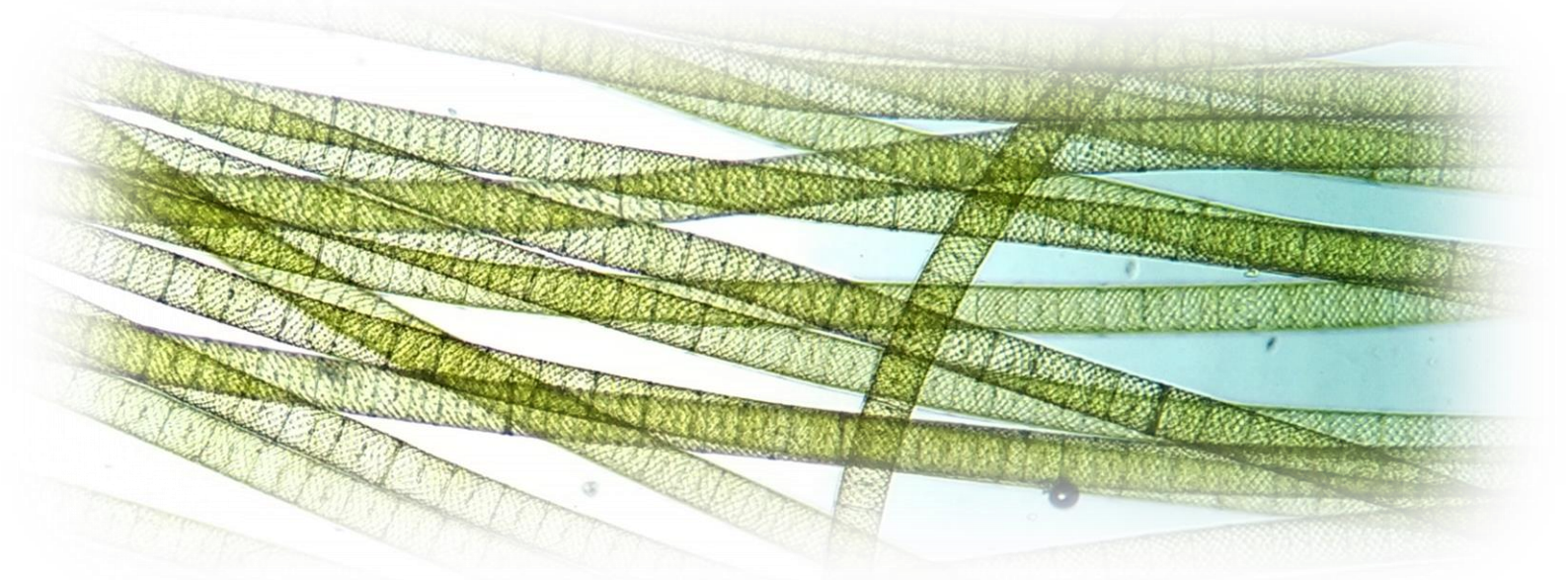
RIVEAL PROJECT

RIPARIAN FOREST VALUES AND ECOSYSTEM SERVICES – MACROALGAE



MACROALGAE ARE…

… multicellular algae of thalli-like structures. Freshwater macroalgae are a heterogeneous group both in terms of taxonomy, morphology and ecological requirements. They mainly include various taxa that form branched or unbranched filaments, or colonies. Freshwater macroalgae occur in flowing and standing waters, as well as bogs. Some macroalgae were even recognised as characteristic for terrestrial or subaerial habitats. They develop best in the water, but they can also grow in the splash zone. Most species anchor to the various substrate and vascular plants, others are free-floating.

