalli a fronte 5—7angularibus, a latere visis (sectione transversa thalli facta) subrectangularibus, 25—33 μ altis et 8—16 μ latis; parte extrorsum versa membranæ cellularum valde incrassata, 8—10 μ crassa; lumine cellularum a latere viso subquadrato ad rectangulari, 9—12 μ alto et 7—15 μ lato.

Veit Wittrock.

Succiæ in Mari Baltico inter Rånö et Ålö Sudermanniæ 18/7 75.

Comm. cl. *T. O. B. N. Krok.*

Historic exsiccate of *Monostroma balticum* collected by the phycologist Veit Wittrock in the Baltic Sea in 1875.

Acknowledgements: We would like to express our thanks to the herbariums at the Finnish Museum of Natural History (H), Lund University (LD), University of Turku (TUR), Swedish Museum of Natural History (S) and Muséum National d'Histoire Naturelle (PC), for their close collaboration and granted access to voucher specimens used in our study. We thank Péter Poczai for the help with data analyses and his support of applying NGS to historic vouchers.

Study of cyanobacterial behaviour in large-scale application of photosynthetic biomineralized engineered living material

Submitted by Prantar Mahanta Tamuli

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I believe it would perhaps be most ideal if I write this report as a continuation of the earlier one that was published in the 100th issue of *The Phycologist*. The context, the objectives of this investigation and the events that unfolded were ensuing outcomes of what was already under development. So, this may very well be considered as 'report part 2' of the engineered living material research with filamentous cyanobacteria. And in that sense a brief recapitulation would be fitting to start with.

In my earlier report I had talked about how my interest in sustainable design, love for biology and an interdisciplinary area of study at the Bio-Integrated design program at UCL, brought me to a path leading to un-charted territory of applying phycology for architectural construction. I was most fascinated by stromatolites; growing, living biomineralized rock like formations made by cyanobacterial communities. And I was interested in answering whether we could adapt the same process to construct our built environment. The most significant challenge was that in nature stromatolites grow one micro biofilm layer at a time and therefore take hundreds of years to grow. By studying the growth behaviour of the chosen model filamentous species *Oscillatoria animalis* (Fig. 1), we were able to devise a hydrogel composition that acted as a volumetric scaffold for the biofilm. This enabled the cyanobacteria to induce biomineralization in a cross-sectional volume embedded with inert aggregates. Working under the supervision of Dr Brenda Parker and Prof Marcos Cruz, I was able to develop the first small-scale prototypes of a new carbon-negative building material with this technique. This material could be classified as an engineered living material (ELM) which are new generation materials whose properties are determined by living cells. This research was shared in the 69th BPS annual conference and was subsequently awarded the Manton prize. This report is a documentation of the work and research that followed thereafter.

My next set of goals thus came to be dictated by three different broad factors. The first was of course the scientific ideal. And that is to simply ask how this technique can be further refined to make it more robust and pragmatically applicable. One of the primary advantages of engineered living materials is bio-programmability and that is by modulating the factors that the living cells respond to; the output properties of the material can be programmed. In the case of this ELM, *Oscillatoria animalis* is known to exhibit strong phototactic and chemotactic behaviour as a response to varying light intensity and wavelength and chemical gradients. And it is evident that if the growth of the biofilm could be deliberately directed inside the hydrogel scaffold by appropriate light

Figure 1. *Oscillatoria animalis* species deposited and now available at the CCAP culture collection

or chemical stimuli, one could achieve designed sections of bio-mineralization within the ELM. However, I was conducting this research under the scope of a two-year master's programme, so the second broad factor was to address the pre-defined academic objectives of the degree. In the case of Bio-Integrated design our final project was to visualize a collaborative and interdisciplinary architectural proposal and prepare models and prototypes for a public exhibition. And for my work, this meant testing the scalability and fabrication processes of this ELM. And finally, as UCL came to know about the Manton prize, the research attracted the attention of UCL-B, a body associated with protecting and commercializing novel technologies developed within UCL. And they reached out to discuss a potential patent for the technology. And for them to be able to do so, some preliminary evaluation of the properties of the ELM was important.

Using photosynthetic cyanobacteria to biomineralize a construction material is not a conventional process. Therefore, to pursue any of the above-mentioned goals, there were no standard methods to refer to nor were there any dedicated equipment available. It was obvious that any further development would require some trial and error. And that is why we decided to apply for the BPS project awards.

