Programme

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https://bps2025.lineupr.com/73rd-british-phycological-society-meeting

Organisation:

Scientific Programme: Rodney Forster, Veronique Créach

Local committee: Sharon Degnan, Enora Lecordier, Ben Whitcombe, Jasmine Simmons

Meeting sponsors: Seagrown Ltd (https://www.seagrown.co.uk/) and Hull Marine Laboratory (https://www.hull.ac.uk/work-with-us/business/hull-marine-lab)

Monday	6th January 2025		
14:00- 17:00	BPS Council meeting		Map Room, Cohen Building, University of Hull
17:00 - 19:00	Registration desk		Canham Turner, University of Hull
Tuesday	7th January 2025		
08:30	Registration desk		Canham Turner, University of Hull
	Coffee and pastries		
	Austen room		
09:00	Introduction to the conference		Prof. Rodney Forster
	Manton prize	Chair	Prof. Saul Purton
09:30		Sally Henderson	Self-cleaning slipways: Harnessing species interactions for sustainable management of coastal infrastructure
09:45		Ruby George	Investigating the resilience of North-East Atlantic intertidal forests to disturbance over a latitudinal gradient
10:00		Riddhi Salotra	Green Extraction of Polyphenols in Brown Seaweeds
10:15		Jack P. Burton	Assessing changes in genetic diversity of the ecologically and economically important kelp, *Saccharina latissima*, in a changing environment

10:30		Luyao Yang	Chloroplast engineering in the green alga *Chlamydomonas* for production of novel recombinant products
10:45	Coffee and tea		
11:20		Amy Lovegrove	Sustainably modified, lipid-dense *Isochrysis galbana* improves Pacific oyster survival to *Vibrio coralliilycticus* infection
11:35		Hannah Thomas	Investigating gut bacterial utilisers of a seaweed-derived common food ingredient (carrageenan)
11:50	***Kelp***	Capuzzo (chair)	Seaweed production in the UK, from wild harvest to aquaculture
12:10		Clark	Sustainable materials for kelp restoration and aquaculture
12:30		Catherall	The effects of historic coal mining wastes on kelp forests in northeast England.
12:50		Lawes (video)	Monitoring our hidden forests
12:55		Fletcher	Phaeophyta book launch

13:00	Lunch and poster setup		
	Austen room		
14:00	***Overseas vice president***	Prof Craig W. Schneider	Using molecular-assisted alpha taxonomy to sort macroalgae from the mesophotic zone off the Bermuda Platform
14:40	***Freshwater***	Kelly (Chair)	Rapid assessment of filamentous algae in rivers as a potential tool for citizen scientists
15:00		Thomson	Scotland's Red Snows – an update on the snow microflora of the UK
15:20		Müller	Climate Change, forest fires and algal blooms: a rapidly changing world.
15:40		Juarez-Rendon	Protein bioaccessibility of *Limnospira maxima* biomass products through static in vitro digestion experiments
16:00		Maggs / Brodie	Junior referee training for EJP
	Byron room		
14:40	***General phycology -1***	Ward (Chair)	Mixed provenance of organic carbon in temperate intertidal seagrass sediments
15:00		Cunningham	Developing a protocol for the sustainable aquaculture of serrated wrack *Fucus serratus* (Phaeophyceae)
15:20		Ross	The potential for *Chlorochromis zofingiensis* to be implemented into a biorefinery: a case-study from Culture Collection of Algae and Protozoa (CCAP)
16:00	Afternoon tea		
16:30	Poster session sponsored by **SeaGrown and Hull Marine Laboratory**	1 minute flash poster presentations	Send a single slide with your main results to bpshull2025@gmail.com
		Katie Andrews (YWT)	Display: Wild Eye / Sea Oak An exciting outdoor art and nature project for the North Yorkshire coast
18:00	Close		

Wednesday	8th January 2025		
08:30	Coffee and pastries **Austen room**		
09:00		Prof Paul Hayes	Professor A. E. Walsby FRS - His Contributions to Phycology
09:30	***Estuarine algae***	Underwood (Chair)	Contributions of benthic microalgal biofilms to sediment organic carbon stocks across a salt marsh gradient
09:50		Adams	Optimising pretreatment methodologies to improve the amenability of nuisance macroalgal bloom *Ulva spp*. to enzymatic saccharification
10:10		Gröcke	Nitrogen isotopes in herbaria document historical nitrogen sewage pollution in the Mersey Estuary, England
10:30		Forster	Investigations of phytoplankton biomass and water quality and in the context of marine mass mortality events on the north-east coast of England
10:50	Coffee and tea		
11:20	***Phytoplankton***	Creach (chair)	Overview
11:50		Thyssen	The turbulent life of microorganisms in the oceans = flow cytometry, an essential tool with its first best practices and interoperable datasets
12:10		Haraguchi	Best practices for automated flow cytometry and its application in the Baltic Sea
12:30		Fournier	Linking high-frequency monitoring and experiments to understand riverine phytoplankton annual succession
12:50		Lanoy	Machine learning application for phytoplankton analysis by automated flow cytometry
13:10	Lunch and posters **Austen room**		
14:00	***General phycology -2***	Cameron (Chair)	Single-nucleus transcriptomic characterization of chlorophyte photobionts in the lichen symbioses
14:20		Maggs	*Ceramothamnion codii*: NGS allows us to access DNA sequences from tiny seaweed specimen and confirms recent taxonomic proposal
14:40		Bunker	Changes over time in a small maerl bed in an industrial setting in Wales, United Kingdom
15:00		Corrigan	The GlobalSeaweed-SUPERSTAR project and the importance of maintaining healthy seaweed stocks for scaling up the seaweed industry
15:20		Prof Saul Purton	Chloroplast engineering of the edible microalga *Chlamydomonas reinhardtii* for oral delivery of biologics
15:40	Afternoon tea		
16:15			BPS Annual General Meeting

19:30		The Deep	Delegates to arrive at Two Rivers entrance and make their way to Cool Seas for pre-dinner drinks
20:00			BPS Dinner
21:30			Manton Prize awards

Posters			
		Jennings	The impact of Opportunistic macroalgae on Seagrass meadows
		Thomson	Algal Isolates from Robert Island, South Shetland Islands, Antarctica
		Alhedaithy	Synthesising ncAA-containing recombinant proteins in the chloroplast of *Chlamydomonas*
		Kusolkumbot	Production in the algal chloroplast of a major capsid protein (MCP) subunit vaccine against the infectious spleen and kidney necrosis virus (ISKNV) of Asian seabass.
		Juettner	Diatom Flora of Britain and Ireland:the collection of William Smith
		Franklin	How are we assessing and communicating the risks of toxic cyanobacteria in recreational waters? Can you help? An invitation to participate.
		Sedgwick	Seaweed-Derived Bioactives: Developing a Novel Synbiotic to Support Immune Function
		Wilkinson	Seaweed Diversity over Time: Comparison of Historic and Current Seaweed Presence at St. Andrews, Scotland
		Simmons	The effect of storms on the loss of fucoids in Autumn of 2023 and 2024.
		Vermeulen	Museum of Microalgae
		Duffy	DIY Kelp - Simulating a kelp forest in a laboratory
	Manton	Griffiths	Aquaculture for Agriculture: a study into seaweed extract for modern growing and human nutrition
	Manton	Mastin-Wynne	Investigating the development of novel techniques for restoring kelp on exposed coastlines
	Manton	McKinney	The effect of light spectra and intensity on the total polyphenolic content of *Fucus serratus* (Phaeophyceae)
		Liken	Artificial Intelligence for Automated Microalgal Classification and Monitoring
		Lawlor	Developing an integrated multi-disciplinary approach to improve understanding of HAB events.
		Vermeulen	Using seaweed to mitigate the impact of Harmful Algal Blooms
	Manton	Priyadharshini Elanchezhian	Optimizing Cultivation and Nutrient Enrichment for Enhanced Biomass Production in *Asparagopsis taxiformis*

Abstracts

Tuesday 7th January 2025.

Session: Manton prize

Oral presentations

Self-cleaning slipways: Harnessing species interactions for sustainable management of coastal infrastructure.
Sally Henderson (Swansea University), Louise Firth (University College Cork), Matthew Perkins (University of Plymouth) and John Griffin (Swansea University).
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Enhancing grazer-algae interactions on coastal infrastructure could provide a sustainable, nature-based solution to hazardous algae management on boat slipways. Slipways must be periodically cleaned to prevent algal growth and meet health and safety standards. Current maintenance solutions are short-term, using chemicals and power-washers which are expensive and environmentally damaging. Intertidal molluscan grazers, such as the common limpet (Patella vulgata), naturally drive shifts between algae dominated and bare substrate patches on rocky shores. Patella vulgata graze most efficiently on flat surfaces, however, such surfaces enhance slip hazards and do not protect grazers from slipway traffic. Ecologically engineering slipway surfaces to encourage targeted limpet grazing could sustainably shift slipways to safer bare-substrate states. Two experiments have been conducted investigating the effects of added surface features and surface roughness on limpet movement and grazing efficiency. Results show limpets clearly exhibiting diurnal movement cycles and comfortably preventing algal growth after 12 months. A scaled-up experiment is now in place with the aim of determining the optimal engineering solutions that facilitate limpets to prevent algal growth at a scale relevant for slipway use.

Investigating the resilience of North-East Atlantic intertidal forests to disturbance over a latitudinal gradient.
Ruby George (Swansea University), Tom Fairchild (Swansea University), Francisco Arenas (CIIMAR), Fraser Brough (MBA), Thomas Burel (UBO), Michael Burrows (SAMS), Amelia Curd (IFREMER), Dominique Davoult (Sorbonne University), Marina Dolbeth (CIIMAR), Gabin Droual (IFREMER), Aline Migne (IFREMER), Pippa Moore (Newcastle University), Joanne Porter (Heriot Watt University Orkney), Daniel Smale (MBA) and John Griffin (Swansea University).
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As climate change intensifies storms and heatwaves, understanding the resilience of ecological communities is crucial. Yet how the resilience of foundational species in marine ecosystems varies across different climatic conditions is poorly understood. To explore the variation and drivers of resilience in marine ecosystems, we are undertaking a large-scale experiment across seven regions spanning from Portugal to Orkney. In Spring 2023, we simultaneously disturbed experimental plots on intertidal shores by removing canopy-forming algae at three treatment levels and are monitoring the fucoid and community responses. Additionally, we are undertaking coordinated measurements of morphological traits and growth of macroalgae to further understand the biological processes underlying resilience. After 18 months, the results are supporting our hypothesis that recovery from disturbances is hindered under stressful climatic conditions. Overall, this collaborative experiment is advancing our understanding of large-scale drivers of resilience in marine systems increasingly impacted by extreme climate-related disturbances.

