January 2020

What are algae, and why do we monitor them?

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Algae are used as biological indicators of water quality because the species compositions of algae communities are sensitive to chemical changes in the water. The relevance of algae and cyanobacteria is not limited to their characteristics as bio-indicators; in addition, their production of oxygen during photosynthesis maintain aerobic or oxygenated conditions for other organisms, and they are at the base of the food chain for many other organisms.

For the RESPiRES project, our main interest is to familiarise academics and the public in general, with the biodiversity of algae and cyanobacteria groups from Bristol blue spaces such as rivers, streams, ponds and lakes. Another interest in studying algae and diatoms is to identify functional resilience of the algae subdivisions across different habitats of the Bristol blue-spaces.

Algae functional groups

The functional classification of algae (phytoplankton) in freshwater has been studied for the past 50 years. Reynolds devised a system of classification of planktonic algae that was sensitive to environmental change in lakes and reservoirs, essentially to phosphorus and nitrogen but also to shorter seasonal fluctuations in stratification and in the accessibility to light and of adequate nutrient supplies. The system subdivides algae reflecting the simultaneity of responses of individual species to environmental variability.

Interestingly algae form a single functional group of several species with similar morphologies, as quantified by the dimensions of the algal ‘units' (cells or colonies, as appropriate, together with any external mucilage): surface area (*s*), volume (*v*) and maximum linear dimension (*m*) are powerful predictors of optimum dynamic performance. Adding to this is that the morphological separation of the algae into functional groups coincides with the distributions of the same species among different types of habitat but differing on the basis of accessibility to light and all nutrient resources

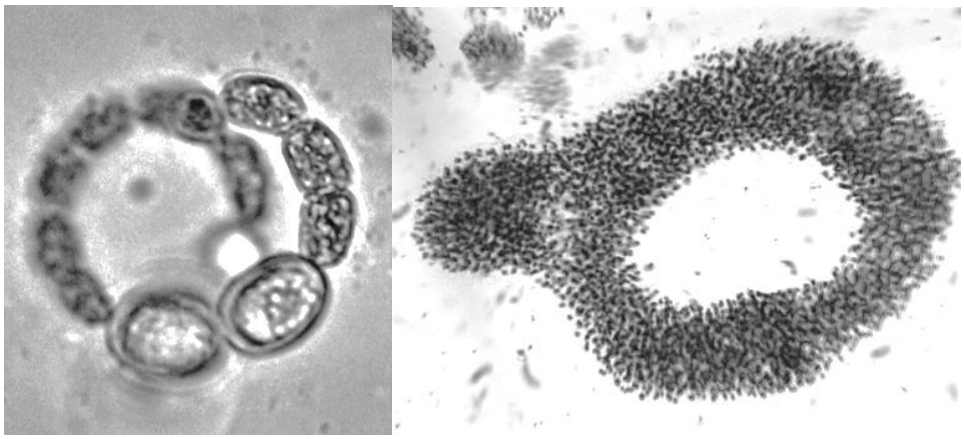
Algae diversity

Algae are a very diverse group. Scientists who classify organisms and place them into groups according to their similarities have had to move species between groups whilst others have remained unchanged since first discovered/described. The reason for this is that with the advance in technology e.g. better microscopes and new genetic techniques, some organisms have been found to be closely related to others despite morphological dissimilarities.

Some “odd” species or entire groups are a real headache when it comes to their classification because they share characteristics with several very dissimilar groups. These are called chimera organisms or “black-boxes”. A well-known chimera group is Cyanobacteria or blue-green algae and Euglena species which share characteristics with bacteria and algae. Among the “stable” and widely accepted groups with little variation are diatoms.

