Determination key of freshwater macroscopic algae and Cyanobacteria blooms

Christophe Laplace-Treyture, Lydie Riera, Julien Lauqué

Determination key of freshwater macroscopic algae and Cyanobacteria blooms

Christophe Laplace-Treyture[1], Lydie Riera[2], Julien Lauqué[3]
1- INRAE , UR EABX, 50 avenue de Verdun, 33612 Cestas, France
2- EPIDOR, Place de la Laïcité, 24250 Castelnaud-la-Chapelle, France
3– SMGBL, Le Bourg, 40660 Messanges, France

When monitoring freshwater aquatic environments (rivers, waterbodies), it may be necessary to know how to detect and characterize the presence of a proliferation on the surface or in the water column. The proliferation can be benthic or planktonic, be algal or composed of cyanobacteria or be of another nature. Its correct characterization will influence its consideration and the actions to be implemented to monitor or manage it. The determination key below, adapted and simple, is recommended for use in the field, without precise taxonomic determination, in order to qualify the proliferation encountered. Summary sheets with the main characteristics are provided at the end for cyanobacterial blooms (benthic and planktonic), macroscopic algae and filamentous heterotrophs.

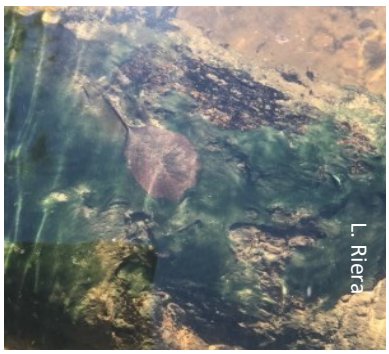
SIMPLIFIED DETERMINATION KEY OF ALGAE AND CYANOBACTERIA BLOOMS

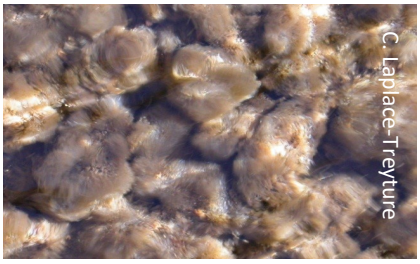
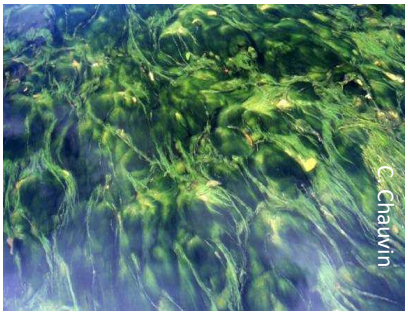
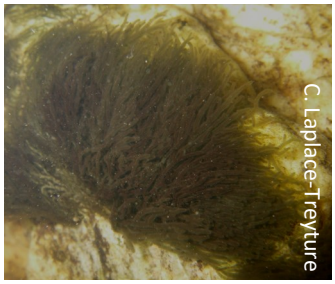
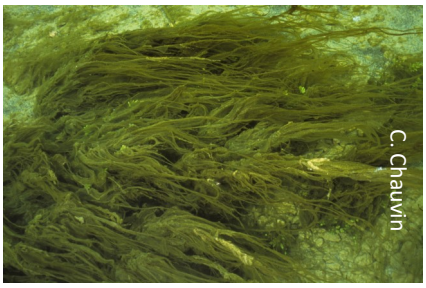
1. Observe the area of proliferation, pass your hand in the water with your fingers slightly apart, or tear off the proliferation of the substrate

If more or less rigid masses are sizeable		**Go to 2**
If there is nothing left or just a few small viscous pieces stuck to your gloves		**Go to 6**

2. Does the mass keep its shape out of the water ?

Yes		**Go to 3**
No or only partially		**Go to 4**

3. Does the mass have elements of different shapes ?		
Yes, presence of leaves, stems and roots. Parts can be emerged (flowers) *Examples: buttercups, waterweed, bryophytes, duckweed*	 Lamiot  Pr.J. Ter Kuile  Lamiot  L. Riera	**Aquatic plants, bryophytes**
No, the smell is sometimes quite strong *Examples : Chara, Nitellopsis genera*	 E. Lambert  V. Bertrin	**Characeae algae**
4. Is the mass in the form of a crust (short mat), sometimes falling off and floating on the surface ?		
Yes, in viscous form covering the substrate or part of the pebble, or floc on the surface. Blue-green to black in colour *Examples : biofilms, floc*	 L. Riera  L. Riera	**Biofilms of Cyanobacteria** **See A**
No, thin filaments of identical shapes grouping together in brush shape when leaving the water. Varied colours yellowish, yellow-green to green *Examples : Didymosphenia, Melosira, Rhizoclonium*	 V. Boucharevchas  C. Laplace-Treyture  C. Laplace-Treyture	**Algae, Heterotrophs, go to 5**

