Do saxicolous lichen communities represent ecological guilds assembled on locally adapted photobionts?

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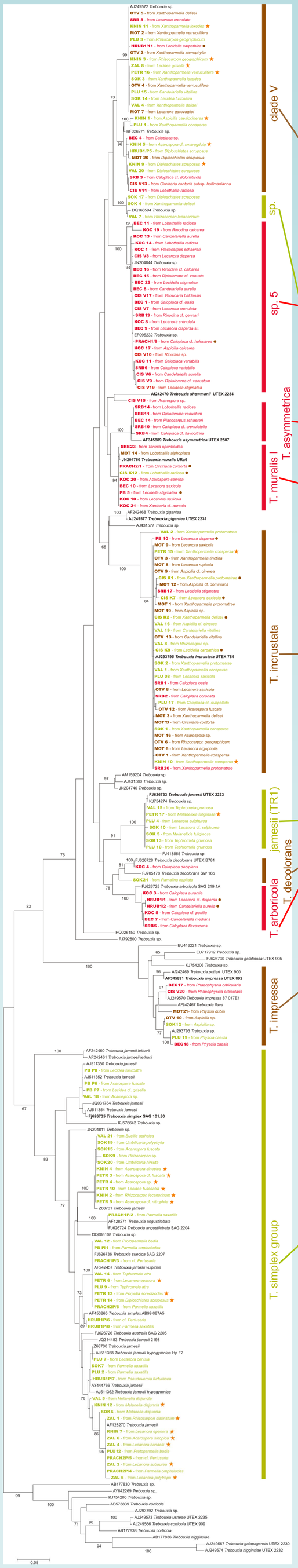
Introduction
Lichens are fungi that live in an intimate association with algae or cyanobacteria (the **photobionts**). More then 15 000 lichen (fungal) species have been described to date, occurring in almost all terrestrial ecosystems, colonizing a wide range of habitats – from tropical forest to arctic tundra, from the tree crowns to the bare rocks. The lichen forming fungus (mycobiont), as a dominant partner, seems to be the main determinant of the environmental requirements of the lichen. However, some recent studies have found the photobionts from different environments clustered in distinct lineages. Such environmental requirements of autotrophic partners may limit the ecological niches available to lichens and result in the existence of specific **lichen guilds** (communities of lichens growing in the same habitat, sharing the same photobionts).

In a certain geographical space, particular habitats (e.g. sand dunes, limestone steppes, siliceous rocks) can host more or less unvarying **lichen communities**. Their composition is usually a good indicator of specific local conditions (e.g. heavy-metal content in siliceous rock). Many of lichen communities were described based on the composition of lichen (fungal) species, however, we know almost nothing about the composition of their photobionts...

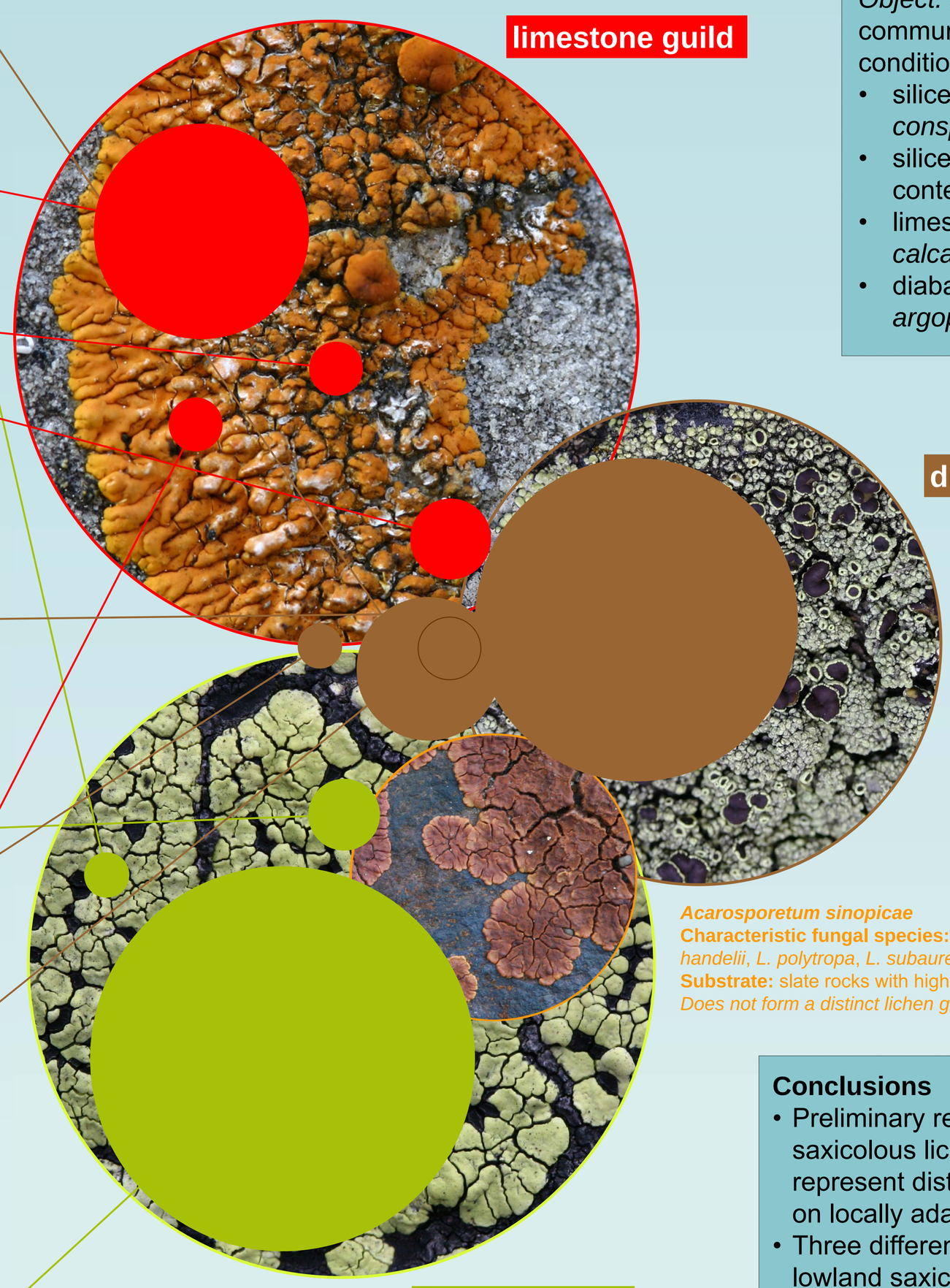
Our hypothesis: Lichen communities function as lichen guilds, i.e. a lichen (fungal) community growing in specific environmental conditions associates with one to several locally adapted photobionts distinct from photobionts of community with different ecology.