Green Extraction of Polyphenols in Brown Seaweeds.
Riddhi Salotra (School of Chemistry and Chemical engineering and School of Mechanical & Aerospace Engineering, Queen's University), Gary Sheldrake (School of Chemistry and Chemical engineering, Queen's University) and Pamela J Walsh (School of Mechanical & Aerospace Engineering, Queen's University).
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Seaweed derived polyphenols have shown significant potential as functional compounds in several applications. In recent years, they have gained significant interest as antimicrobial[1], anti-methanogenic agents[2], antioxidant and anti-inflammatories[3]. Polyphenols are structurally complex

compounds and are classified into different structural groups like tannins, stilbenes, phenolic acids, flavonoids, and lignans; depending on the distribution of phenolic groups[4]. This structural diversity makes it challenging for scientists to perform the extraction of polyphenols from seaweeds with high recovery rates. To date, different conventional methods have been employed such as Soxhlet and maceration[5,6], which uses large volumes of organic solvents that are not safe for the environment.
In the present work, a supercritical CO2 extraction method has been developed that used supercritical carbon dioxide (scCO2) instead of organic solvents to extract polyphenols from three different brown seaweeds species namely: Fucus vesiculosus (FV), Ascophyllum nodosum (AN), and Fucus serratus (FS). The method development involved the optimisation of extraction parameters for all the three seaweeds using design of experiments (DOE) software. The total phenolic content (TPC) obtained from the optimised runs was measured using 1H NMR spectroscopy[7]. The TPC obtained for all three seaweeds extract from the respective optimised supercritical experiments were compared to the TPC obtained from conventional maceration extracts. Overall, the TPC yield from supercritical extracts was found to be significantly higher than the maceration yield, which proved the efficiency of the supercritical extraction. Furthermore, extraction parameters were found to be different for different seaweeds, suggesting the type of phenolic within the Fucus differs, which is supported by literature[8], [9]. This different set of parameters exhibited different trends for different seaweed species. The results show that supercritical extraction could be a more environmentally friendly, greener alternative to the conventional maceration as it negates the use of organic solvents, however, an LCA would be required to validate the results.

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Assessing changes in genetic diversity of the ecologically and economically important kelp, Saccharina latissima, in a changing environment.

Jack P. Burton (Marine Laboratory, School of Mechanical and Aerospace Engineering, School of Biological Sciences, Queen's University), Pamela J. Walsh (Marine Laboratory, School of Mechanical and Aerospace Engineering, Queen's University), Heather M. Moore (Agri-Food and Biosciences Institute, Belfast), Manus E. Cunningham (Marine Laboratory, School of Mechanical and Aerospace Engineering, Queen's University), Christine A. Maggs (School of Biological Sciences, Queen's University) and Paulo A. Prod (School of Biological Sciences, Queen's University).
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The assessment of genetic resources is essential for preserving species of economic and ecological importance. Genetic assessments provide insights into a population's adaptive potential and, ultimately, the species' ability to survive in changing environments. Greater genetic diversity increases the likelihood of survival by providing the variability needed to thrive across a wider range of abiotic conditions. Kelps are foundational species in temperate and cold-water coastal regions. Kelp forests, dominated by Saccharina and Laminaria species, provide essential ecosystem services that benefit both small coastal communities and global environment. These services include the removal of excess nutrients in eutrophic areas; the absorption of pCO2 to help reduce ocean acidification and warming and serving as nursery grounds for fish stocks. Globally, kelp decline is moderate, yet significant regional losses highlight the dominant role of local factors in kelp resilience to global change. Kelp survival is influenced by various abiotic factors, including temperature, salinity, wave height, nutrient availably, pH, and pCO2 levels. Since 1990's substantial declines in European kelp populations have been observed, primarily due to ocean warming, grazing, eutrophication, pollution,

and invasive species. This study builds on previous research investigating the genetic diversity within and among sugar kelp populations along the coastlines of Northern Ireland and the Donegal region. Initially, microsatellites will be screened to assess genetic changes in diversity relative to prior studies. A more comprehensive sampling design will allow for a more thorough examination of kelp population structure in the area. Based on the results of this analysis, additional screeding using ddRAD-sequencing may be undertaken. Genetic data will also be correlated with environmental variables to better understand how potential habitat changes may affect kelp resilience and adaptability. By linking genetic diversity with environmental factors, this study aims to identify patterns that will inform effective conservation plans for the species.

Chloroplast engineering in the green alga Chlamydomonas for production of novel recombinant products.

Luyao Yang (Algal Research Group, Institute of Structural and Molecular Biology Department, University College London), Patai Charoonnart (Center of Excellence for Shrimp Molecular Biology and Biotechnology, Mahidol University, and National Center for Genetic Engineering and Biotechnology (BIOTEC) Thailand Science Park, Pathumthani), Vanvimon Saksmerprome (Center of Excellence for Shrimp Molecular Biology and Biotechnology, Mahidol University, and National Center for Genetic Engineering and Biotechnology (BIOTEC) Thailand Science Park, Pathumthani) and Saul Purton (Algal Research Group, Institute of Structural and Molecular Biology Department, University College London).
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Aquaculture faces significant challenges in controlling viral disease amongst farmed fish or shellfish under intensive production conditions. These challenges could be mitigated by oral delivery of affordable therapeutics designed to block the infection process. The edible microalga Chlamydomonas reinhardtii has emerged as a promising platform for producing such recombinant therapeutics. Our research focuses on engineering the chloroplast of C. reinhardtii to produce double-stranded RNA (dsRNA) molecules designed to target key viral genes. These dsRNAs can trigger RNA interference (RNAi) in animals, producing small interfering RNA (siRNA) that silences viral genes. Traditional therapeutic delivery in aquaculture, involving purification, cold chain storage, and manual injection, is technically challenging and expensive, limiting its widespread use. Our study aims to develop a system for whole-cell bio-encapsulation and oral delivery of dsRNA via C. reinhardtii. Using shrimp as a model, we optimized dsRNA administration doses, evaluated shrimp growth and viral challenge performance, and developed a low-cost 'hanging bag' photobioreactor system for large-scale algae production. This system successfully produced sufficient dried biomass for shrimp feeding trials. Moreover, the dsRNA expression system can be adapted for other research purposes, such as studies aimed at silencing key endogenous genes in animals that naturally feed on microalgae, such as the larvae of mosquitoes and other insect vectors.

Sustainably modified, lipid-dense Isochrysis galbana improves Pacific oyster survival to Vibrio coralliilycticus infection.

Amy Lovegrove (University of Southampton), Professor Tom Bibby, and Professor Chris Hauton.
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Every year, up to 100% of Pacific oyster (Magallana gigas) stocks are lost to mortality from Pacific Oyster Summer Mortality Syndrome (POMS). The syndrome is a polymicrobial infection where Ostreid herpesvirus (OsHV-1) weakens the immune system allowing opportunistic bacteria, like Vibrio coralliilyticus, to invade. Despite monitoring and biosecurity measures, current management strategies involve broad spectrum antibiotics that have led to resistance, and selectively breeding resistant triploid oysters which are inaccessible to lower-income areas due to patenting. This study aimed to develop a sustainably modified phytoplankton diet rich in immune-essential polyunsaturated fatty acids (PUFAs). Isochrysis galbana and Nannochloropsis gaditana were selected for modification due to their established use in oyster diets, and the existing research into using N. gaditana for biofuel. They were cultured in f/2 media with varying $NaNO_3$ concentrations, and growth rates and cellular content were monitored using FTIR spectroscopy and GC-MS. In reduced $NaNO_3$ (under 6.62 x 102 µmol L-1), levels of arachidonic acid, itaconic acid, and a-linolenic acid were significantly higher in I. galbana than in N. gaditana, and throughout the feeding trial the modified I. galbana cultured at 2.23 x 102 µmol L-1, these PUFAs were 294 % higher than in the unmodified diet. To assess survival of M. gigas when fed the lipid-dense and unmodified I. galbana, juvenile diploid and triploid oysters were infected with V. coralliilyticus. There were no mortalities were observed in oysters fed the lipid-

dense diet, compared to a 20% mortality rate in those fed the normal diet. This research offers a promising alternative to current POMS management strategies, potentially improving M. gigas survival rates in a more environmentally sustainable way.

Investigating gut bacterial utilisers of a seaweed-derived common food ingredient (carrageenan).

Hannah Thomas (University of Reading), Gemma Walton, Jessica Adams Paul Smith and Anisha Wijeyesekera .
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Carrageenan is a marine hydrocolloid extracted from red seaweeds (Rhodophyta) which acts as a versatile functional ingredient in foods (e.g. milkshakes). Structurally, carrageenan is a polysaccharide composed of alternating sulphated galactose units. Carrageenan's use has been controversial as it has been tentatively linked with intestinal inflammation however it continues to be classed as safe for human consumption by EFSA. Conversely, as a polysaccharide resistant to gastric and intestinal enzymatic digestion, carrageenan may also potentially possess prebiotic characteristics. Preliminary in vitro experiments show that at high dosage carrageenan enhances the growth of the genera Bacteroides and Escherichia/Shigella. At dietary relevant low levels, carrageenan has little impact on the microbiome however when the prebiotic fibre inulin is added there is proliferation of beneficial microbial species and an increase in bacterial load. The objective of this study is to assess the impact of carrageenan on the gut microbiome when integrated into a food product and combined with a prebiotic fibre. This study employs a three-armed, double-blind, parallel intervention design. Participants will receive one of three interventions in the form of gummy sweets: a placebo (using an alternative gelling agent), a carrageenan-containing gummy, or a gummy containing both carrageenan and a prebiotic. Urine and stool samples will be collected at baseline, after a 4-week intervention period, and following a 4-week washout period. Participants will self-report stool frequency, stool consistency, and gastrointestinal symptoms through online surveys. Microbial composition and abundance will be analysed using 16S rRNA sequencing and FISH-flow cytometry, respectively. Metabolite production in stool and urine samples will be assessed using 1H-Nuclear Magnetic Resonance (NMR) spectroscopy.

Posters

Aquaculture for Agriculture: a study into seaweed extract for modern growing and human nutrition.

J. Griffiths (IBERS, Aberystwyth University, and NRI, University of Greenwich), C. K. Nikolaou (NRI, University of Greenwich) and J. M. M. Adams (IBERS, Aberystwyth University).
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The historical use of seaweed in agriculture and as a growth enhancer offers a tangible opportunity to expand UK seaweed markets whilst simultaneously improving the provision of healthy, nourishing food. This opens pathways to more sustainable future growing patterns that bring together terrestrial and marine agriculture to form a more holistic system. Since the advent of nitrogenous fertilisers and chemical treatments terrestrial agriculture has maximised yields of fresh produce through intensive methods. The negative and wide reaching environmental, ecological, climatic, sociological and health consequences are now becoming clear. Future food provision must revolutionise to alleviate pressure on these systems; controlled environment agriculture (CEA): including hydroponics and vertical farming: provides one such solution. The present research is in its early stages but will investigate seaweed extracts and their role in soilless culture of lettuce in controlled environments. Analyses include effects on plant growth and yield, as well as nutritional make-up from a human perspective. It is expected that seaweed extract, as a molecular priming agent that stimulates stress response without causing tissue damage, will result in the production of greater levels of compounds beneficial to humans. Seaweed extracts, being inherently aqueous, lend themselves well to hydroponic applications offering potential benefits beyond simple plant nutrient provision. These areas offer scope for future expansion and a new market direction for seaweed growers and producers to play a fundamental role. Rather than being a nitrogenous fertiliser replacement seaweed may therefore offer a novel and ideal future plant and dietary fortifier.

The effect of light spectra and intensity on the total polyphenolic content of Fucus serratus (Phaeophyceae).