5. What is the colour and pattern of the bloom ?		
Yellowish to brownish coloured fluffy/ filamentous/ gelatinous/ feathery mass *Examples : Gomphoneis, Didymosphenia, Sphaerotilus*	 L. Riera  C. Laplace-Treyture  C. Laplace-Treyture	**Diatoms algae** **See C** **Or heterotroph organisms** **See D**
Filaments forming clusters visible to the naked eye, more or less viscous, yellow-green to green, even brown to red *Examples : Vaucheria et Cladophora, Oedogonium, Batrachospermum (red alga), Melosira*	 C. Chauvin  J. Kardacz  C. Laplace-Treyture  C. Chauvin	**Filamentous algae: green, brown or red** **See C**
6. Is the bloom white to yellowish in colour ?		
Yes		**Go to 7**
No		**Go to 8**
7. What does the proliferation look like ?		
Flocculent foams, beigeish, whitish on the surface *(in waterbodies essentially)*	 H. Beuffe  H. Beuffe	**Lake foams**
Floating particles of powdery appearance, yellowish in colour	 G. Vellut	**Pollens or spores**

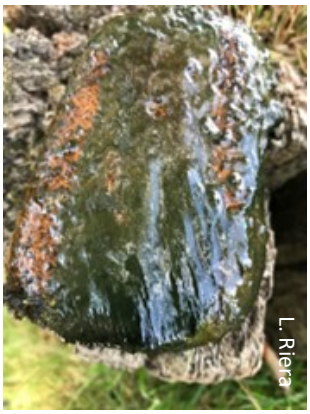
8. What is the colour and appearance of the bloom ?		
Brown particles suspended in the water column	 C. Laplace-Treyture	**Planktonic diatoms algae**
Particles of mainly blue-green or red colour, in the form of clusters, beads in the water column and/or on the surface	 L. Riera  C. Laplace-Treyture	**Planktonic Cyanobacteria** **See B**

Citation of the document:

Laplace-Treyture Christophe, Riera Lydie, Lauqué Julien, 2023. Determination key of freshwater macroscopic algae and cyanobacteria blooms. INRAE. 8 p.

A

GENERAL CHARACTERISTICS OF BENTHIC CYANOBACTERIA	
Colour	Cyanobacteria biofilms can take on hues ranging from black to bottle-green
Biofilm sizes	From a few cm^2 to several m^2
Smell	Damp cellar smells
Proliferation area	Very large biomasses can be occasionally observed on one or a few pebbles. Very large spatio-temporal variability
Localisation in the water column	Benthic cyanobacteria develop preferentially on the surface of pebbles, within biofilms which contain numerous microorganisms (microalgae and bacteria). Under the effect of currents, recreational activities or aging, these biofilms detach and are carried by the river to accumulate in the form of floc in areas of calm water
Appearance	Biofilms likely to contain cyanobacteria are generally thicker than 2mm and bottle green or black in colour. They are sometimes mottled with grey and have a viscous, more or less bubbly appearance that can be felt to the touch. They can also colonize aquatic plants



Biofilm on pebble

Immerged biofilm

Biofilm on sand

Floc on surface

Bubbly immerged biofilm

Biofilms on macrophytes

B

GENERAL CHARACTERISTICS OF PLANKTONIC CYANOBACTERIA	
Colour	The cyanobacteria formerly called "blue algae", are generally blue - green, however some are red in colour
Biofilm sizes	The particles can be barely perceptible up close, their agglomeration can measure only a few millimetres or even less
Smell	Smells of freshly cut grass or garbage may accompany huge growth (bloom)
Proliferation area	Blooms can extend over very large areas or be very localized (calm coves, orientation to prevailing winds). Mostly found in eutrophic to hypereutrophic environments
Localisation in the water column	Cyanobacteria blooms can occupy the surface of the water but also the water column over 1 or more meters deep
Appearance	Cyanobacteria can have different appearances depending on the stage of development: single scattered particles that can make the water cloudy, large mass in the water column, "mushy peas", film, surface streaks resembling paint spillage , coloured foam

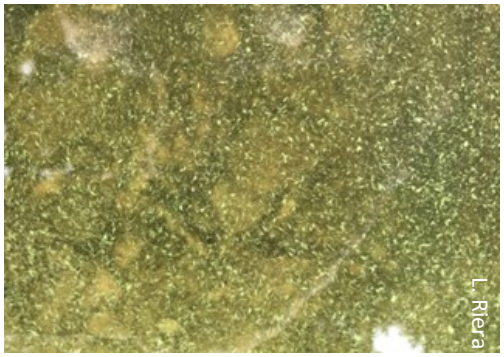
Bloom at confluence on a reservoir

Surface streaks

Water colouration

Bloom leaves

Surface cluster



Cluster in the water column
”mushy peas”