And having been approved of the funds, we spent the first month of June into planning and strategizing. Our first task was to prioritize the objectives. We decided to tackle first what we would have otherwise considered as the most

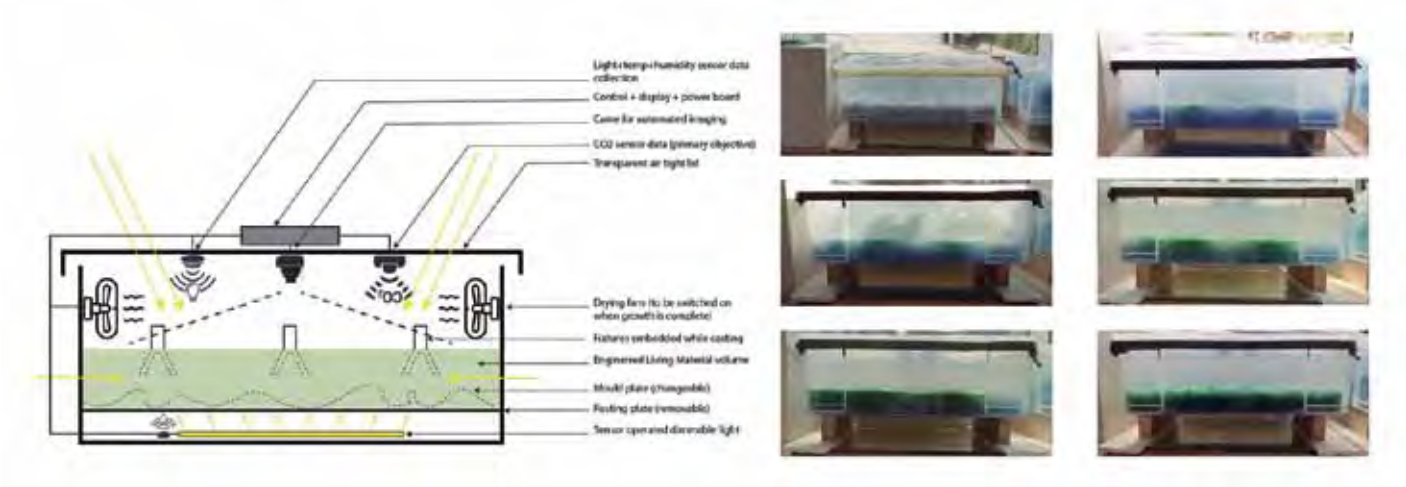

Figure 2. The design of the solid state ELM growth reactor (right) and the growth of the cyanobacteria ELM over 21 days

bold and risky objective i.e., to create a real (1:1) scale prototype of the ELM. To do this we designed a very basic primitive version of a solid-state reactor. In its essence this reactor was a transparent container and had a capacity of at least 30 L to grow a 60cm x 30cm ELM piece with equal air and hydrogel distribution. At the bottom, it was fitted with mirrors and artificial grow lights to account for the decrease in light transmission through the material volume. The container was filled with the hydrogel-aggregate composition prepared with the appropriate growth nutrients, and it was inoculated with the cyanobacteria for the biofilm to grow through the volume. This would enable the precipitation of biogenic calcium carbonates in the volume and bind the aggregates. The ELM was then harvested after sufficient curing. It was fitted with different kinds of sensors such as CO2, temperature, light, humidity loggers to gather data over the growing stage. And finally, it had fans attached to it to create directional air flow for the curing process (Fig.2). Since the estimated growth time of one of these ELM pieces were 6 weeks and there were only 8 weeks left until the completion of my master's degree, we decided to create three of these reactors in the month of July with minor variations and hoped for the best. At the same time, some meso scale samples were prepared. These were made in bespoke stackable sectioned containers. These were used to prepare a culture stock/farm for the larger prototypes as well as to investigate and observe the behaviour of the cyanobacteria under variations of different physical and chemical factors such as hydrogel-viscosity and light intensity, temperature etc. Finally, many small-scale petri-dish sized samples were also prepared for tests that were destructive in nature such as compression strength testing and robotic milling.

Figure 3. Large scale prototype of an ELM architectural pane

After some trials and course corrections, we were successful in attaining a real scale ELM architectural panel prototype by the end of August (Fig 3, 4). This also coincided with the filing of the patent application by UCLB and the final submission of my master's thesis. And circumstances and opportunities seemed right to put some effort into public engagement and dissemination of the work.

The months of September and October were spent in preparing two large scale public exhibition of the prototypes. The first was the Bio-integrated design open house which was a department wide exhibition inviting other prominent academics and people from the personal networks to showcase the work (Fig. 5).

The second was a larger one at the London Design Museum. The design museum hosted a special exhibition on Wastage and techniques that can help us redesign the idea of waste. For this exhibition we attempted to grow more curated large-scale pieces in digitally designed and fabricated moulds with recycled glass particles as aggregates (Fig. 6). And finally, we were able to present the work in an international conference titled Designing with the Living.