Rebecca E. McKinney (Marine Laboratory and School of Biology, Queen's University), Eoghan Mánus Cunningham (Marine Laboratory, and School of Mechanical and Aerospace Engineering, Queen's University), Nathan Skillen 4, Jaimie T.A. Dick (Marine Laboratory and School of Biology, Queen's University) and Pamela J. Walsh (Marine Laboratory, and School of Mechanical and Aerospace Engineering, Queen's University).
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Phlorotannins are naturally occurring, phenolic compounds unique to brown macroalgae which have gained increasing industrial interest due to their wide spectrum of bioactive properties. Assessing the commercial viability, however, is underpinned by the need to understand the role of environmental stimuli in phlorotannin production. The vast number of interconnected, environmental stimuli and the plasticity of brown macroalgae makes it exceptionally difficult to elucidate any correlation between phlorotannin content and any single environmental variable. Intertidal macroalgae cannot avoid irradiation due to the changing elevation of tides and fixed position on shorelines, with high levels of photosynthetically active (PAR) and ultraviolet (UV) radiation capable of causing detrimental effects. Due to these factors, brown macroalgae have developed defence mechanisms to cope with frequent changes in solar irradiance characteristics. Phlorotannins have been reported to act in an inducible defence response, with secondary roles as a photoprotective mechanism. As the pathways for production are yet to be fully understood, the impact of key parameters such as light intensity and wavelength on phlorotannin production has yet to be fully explored. Therefore, using a bespoke photobioreactor capable of varying the irradiation spectra and light intensities, we investigated the optimal peak wavelength and PAR intensities for inducing phenolic production in Fucus serratus. Light intensity was set to 300, 550, and 800 Âµmol m-2 s-1, with LEDs running above and below glass tanks to maximise irradiation and reduce shading. Both light spectra have peaks at 560 nm and 450 nm, with treatment 1 having a higher peak at 450 nm and a spectrum more towards the blue region of light, whilst treatment 2 had a higher peak at 560 nm and a spectrum more towards the red region of light. Percentage total polyphenolic content was calculated with respect to total dry biomass of seaweed.

Investigating the development of novel techniques for restoring kelp on exposed coastlines
Miss Robyn Mastin-Wynne (Newcastle University), Dr Miguel Morales Maqueda, Dr Heather Sugden and Professor Pippa Moore.
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Kelp forests are increasingly threatened by a variety of anthropogenic stressors, leading to documented declines in their spatial extent. For this reason there is a growing interest in developing effective kelp restoration techniques, especially for exposed coastlines, which have received comparatively less attention than terrestrial ecosystems and other marine habitats like seagrass meadows. Existing research often lacks scalability, limiting its applicability to large-scale restoration efforts. This is particularly crucial for wave-exposed coastlines, which present unique challenges that complicate successful restoration. For instance, transplant survival may be compromised by intolerance to new environmental conditions, such as high wave action, which can dislodge newly established individuals. Large-scale kelp restoration is costly, which is often not feasible for smaller-scale projects. Therefore as the need for restoration increases it is important to develop cost effective, easy to implement and suitable techniques for wave exposed areas, where the role of these habitats in wave attenuation is most required. This research will assess the suitability for kelp growth on various eco-engineered topography tiles, either based of natural bedrock or seawall structures. Preliminary results will be presented.

Optimizing Cultivation and Nutrient Enrichment for Enhanced Biomass Production in Asparagopsis taxiformis.
Priyadharshini Elanchezhian (SAMS), Puja Kumari and Michele Stanley.
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Asparagopsis taxiformis, a red macroalga, holds considerable promise as a methane-reducing feed additive for ruminant livestock, representing a viable strategy for mitigating agricultural greenhouse gas emissions and enhancing sustainability in livestock farming. Despite its potential, the effective commercial cultivation of A. taxiformis requires a detailed understanding of strain-specific growth responses, nutrient demands, and biochemical characteristics. In this study, we conducted the phylogenetic analyses of three strains of A. taxiformis (CCAP 1341/1, KU1884, KU 1885) and one

strain of A. armata (KU 1196) using 18S, cox2-3 spaces and RuBisCo spacer to confirm their identities. Further, the growth rates were analysed in different media F/2 and organic media Cell-Hi Bio (CHBio) under standard laboratory conditions (20 â °C, 16:8 light: dark photoperiod for 28 days) for maximum biomass yield. Both F/2 and Cell-Hi Bio promoted the algal growth, with higher biomass obtained in CHBio (2 mL media per 800 mL seawater), particularly for A. taxiformis KU1885. Enhanced nitrogen: phosphorus ratios in F/2 medium significantly improved growth of A. taxiformis CCAP 1341/1, with a 2:1 ratio yielding the highest biomass. F/2 consistently enhanced protein content and growth rates in CCAP 1341/1, while Cell Hi Bio supported superior pigment production, including chlorophyll and carotenoids, in strains like KU1885.Biochemical assays indicated that nitrogen-enriched formulations, particularly a 2N:P ratio, significantly improved biomass yield and metabolic efficiency. Phycoerythrin and phycocyanin concentrations were higher in Cell Hi Bio, while F/2 favored carbohydrate and protein synthesis. These results underscore the necessity for tailored cultivation strategies to maximize the biochemical potential of each strain.

Session: KELP

Oral presentations

Seaweed production in the UK, from wild harvest to aquaculture.
Elisa Capuzzo (CEFAS)
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In the UK, seaweeds have been harvested from the wild for centuries and traditionally used for food, feed and fertilizers. More recently, seaweed biomass has been used to produce bio-stimulants, nutraceuticals, cosmetics, biofuel, bioplastic and biomaterial.In the last decade, a resurgence in interest in seaweed has led to the development of seaweed aquaculture, with the first UK commercial seaweed farm established in 2015. The number of UK seaweed-related businesses has more than doubled in recent years. However, there are no recent estimates of current seaweed production from aquaculture or wild harvest in the UK. Seaweed species farmed in the UK include brown seaweed (e.g. Saccharina latissima, Laminaria digitata, Alaria esculenta), red seaweed (Palmaria palmata) and green seaweed (Ulva spp.). These are farmed adopting multiple techniques (longline, droppers, etc.), to suit location, farm size, end uses and local environmental conditions. However, upscaling of the industry is hindered by multiple issues. Particularly, difficulties remain in obtaining licences for seaweed aquaculture and funding availability for prospective seaweed farmers. Furthermore, lack of standards on farming and products, technological barriers, and the need for social licence to operate and spatial planning are still important issues, common to the UK and Europe.

Monitoring our hidden forests.
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Kelp forests are some of the most diverse and productive habitats on Earth, providing numerous ecosystem services upon which human societies depend. Yet there’s no national monitoring programme being delivered by any organisation for this important habitat to improve our understanding of its extent and condition.

Thermal adaptation of A. esculenta gametophytes.
Reina Veenhof (SAMS) and Michele Stanley.
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The kelp Alaria esculenta is ecologically and economically important, supporting both biodiverse kelp forests in the North Atlantic and the seaweed aquaculture industry through cultivation. As a cold-affiliated species, A. esculenta is particularly under threat of ocean warming, and accurately forecasting range restrictions can assist decisions on where to concentrate conservation efforts. Concurrently, strategies for increasing thermal resilience are needed to support both ongoing cultivation and restoration into a warmer future. A. esculenta has a typical Laminarian life cycle where the microscopic gametophyte alternates with the adult sporophyte. The gametophyte stage may be leveraged during early growth in the nursery phase to improve thermal resilience in subsequent generations. Experimentally establishing thermal limits of early life stages of separate populations of

A. esculenta, as well as testing the influence of culture temperature on the thermal resilience and whether this carries over to the sporophyte stages, will provide a strong base on which to improve cultivation and restoration techniques. Here, we find that cold acclimation increases thermal thresholds for fertility in A. esculenta gametophytes, while the warm-acclimated treatment resulted in higher growth under thermal stress. This work is ongoing to include multiple populations, resulting in fine scale population-specific thermal response data. This will be used to predict future range shifts in A. esculenta and identify locations that are likely to support successful cultivation and restoration of this ecologically and economically important species of kelp.

Sustainable materials for kelp restoration and aquaculture.
Ethan Clark (University of Newcastle) and Professor Pippa Moore (University of Newcastle).
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With rising demand for sustainable aquaculture and marine restoration, there is increasing interest in eco-friendly materials that can be used as a substrate for macroalgal attachment that alleviate the drawbacks of conventional plastics. This study adapts existing aquaculture techniques, specifically the use of seeding on strings and ropes, and applies these methods to seaweed restoration. Materials investigated include natural fibers such as jute, wool, and cotton, alongside synthetic options including nylon and polypropylene. Given the current challenges faced by the UK wool industry, which has seen a steep decline in demand, this research also explores the potential for surplus wool to serve as a sustainable resource in marine applications, thereby supporting local economies. Seaweed lines were deployed in the intertidal zone, where growth rates and density were monitored over time to assess the effectiveness of each material in supporting restoration. Additionally, the attachment strength of juvenile seaweeds on these lines was measured at varying flow rates within a controlled flume environment. By combining sustainable material testing with aquaculture seeding techniques, this study aims to advance methods for enhancing seaweed growth and survival, ultimately contributing to sustainable restoration practices, and exploring new uses for UK wool in marine contexts.

The effects of historic coal mining wastes on kelp forests in northeast England.
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While kelp forests play a crucial role in coastal ecosystems, providing habitat, supporting biodiversity, and contributing to carbon sequestration, their response to environmental perturbations, such as pollution, is not well understood. Along the coastlines of County Durham and Northumberland, coal mining activities throughout the 18’ and 1900s disposed of over 40 million tonnes of waste into the marine environment over a 100-year period. This had severe negative effects on coastal habitats, smothering vast areas and introducing a large quantity of heavy metal laden sediment. We investigated the effects of coal mine wastes on kelp forests ecosystems through comparative studies between polluted and non-polluted areas. The results show that kelp forests affected by historic coal mine waste have largely recovered, with growth patterns and carbon contributions similar to unpolluted sites. However, holdfast-associated fauna exhibited reduced abundance and diversity in polluted areas. Whilst this was predominantly an effect of habitat volume, it suggests that there could be lingering ecological impacts that may be affecting broader ecosystem dynamics. Additionally, examination of the effects of historic pollution on the kelp microbiome showed that while bacterial taxa adapted to polluted sites were more abundant, the overall diversity, structure, and abundance of surface microbiomes were similar between polluted and non-polluted kelp forests. This research advances understanding of both natural and pollution-driven variability in L. hyperborea forests, demonstrating that while the structural recovery of kelp forests impacted by mining activities has been successful, biodiversity in some areas remains compromised. These findings underscore the resilience of kelp ecosystems but also highlight the ongoing need for conservation and management to protect these valuable habitats from historic and future environmental stressors.

Posters

DIY Kelp - Simulating a kelp forest in a laboratory.

