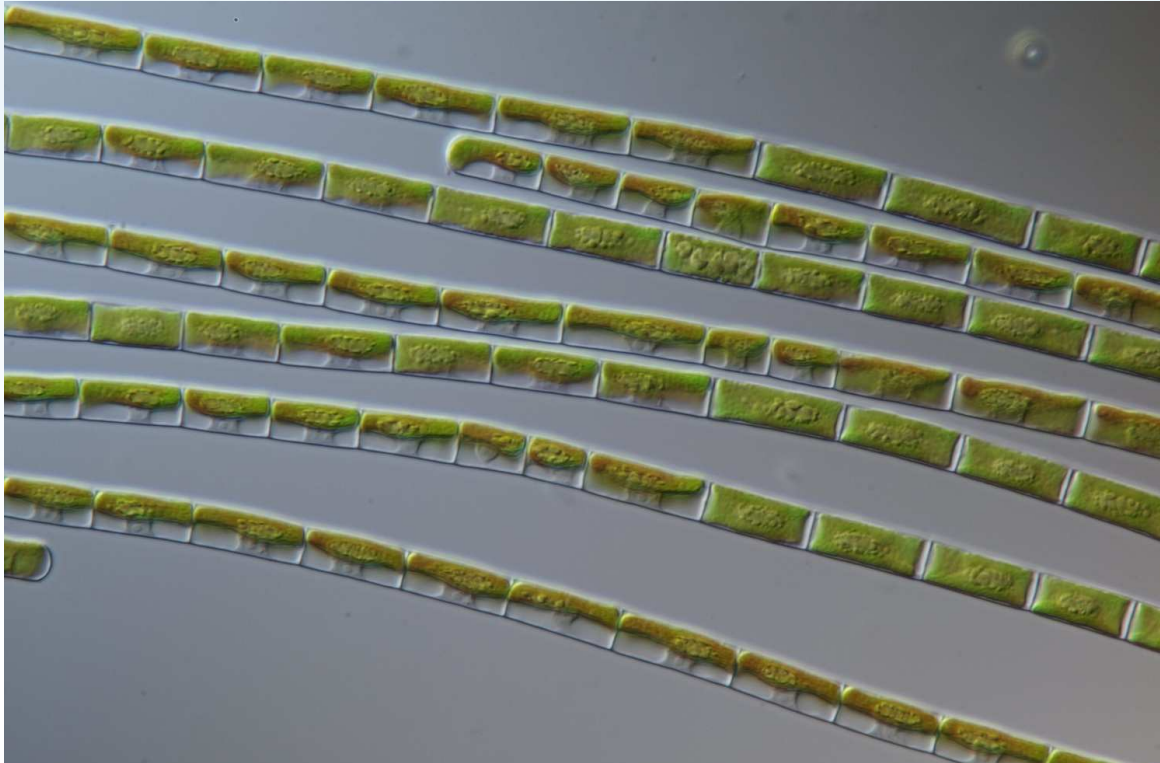


Ecological differentiation of cryptic species in green microalgae

Pavel Škaloud¹, Ondřej Peksa¹, Fabio Rindi²