These exercises were major learning processes. And several observations and inferences were made which are in the process of being technically analysed and being written down as scientific paper to be shared soon. But to give a gist,

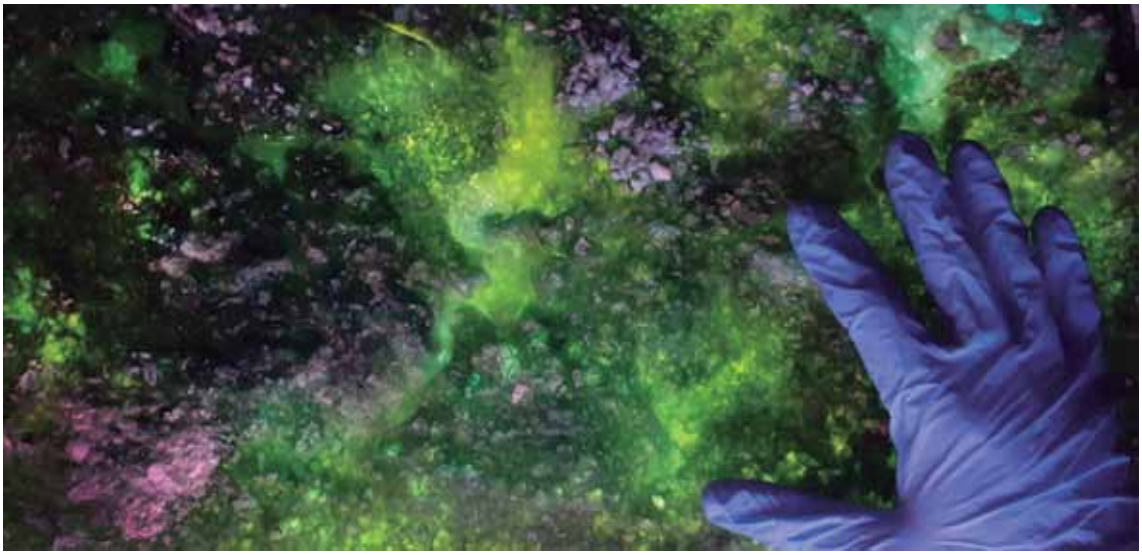

Figure 4 (on top). Close up of the large scale ELM architectural panel prototype
Figure 5 (below) The Bio-ID open house exhibition

certain things were understood about the ELM property such as that the average compressive strength of the material seems to be around 6 MPa currently which is comparable to a conventional brick. However, finer sized aggregates result in a more malleable ELM that has higher plastic capacity. At the same time, the rougher and more porous the aggregates are, the less brittle the output ELM is. In terms of the cyanobacteria species, it was evident that this ability of *Oscillatoria animalis* (Fig. 6) to grow within the hydrogel matrix in a 3-dimensional volume is quite a unique phenomenon that occurs within a specific range of conditions. The reason behind this is yet to be confirmed but it is apparent that the chemical bond within the hydrogel forms a particular physical structure which supports the characteristic gliding motility of the species. By observing the CO2 concentration dynamics inside the growth reactor, we could make a rough estimation that an ELM panel of 60 cm x 30 cm could sequester about 1000ppm of CO2 within a period of 3 weeks. At same time, the dynamics also revealed the circadian rhythm of *Oscillatoria animalis* to be a 12-hour cycle that independently switches between roughly around 7 am and 7 pm every day. This was an important understanding as existing literature suggests that several physiological processes of cyanobacteria depend on the circadian rhythm of the species. And resonating culturing conditions with the circadian rhythm can result in more optimum growth and outcomes. The cyanobacteria species also exhibits phototactic and chromatic acclimation responses to light which have been typically identified for other cyanobacteria species as well, such as red and green light creating positive phototactic bias and blue light inhibiting phototactic altogether. However some more complex relationships were noticed with the wavelength and intensity of light which begs more careful study and experimentation. Under low viscous conditions of the same hydrogel composition, the biofilm exhibits more dynamic intercellular communication and can rapidly change the collective morphological form/pattern based on lighting conditions (Fig. 7).

One of the most positive outcomes by the end of this period was being awarded an EPSRC doctoral training scholarship at the department of Biochemical Engineering, UCL to further develop the research under my supervisors. The last two months of November and December were thus spent in planning and organizing a more detailed structure of in-