Jack Duffy (University of Newcastle), Heather Sugden (University of Newcastle), Pippa Moore (University of Newcastle) and Robert Houseago (Universityof Loughborough).
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Kelp forests are increasingly being promoted as a nature-based solution to coastal protection. Forests of Laminaria digitata and Laminaria hyperborea, through their large biomass and surface area, are believed to generate considerable drag on waves propagating over them, resulting in a significant reduction in wave energy reaching shorelines where kelp forests are present, leading to reduced coastal erosion. However the evidence supporting this is inconclusive and the role of kelp in attenuating wave energy remains undecided. Hydrodynamically-scaled artificial kelp mimics in laboratory wave tanks can provide unique insight into the role of kelp forests in attenuating wave energy, providing a degree of environmental control and replication not possible in field studies. For the behaviour of these mimics under wave conditions to be consistent with nature, and so provide meaningful instruction on kelp forest wave attenuation, requires careful choice of material properties and design to ensure geometric, kinematic and dynamic similarity with their natural counterparts. This poster outlines how these conditions can be achieved through precise matching of dimensionless parameters governing kelp hydrodynamics between mimic and nature, and the use of novel construction techniques. By first designing 3D printed kelp to exact measurements, then using these models to produce silicone moulds, artificial kelp mimics were cast using liquid polyurethane rubber directly from the moulds. The polyurethane kelp mimics produced possessed the requisite material and geometric properties to hydrodynamically mimic a kelp forest in a laboratory wave tank.

Using molecular-assisted alpha taxonomy to sort macroalgae from the mesophotic zone off the Bermuda Platform.
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The mesophotic, the zone between the euphotic and the aphotic zones, is from depths of ~50–200 m off the coast of Bermuda where penetrating light extinguishes at its lowermost depth. In lower portions of the mesophotic, extreme light conditions clearly limit the macroalgal species that can survive, as well as their cover on these deep reefs, but many of those found are a collection of previously unknown species from the inshore coast, many in genera that are only found in distant oceans. Beginning with the Challenger Expedition in 1873 and the U.S. Navy during the Cold War 1960s, macroalgae were dredged off Bermuda with dried specimens left as archival records in herbaria. More recent collections made by surface-supplied air in the 1980s and technical diving and submersibles in 2016, have allowed the use of sequenced DNA character strings for more precise identifications than those made using? taxonomy from the earlier deep-water collections. Several species encountered in the mesophotic zone have allowed us to compare with related species in Australasia, Hawaii or Europe, some of the siblings likewise being restricted to low-light environments halfway around the Earth. Examples of such disjunct species in the same genus will be highlighted using a list of the new species discovered in the Bermuda mesophotic including the red algae *Galene*, *Nothokallymenia* and *Psaromenia*. Other genera discussed include species with disjunct populations in Bermuda and the Gulf of Mexico (*Halarachnion*), new species in the Atlantic with long distances between sibling species (*Tepoztequiella*, *Contarinia*), and unique species surviving severe light limitation when sister taxa live a stone's throw away the in the euphotic zone of Bermuda (*Cryptonemia*, *Dasya*, *Gloiocladia*, *Halopeltis*, *Wrangelia*).

Session: Freshwater

Oral presentations

Rapid assessment of filamentous algae in rivers as a potential tool for citizen scientists.
Martyn Kelly (School of Geography, University of Nottingham NG7 2RD, UK), Katrina Woodfield (Lancaster Environment Centre, Lancaster University), Bill Brierley (Freshwater Biological Association) and Jason Doe (Environment Agency).
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RAPPER (Rapid Assessment of PeriPhyton Ecology in Rivers) was first developed as a means of gathering data on the condition of streams more quickly than possible using the standard tools for macrophyte and phytobenthos assessment, allowing biologists working for statutory agencies to get insights into sub-catchment variability that would inform appropriate restoration measures. However, this tool still depended upon users having access to a compound microscope and the capability to identify algae to at least genus. A number of Rivers Trusts expressed interest in using RAPPER but were concerned that their volunteers did not have access to microscopes and, for this reason, a version that was based solely on properties that could be discerned in the field was developed. Alongside this, another variant of RAPPER was developed for use in the River Wye, a much wider river, and also one where there has been considerable concern about filamentous algae growths in recent years. Being able to collect data much faster than is possible with conventional macrophyte surveys means that it becomes possible to make several observations over the course of a year. This, in turn, shows that the magnitude of algal growths is strongly dependent on water temperature, broadening the debate about the River Wye algae out beyond a narrow focus on nutrients to encompass wider climatic effects.

Scotland's Red Snows – an update on the snow microflora of the UK.
Alex Innes Thomson (SAMS), Naomi Thomas and Matthew P. Davey.
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Snow and glacier algae communities represent a unique pool of biodiversity and biological adaptation, which contribute significantly to biological albedo reduction in cryosphere environments. Alpine snow algae characteristically bloom on summer snowpacks in mountain regions, a phenomenon known as Watermelon Snow or Sang de Glacier. Only one known report, by J.J. Light and Hillary Belcher (1968), exists for snow algae in the UK, despite the occurrence of suitable habitat. Here, we provide an update on that report, based on opportunistically collected sightings and samples from the Scottish Highlands during recent summers. We report key species observed via light microscopy in these blooms and assess community composition using 18S and ITS2 metabarcoding. In addition, we summarise the geographic distribution of red snow sightings in Scotland, gathered through personal observations and contributions from citizen science volunteers.

Climate Change, forest fires and algal blooms: a rapidly changing world.
Shardlow, T. (Department of Biology, University of Waterloo, Canada), Valero, A. (Department of Biology, University of Waterloo, Canada), Virgin, T. (Department of Civil and Environmental Engineering, University of Waterloo, Canada), Shannon, A. (Department of Biology, University of Waterloo, Waterloo, ON, Canada), Kremer, S., Stone, M., Emelko, M. (Department of Civil and Environmental Engineering, University of Waterloo, Canada) and Müller, K.M (Department of Biology, University of Waterloo, Canada).
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Climate-change-exacerbated large scale wildfires have increased in severity and frequency globally, including western Canada. Post-fire erosion and runoff can especially deteriorate drinking water source quality and treatability. Considered Canada's most expensive natural disaster, the May 2016 Horse River wildfire resulted in the evacuation of ~90,000 people and loss of ~600,000 ha of forest cover. The fire resulted in a continued legacy of water quality change that includes increased delivery of bioavailable particulate phosphorus to untreated/raw water storage reservoirs serving the region. Fed by the wildfire- impacted Athabasca River and its tributaries, these "ponds" have experienced yearly blooms of cyanobacteria. To characterize wildfire impacts on drinking water treatment, in the summer (June to September) of 2023 and 2024, we characterized microbial communities in the water column and sediment using 16S rRNA gene sequencing and quantified two toxin genes, (anaC and mcyE) using qPCR. We also detected microcystin toxin that coincided with an increase in mcyE gene copy number in late summer. Anatoxin genes were observed at high copy numbers in the early and late summer. The sediments also exhibited potential toxin-producing species including a high abundance of Aphanizomenon following a bloom. Thus, monitoring the distributions of potentially toxin-forming cyanobacteria in source water, in both the water column and sediment, is increasingly essential to ensuring the provision of safe drinking water. A bioinformatic predictive analysis based on 16S rRNA genes suggested that bacterial communities present likely have a higher gene abundance for enzymes involved in bioavailable phosphorus cycling than nitrogen cycling. This may indicate the need to prioritize the management of phosphorus from the sediment in these water systems over other nutrients in the mitigation of cyanobacterial blooms. These results demonstrate the legacy

impacts of wildfires can have on the presence of cyanobacterial blooms that can persist almost a decade after a fire.

Protein bioaccessibility of Limnospira maxima biomass products through static in vitro digestion experiments.
Juarez-Rendon Nadine E (University of Glasgow), Combet-Aspray Emilie and Watson Ian A.
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The current world's growing population demands new sources and strategies to provide nutritious food alternatives with minimal impacts and detriment to ecosystems. A promising and reliable opportunity for novel food production are microalgae and microalgal products. Although microalgae are a vehicle of highly valuable components such as proteins, lipids, carbohydrates and pigments, there is still a lack of knowledge about the impact of microalgae on human health, and in particular gut function. Many cultivation systems focus on determining their parametric impact on the biochemical composition of microalgae, with fewer studies identifying their impact on human health via gut function analysis. In this research, Limnospira maxima biomass was cultivated in SAG media under different cultivation periods to investigate their impact on protein bioaccessibility via an in vitro human gut function model. Bioaccessibility is defined as the fraction of nutrients that are available to be potentially absorbed in the intestine (Rein et al., 2013). The digestion model was performed following the INFOGEST static in vitro simulation digestion protocol for food, based on Brodkorb et al. (2019), Canelli et al. (2020), and Minekus et al. (2014). Freeze-dried biomass from different time points of harvesting (7, 12, 17, and 19 days) was tested for protein bioaccessibility. The results showed that biomass harvested after 7 days presented the highest protein bioaccessibility (82.87 ± 2.55%) whereas the biomass obtained after 17 days had the lowest bioaccessibility of proteins (31.23 ± 11.03%), with much greater variability. The results indicate that the harvesting time is a key indicator regarding the level of protein bioaccessibility of microalgae, where short cultivation periods can deliver higher levels of protein from microalgae to be possibly absorbed by the intestines. These outcomes are particularly important in terms of commercialisation and industrial scale production for microalgal systems where harvest time can be reduced.

Posters

Synthesising ncAA-containing recombinant proteins in the chloroplast of Chlamydomonas
Rinad Alhedaithy (Department of Structural and Molecular Biology, University College London), Harry Jackson and Saul Purton.
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Genetic code expansion aims to reassign codons to incorporate non-canonical amino acids (ncAA) at specific sites in a polypeptide chain for the chemical diversification of the target protein. In nature, the full potential of protein functionality has not been unlocked due to the limited set of 20 proteogenic amino acids; however, ncAAs offer a diverse set of building blocks to broaden a protein's chemical repertoire. The incorporation of a ncAA at a specific site in a target protein relies on a genetic system that has an unused codon that can be reassigned to the ncAA, an orthogonal pair comprising a tRNA specifically for the ncAA that recognises the codon together with the cognate aminoacyl tRNA synthetase (aaRS), and the presence of the ncAA itself within the system. Chlamydomonas reinhardtii is a model microalga that is genetically tractable, allowing it to be used as a light-driven platform for the manufacturing of recombinant proteins. The chloroplast is particularly suited for genetic engineering using ncAAs due to its tiny chloroplast genome where none of the endogenous genes overlap or undergo RNA editing, and DNA integration occurs via homologous recombination. Importantly, the chloroplast genome does not use the UGA stop codon, allowing for its reassignment. Using synthetic biology techniques, elements of the ncAA-incorporating machineries can be engineered into the chloroplast to synthesise novel recombinant proteins in C. reinhardtii. I will present my research into the expression of different ncAA tRNA/aaRS pairs in the chloroplast, and the engineering of a pathway for biosynthesis in situ of the 22nd amino acid, pyrrolysine.

Algal Isolates from Robert Island, South Shetland Islands, Antarctica.
Alex Innes Thomson (SAMS), Naomi Thomas and Matthew P Davey.
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Snow and glacier algae communities represent a distinct pool of biodiversity and extremophilic adaptations. They play a crucial role in their environments by driving primary production, facilitating

nutrient cycling, and contributing to biological albedo reduction in cryospheric regions. In Antarctica, glacier and snow algae represent a major source of terrestrial primary production. Our understanding of their distribution, biology, and diversity in Antarctica is rapidly improving through field studies and in-situ observations. However, there is also a pressing need to understand these organisms and their biological adaptations to the cryosphere under controlled conditions and through experimental systems. Here, we report on the isolation of a novel and diverse collection of algal isolates from a field campaign on Robert island in the South Shetland Islands in January 2023. These isolates represent a valuable resource for advancing our understanding of cryophilic algal biology and diversity.