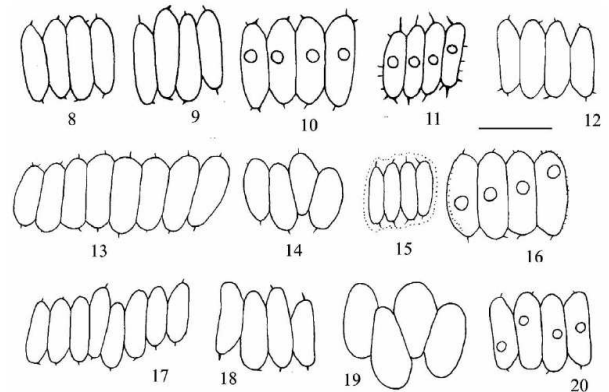
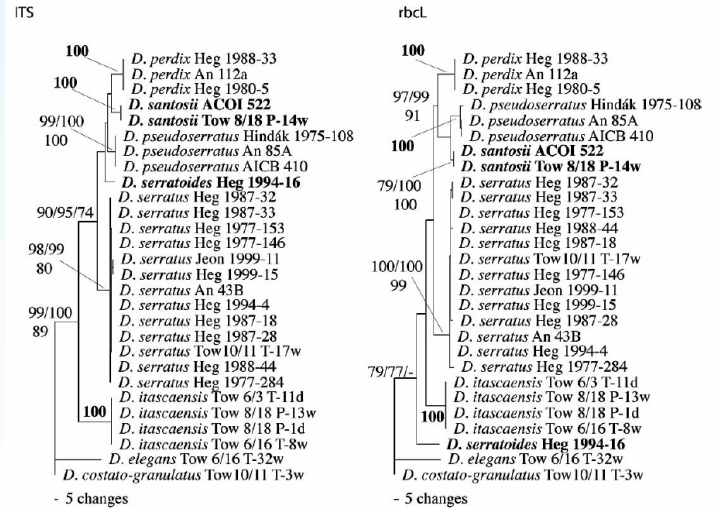
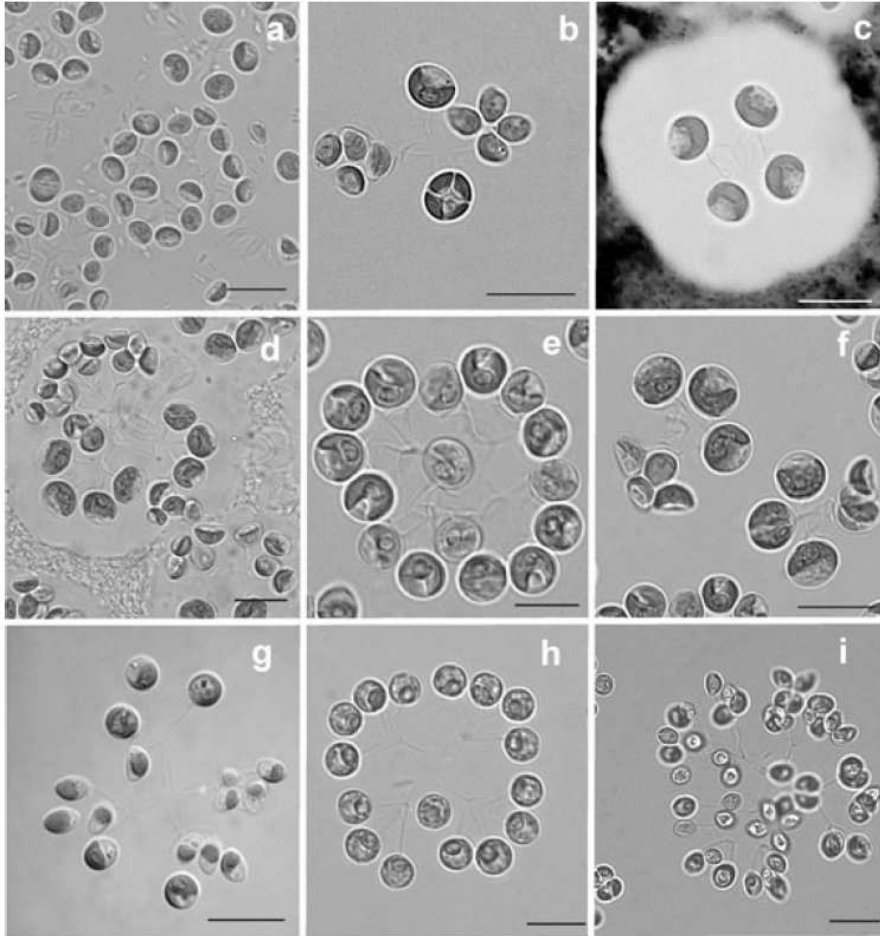