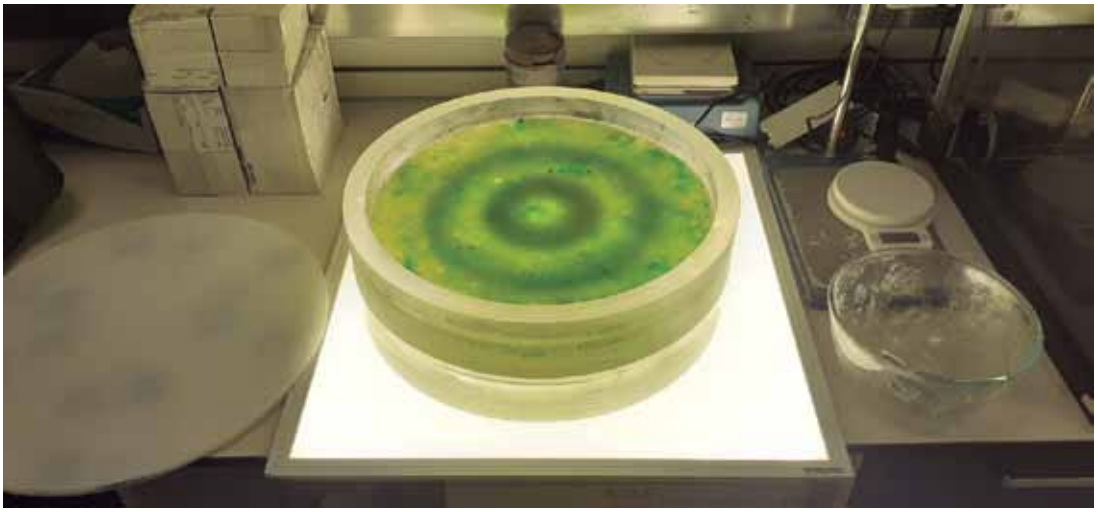

Figure 6 (on top). ELM prototype grown in digitally designed mould with recycled glass aggregates the Design Museum exhibition

Figure 7 (below). Photoresponse of *Oscillatoria animalis* to varying light intensities

vestigation. We fabricated some custom made phototaxis assay experimental set-ups based on the functional working thickness of the ELM and to test the effect of different wavelengths at different intensities corresponding to the species circadian rhythm. These experiments are ongoing with relative but not concrete success yet. And we hope to share these understandings in a more formal paper soon.

In conclusion, the entire process kindled my interest in studying these simple but wonderfully complex photosynthetic life forms. In my previous report I had mentioned that studying the behaviour of a cyanobacterial species in such proximity has helped me develop a more intimate perspective akin to a personal pet for *Oscillatoria animalis*. And that bond and understanding has only deepened. *Oscillatoria animalis* is a very robust, fast growing filamentous species with quite sophisticated abilities of intercellular communication, self-organization and easily identifiable response to stimuli and therefore could serve as good model species to uncover different kinds of knowledge in phycology. We have therefore decided to deposit the species at the CCAP bank for public access and would encourage fellow interested phycologist to indulge in their curiosities. With great gratitude, I want to express that the BPS project award was a tremendous boost in terms of helping me bridge the uncertainties of this new research path. I was able to test a wide range of aspects simultaneously and arrive at more defined avenues to carry forward this research. To continue this research as a self-funded international master's student would have been extremely difficult had it not been for the support from the BPS, and therefore I am indelibly grateful to have received it.

Metabarcoding bedrock in kelp forest communities; proofing methodology for describing banks of macroalgal stages in the marine environment

Submitted by Dr Kathryn M. Schoenrock

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Introduction

Terrestrial ecosystems have been studied for hundreds of years (arguably millennia), allowing scientists to develop ecological concepts (e.g., succession or facilitation) which, with the development of technology like SCUBA, can now be applied to subtidal marine ecosystems. One concept that is not easy to describe in marine communities is the presence of 'banks of macroalgal forms' (analogous to terrestrial seed banks; reviewed in Schoenrock *et al*., 2021*a*), which may allow communities to bounce back from disturbance events quickly. The macroalgal forms in this context could be any microscopic life cycle stage, especially prominent in species with heteromorphic life cycles. For the purposes of this project, we specifically targeted microscopic kelp gametophytes and sporophytes, making an assumption they arrest development before environmental cues trigger further growth in the subtidal (Kinlan *et al.*, 2003). Presence of this community could be especially important for kelp forests worldwide as they are exposed to multiple stressors and are experience distribution shifts driven by various stressors (Krumhansl *et al.*, 2016).

Figure 1. Map of bedrock collection sites within kelp forests across Ireland, including sites sampled during the summer of 2020 or 2021 (blue) and sites sampled seasonally from 2019–2020 (yellow).

In this project, we hoped to describe the presence of these microscopic communities in *Laminaria hyperborea* kelp forests in Ireland while creating a methodology for identifying these communities in the future. These communities (aka banks of macroalgal stages) could be important to kelp forest resilience, which we define as the ability of the habitat to recover and maintain ecosystem function after a disturbance. The existence of these 'banks' has been hypothesised for decades, and they have been found in intertidal communities from France and Chile (Robuchon *et al*., 2014; Santelices *et al.*, 2002), as well as mesophotic rhodolith communities in the Gulf of Maine (Fredericq *et al*., 2019). Theoretically these banks could be found in subtidal kelp habitats that are heavily shaded because the low light conditions are good for reproductive development in gametophyte stages and vegetative growth in both gametophyte and sporophytes; those of *L. hyperborea* require 0.2 µmol photon m^{-2} s^{-1} (at 5°C) to become fertile while sporophytes can grow well at light levels under 50 µmol photon m^{-2} s^{-1} (Lüning, 1980; Han & Kain, 1996). Low light requirements may allow kelp stages to lie dormant until they can facilitate regrowth of forests after canopy removal (or light levels increase) post-disturbance (e.g. heavy storm activity or harvesting).