First partial study: effect of substrate

Object: saxicolous (epilithic) lichen communities growing in similar climatic conditions on very different rock types:
- siliceous rocks („*Parmelion conspersae*“ community)
- siliceous rocks with high heavy metal content („*Acarosporion sinopicae*“)
- limestone rocks („*Aspicilion calcareae*“)
- diabase rocks („*Lecanoretum argopholis*“)



***Aspicilion calcareae* and closely related communities**
Characteristic fungal species: *Aspicilia calcarea*, *Circinaria contorta*, *Caloplaca* sp. div., *Lobothallia radiosa*, *Placocarpus schaereri*, *Rinodina calcarea* etc.
Substrate: limestone rocks with high Ca content and high pH.



Lecanoretum argopholis
Characteristic fungal species: *Circinaria contorta*, *Lecanora argopholis*, *L. garovaglioi*, *L. saxicola*, *Lobothallia alphoplaca*, *Xanthoparmelia* sp. div. etc.
Substrate: diabase (and basalt) rocks with high content of augite and basic plagioclase (lime-soda feldspar) and high pH.
Interesting guild based on ubiquitous Trebouxia species participating also in other two communities!

Acarosporetum sinopicae
Characteristic fungal species: *Acarospora sinopica*, *Lecanora epanora*, *L. handelii*, *L. polytropa*, *L. subaurea*, *Rhizocarpon* sp. div. etc.
Substrate: slate rocks with high content of Fe and other metals and very low pH.
Does not form a distinct lichen guild, but it is a part of siliceous guild!

***Parmelion conspersae* and closely related communities**
Characteristic fungal species: *Acarospora fuscata*, *Diploschistes scruposus*, *Lecanora polytropa*, *Lecidea fuscoatra*, *Parmelia saxatilis*, *Rhizocarpon geographicum*, *R. lecanorinum*, *Xanthoparmelia* sp. div. etc.
Substrate: siliceous rocks (granit, gneiss) with high Si content and low pH.

Phylogenetic tree: maximum likelihood analysis using GARLI v. 2.0 (Zwickl 2006) providing by The CIPRES Science Gateway v. 3.3 (https://www.phylo.org/). Values at the nodes indicate maximum-likelihood bootstrap. Green – „*Parmelion conspersae*“ community, green with orange star – „*Acarosporion sinopicae*“, green with brown dot – siliceous vein in limestone rock, red – „*Aspicilion calcareae*“, red with brown dot – piece of concrete in sandstone rock, brown – „*Lecanoretum argopholis*“ (and other mixed clades).
The names of *Trebouxia* clades loosely follow O´Brien (2013) and Muggia et al. (2014).

Methods
Sampling (incomplete yet): „*Parmelion conspersae*“ community – 4 localities, „*Acarosporion sinopicae*“ – 3 loc., „*Aspicilion calcareae*“ – 3 loc., „*Lecanoretum argopholis*“ – 1 loc.; all localities occur in similar altitude (220–455 m a.s.l.) in area of Central Europe (CZ, SK). At each site, all lichen taxa belonging to a distinct community were collected and analyzed.
DNA was extracted from one thallus of each lichen species; 170 ITS rDNA sequences were obtained till now.

Conclusions
- Preliminary results supported our hypothesis – saxicolous lichen communities seem to represent distinct ecological guilds assembled on locally adapted photobionts.
- Three different guilds have been detected in lowland saxicolous communities of Central Europe.
- Some photobionts exhibit clear environmental preferences and participate only in one specific guild, however, several algae represent ubiquitous taxa participating in various guilds (*Trebouxia* species of „diabase guild“ and nitrophytic species *T. decolorans*).

Our next study will be aimed at finding of climatical guilds (along altitudinal gradient).

References
O'Brien H. (2013): A preliminary look at host association patterns in Trebouxia. https://photobiontdiversity.wordpress.com/2013/06/05/a-preliminary-look-at-trebouxia-host-associations/
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