

Foraging for Freshwater Red Algae in Australia (and New Zealand), 1980-2010

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Batrachospermum is an attractive, addictive and sometimes allusive freshwater red alga. It grows in some of the most beautiful locations on Earth; many in Australia, and New Zealand. Between 1980 and 2010 the number of freshwater red algal species known from these two countries rose from 7 to 34, most of them endemic species of *Batrachospermum* described by myself and Helen Foard. The south-west corner of Tasmania is my favourite Phycological foraging area – it is particularly rich in species as well as a spectacular place to walk. One of the new taxa was first collected by Peter Tyler from the edge of Lake Pedder a few years before it was flooded in 1969, and sent to the brilliant Heinrichs Skuja in Uppsala shortly before he died. For this reason I named it *B. diatyches*, the twice unfortunate batrachospermum. The intriguing genus *Psilosiphon*, embedded within a paraphyletic *Batrachospermum*, occurs just south of Sydney - where I lived last – as well as the northern tip of New Zealand and south-west Tasmania. A colleague Morgan Vis (Ohio University) and I found the Tasmanian and New Zealand populations to be more similar to each other than they are to the New South Wales population, and postulated a Gondwanic origin for this genus. Australia is a fascinating place to study algae, with plenty to discover and strong endemism in the groups I fancied. Now living and working at Royal Botanic Gardens Kew, not far from the type locality of *Batrachospermum*, I have the opportunity to tie down the identities of the first described species, study a little phenology, and perhaps even embark on a broader phycological project – ‘From Fritsch to Metagenomics’ – in the ponds of Kew.

Occurrence of *Mesophyllum* sp. along the Atlantic Iberian coast

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Along the Atlantic European coasts, the genus *Mesophyllum* is represented by three species: *M. lichenoides*, *M. sphaericum* and *M. alternans*. The type of the genus, *M. lichenoides*, is widely distributed and it is commonly found epiphytic on *Corallina* species in the lower intertidal zone. By contrast, the recently described *M. sphaericum* was recorded as maërl from a single Galician locality only, and *M. alternans* (type locality: Tanger, Morocco) has only been reported from southern Atlantic France (Biarritz). The latter species, however, is frequently cited from Mediterranean coral-ligenous assemblages together with *M. expansum* (type locality: Sicily). The latter species is also known from the Macaronesian region and Morocco. In our recent surveys of intertidal and subtidal non-geniculate corallines in the Atlantic Iberian Peninsula (Basque Country to North Portugal), we have detected the occurrence of large encrusting specimens of *Mesophyllum*. Specimens are commonly found epilithic on stable rocky substrate in the lower intertidal and sciaphilous mid-littoral. Specimens with reproductive structures (uniporate sexual and multiporate asexual conceptacles) were found, and two types of multiporate conceptacles were observed: i) presence of peripheral raised rim and

flattened to concave roof, and ii) absence of peripheral rim and flattened to convex roof. The latter type was the most common in our collections. Based on these features, our material could correspond to *M. alternans* and *M. expansum*, respectively. We carried out a morphological examination of the collected samples, with a particular attention to the anatomy of multiporate asexual conceptacles which is regarded as the main diagnostic feature for the identification of *Mesophyllum* species. Molecular data (COI-5P sequences) were obtained to support the morphological observations. In addition, Mediterranean material of *M. expansum* and *M. alternans* was also studied for comparison with their Atlantic counterparts.

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BOLD project “MAERL”: Assessing biodiversity of these key species in the OSPAR maritime area using DNA barcodes

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Maërl beds are relevant coastal habitats with worldwide distribution. In the European Atlantic, maërl beds are formed by various species. However, only *Phymatolithon calcareum* and *Lithothamnion corallioides* are listed in the EC Habitats Directive, in agreement with the fact that these two species are widely cited in the literature as the main maërl-forming algae. Yet, many of these previous studies generally suffer from the lack of thorough anatomical studies needed for accurate identification, as maërl-forming species are prone to high phenotypic plasticity. The present study aims to assess maërl species diversity using DNA barcodes (COI-5P sequences). Samples of maërl beds from OSPAR area and adjacent regions (Madeira Archipelago and Canary Islands) were investigated. Specimens used in our analyses included the various shapes and morphologies found in each maërl bed. They also comprised the neotype of *P. calcareum* (BM), specimens from the neotype locality (Falmouth) and from the Galician site (Ría de Vigo) used by Adey & McKibbin (1970) to propose the combination, and specimens of *L. corallioides* from the type locality (Rade de Brest). Barcodes for maërl taxa (as OTUs) were uploaded to the on-going BOLD project “MAERL” (Barcode Of Life Data Systems). Results obtained so far reflect the occurrence of 13 OTU’s in European Atlantic waters. Some maërl species display a wide distribution whereas others occurred in small areas. From a biogeographic perspective, species composition in the southern boundary of the OSPAR area (Iberian Peninsula) shows similarities with neighbouring regions (Canary Islands and Madeira) while Galicia (northwest Iberian Peninsula) appears as the limit of distribution for several OTUs. Future efforts will be devoted to assign specimens to existing names or propose new ones and to infer phylogenetic relationships of the detected OTUs. Our results suggest that current protection legislation may need to be updated.