Macroalgae include taxa that belong to several groups. Those main groups are:

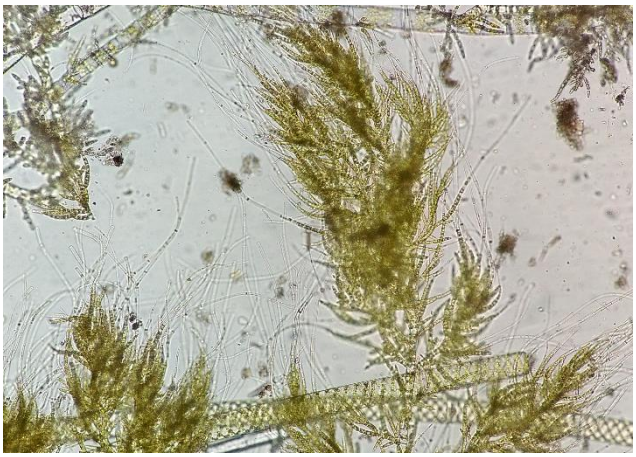
1. Chlorophyta (green algae) – bright to dark green, most closely related to the higher plants (predomination of chlorophyll a and b).

2. Charophyta (charophytes) – contain the same pigments as Chlorophyta, unique oogamous mode of reproduction.

3. Xanthophyta (yellow-green algae) – contain chlorophyll *a* and *c* and xanthophylls (accessory pigment).

4. Rhodophyta (red algae) – usually red, but they can also be olive-green or brown.

5. Cyanobacteria (blue-green algae) – blue-green to brown to almost black, bacteria included in macroalgae group (only by morphology, not taxonomy).



Microscopic photo of branched filament of Draparnaldia sp.

SAMPLING AND IDENTIFICATION

Some macroalgae can be identified in the field (e.g. *Batrachospermum* sp., *Spirogyra* sp. *Hydrodictyon* sp.) but should always be sampled and confirmed by microscope.

If possible, they should be identified fresh. Sample preservation is necessary when time between collection and identification is longer than three days. Formalin (formaldehyde) and glutaraldehyde is a good preservative but they are highly toxic. Lugol's Iodine can be used but it can complicate identification of Cyanobacteria. A few drops of ethanol extend storage life but can make recognition difficult due to the degradation of chlorophyll.

MACROALGAE AS BIOINDICATORS

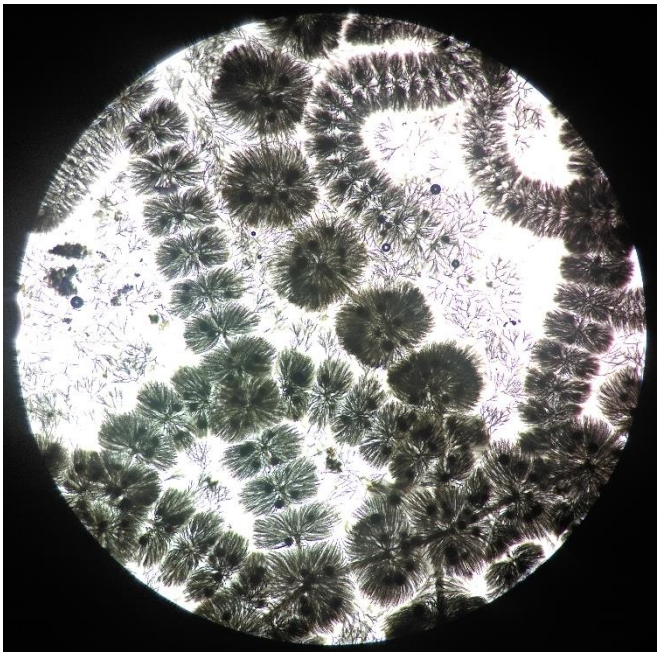
Macroscopic algae are used in macrophyte methods of ecological assessment. Thanks to the long filament or extensive colonies, many algae are clearly visible in the field, but the smaller macroalgae can be easily overlooked. In many monitoring systems, macroalgae are often identified at the genus level, which is usually sufficient to draw conclusions about the ecological status. Identification to the species level can be very difficult and often outweigh the benefits.

- Good indicators of water quality, especially nutrient enrichment;
- Hydrological and morphological quality response;
- React to light conditions, water temperature, acidification, hardness and salinity;

Indicator taxa examples of particular freshwater trophic states or ecological tolerance.