To investigate the presence of these communities in Irish kelp forests, bedrock samples from twelve kelp forests (Figure 1) were collected during the summer (n = 5–6) of 2020 haphazardly inside the kelp canopy. Further, bedrock and recruitment slides were sampled seasonally at two sites (Co. Galway and Co. Kerry; Figure 1) across three depths and three levels of canopy cover: inner canopy (highest kelp cover), mid-canopy (moderate kelp cover), and kelp forest edge (low cover). This sample design will allow us to determine 1) presence of kelp gametophytes and sporophytes in biofilm communities covering the bedrock in kelp forests and 2) intra-site variation across canopy density and depth both of which influence light level and kelp species composition (Schoenrock *et al.*, 2021*b*). We will use a metabarcoding approach, previously employed for subaerial algal communities (Sherwood *et al*., 2017) using custom brown algal primers.

Table 1. Barcoding results for two sites monitored seasonally. *Alaria esculenta*, Ae; *Laminaria hyperborea*, Lh; *Laminaria digitata*, Ld; *Laminaria ochroleuca*, Lo; Mixed kelp, mk; *Saccharina latissima*, SL; *Sacchoriza polyschides*, Sp; *Undaria pinnatifida*, Up.

Site	Depth	Canopy	Spring	Summer	Autumn	Winter	Annual
Carraroe	Deep	Outer	mk, Up	Up, mk	Ld	Lh	mk
		Middle	Lh	Up, mk	Ld	Lh	mk
		Inner	Lh	Ld, Up, mk	Ld	Lh	Sp, mk
	Middle	Outer	Sp, Lh		Ld	Lh	
		Middle	Lh		Ld	Lh	Up, Ld
		Inner					Up, mk
	Shallow	Outer			Ld	Lh	
		Middle	Lh	mk		Lh	mk
		Inner	Ae, Ld, mk	mk	Ld		mk
Derrynane	Deep	Outer					
		Middle					
		Inner					
	Middle	Outer		mk	Ld		
		Middle	mk				
		Inner			Ld		
	Shallow	Outer					
		Middle	mk	mk	mk, Sp		mk
		Inner	mk		Ld, mk		

Table 2. Presence of species in bedrock collections from 17 sites across Ireland in the summers of 2020-2021. *Alaria esculenta*, Ae; *Laminaria hyperborea*, Lh; *Laminaria digitata*, Ld; *Laminaria ochroleuca*, Lo; Mixed kelp, mk; *Saccharina latissima*, SL; *Sacchoriza polyschides*, Sp; *Undaria pinnatifida*, Up.

Site	Lh	Ld	Lo	Sl	Sp	Up	Ae	mk
East						x		x
South east								x
South west								x
West	x	x						x
North west	x					x		x

Methodology

Seventeen sites across Irelands coastline were sampled in the summers of 2019 and 2020 by SCUBA and skin divers (~2–8 m depth depending on site; Figure 1). Samples were collected in triplicate or quintuplets, carefully stored in bags of ambient seawater and transported back to shore for processing. Samples were processed by scrubbing the exposed surface of bedrock in sterile seawater with a toothbrush to remove all biofilm material. The slurry was then filtered through a hydrophilic PVDF membrane filters (0.45 mm, 47mm diameter, Durapore®, Sigma Aldrich, Ireland) to capture even the smallest of kelp propagules. Two sites were sampled seasonally, and bedrock was taken in triplicate across a gradient of canopy cover from the edge of the forest (outer), to moderate cover (middle), and dense canopy cover (inner; see Figure 1) and processed as summer samples were.

All samples were extracted with NucleoMag® 384 Plant kit (Macherey-Nagel, Germany) following manufacturer's instructions. adding initial grinding step in lysis buffer with micro pestle and heating final elution buffer to 56°C. All DNA extractions were amplified in 25 ml volumes using the reaction mixture: 0.625 ml forward and reverse primer, 5 ml H_2O, 5 ml DNA, and 13.75 ml DreamTaq Green PCR (Thermo Fischer Scientific, Ireland) with the PCR cycle 95°C 2 min initial denaturation followed by 35 cycles of 95°C 30s, 45°C 30s, 72°C 1:30 min, ending with a final annealing step of 72°C 10 min. Barcoding target genes were two mitochondrial intergenic spacer regions: 1) trnWI, the spacer between tryptophan and isoleucine genes and 2) atp8, the spacer between ATP subunit 8 and t-RNA serine genes (Voisin et al. 2005, table 2). Metabarcoding was done with the same DNA extracts and the PCR protocol and labelled primers from Bonthond et al. (2020) were used to amplify the 18S and trnWI region of the mitochondrial genome in Laminariales with F-1183mod and R-1443mod (Ray et al., 2016).

