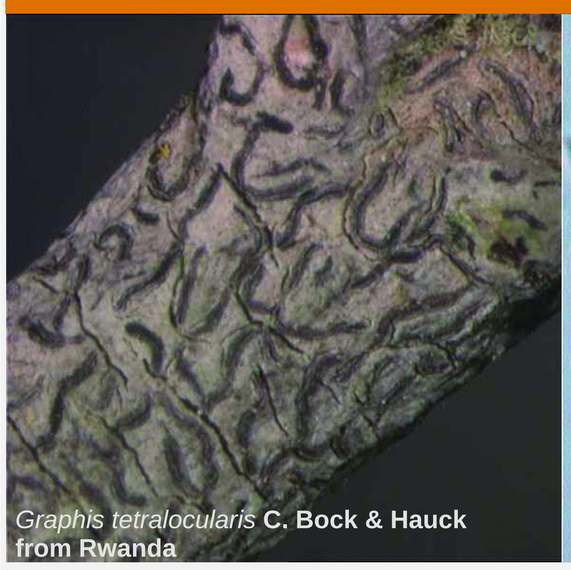
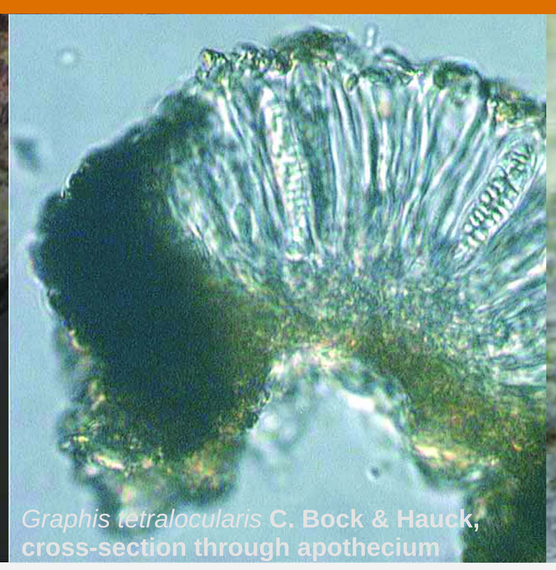
*Department of Plant Ecology and Ecosystems Research*

# Functional ecology of lichens



*Graphis tetralocularis* **C. Bock & Hauck from Rwanda**



*Graphis tetralocularis* **C. Bock & Hauck, cross-section through apothecium**

*Lecidea hercynica* **Hauck & Schmull from Germany**

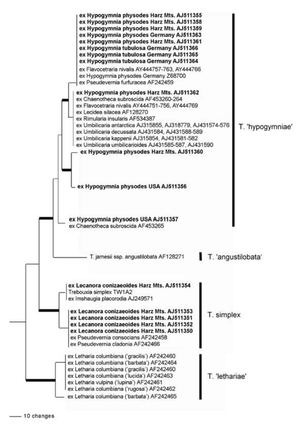
*Pyrrhospora gowardiana* **Spribille & Hauck from Montana, USA**

## Background

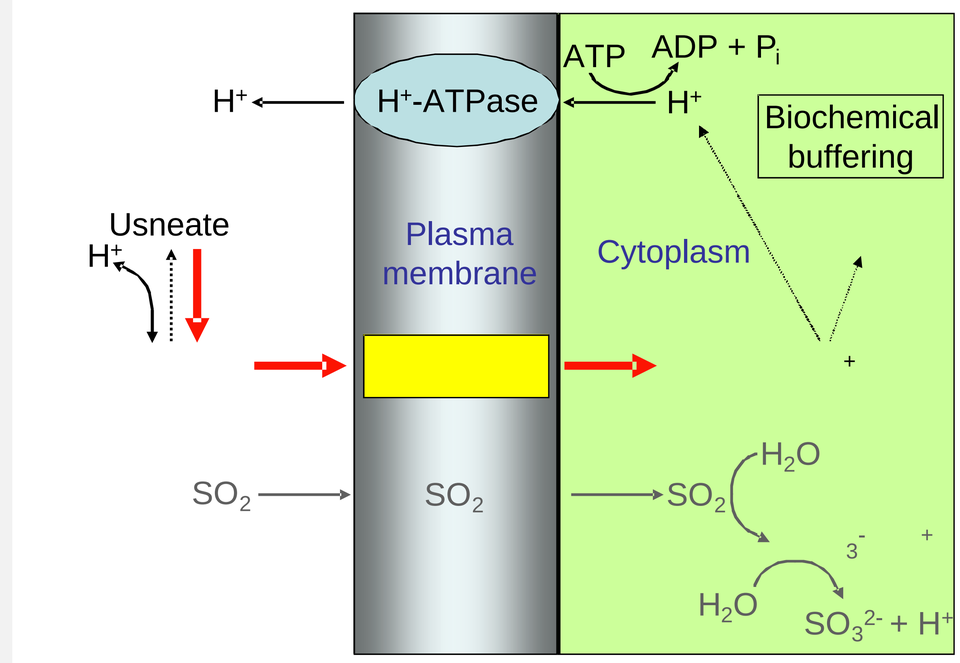
Lichens are symbioses of fungi (primarily ascomycetes) with algae and/or cyanobacteria. Lichens are, thus, not individual organisms, but little ecosystems, resulting in unique metabolic pathways and ecological characteristics. Large parts of the biodiversity of lichen bionts are still unexplored. New lichen-forming fungi are regularly discovered even in Europe, while only a small percentage of algae and cyanobacteria living in the lichen symbiosis are identified on the species level. The ecology of lichens is unique due to their occurrence under extreme climates, e.g. in deserts or in Antarctica. Many lichens avoid the competition of higher plants by colonizing substrates extremely poor in nutrients or rich in heavy metals.

