

# Photosynthesisers – Lichens

## Morphology

Lichens originate from symbiosis, involving a fungus 'mycobiont' (the dominant partner) and one or several photosynthetic 'photobionts' (the energy producers), either unicellular green algae, cyanobacteria (see page 35) or both. The symbiosis is mutualistic since the fungus benefits from the food (carbohydrates) produced by algae or cyanobacteria, and the algae or cyanobacteria benefit by being protected from the environment by the fungus. This symbiosis is also cyclical as the two partners must activate the association with every new generation. Also, specific bacterial communities are obligate lichen symbionts and, therefore, considered to be an integral part of lichen structure. The thallus is the vegetative and assimilative body that relies on the interactions among the symbionts. The thalli (growth forms) can vary from discrete granules of 0.5–50 mm to pendent lichens of 2 m in length, and have an extraordinary range of growth types, each of which show particular adaptations to different environments. [39]



Cladonia diversa is a lichen with composite thalli of scales (basal part) and scyphi (erect). Lichens are the result of a symbiotic relationship between an alga or a cyanobacterium (or both) and a fungus. This relationship is beneficial to both the partners. (JDF)

## Taxonomy

Lichens are derived from the fusion of two unrelated groups of organisms, where the taxonomy of the resulting hybrid organism is based on the fungus. Ninety-eight percent of lichenised fungi are Ascomycota in 18 of the 45 recognised orders (only five contain exclusively lichenised taxa), and two percent are Basidiomycota (see pages 38–39). The lichenised green algae are placed in Trebouxiophyceae (Chlorophyta), while cyanobacteria comprise several orders.

## Microhabitat

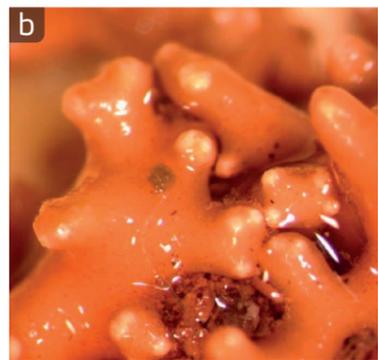
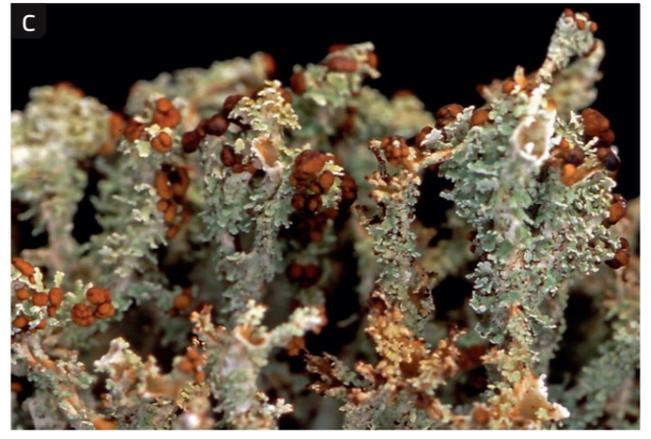
Lichens growing on the ground are 'terricolous' or 'epigeous' and colonise a wide range of soils. The habitats include: mineral or organic soils, thin layers of strongly weathered rocks, rock crevices, sand dunes, grasslands, bryophytes (i.e. mosses, hornworts and liverworts), damp trunks or rocks, peatlands and rotting wood. In tundras, cushions of 'reindeer lichens', mostly Cladonia species, are basic food for these herbivores. Continental steppes harbour specialised types of erratic vagrant thalli that allow them to disperse easily. Lichens are a major component of biological soil crusts (see page 73) in desert and dryland regions, growing in patches that increase soil stability and permeability, as well as resist erosion.

## Diversity, abundance and biomass

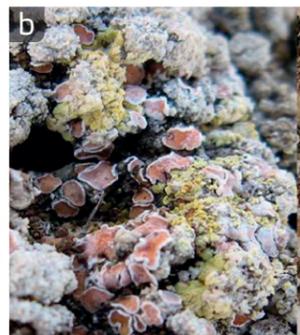
There are about 28 000 species living in all types of habitats. Only 5–12 species thrive in tundra or desert soils, while in tropical areas, rocks and bark surfaces may support more than 50 species in less than 0.5 m<sup>2</sup>.

### Uniqueness of lichens

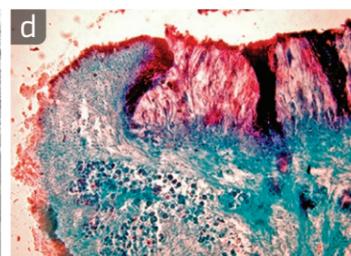
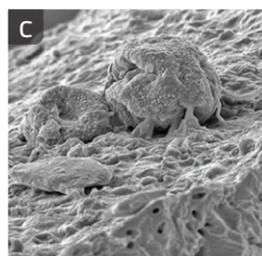
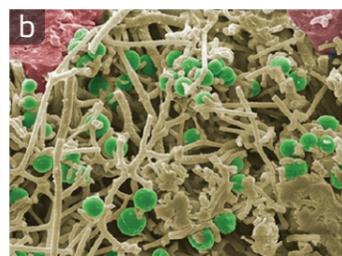
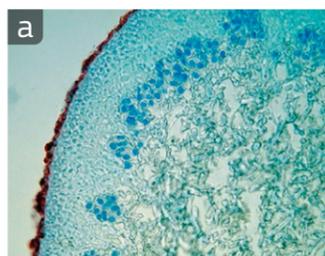
- Lichens are complex and unique entities with characteristics not found in either the original fungi or algae. These include slow growth, long life, ability to revive from severe desiccation, high habitat specificity, tolerance to extreme temperatures and the ability to survive on all types of substrata and habitats.
- Some rock-inhabiting species are among the oldest living organisms on Earth.
- Lichens are extremely vulnerable to habitat alteration and are effective 'early warning indicators' of environmental changes.



(a) Community of vagrant and erratic lichens in continental, windswept steppes; (b) the black dot is a bacterial community living on a lichen; (c) a specimen of *Circinaria fruticulosa-foliacea* with its shrubby aspect. (EB, CS)



Biological soil crust on semi-arid soils: (a) lichen community of *Acarospora nodulosa* and *A. placodiiformis* growing tightly appressed to the gypsum soil (crustose growth); (b) the pink squamulose *Psora decipiens*, and the yellow *Fulgensia desertorum*; (c) the placodioid *Squamarina lentigera* that radiates out from the centre. (EB, SPO)



Lichen anatomy: (a) light microscopy of the undifferentiated body (thallus) of *Circinaria fruticulosa* with a dark layer of soil particles; (b) thallus layer with fungus and algae (green spheres); (c) symbiotic bacteria growing on a lichen; (d) reproductive structure (apothecium) of the mycobiont in the lichen *Acarospora nodulosa*. (EB, FGB)

Diversity of the lichen genus *Cladonia*: (a) *C. rangiferina*; (b) *C. cervicomis* subsp. *pulvinata*; (c) *C. squamosa*; (d) *C. convoluta*; (e) *C. confusa*; (f) *Asterochloris mediterranea*, a common alga in the genus. (SPO, EB)