PCR products for barcoding were sent to Eurofins (USA) for sequencing, and sequences were edited in 4peaks (Nucleobytes B.V., The Netherlands). Metabarcoding samples were submitted to the Heflin Center for Genomic Sciences (University of Alabama at Birmingham) to be sequenced on an Illumina MiSeq for 300 bp x 2 paired end reads. Raw reads were assembled and cleaned (e.g., remove chimeras) and taxonomy assigned using a SILVA LSU database (curated

to ensure kelp LSU data are included) in QIIME v2. Algal OTUs with 50 or more reads were further analysed using a barcoding approach, and diversity and abundance (categorical, e.g., 50-500 reads, 500-1000 reads) metrics were used to compare metabarcoding results across regions of Ireland (east, southeast, southwest, west, northwest) and kelp canopy cover and season at two sites.

Results

Most DNA extractions with the filter paper were very successful, and 90% of samples returned sequence data. Many sequences came back with what looked like multiple species in the same sample (large peaks for multiple base pairs across the sequence), driving the need for metabarcoding (mk, Table 1 and 2). Metabarcoding results deciphered the 'mixed kelp signal' from barcoding results providing a robust picture of the banks of microscopic algal communities across a range of kelp canopy cover, season and sites.

The results of this pilot-project provide a methodology that streamlines characterisation of the phototrophic community in benthic biofilms of kelp forests that enable us to quantify the potential for macroalgal stages to 'bank', or accumulate in dormancy, in the marine benthos (likely benthic boundary layer). These data will enable us to design further experiments to test viability of macroalgal spores in biofilm communities and determine restrictions to recovery in these kelp forests which are continually hounded by storms and vulnerable to exploitation and warming. This information will enable us to understand how to protect the health of ecosystems and their biodiversity using an Ecosystem Services Approach (ESA) to kelp forest restoration, for instance nature-based solutions like 'green gravel'[7] post harvesting or storm event. These data also contribute to outreach materials requested by Ireland's EPA (via the KelpRes project) including a policy document, infographic, and public workshops coordinated by Seasearch Ireland.

References

1. Bonthond, G. et al. (2020) *Mol. Ecol.,* 29(11): 2094-2108.
2. Caporaso, J. G., et al. (2012) *ISME,* 6.8: 1621–1624.
3. Fredericq, S. et al. (2019) *Front. Mar. Sci.,* 5: 502.
4. Fredriksen, S. et al. (2020) *Sci. Rep.*, 10(1): 1–7.
5. Han, T., & Kain, J. M. (1996) *Eur. J. Phycol.,* 31(3): 233–240.
6. Hoffmann, A. J., & Santelices, B. (1991) *Mar. Ecol. Prog. Ser.,* **79(1):** 185–194.
7. Kinlan, G. et al. (2003) *J. Phycol.*, *39*(1), pp.47-57.
8. Krumhansl, K.A., et al. (2016) *PNAS*, **113(48)**: 13785–13790.
9. Lüning, K. (1980) *J. Phycol.*, **16(1)**: 1–15.
10. Robuchon, M. et al. (2014) *Eur. J. Phycol.*, **49(1)**: 128–133.
11. Santelices, B. et al. (2002) *Rev. Chil. Hist. Nat.,* **75**:547–55.
12. Schoenrock, K.M. et al. (2021a) *J. Phycol.* 57(1): 14–29.
13. Schoenrock, K.M. et al. (2021b) *Limnol. Oceanogr.,* **66(9)**: 3439–3454.
14. Sherwood, A. R. et al. (2017). *J. Phycol.*, **53(2)**: 437–445.
15. Voisin, M. et al. (2005) *PNAS,* **102(15)**: 5432–5437.

Thurlestone (and the Tree of Life)

Submitted by Francis Bunker with species list and species descriptions by Lin Baldock

Figure 1. Panorama of Thurlestone beach

Thurlestone is a seaside village approximately 5 miles west of Kingsbridge in Devon. Its beach is an exposed southwest facing sandy embayment, flanked on each side by low lying rocky reefs. Looming high over the south side of the bay is a rock arch named the "thirled (pierced) stone" from which the village name is derived.

This area first came to my notice when I was looking for sites for the BPS / Marine Biological Association of the UK (MBA) 'Collecting and Identifying Seaweeds' course in 2017. Google Earth revealed extensive rocky reefs which looked promising for seaweeds. The site lived up to expectations. It is rich is both habitats and species. The rocky platforms are dissected by gullies with overhangs and there are lots of rock pools of various size. Adjacent to the beach the rock is inundated by sand and is colonised by a characteristic hardy flora.

Figure 2. Vertical rock face with *Cryptopleura ramosa*, *Gymnogongrus crenulatus* and *Chondrus crispus*

Since the seaweed course I had been wanting to dive and explore the underwater world at Thurlestone. My interest was sharpened when in 2019 Chris Maggs picked up a fresh specimen of *Gelidium corneum* from the strandline, suggesting the species could be growing in the adjacent subtidal. *G. corneum* is an uncommon species in Britain and Ireland and has seldom been recorded. I returned to try and dive at Thurlestone in the autumn of 2019, but storms had reduced the visibility to practically zero.