Diatom Flora of Britain and Ireland – the collection of William Smith.

Ingrid Jüttner (Amgueddfa Cymru – Museum Wales, Department of Natural Sciences, Cardiff), David Williams (The Natural History Museum, London) and Bart Van de Vijver (Meise Botanic Garden, Research Department, Nieuwelaan, Belgium and University of Antwerp, Department of Biology, Belgium).
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The Diatom Flora of Britain and Ireland consists of a web-based diatom flora and of peer-reviewed publications on diatoms from non-marine (usually aquatic) habitats. Currently a total of 351 species have been published on the website https://naturalhistory.museumwales.ac.uk/diatoms/. Despite recent taxonomic revisions there is still disagreement about the application of many species' names. Many poorly understood taxa described from Britain together with many rare and endangered species in insufficiently-studied unpolluted freshwaters require re-examination. William Smith was one of the most prominent diatomists in the 19th century and published the first comprehensive flora of British diatoms (Smith 1853, 1856). His slide and original type material collections comprise more than 1200 samples from all over Britain. We are currently investigating his collection including the types of the species he described, conserved in the diatom collections at the Natural History Museum, London (BM) (Smith 1859), in the Royal Botanic Garden of Edinburgh (E), UK, and in the Van Heurck Collection, Meise Botanic Garden, Belgium (BR) (Hoover 1976). We provide an overview of 80 species studied during the current funding period (Diatom Flora of Britain and Ireland - Phase 2) and during previous investigations using light and scanning electron microscopy. These include, for example, 3 species in Amphora, 4 species in Cymatopleura and in Epithemia, 12 species in Nitzschia, 13 species in Pinnularia and 5 species in Tryblionella.

Hoover, R.B. 1976. Inventory of the original typical collection of the Reverend William Smith (1808–1857). Types du Synopsis of British Diatomaceae. pp. [i]–xlv, 1–106, 11 pls. Antwerp, Koninklijke Maatschappij voor Dierkunde van Antwerpen.
Smith, W. (1853, 1856). A Synopsis of the British Diatomaceae , Vol. 1+2., John Van Voorst, London.
Smith W. 1859. List of British Diatomaceae in the Collection of the British Museum. Taylor and Francis, London, 55 pp.

Production in the algal chloroplast of a major capsid protein (MCP) subunit vaccine against the infectious spleen and kidney necrosis virus (ISKNV) of Asian seabass.

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The Infectious Spleen and Kidney Necrosis Virus (ISKNV) causes a severe pandemic in fish. ISKNV infection results in epidermal lesions with significant petechial haemorrhages and abdominal edema. The chloroplast of the green microalga Chlamydomonas reinhardtii offers various advantages for the sustainable production of recombinant proteins. The alga is Generally Recognized as Safe (GRAS), and the chloroplast compartment represents an enclosed system that allows transgene expression to a high level and correct protein folding. The algal strain selected for this experiment is C. reinhardtii CC-4033 which is engineered to contain a bacterial gene that allows selective growth of the strain in

media containing phosphite. The strain also loses chlorophyll when cultures are transferred from the light to the dark. The two features will reduce scale-up costs and palatability. To demonstrate the efficiency of the subunit vaccination, fish were administered an injection of a crude algal extract containing MCP. It demonstrated significantly elevated serum antibody titers compared to fish immunised with a crude algal control and recombinant protein from E. coli ($p < 0.05$) at 14, 21, and 28 days. A novel method to resolve downstream processing costs is to use the whole of the edible algae, allowing vaccine encapsulation in the dried algae and formulation into the aquaculture feed. Moreover, a codon reassignment strategy results in the biocontainment of the transgenes in the chloroplast and prevents horizontal gene transfer. This approach is improving the genetic features of the C. reinhardtii host, which will be beneficial for oral vaccine production in the future.

Glacier algal communities from an Antarctic ice cap.
Alex Innes Thomson, Andrew Gray, Naomi Thomas, Claudia Colesie, Hannah Moulton, Peter Convey, Lloyd Peck, Alison Smith, Peter Fretwell, Matthew P. Davey.
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Glacier algal communities represent a unique pool of biodiversity and extremophilic adaptations, distinct from surrounding snow and permafrost communities. In the northern hemisphere, these communities are known to contribute significantly to albedo reduction on ice surfaces and contribute to primary production and nutrient cycling in Artic polar regions. However, little is known about the composition and contribution of algal communities to biological dynamics on ice cap surfaces in Antarctica and the Southern Hemisphere. Here, we present on the extent and diversity of bloom-forming algal communities on the Robert Island ice cap in the South Shetland Islands, Antarctica. In addition, we report on morphological and phylogenetic diversity within the streptophyte algal genus Ancylonema from Robert Island, which suggests the occurrence of regional endemism in this group, and hints at a potentially unique cryo-refugial history.

How are we assessing and communicating the risks of toxic cyanobacteria in recreational waters? Can you help? An invitation to participate.
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Session: General Phycology

Oral presentations

Mixed provenance of organic carbon in temperate intertidal seagrass sediments.
Emma A. Ward (Institute of Marine Sciences, School of Environment & Life Sciences, University of Portsmouth), Sarah E. Reynolds (School of the Environment, Geography & Geosciences, Faculty of Science and Health, University of Portsmouth), Melanie J. Leng (National Environmental Isotope Facility, British Geological Survey and School of Biosciences, University of Nottingham), Jack H. Lacey (National Environmental Isotope Facility, British Geological Survey), Marianna Cerasuolo (Department of Mathematics, School of Mathematical and Physical Sciences, University of Sussex), Bronwen Paxton (Institute of Marine Sciences, School of Environment & Life Sciences, University of Portsmouth), Federica Ragazzola (Department of Integrative Marine Ecology, Genoa Marine Centre, Stazione Zoologica Anton Dohrn, Italy) and Joanne Preston (Institute of Marine Sciences, School of Environment & Life Sciences, University of Portsmouth).
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Blue carbon accreditation for climate mitigation services provided by coastal ecosystems, such as seagrass beds, currently includes only autochthonous organic carbon in their valuations, not allochthonous carbon from other habitats. Here, a multi-proxy approach is used to determine the provenance of organic carbon in two intertidal temperate seagrass ecosystems in the Northeast Atlantic. The organic carbon to nitrogen ratio (Corg/N) and carbon isotope composition (δ13C) of seagrass sediments from an open coastal sandy site (Ryde, UK) and a muddy tidal inlet site (Farlington Marshes, UK) were measured. Further to this the carbon and nitrogen isotope composition (δ13C, δ14N) of seagrass, saltmarsh and algae tissue found at these sites were also measured. Sedimentary Corg/N was found to be higher at the muddy site than the sandy site, suggesting a greater contribution of marine algal organic matter in the latter. Isotopic mixing model analysis considered whether seagrass sedimentary carbon was seagrass, algal, suspended particulate matter, saltmarsh or terrestrial in origin. These models showed seagrass biomass contributes 12-16% to accumulated sedimentary Corg. These findings demonstrate that temperate Northeast Atlantic

seagrass sediments are dominated by allochthonous Corg (84-88%) and that current blue carbon accreditation frameworks undervalue these ecosystems.

Developing a protocol for the sustainable aquaculture of serrated wrack Fucus serratus (Phaeophyceae).

Manus Cunningham (Marine Laboratory and School of Mechanical and Aerospace Engineering, Queen's University), Louise Kregting (The New Zealand Institute for Plant and Food Research, New Zealand), Rebecca E. McKinney (Marine Laboratory and School of Biological Sciences, Queen's University), Riddhi Salotra (School of Mechanical and Aerospace Engineering and School of Chemistry and Chemical Engineering, Queen's University), Christine A. Maggs (School of Biological Sciences, Queen's University), Emma Healey (Marine Laboratory and School of Biological Sciences, Queen's University), Jaimie T.A. Dick (Marine Laboratory and School of Biological Sciences, Queen's University) and Pamela J. Walsh (Marine Laboratory and School of Mechanical and Aerospace Engineering, Queen's University).
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With the global seaweed market set to exceed £20 billion by 2030, the aquaculture of seaweeds has never been more important. The serrated wrack Fucus serratus, which contains natural antimicrobial compounds, may be at risk of future overexploitation as demand for biomass increases across various markets. At Queen's University Marine Laboratory, we aim to develop a protocol for sustainably growing F. serratus biomass which could supplement the wild-harvesting industry. To test this, we cultured F. serratus over 8 months in the nursery and monitored their growth, amino acid and phenolic contents in a lab vs field trial. F. serratus were successfully fertilised in vitro, attached to two substrata (Tiles and Dyneema Twine) and grown to juveniles of ~4 mm in the lab nursery. After 6 months in the nursery, the twine was deployed at the Strangford Lough seaweed farm and compared against the tiles which continued to grow in the nursery for two additional months. Prior to field deployment, seaweeds grown on tiles were significantly longer (~17%) than those on twine, however, after the field trial, the seaweeds on twine grew significantly longer than those on the tiles (~33%). The amino acid content was also higher in those grown in the field (~62 mgPGE/g), but the phenolics were higher in those from the nursery (~128 mgPGE/g). Our results show that F. serratus can successfully grow in subtidal areas, which is highly important for providing sustainable biomass, whilst avoiding competition for space from other aquaculture industries operating in the intertidal zone. While initial cultivation has been successful, we are conducting further research into the feasibility of cultivating F. serratus at scale through assessments of monthly zygote fertilisation and settlement density, and controlled lab and field experiments investigating the use of nursery preconditioning and onward growth in both intertidal and subtidal zones.

The potential for Chlorochromis zofingiensis to be implemented into a biorefinery: a case-study from Culture Collection of Algae and Protozoa (CCAP).

M. Ross (CCAP and SAMS), E.E. Wood (British Sugar & AB Agri, Livalta), S. Jubeau (Cargill, France), V. Montalescot (Cargill, France), M.S. Stanley (SAMS), R. Allen (CCAP and SAMS), M.P. Davey (SAMS), C. Drysdale (CCAP and SAMS), J. Field (CCAP and SAMS), D.H. Green (SAMS), K. MacKechnie (CCAP and SAMS), R. Saxon (CCAP and SAMS), N. Thomas (CCAP and SAMS) and C. Rad Menéndez (CCAP and SAMS).
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The Culture Collection of Algae and Protozoa (CCAP) is one of the most diverse biological resource centres for algae and protozoa, with >3,100 strains available. We have a worldwide customer base, serving academia and industry, offering a range of services including strain and media provision, biobanking, taxonomic and molecular studies, training, and collaborative research. CCAP has expanded the services in our repertoire by launching the Algal Research, Innovation and Environmental Science centre (CCAP-ARIES). CCAP-ARIES has cutting-edge equipment enabling algal scale-up, downstream processing, and metabolomic analyses. During this presentation, we will provide an overview of CCAP, our services, and present a case study on recent research arising from the CCAP-ARIES centre which focussed upon investigating the potential for Chlorochromis zofingiensis to enter into a biorefinery. Chromochloris zofingiensis is viewed as a potential competitor to Haematococcus sp. for the production of astaxanthin. This is due to its considerably simpler life-cycle and greater production of biomass with a resultant increased yield of astaxanthin per unit volume. Furthermore, C. zofingiensis synthesizes other biomolecules which have commercial interest, such as lipids, starch, and soluble proteins and carbohydrates which make it a prime candidate for biorefining to maximize the value of biomass. To accumulate biomass and induce carotenogenesis,

C. zofingiensis was cultivated in a two-phase phototrophic-mixotrophic manner in 65L photobioreactors. Biomass was collected throughout the cultivation, facilitating a time-resolved composition of the biomass to determine best time of harvest. This study reports the largest-scale cultivation of mixotrophic cultivation of C. zofinigiensis available in the literature.