¹ Charles University in Prague, Czech Republic

² Università Politecnica delle Marche, Ancona, Italy

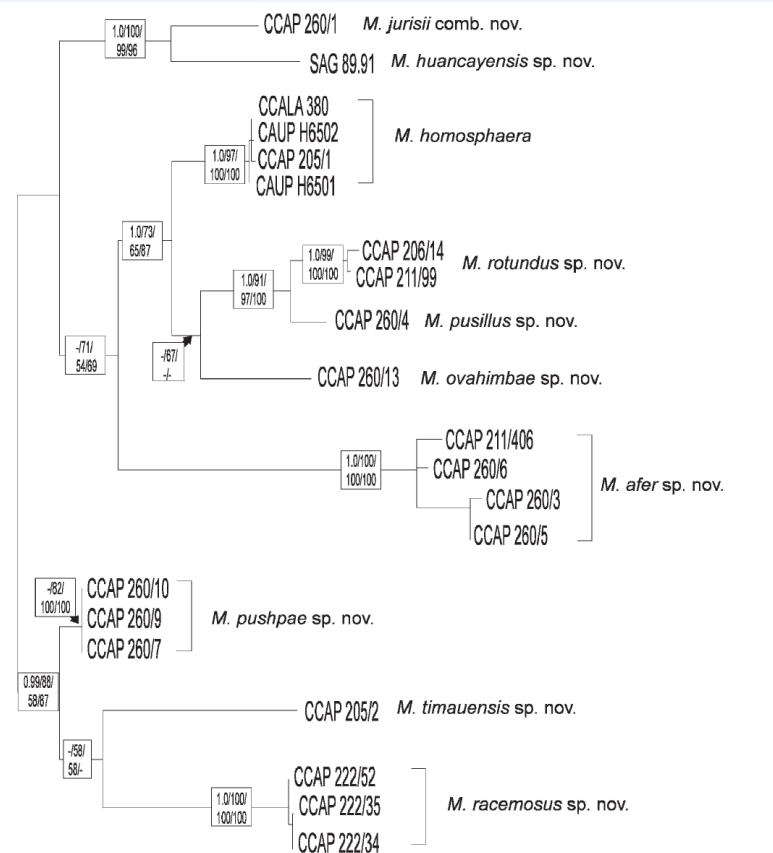
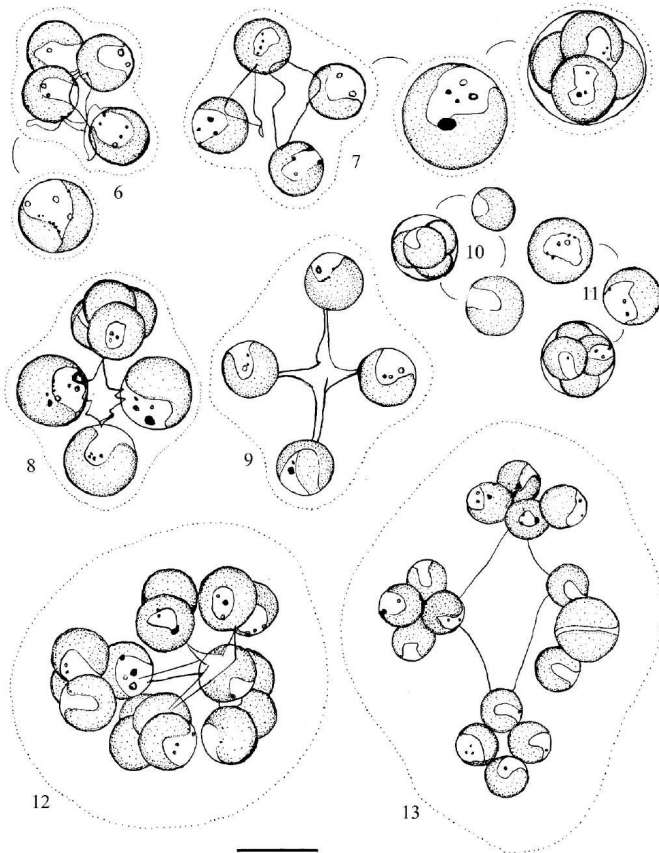
Hidden diversity in green microalgae

- High levels of cryptic diversity recently discovered in many green microalgae, e.g.:
 - Bock et al. (2011): Polyphyletic origin of the *Dictyosphaerium* morphotype
 - Fawley et al. (2011): Cryptic diversity within the *Desmodesmus serratus* complex



Hidden diversity in green microalgae

- No morphological features to unambiguously define the species – taxonomy based on single, phylogenetic species concept
- „ITS rRNA sequentia genetica demonstrat differentiae a speciebus ceteris generis.“