Finally the opportunity to dive came in August 2021 when John Bishop from the MBA invited a few 'seaweed people' to help procure specimens for the Darwin Tree of Life project. I was joined by Chris Maggs, Juliet Brodie, Anne Bunker, Lin Baldock and Juliet's PhD student Margot Arnold Petre who is studying iridescence in seaweed. Earlier in 2021 Juliet's team had found the red seaweed *Chondria scintillans* at Thurlestone and they were keen to find

Figure 3. Chris Maggs with *Gelidium corneum*

Figure 4. *Chondria scintillans*

Figure 5. Foliose algae on gulley sides

more. *C. scintillans* is a new record for Britain and Ireland and is more commonly thought of as a southern European species. Lin shared my desire to dive at Thurlestone and as conditions seemed ideal a dive was planned.

Thursday 25th August 2021 was a hot summer's day and the Devon lanes and beaches were packed with more tourists than usual in this 'staycation' year. Getting diving equipment down to the sea at Thurlestone would be a struggle on any day but this time it was particularly tricky because of the crowds. We dropped our heavy gear by the side of the road next to a low cliff that descended to the beach. We then took turns to park, change and look after the equipment. As soon as the diving suits were on, we started to bake in the sun, and then we had to make multiple trips to the water's edge carrying heavy tanks and weight belts. Our struggles weren't helped by interested tourists who were keen to chat and ask us what we were doing. They assumed that we were after crabs and lobsters but when we started talking about seaweed you could see on their faces that they were mystified.

The water was calm, clear, and cool and stepping into it from the shore was bliss after the heat of the beach. We are both seasoned seaweed hunters and enjoyed a slow and easy dive, swimming along a sandy gulley which bisected the rocky reefs. Our maximum depth was 4 m but this was enough to keep us occupied for over an hour.

The sublittoral fringe on the open coast is difficult to study. Normally waves or swell make it impossible to stay still in one place. Photography is generally out as the seaweeds sway around madly. Worse still, there is a danger of being dashed against the rocks, camera and all. Not today as the sea was uncannily calm.

The seaweed flora on the rocky sides of the gulley was both prolific and rich in species. In this limited space we found three distinct habitats: the kelp forest dominated by scour tolerant *Saccorhiza polyschides* on the reef tops; the gulley sides dom-

Figure 6. *Taonia atomaria*

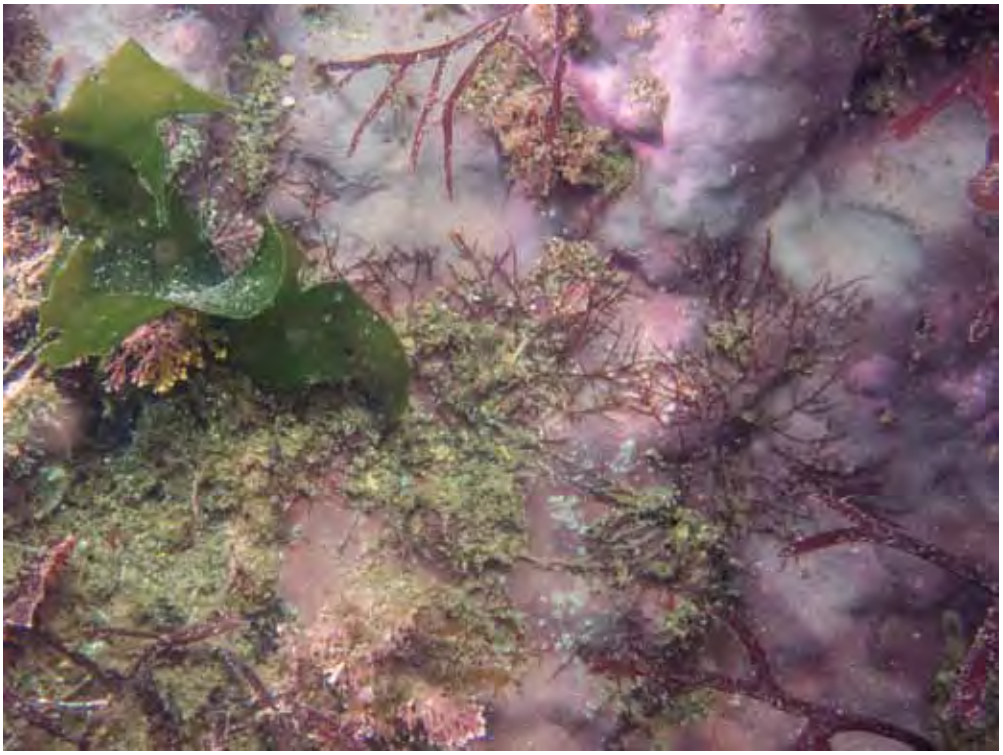

Figure 7. *Gelidiella calcicole* on crustose Corallinaceae

inated by red algae (*Chondrus crispus*, *Phyllophora* spp and *Heterosiphonia plumosa*); and sand inundated rocks at the sand-rock interface. This last habitat of a sandy sediment veneer over rock has a very characteristic algal community typified by the presence of species such as *Cladostephus hirsutus*, *Taonia atomaria*, *Ahnfeltia plicata*, *Carradoriella elongata* and *Scinaia furcellata*.