Posters:

Seaweed-Derived Bioactives: Developing a Novel Synbiotic to Support Immune Function.
Holly Sedgwick (University of Reading), Glenn Gibson, Jessica Adams, Paul Smith and Anisha Wijeyesekera.
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Brown seaweed-derived bioactives, particularly complex polysaccharides, are fermented by the gut microbiota and may have prebiotic potential. In prior in vitro work, alginate, laminarin, and in some cases fucoidan, have been shown to modify the gut microbiota and its metabolites, such as short chain fatty acids (SCFA), which are considered beneficial to health. Synbiotics (a combination of prebiotics and probiotics) are emerging as a promising dietary-driven approach to improve health through targeting of the gut microbiota. Further understanding of the influence of brown seaweeds on the gut microbiota presents an exciting opportunity to develop an optimised synbiotic food product to support immune health. To screen and compare bioactive complex polysaccharides derived from brown seaweeds, as well as testing whole brown seaweeds, for prebiotic potential in vitro to support the development of a novel synbiotic product to later test in vivo. Using dynamic pH batch fermentations, pure complex polysaccharides from brown seaweeds and whole brown seaweeds were screened for prebiotic potential (in triplicate, using three independent stool donors). Fermentation samples were collected at 0, 8, 24, and 48 hours. Changes in microbial ecology were assessed using 16S sequencing. SCFA production was determined through Gas Chromatography-Flame Ionisation Detection. SCFA analysis showed that alginate, laminarin, as well as whole brown seaweed Ascophyllum nodosum significantly increased acetate production during fermentation compared to the negative control (containing no prebiotic substrate). Furthermore, laminarin additionally significantly increased propionate production compared to the negative control. This analysis indicates that alginate, laminarin, and Ascophyllum nodosum are suitable candidates for further screening for prebiotic properties.

Seaweed Diversity over Time: Comparison of Historic and Current Seaweed Presence at St. Andrews, Scotland.
Martin Wilkinson (Heriot-Watt University, Edinburgh), Clare Scanlan (Perth, Scotland), Juliet Brodie (Natural History Museum, London).
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St. Andrews on the North Sea coast of Scotland is renowned as a rich area for marine biology. One of the British Phycological Society's (BPS) founders, Helen Blackler, spent much of her career there at the Gatty Marine Laboratory and she produced detailed lists of the seaweed flora of East Fife. A BPS Seaweed Field Meeting in August 2023 revisited three of Helen's collecting sites in St. Andrews and compiled full species lists for them. The very high totals of species recorded on each shore (116-123) were very similar to Blackler's (103-128). But the actual named species present were different. The basic dominant species were all there but we recorded in total 47 species not found by Blackler and she recorded 54 species that we did not find. A similar pattern was found in a survey in 1977 at Elie nearby when Wilkinson & Tittley found the same species richness as Traill had found a century earlier but only 70% of species were shared. This is one reason why the EC Water Framework Directive Rocky Shore Assessment Tool for the UK and Ireland only uses species total and not detailed species presence. The species totals found in this field meeting were higher than any of the seven previous BPS field meetings held in Scotland, in remote unpolluted areas, since 1971 establishing the richness of the St. Andrews flora.

Museum of Microalgae
Francisca Vermeulen (SAMS) and Alexander Thomson.
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The museum of microalgae, a free one-day free pop-up event, was held on the 29 November 2024 in the Glasgow botanic garden. This collaborative initiative brought together a diverse team of phycologists, industry experts, biodesigners, students, artists and entrepreneurs. The focus was on

bringing the extraordinary world of microscopic algae to people by showcasing the important role microalgae play in the environment and its many applications from energy to food to cosmetics to art. Promoting microalgae to the public via the museum of microalgae is an innovative way to familiarize with and immerse people in the world of algae. During the event stations were set-up with different activities involving microalgae. Such as a craft station for kids and adults to make algae storage boxes, ornaments, and badges. Chlorella sp.-based flap jacks, brownies and muffins could be taste tested. Live microalgae could be studied using microscopes and through an immersive experience where people observed bioluminescent microalgae in the dark. Algal biodesign and engineering was represented by a skin care product made from an algae-bacteria biofilm, a photovoltaic cell using cyanobacteria to produce electricity, a plankton scope and a low-cost open-source homemade microscope. Microalgae art could be seen in the form of origami and a headdress engraved with diatoms. Algal souvenirs, such as postcards, stickers and buttons were sold to raise funds for the museum of microalgae. The location and activities provided proved the be very successful with a wide range of people visiting the museum including locals and tourists, families, students, drop-ins and commuters goes though the gardens. In total the event saw over 300 visitors engaging with the various activities and left many inspired by importance and breathtaking diversity of algae. https://www.microalgaemuseum.com/.

The effect of storms on the loss of fucoids in Autumn of 2023 and 2024.
Jasmine Simmons (University of Hull).
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The loss of individual fucoid algae has not successfully been monitored. In this study, the survivorship of Fucus serratus, Fucus vesiculosus and Fucus spiralis were monitored along the Yorkshire coast from August 2023 to the current date. There were 7 storm events that occurred from the end of September to the end of December 2023, compared to 4 storm events in 2024 over the same time. To determine whether storm events impact the loss of fucoids, Autumn of 2023 loss will be compared to Autumn of 2024 loss. The greater number of storms in 2023 caused a significant loss of tagged fucoids on the Yorkshire coast in comparison to loss seen in 2024. The growth of macroalgae that survived the 2023 storms was recorded monthly and lost individuals retagged to new alga. Whether individuals survived to Autumn 2024 or lost during the year will demonstrate survivorship. Here we will present preliminary findings on the rate of loss between the two time periods.

Wednesday 8th of January 2025.

Session: Estuarine algae

Oral presentations

Contributions of benthic microalgal biofilms to sediment organic carbon stocks across a salt marsh gradient.
Graham J C Underwood (School of Life Sciences, University of Essex), Nicola J. D. Slee (School of Life Sciences, University of Essex), Jessica C. J. Underwood (School of Archaeology, Geography and Environmental Science, University of Reading), Christopher I. D. Underwood (Independent Scientist, Bristol) and James L. Pinckney (Estuarine Ecology Laboratory, Department of Biological Sciences, and School of the Earth, Ocean, and Environment, University of South Carolina, USA).
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Salt marshes are important coastal habitats that store significant quantities of organic carbon. The contribution of halophytic plants to sediment total organic carbon (TOC) stocks in salt marshes is well described, but the importance of microalgae in salt marsh carbon budgets is less well understood. In this study, benthic microalgal (BMA) biofilms in sub-habitats within a South Carolina (USA) salt marsh were characterised, and related to sediment organic carbon, carbohydrate, water, organic matter and bulk density contents. There were significant differences in the contribution of BMA carbon to measures of total sediment organic content between unvegetated upper marsh sediments, within Sporolobus (Cordgrass) stands and on mudflats. Near Infra-Red (NIR) spectroscopy of sediment found different relationships in the nature of the organic matter present in sediments, with differences linked to the relative contribution of BMA to the overall carbon stocks. A variety of upscaling and modelling approaches estimated BMA carbon to contribute between 1.2 and 8.0 % of the surface sediment TOC, with a median stock of 0.06 – 0.08 tonnes hectare-1, compared to salt marsh median

total organic carbon stocks of 18 tonnes ha-1. Both measures could be modelled across a whole salt marsh using relationships between habitat type and position across the tidal height gradient to generate maps of salt marsh organic carbon stocks at a landscape scale.

Optimising pretreatment methodologies to improve the amenability of nuisance macroalgal bloom Ulva spp. to enzymatic saccharification.

Eloise Jackson (IBERS, Aberystwyth University), Valerie Rodrigues (IBERS, Aberystwyth University), Juan Sandoval Rueda (IBERS, Aberystwyth University) and Jessica M.M. Adams (IBERS, Aberystwyth University).
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The utilisation of macroalgae for bioresource applications, particularly those derived from Ulva spp., is gaining global interest. This study presents an optimised process for the separation of Ulva biomass into its reducing sugar constituents, covering aspects of sourcing, washing, pre-treatment and enzyme saccharification.Tubular-form Ulva spp. from nuisance blooms was collected wild with content analyses conducted to quantify carbohydrate abundance relative to biomass weight. Optimal washing conditions were determined through tap-water wash cycles, with six washes resulting in 97.6% decrease in salinity compared with the initial wild Ulva composition. Subsequent trials used a commercially grown U. lacinulata; trialling dewatering methods by comparing screw-pressing and electric spinner techniques. Here a higher efficacy of electric spinner batch dewatering was demonstrated, whilst retaining significantly higher carbohydrates than those following dewatering by screw-pressing. Comparative drying using different temperature oven drying and freeze-drying revealed that freeze-drying maintained a significantly higher carbohydrate abundance over biomass that was oven dried at lower temperatures, giving the highest carbohydrate yield overall. The second part of this study evaluated how pre-treatment mechanisms and Ulva quality impact on enzymatic saccharification. Freeze-dried U. lacinulata samples were autoclaved for 60 min at 60, 90 and 120 °C prior to enzyme saccharification using commercial mixed cellulases and in-house ulvan lyases. Pre-autoclaved biomass treated at 120 °C was optimal for glucose release whereas 90 °C gave the maximum release of rhamnose and other reducing sugars. Finally, in controlled degradation experiments, U. lacinulata was left in air at room temperature for 0-72 h, then autoclaved and enzymically degraded as above. A significant difference in sugar yields were seen, with longer degradation times typically leading to lower quantities of reducing sugars released. Collectively, these findings contribute to the development of efficient methodologies for processing and utilising Ulva biomass including that from blooms for further bioprocessing applications.

Nitrogen isotopes in herbaria document historical nitrogen sewage pollution in the Mersey Estuary, England.

D.R. Gröcke (University of Durham), F.C. Alldred (University of Durham) and G. Reid (World Museum)
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Stable nitrogen isotope ratios ($\delta^{15}N$) in macroalgae are an under-utilised tool in the UK for studying coastal and estuarine pollution. Nitrogen loading from effluent and industrial sources produce distinct nitrogen isotope signatures. Museum herbaria are an untapped resource for understanding anthropogenic modification of the environment, especially nitrogen pollution. In this presentation we will demonstrate how $\delta^{15}N$ in seaweed herbaria from the World Museum (Liverpool) can be used to reconstruct nitrogen pollution in the Mersey Estuary. To produce a more accurate historical record, modern seaweed, primarily Fucus sp. and Ulva sp., were collected and analysed in the Stable Isotope Biogeochemistry Laboratory (Durham). The Mersey Estuary recorded reveals that agricultural and raw human sewage were dominant nitrogen pollution sources in the 1800s. From the 1970s to present day this was now dominated by treated sewage and record some of the highest seaweed $\delta^{15}N$ values recorded to date (Alldred et al. 2024). This study supports other documentation that England is currently experiencing a water quality environmental disaster. Museum archives should not be forgotten, as they are an extremely valuable resource of past material for scientific research.