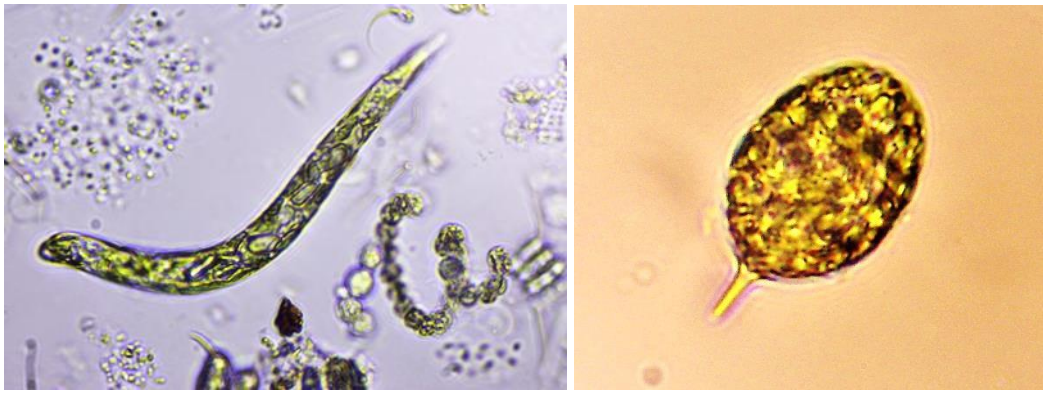
Cyanobacteria/blue-green algae share characteristics with bacteria and algae. This group is generally on the news because the formation of blooms or scum in ponds, lakes, reservoirs and rivers late in the summer. The blooms taint the water with green, blue or blue-green colour, hence

the name. The blooms can make the water smell bad, but more importantly can be toxic with fish, birds and dogs who drink the water falling ill, and sometimes it can be fatal.



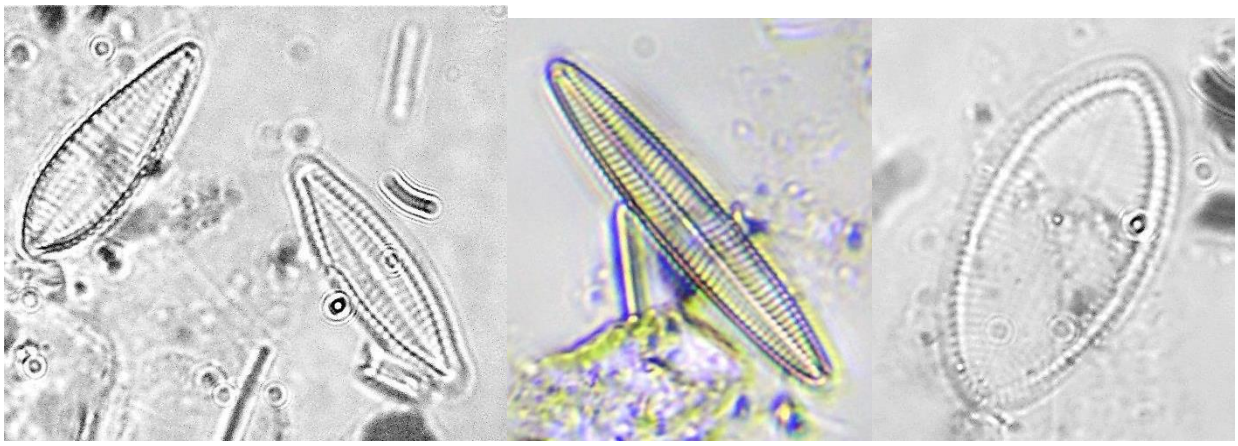
The figure shows two cyanobacteria species. Left: Filamentous cyanobacteria: *Anabaena* spp. x400 (this group has been almost entirely re-classified), Right. Colonial cyanobacteria: *Microcystis aeruginosa* x100.

Another chimeral or black-box group is the Euglenoids to which *Euglena* belongs. *Euglena* is a very characteristic organism from live in ponds and streams and it can be found in many biology books. *Euglena* is a single cell organism with an has an “S” shaped-body that swims vigorously helped by a structure call flagella. *Euglena* is classified in the group of Protists or Protozoa which means “pre-animal” or animal-like” but the Euglenophyceae taxonomical Class can photosynthesise like other algae groups or plants. Another member of this group is *Phacus* spp.



Two Euglenoid species. Left: *Euglena* spp. x400. Right: *Phacus* spp. x400.

Diatoms are a subgroup of algae and as a main characteristic is that their single cell bodies are rigid, and not soft like other algae groups, because their bodies have silica which forms a “shell of glass”. See the figures below.



Diatoms x1000. Left: *Gomphonema* spp. Center: *Navicula* spp. Right: *Cocconeis* spp.

We identified these organisms with identification keys from the 2nd edition of The Freshwater Algal Flora of the British Isles in 2011; and databases such as AlgaeBase (https://www.algaebase.org/about/) and AlgaeVision. (http://algaevision.myspecies.info/node/3505). For diatom identification we used Kelly's key Identification of common benthic diatoms in rivers (Kelly 2008) and the website from the Natural History Museum Wales (https://naturalhistory.museumwales.ac.uk/diatoms/taxalist.php?-skip=100&-max=50).

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