## Research

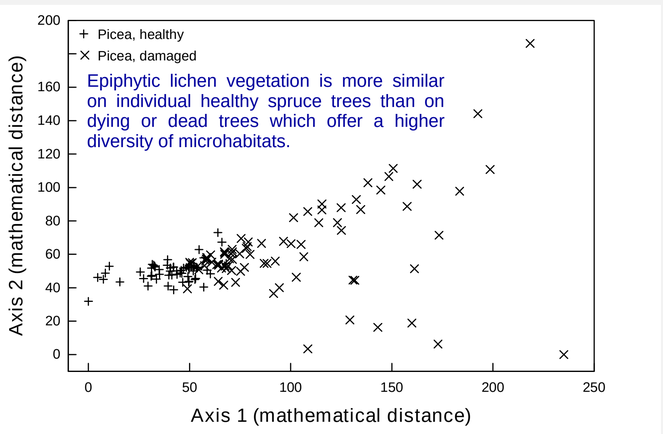
Epiphyte ecology. Measurements of microclimate and chemical site parameters (element content of precipitation, bark, and soil) allow the identification of significant site factors. Analyses in cold-temperate forests of Europe, north-eastern Asia and North America.



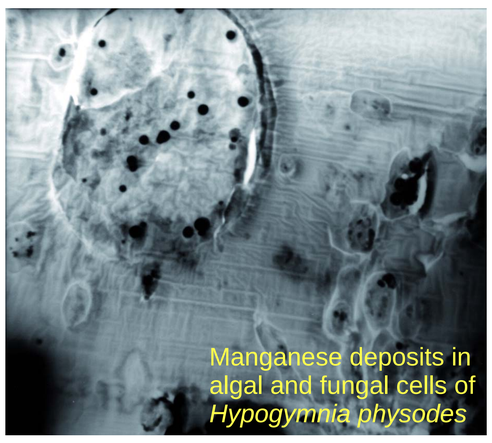

Molecular ecology of the lichen symbiosis. Ecological role of photobionts for the symbiosis and evolution of substratum-species relationships.




Biological functions of lichen substances (i.e. secondary metabolites largely specific for lichens), e.g., for the acidity and sulphur dioxide tolerance of lichens. The dibenzofuran usnic acid, for example, reduces the acidity tolerance of lichens apparently due to its ability to shuttle protons through phospholipid membranes.



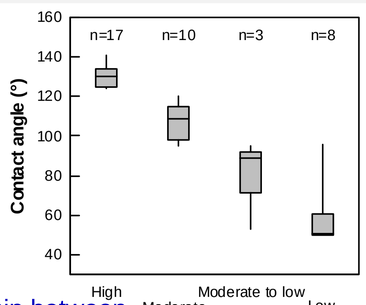

Biodiversity and conservation of lichens.




Metal homeostasis in the lichen symbiosis.

Strongly hydrophobic thallus surface of *Lepraria jackii.*

Surface hydrophobicity ('Lotus effect') in lichens.




Relationship between hydrophobicity and $SO_2$ tolerance.

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*"Functioning of lichen substances in metal homeostasis and acidity tolerance of lichens" funded by DFG*
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## Key results

- Natural and anthropogenic variation of element concentrations in the atmosphere and the substrate are crucial site factors for lichens in addition to microclimate.
- High manganese concentrations (originating from the soil) in bark and stemflow naturally limit the abundance and diversity of epiphytic lichens in coniferous forests throughout the northern hemisphere.
- Lichen substances specifically control metal homeostasis and acidity tolerance of lichens.
- Surface hydrophobicity causes pollution tolerance in lichens.