Investigations of phytoplankton biomass and water quality and in the context of marine mass mortality events on the north-east coast of England.

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A series of mass mortality events, known locally as ‘wash-ups’, have impacted marine fauna on the north-east coastline, causing local reductions in commercially-important crustacean landings, and leading to a parliamentary enquiry. Centered on the mouth of the Tees estuary, the cause of mortality is not known. Possible mechanisms relate to: harmful algal toxicity and/or benthic oxygen depletion, pollution by sewage or industrial waste following recent dredging, or a substantial shift in ecosystem composition and productivity. Here, we present oceanographic studies and a time series analysis of water quality and phytoplankton biomass in an effort to understand productivity at the base of the coastal food-web. Analysis of Environment Agency data showed that average chlorophyll concentration during the peak of shellfish mortality in Autumn 2021 were higher than the long-term average. 18 potentially harmful algae species were identified in coastal water samples collected in 2021 and 2022. Additionally, increased salinity and temperature were noted in 2021 and 2022. The north-east coast has three distinct hydrodynamic zones, as derived from a combination of bathymetry and modelled mixed layer depths. To the north are inshore and offshore seasonally-stratified waters, and to the south, a permanently mixed zone was identified. Research in 2022 utilised a range of data collected in situ, together with remotely-sensed data and modelling to assess the physical and biological controls on varying phytoplankton bloom phenology and primary production in the differing hydrodynamic regions. A north-south gradient was apparent, whereby increased phytoplankton biomass (the spring bloom) was initiated earliest in stratified waters off Northumberland, with delayed (or no) plankton bloom in the permanently mixed waters to the south of Flamborough Head. The key drivers for bloom development were the onset of stratification and varying light attenuation. Phytoplankton biomass correlated to neap-spring tidal cycles where stratification formation occurred on the neap phase of the tidal cycle with lower current speeds, facilitating short periods of stratification formation and potentially aiding in the reduction of light attenuation, enhancing phytoplankton growth in summer and autumn. The presence of sub-surface phytoplankton biomass, and potentially low benthic oxygen in late summer, are the subject of ongoing investigations.

Posters

The impact of Opportunistic macroalgae on Seagrass meadows.
Charlotte Jennings (University of Newcastle), Pippa Moore and Heather Sugden.
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Algal blooms are on the rise globally, occurring more frequently and intensely year on year. Typically, these blooms will either be growing or drifting in estuaries. In these areas we find seagrass meadows, an important habitat forming species. These habitats are under pressure from algal blooms, especially in nutrient rich areas, that may further cause these blooms to grow out of control. This algae can settle on seagrass meadows, smothering them especially in intertidal areas. This meta analysis was conducted to examine the effects of this opportunistic macroalgae on seagrass meadows, to understand these impacts, the morphological, physiological and taxonomy of the algae and seagrass were assessed. The data from 45 studies were extracted and a Hedges g score was calculated for every observation. The overall result was significantly negative, showing there was an overall negative impact on seagrass physiology and morphology under algal bloom scenarios, this included measure variables such as shoot length, above ground biomass and root length. The main significant findings were (a) that unmanipulated studies showed a significant positive result in comparison to manipulated which showed a significant negative. (b) that native algae had a more negative impact then invasive algae, (c) when looking at survey method, algal loading studies were significantly more destructive to seagrass meadows then any other method found. These findings suggest that the impact of opportunistic macroalgae can result in degraded seagrass meadows and even in cases of algal removal, recovery is not achieved in the examined studies timeframe. This review was limited by number of studies, and identified knowledge gaps that need to be addressed before a more comprehensive review can take place.

Session: Phytoplankton

Oral presentations:

The turbulent life of microorganisms in the oceans = flow cytometry, an essential tool with its first best practices and interoperable datasets.
Melilotus Thyssen (MIO, University of Marseille, France).
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Understanding marine phytoplankton distribution and ecology is fundamental, and require highly resolutive data sets combining spatiotemporal distribution and a sense of diversity. Unfortunately, phytoplankton cells have daily cellular dynamics, their size ranges from submicrons to mm and ocean is in motion, generating three-dimensional meanders, making their study a real challenge. A solution to encompass some of those limitations is flow cytometry, a single cell level analysis technique, that has been adapted to jump from the bench to a moving ship, improving its autonomy for long crossings without direct interventions, but also for observation underwater and in continuous measurement stations. Instrument resolution has also increased to fully catch the size distribution of marine microorganisms, by combining powerfull lasers with image in flow devices. A common vocabulary has been built recently by a group of experts to implement large scale intercomparisons of data sets, and make people agree in manually gating the observed groups. From this, automated classifications can be set up, in combination with interoperable data bases, increasing the potential number of data sets to study phytoplankton at a global scale. I will present to you some examples of deployments and how this tool makes it possible to study impulsive phenomena such as storms, often inaccessible to oceanographic vessels and ocean color from remote sensing. At the same time, I will present to you the international effort put in place to develop good practices, and make the datasets accessible and interoperable for the scientific community.

Best practices for automated flow cytometry and its application in the Baltic Sea
Lumi Haraguchi (Finnish Environment Institute, Finland), Clémentine Gallot (MIO, University of Marseille, France), Zéline Hubert (Université Littoral Côte d'Opale, France), Veronique Creach (Cefas), Luis Felipe Artigas (Université Littoral Côte d'Opale, France), Mélilotus Thyssen (MIO, University of Marseille, France), Kaisa Kraft (Finnish Environment Institute, Finland), Annaliina Skyttä (Finnish Environment Institute, Finland), Pasi Ylöstalo (Finnish Environment Institute, Finland), Sami Kielosto (Finnish Environment Institute, Finland),Sebastian Ehrhart (Finnish Environment Institute, Finland), Martti Honkkanen (Finnish Meteorological Institute), Lauri Laakso (Finnish Meteorological Institute, Finland) and Jukka Seppälä (Finnish Environment Institute, Finland).
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Automated flow cytometry (FCM) has improved the capabilities to observe phytoplankton at high frequencies, allowing to observe the communities at smaller and faster scales, which are intrinsic to those organisms life cycles and essential to understand their dynamics. While best practices are available for traditional bench top FCM, the technique automation involves a different set of challenges. During the Euromarine TT-Cyto workshop, those challenges were discussed among multiple automated FCM users and a set of best practices was compiled. Although those best practices were designed for the pulse-shape recording FCM (CytoSense), those can be easily adapted to instruments with different configurations (and even other brands). By incorporating those best practices in their routines, researchers using automated FCM can ensure the quality and improve comparability of their acquired data, advancing the acquisition of FAIR data. Examples of automated imaging and FCM data acquired at the Utö Atmospheric and Marine Research Station and on a ship-of-opportunity will be shown to demonstrate the value of high frequency data to understand phytoplankton dynamics.

Linking high-frequency monitoring and experiments to understand riverine phytoplankton annual succession.
Fournier Isabelle (UKCEH), O'Brien Alex (UKCEH), Duenas-Lopez Manuel-Angel (UKCEH) and Bowes Mike (UKCEH).
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Predicting phytoplankton growth in rivers is important to support the catchment management decisions related to algal blooms. The long-term monitoring platform Thames Initiative provides weekly flow cytometry and chemistry data across the River Thames catchment. These data, alongside publicly available datasets, were used to develop a niche model that predicts the bloom timing of different groups of algae based on water temperature, flow, solar irradiation, and phosphorus. The model showed regular annual community succession with a spring diatom bloom, followed by green algae bloom, and the occasional cyanobacteria bloom in late summer. Moving from

predicting bloom timing to predicting bloom intensity requires a better understanding of the drivers behind phytoplankton community succession and of the phytoplankton community response to the niche model parameters. In AQUA-REP facility, we conducted experiments to evaluate the effects of temperature on the growth rate and community composition of riverine phytoplankton. Temperature was chosen as it appeared to be the key driver in determining river phytoplankton community. We exposed the natural phytoplankton community of the River Thames to temperatures ranging from 5 to 25°C for 2 days. The experiment was repeated across the year to vary the starting communities and the temperature they were acclimated to, i.e. the river temperature. For all groups, the temperature of maximum growth rates was unaffected by the river temperature and was ≈20°C. We were expecting the diatoms, which thrive in spring, to achieve higher growth rates than the other algae when the water temperature was lower. However, we observed that diatoms' growth rates were higher than the other algae at any temperature when the river temperature was lower. While temperature is an important factor affecting algal growth, its ability to predict mechanistically the timing of blooms appears to be indirect and may be linked to confounding factors, such as grazing.

Machine learning application for phytoplankton analysis by automated flow cytometry.
Lucinda Lanoy, Zeline Hubert & Luis Felipe Artigas (LOG, University of Côte d'Opale, France), Veronique Creach & Joseph Ribeiro (Cefas), Robert Blackwell (Alan Turing Institute), Melilotus Thyssen & Clementine Gallot (MIO, University of Marseille, France), Lumi Haraguchi (Finnish Environment Institute,Finland), Emilie Poisson Caillault & Pierre-Alexandre Hebert (Opal Coast Signal and Image Computer Laboratory, University of Cean, France),
email: lucinda.lanoy@univ-littoral.fr

Automated pulse-shape recording flow cytometry is a valuable tool to improve the characterization of the entire size range of phytoplankton communities and to perform in vivo/in situ monitoring at high spatial and temporal resolution. However, manual gating performed on huge amounts of raw data acquired is time-consuming, difficult, and biased by intra- and inter-expert variability. This makes it necessary to develop automated tools using machine learning to provide a better inter comparable data (FAIR principle). Even though some analytical tools already exist, most of them are closed-source software, use outdated file formats, or are difficult for a non-AI expert to understand and use. The goal of the ongoing CYPHAIA project (Artificial Intelligence Application for PHytoplankton analysis by automated in vivo flow Cytometry) is to create and share an open-source and optimized automated classification tool with easily reproducible results. It continues and improves the exploratory work presented at the TT-CYTO Euromarine workshop (Wimereux, June 2024). The novel tool would enable to deal with varying sizes of training sets, class imbalance, numerous variables, and the choice of the model, its hyperparameter combination, and the evaluation of its performance. It will be able to use directly the cytometer .CYZ files converted into the interoperable .JSON file format, obtained via the cyz2json conversion tool using the Cyz-File API, to be able to process the data independently of the cytometer company analysis software. Provided detailed explanations and guidance through open-source R scripts that build an entire workflow for the analysis of automated flow cytometry data, this new transparent and intuitive tool could be used by anyone regardless of their knowledge of AI. This tool is devoted to be applied to data from various ecosystems and for different study contexts, making the use of automated flow cytometry more powerful to produce interoperable datasets for phytoplankton functional diversity assessments at multiscale.