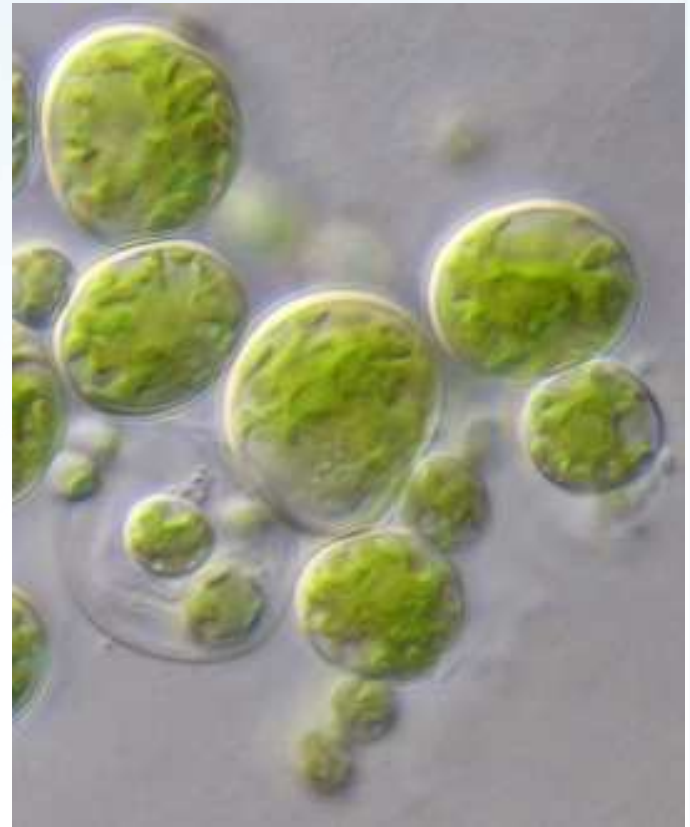
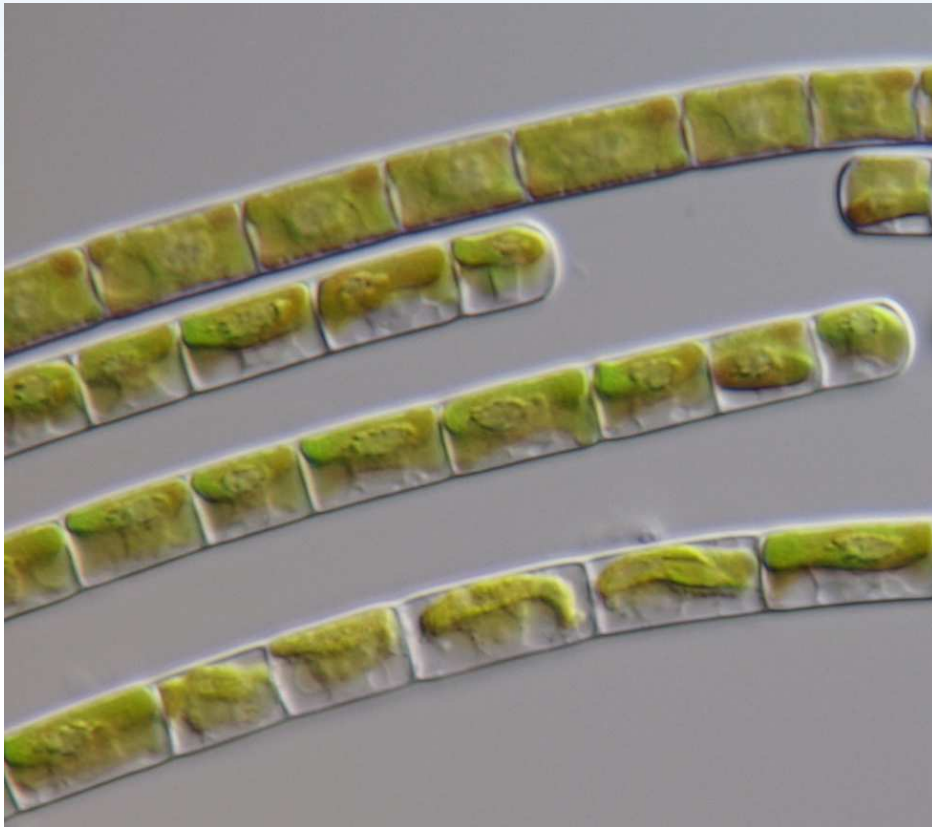


Aims

- Do the cryptic, morphologically unrecognizable species, differ in their ecology?