Indicator	Examples of indicator taxa
Oligotrophy	*Draparnaldia* sp., *Hydrurus* sp.
Mesotrophy	*Chara* sp., *Phormidium* sp., *Ulotix sp.*
Eutrophy	*Oedogonium* sp., *Hydrodictyon* sp., *Vaucheria sp.*
Environmental generalist	*Spirogyra* sp., *Cladophora* sp.
Environmental specialist	*Draparnaldia* sp., *Lemanea fluviatillis*

Filamentous algae are able to anchor to the stable natural substrate (rocks, stones) as well as artificial substrates. Their high morphological plasticity enables survival in fast-flowing river channels and under other unfavourable conditions. By this, they occur often in rivers with poorly developed vascular plants – in upland and mountainous streams and hydromorphological modified rivers. Some taxa developed in spatially restricted microhabitats, others occur along the entire length of the river.



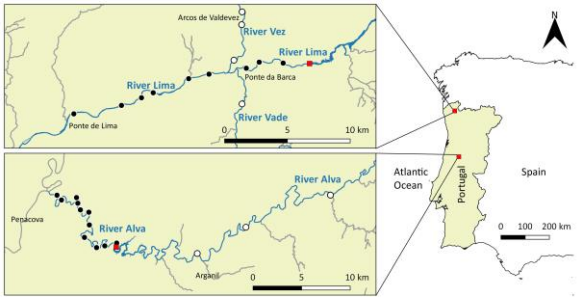
Microscopic photo of Batrachospermum sp.

MACROALGAE IN RIVEAL

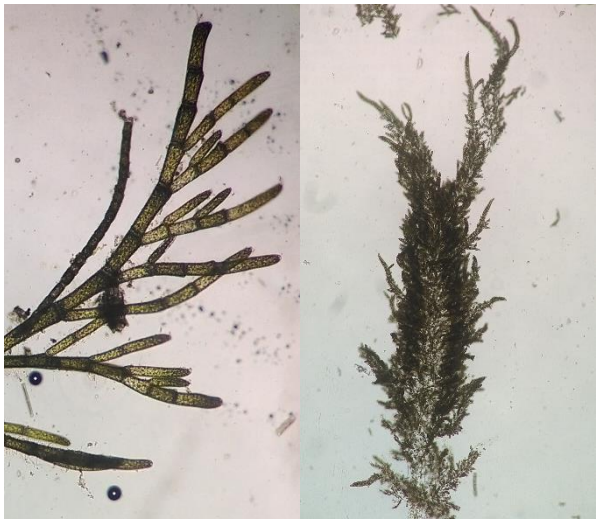
In the two rivers: River Lima, and River Alva, we found **16** macroalgae taxa, which considering the overall study area indicates a relatively high diversity.

- **14** taxa in River Lima (average three taxa per site and only two sites without any macroalgae)

- **8** taxa in River Alva (average 1 taxa per site and ten sites without macroalgae)



Sampling sites of the RIVEAL project in Lima and Alva case studies; black dots are located on regulated reaches and white dots are located on free-flowing streams (from Lozanovska et al., 2020; doi:10.1016/j.scitotenv.2020.141616).



Cladophora sp. (left) and Hydrurus sp. (right).

The most common taxa were the mesotrophic *Spirogyra* sp. and the more eutrophic *Oedogonium* sp., which were found in 13 and 12 sites, respectively. Both algae prefer slowly flowing and stagnant waters. Also the oligotrophic *Lemanea* sp. was frequent (collected in 12 sites) and contrary to the above, it is a rheophylic algae. Not surprisingly, these were also the most abundant algae, covering up to 42.5% of the river channel in the case of *Spirogyra* sp., and 15% in the case of *Oedogonium* sp. and *Lemanea* sp.

The rarest macroalgae were *Batrachospermum* sp., *Klebsormidium* sp., *Tetraspora* sp. and *Ulotrix* sp., which were found on a single site. Four more species were recorded at only two sites (*Bulbochaete* sp., *Draparnaldia* sp., *Hydrurus* sp., *Phormidium* sp.).

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