We recorded several interesting red algae: *Bornetia secundiflora* which has a very restricted western and southern distribution in England; *Ahnfeltia plicata* – which appears to be getting less frequent (at least in Dorset) while *Gigartina pistillata* has a limited southwestern distribution in England. Thread-like thalli of *Gelidium calcicola* were found creeping over a coralline crust. This species is usually closely associated with living maerl fragments, and maybe it has been overlooked as an associate of other coralline algae? It was particularly gratifying to find frequent large thalli of *Chondria scintillans,* a spectacularly iridescent species recorded here for the first time from the sublittoral. The old kelp fronds had several unidentified species of Ectocarpales, a group which is very much under recorded, especially from the sublittoral fringe.

Table 1. Seaweed species recorded by Lin Baldock and Francis Bunker in the shallow sublittoral at Thurlestone, Devon on 25th August 2021.

Rhodophyta (red algae)		
Acrosorium ciliolatum	*Cordylecladia erecta*	*Heterosiphonia plumosa*
Ahnfeltia plicata	*Cryptopleura ramosa*	*Jania rubens*
Bornetia secundiflora	*Dasysiphonia japonica*	*Lomentaria clavellosa*
Callophyllis laciniata	*Dilsea carnosa*	*Meredithia microphylla*
Carradoriella elongata	*Furcellaria lumbricalis*	*Osmundea osmunda*
Ceramium echionotum	*Gayliella flaccidum*	*Palmaria palmata*
Chondracanthus acicularis	*Gelidiella calcicola*	*Phyllophora crispa*
Chondria dasyphylla	*Gigartina pistillata*	*Pterocladia capillacea*
Chondria scintillans	*Gracilaria gracilis*	*Pterosiphonia complanata*
Chondrus crispus	*Grateloupia turuturu*	*Scinaia furcellata*
Corallina caespitosa	*Gymnogongrus crenulatus*	*Sphaerococcus coronopifolius*
Corallina officinalis	*Halurus equisetifolius*	*Titanoderma pustulatum*
Phaeophyceae (brown algae)		
Cladostephus hirsutus	*Dictyota dichotoma*	*Laminaria hyperborea*
Cladostephus spongiosus	*Desmarestia aculeata*	*Laminaria ochroleuca*
Colpomenia peregrina	*Fucus serratus*	*Saccharina latissima*
Cutleria multifida	*Halidrys siliquosa*	*Saccorhiza polyschides*
Desmarestia ligulata	*Laminaria digitata*	*Taonia atomaria*
Chlorophyta (green algae)		
Bryopsis plumosa	*Cladophora hutchinsiae*	*Ulva fenestrata*

There were the inevitable non-native species present: *Grateloupia turuturu* and *Dasysiphonia japonica* two red algae which have greatly extended their range in the last decade or so, as well as an old friend *Colpomenia peregrina*. Surprisingly *Sargassum muticum* was absent from our records. The site may be too exposed and scoured to allow this non-native to establish.

All too soon it was time to leave the Thurlestone's seaweed garden, emerge onto the hot beach and begin the laborious task of lugging our gear up to the road (even more difficult than bringing it down). It was all worth it, just to have the privilege of being in amongst all that diversity and wonder.

This dive gave us a rare chance to do a thorough survey of the sublittoral fringe on a diverse and interesting shore. Although we didn't find *Gelideum corneum*, we took specimens back to the lab, several of which were processed for their DNA by the Tree of Life team. Lin made a list of what we'd found which totalled more than 50 species. This list was submitted to the Seasearch project and so the records will be incorporated into the NBN database.

Conference Announcement:

The UK and Ireland Lakes Network Conference is taking place in Cheshire on the 14th and 15th of June 2022.

Two days comprising networking, presentations and site visits with environmental NGOs, practitioners, academics, researchers and statutory agencies providing a great opportunity to learn and share experience on:

-The role of lakes in the context of nature recovery networks, landscape and catchment scale restoration

-Engagement of citizens in understanding lakes

-How lake restoration is being delivered across England

The conference includes a day at Nunsmere Hall in Cheshire, with speakers, networking and the opportunity to share posters, followed by an optional conference meal.

The second day is based around two field visits to internationally designated lakes in Cheshire, Hatchmere and Tatton Mere, to see and hear about issues affecting them, and discuss solutions implemented for their restoration. Including the introduction of beavers, restoring the hydrological regime, altering fish assemblages and improving water quality.

More information and registration details will be available shortly. If you would like us to keep in touch about the conference please leave your details here: (https://www.surveymonkey.co.uk/r/NW6V6T5).

INSTRUCTIONS FOR CONTRIBUTORS

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

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

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