Posters

Artificial Intelligence for Automated Microalgal Classification and Monitoring.
Holly Liken, Jennifer Smith (University of Cardiff), Sonia Giulietti (University of Bristol), Levi Wolf (University of Bristol), Ce Zhang (University of Bristol), Peter Kille (University of Cardiff), Rupert Perkins (University of Cardiff) and Chris Williamson (University of Bristol).
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The monitoring of marine and freshwater microalgal communities is critical for numerous reasons, ranging from ecological studies to mandated water quality checks. While traditional methods of manual microscopy typically undertaken by trained algologists can be time consuming and resource limiting, the field of Artificial Intelligence (AI) holds significant potential to automate microalgal monitoring tasks. Specifically, the use of Convolutional Neural Networks (CNNs) for microalgal cell detection and classification has shown promising results for microscopy and flow-cytometry derived datasets. This study, undertaken as part of the Ofwat funded AI for Algal Monitoring project, tested

the application of four different CNNs (AlexNet, ResNet50, Inception V3, and VGG16) to classify an open-source dataset of marine microalgae with 6 classes (genera).. Experiments were conducted to further study the impact of hyperparameter tuning (epochs, transfer learning and, model optimizers) on classification outcomes. A key consideration for training CNNs is class bias/imbalance, a common feature of microalgal training datasets due to natural population variations. To manage this, data augmentation techniques were also applied both in pre-processing and within training to increase the number of images of rare genera . Strong variability in CNN accuracy was apparent related to model architecture and hyperparameter selection, including the application of data augmentation. The greatest accuracy was achieved with ResNet50 (95%) and AlexNet (96%). Variation in success, e.g. Inception V3 only demonstrating up to 84% accuracy, demonstrates the importance of choosing the right architecture. AlexNet, with a simplistic structure achieved the highest accuracy, compared to more complex models, illuding to simplistic architectures being most effective. For future exploration, these findings will be applied to a larger open-source dataset that contains more marine classes/genera and a freshwater dataset developed as part of the wider project.

Developing an integrated multi-disciplinary approach to improve understanding of HAB events.

Keelan C. Lawlor (MBA), Lawrence Shepard and Michael Cunliffe.
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Harmful algal bloom (HAB) events cause environmental, economic and human health impacts globally. To ensure shellfish are safe for consumption microscopy counts and biotoxin monitoring are conducted. However, these methods are costly, time consuming and require specialized skills. Molecular techniques have huge potential to revolutionise regulatory monitoring by offering high-throughput, cheap and rapid analyses, but challenges (particularly variable gene copy number) remain. To resolve these challenges we are applying a multi-disciplinary approach to monitor, understand and predict HAB events. We are developing and applying molecular assays that, instead of identifying and quantifying species, quantify gene copy number and correlate to levels of toxin (saxitoxin or domoic acid). Six strains of Alexandrium (a saxitoxin-producing dinoflagellate) comprising of toxic and non-toxic strains were used to develop a qPCR method employing primers targeting domain 4 of the sxtA gene (sxtA4) and sxtA4 copy number was determined for each strain. Copy number ranged from 1-139 copies.cell^{-1}. The lowest was observed in A. minutum CCAP 1119/48 a 'non-toxic' strain. Work is ongoing to quantify the toxins in these strains. This methodology will be extended to domoic acid by linking dab gene quantification to toxin level. To facilitate this DNA from 18 strains of Pseudo-nitzschia spp. have been obtained. A Europe-wide sampling effort conducted at five long term environmental monitoring sites over sixteen months collecting samples for biotoxin and molecular analyses has been conducted. This dataset will be combined with available historic data and used for joint species distribution modeling using hierarchical modeling of species communities (HMSC) to identify key factors in bloom formation and develop predictive models. This multi-disciplinary approach will highlight potential for deployment of gene quantification methods alongside conventional monitoring and by applying ecological modeling techniques to molecular datasets will provide new insights into the ecology of these species.

Using seaweed to mitigate the impact of Harmful Algal Blooms.

Francisca Vermeulen (SAMS).
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Harmful algal blooms (HABs) pose an increasing threat to the environment and aquaculture. Increasing interests are focussed on environmentally friendly strategies to reduce or mitigate the impacts of HABs. One promising approach involves the potential allelopathic properties of phytochemicals produced by seaweeds, though the underlying mechanisms and practical utilization remain unclear. In this study, Laminaria digitata, a widely distributed macroalga, was investigated for its allelopathic effects on the photosynthetic performance of harmful and non-harmful microalgae species. Powdered and extracts from L. digitata were studied for their effects on several microalgae, revealing species-specific and dose-dependent impacts. At low dosing within 24h a reduction in photosynthetic performance occurred in some of the microalgae species, while higher doses proved detrimental to all species after 72h. Notably, powdered L. digitata inhibited the photosynthetic activity of the harmful species Prorocentrum lima and Scripsiella trochoidea in a dose-dependent manner, while showing no negative effects on the non-harmful chlorophyte Dunaliella salina. The effects of L. digitata extracts varied depending on the extract solvent used. Water extracts affected Phaeodactylum tricornutum, while compounds in the methanol extract targeted Scripsiella trochoidea.

A key criterion for using macroalgae allelopathic compounds is its specificity, it needs to be able to target harmful algal species while not effecting non-harmful microalgae. These results suggest that L. digitata has multiple allelopathic compounds that can be used against HABs in a species-specific and dose dependent manner.

Session: General Phycology 2

Oral presentations

Single-nucleus transcriptomic characterization of chlorophyte photobionts in the lichen symbioses.
Ellen Cameron (Earlham Institute, EMBL-EBI, Wellcome Sanger Institute), Robert Finn (EMBL-EBI), Mark Blaxter (Wellcome Sanger Institute) and Irene Papatheodorou (Earlham Institute)
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Lichens are formed through the symbiotic association between a fungal partner (mycobiont) and photosynthetic algal partners (photobionts). While characterization of the photobiont has previously proved challenging, the application of DNA sequencing has rapidly advanced our understanding on algal diversity in lichen symbiotic associations. Metabarcoding and metagenomic approaches have revealed the co-occurrence of more than one algal species in what was previously assumed to be a single species. Whether one species or numerous co-existing species, the question remains of whether all photobionts in a lichen are functionally identical and interact with the mycobiont equivalently. Here, we demonstrate the application of single-nucleus RNA sequencing (snRNAseq) to characterize photobiont diversity in the lichen, Xanthoria parietina. Unlike traditional bulk sequencing approaches which provide an overview of average gene expression in a sample, snRNAseq provides a high-resolution look into variation in gene expression in each individual nucleus. We sequenced over 10,000 nuclei isolated from the lichen thallus capturing both mycobiont and photobionts. Differential gene expression of photobiont nuclei identified functionally diverse populations within the lichen. This work represents the first attempt at generating a cell atlas for a lichen and provides promise for future work in advancing our understanding on functional diversity of algal populations found in symbiotic associations.

Ceramothamnion codii: NGS allows us to access DNA sequences from tiny seaweed specimen and confirms recent taxonomic proposal.
Beatriz de Barros Barosa (School of Biological Sciences, Queen's University), Christine A. Maggs (Division of Mathematics, Science, and Engineering, Hartnell College, USA) and Jeffery R. Hughey (Rio de Janeiro).
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Recently we proposed an extensive morphological and molecular reclassification of the tribe Ceramieae, including several new genera. The new genus Stirkia, typified by Stirkia fujiana from Brazil, was described for a robustly monophyletic but morphologically diverse clade. Based on a partial LSU rDNA sequence of “Ceramium codii” from Kure Atoll, Hawai'i “C. codii” was included in Stirkia and the new combination S. codii (H.Richards) Barros-Barreto & Maggs was proposed. The basionym of Ceramium codii is Ceramothamnion codii H.Richards, originally described in 1901 from specimens forming minute red turfs epiphytic on Codium tomentosum Stackhouse from Bermuda. Wynne & Schneider noted that Ceramothamnion is a valid genus and has nomenclatural priority, and transferred all Stirkia species to Ceramothamnion. The type of Ceramothamnion codii was issued as no. 845 in the exsiccatum Phycotheca Boreali Americana (PBA) and the mica-mounted type material in BM has been replaced by fungi. PBA 1899, authentic topotype material from Bermuda, was sampled instead. Using NGS, the rbcL, COI-5P and LSU genetic markers were assembled and used to infer gene and multi-gene phylogenies. The topotype of C. codii was closely allied with C. fujianum, as well as with other species of Ceramothamnion from the southwestern Atlantic and Pacific Oceans. These data support the relegation of the genus Stirkia to Ceramothamnion and indicate that the only previously published DNA sequences of "C. codii", from Hawai?i, represent a different, presumably undescribed, species of Ceramothamnion.

Changes over time in a small maerl bed in an industrial setting in Wales, United Kingdom.
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Milford Haven in south-west Wales is the UK's most important energy port with liquified natural gas and oil terminals present. Bordering the waterway are several urban developments as well as agricultural land. The waterway lies within the Pembrokeshire Marine Special Area of Conservation and includes a small maerl bed which is the only one in Wales. The bed is ancient and a sample of fossil maerl had a calibrated date of between 184 BC to 12 AD. This maerl bed has diverse fauna and floral assemblages including several algal species known to be either endemic or closely associated with maerl. A program to monitor the health of the bed was started in 2004 by the Countryside Council for Wales, now Natural Resources Wales (who are managers of Wales's natural resources). The monitoring program involves mapping using drop down video, in situ quadrat studies by divers and the taking of cores for infaunal analysis. Monitoring has continued at roughly 6 yearly intervals with the last study period being 2023. Since 2004, a jetty (built in the early 1960's) and which traverses the maerl bed, was refurbishment for a new liquified natural gas terminal. This refurbishment took place between 2005 and 2012 and involved heavy construction work. The results show a decline in both the area in which live maerl occurs and in the quantities present. Other changes include colonization of the sediments by the non-native slipper limpet Crepidula fornicata and its subsequent die-back. There has also been an observed increase in siltation and changes in the infaunal communities show a general increase in surface and sub-surface deposit feeders over the time-period. There are concerns about increased nutrients and sediment load in the Milford Haven waterway. The results of the monitoring program are summarized and discussed.

The GlobalSeaweed-SUPERSTAR project and the importance of maintaining healthy seaweed stocks for scaling up the seaweed industry.

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Seaweeds and their associated habitats are vital for the health of the planet and are increasingly recognised for their significant ecological and economic importance. Wild seaweed stocks form the basis of the seaweed industry, which supports millions of livelihoods worldwide, many of which are in developing countries. However, wild seaweed stocks and seaweed farms are increasingly threatened by the climate crisis, pollution, overexploitation, and other anthropogenic stressors such as pests and diseases. This is leading to a rapid decline in wild seaweed stocks and a loss of productivity in farms, which threatens the socioeconomic resilience of the communities that depend on them. The GlobalSeaweed-SUPERSTAR (GSSS) project is working to develop a global strategy that protects, conserves and restores wild seaweeds and enhances biodiversity, whilst supporting livelihoods of seaweed farmers and their communities. The GSSS project is funded by the Global Centre on Biodiversity for Climate (GCBC) through the UK Department for Environment Food and Rural Affairs (Defra). The GSSS team spans three institutions, the Scottish Association of Marine Sciences, The University of Malaya and the Natural History Museum, London, as well as other international experts in science, policy and economics from partner institutions across the world. This talk will describe the work carried out by the GSSS team, highlighting the importance of maintaining healthy seaweed stocks for scaling up the seaweed industry. It will also highlight the benefits of adopting an international, collaborative and transdisciplinary approach to research and evidence provision to inform policy makers.