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SESSION B: Algal impact on environment and human health

Chair: Dr Eileen Cox

MIDTAL: Microarrays for Toxic Algae, close to a final report

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Microalgae in marine and brackish waters of Europe regularly cause harmful effects, considered from the human perspective, in that they cause economic damage to fisheries and tourism. Cyanobacteria cause similar problems in freshwaters. These episodes encompass a broad range of phenomena collectively referred to as «harmful algal blooms» (HABs). For adequate management of these phenomena, monitoring of microalgae is required. However, effective monitoring is time consuming because morphology as determined by light microscopy may be insufficient to give definitive species and toxin attribution. In the EU FP7 project MIDTAL (microarrays for the detection of toxic algae) we achieved rapid species identification using rRNA genes as the target. These regions can be targeted for probe design to recognize species or even strains. We also included antibody reactions to specific toxins produced by these microalgae because even when cell numbers are low, toxins can be present and can accumulate in the shellfish. Microarrays are the state of the art technology in molecular biology for the processing of bulk samples for detection of target RNA/DNA sequence. After 36 months we have completed RNA-cell number-signal intensity calibration curves for 18 HAB species, and the analysis of monthly field samples from five locations from year one, and are partway through the analysis of year two samples. Results from all partners will be presented.

Cyanobacteria responses to phosphorus: identifying risks to recreational use

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CEH Edinburgh

A safe, clean water supply is critical for sustaining many important ecosystem services provided by freshwaters. The development of cyanobacterial blooms in lakes and reservoirs has a major impact on the provision of these services, particularly limiting their use

for recreation and water supply for drinking and spray irrigation. Using a dataset from over 1500 European lakes, we highlight the use of quantile regression modelling for understanding the maximum potential capacity of cyanobacteria in relation to phosphorus and the use of a range of quantile responses, alongside World Health Organisation (WHO) thresholds for recreational waters, for setting robust phosphorus targets for lake management in relation to water use. The analysis shows that cyanobacteria exhibit a non-linear response to phosphorus with the sharpest increase in cyanobacterial abundance occurring in the TP range from about 20 $\mu\text{g L}^{-1}$ up to about 100 $\mu\text{g L}^{-1}$. The likelihood of exceeding the WHO 'low health alert' threshold increases from about 5% exceedance at 16 $\mu\text{g L}^{-1}$ to 40% exceedance at 54 $\mu\text{g L}^{-1}$. About 50% of lakes remain below the WHO low threshold, irrespective of increasing TP concentrations, highlighting the importance of other limiting factors affecting cyanobacteria populations, such as high flushing rates. Our results can be used to set nutrient targets to sustain recreational services and provide different levels of precaution that can be chosen dependent on the importance of recreation at the site.

Magnetic Particle Induction and its Importance in Biofilm Research

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In recent years awareness of antibiotics as common contaminants of aquatic systems has increased significantly. They reportedly occur in wastewater treatment plant (WWTP) effluent and surface waters at concentrations ranging from ng l^{-1} to several $\mu\text{g l}^{-1}$. Antibiotics released into aquatic environments are a concern for several reasons, including their potential to negatively impact important ecosystem services regulated by microorganisms. One such ecosystem service which may be adversely affected is biostabilisation whereby, microbial consortia living in biofilms at the sediment surface mediate the response of the sediment to erosive forces. Understanding the biostabilisation capacity of biofilms and its impairment by pollutants is important for successful sediment management in waterways and coastal zones. We will present the findings of an investigation into the biostabilisation potential of natural biofilms when exposed to environmentally relevant concentrations of antibiotics. Over the course of the experiment the MagPI System was used to measure the adhesive capacity of the substratum, a proxy for sediment stability. The MagPI System is a relatively new device developed to evaluate biofilm formation and state of development. The results of this experiment successfully demonstrate its ability to determine subtle changes in surface adhesion as a result of biofilm formation. This presentation will also encompass a brief review of previous investigations in which the MagPI System has been used and detail other potential uses for this device.

Large-Scale Cultivation of *Spirulina* in Saudi Arabia

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The unique chemical composition of *Spirulina* makes it a good food supplement in human and animal nutrition. A strain of *Spirulina platensis* (Nordstedt) Geitler (UTEX No. LB 2340) was acquired from the University of Texas at Austin, U.S.A. and it was adapted to grow under the harsh environment which prevails