C

GENERAL CHARACTERISTICS OF FILAMENTOUS ALGAE

Colour	Filamentous algae can be green, brown or red. They are often present in a mixture. Filamentous diatoms are yellowish to brownish in colour
Biofilm sizes	From a few mm to several meters
Smell	Uncharacteristic but nauseous in case of strong decomposing biomasses
Proliferation area	Very large biomasses can be produced, particularly in a eutrophic environment, under optimal climatic, nutritional and environmental conditions (shallow depth, strong light). A proliferation of diatoms can cover all substrates and algae in place
Localisation in the water column	Essentially benthic at the start of their life cycle, they can be found on the surface in the form of a more or less thick floating layer (maintained by the oxygen produced). They are between a few centimetres and 1m deep in the case of large biomasses, because beyond that, the algal masses obstruct the penetration of light and the lower part of the filaments decomposes very quickly
Appearance	Filamentous algae are very often fixed, some only when young (*Cladophora*, *Ulothrix*). All types of substrates can be colonized. Coming out of the water, filamentous algae have flexible and fibrous filaments. Diatoms are mostly fixed, they are difficult to collect because the filaments have a fragile structure, which splits when leaving the water

Mix of *Ulothrix zonata, Gomphoneis, Melosira,*

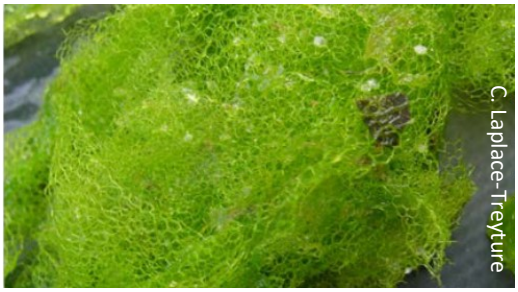
Cladophora

Ulothrix zonata, Melosira

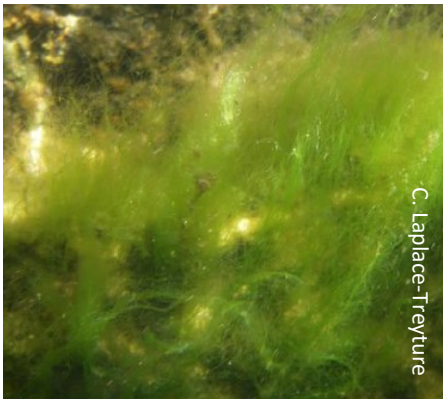
Rhizoclonium

Gomphoneis

Spirogyra



Hydrodictyon



Spirogyra

D

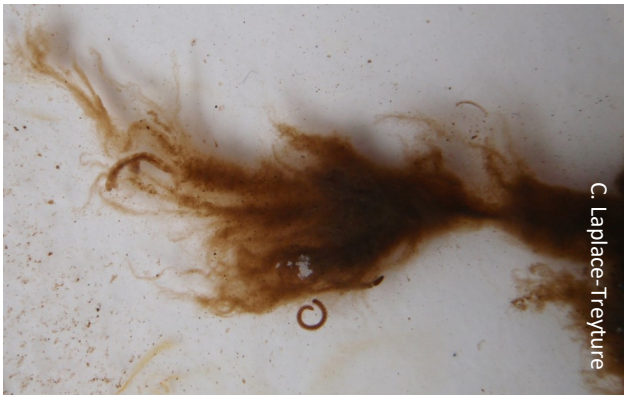
GENERAL CHARACTERISTICS OF FILAMENTOUS HETEROTROPHS

Colour	Filamentous heterotrophs found in blooms are white, whitish to yellow, brownish in colour (silt or detritus retention)
Biofilm sizes	From a few cm to a metre or more
Smell	Sweetish to nauseating (smell of decomposing slime)
Proliferation area	High biomass can be produced in running water and streams, particularly in eutrophic to hypereutrophic, polluted environments (rich in carbonaceous organic matter in particular and sugar). Able to grow in very low oxygen environments, downstream of industrial discharges (paper mills, dairies), wastewater treatment plants. Favoured growth, for certain genera, in the presence of high sulphite contents. Nevertheless, sometimes encountered in an unpolluted environment (*Leptomitus*).
Localisation in the water column	Essentially benthic at the start of their life cycle, they can be found on the surface or in the water column in the form of more or less thick floating clusters. Often attached to branches, covering macrophytes or growing on stones, blocks and slabs. Can colonize drains deprived of light but with water rich in organic matter
Appearance	Filamentous heterotrophs are in the form of tufts ("sheep's tail") that have a flaky (*Leptomitus*) or feathery (*Sphaerotilus*) appearance and have a silky feel, slightly sticky to sticky (*Sphaerotilus*). The clusters can come loose with the currents

Sphaerotilus (filamentous bacteria)

Sphaerotilus (filamentous bacteria)

Leptomitus (filamentous mushroom)



Leptomitus (filamentous mushroom)