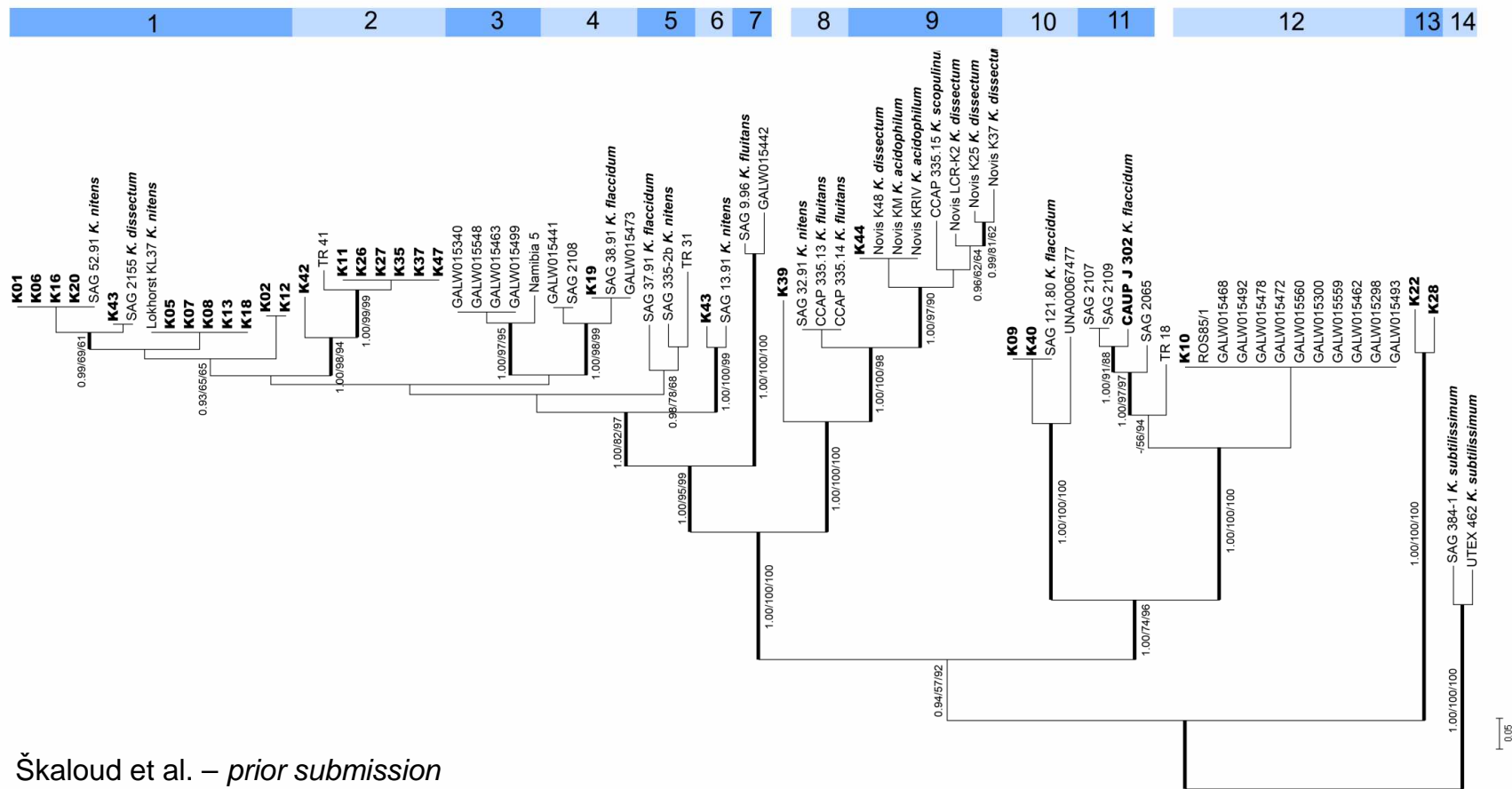
Klebsormidium – ubiquitous, common free-living green alga (Streptophyta)

Asterochloris – photobiont of all Cladoniineae lichens (Chlorophyta)



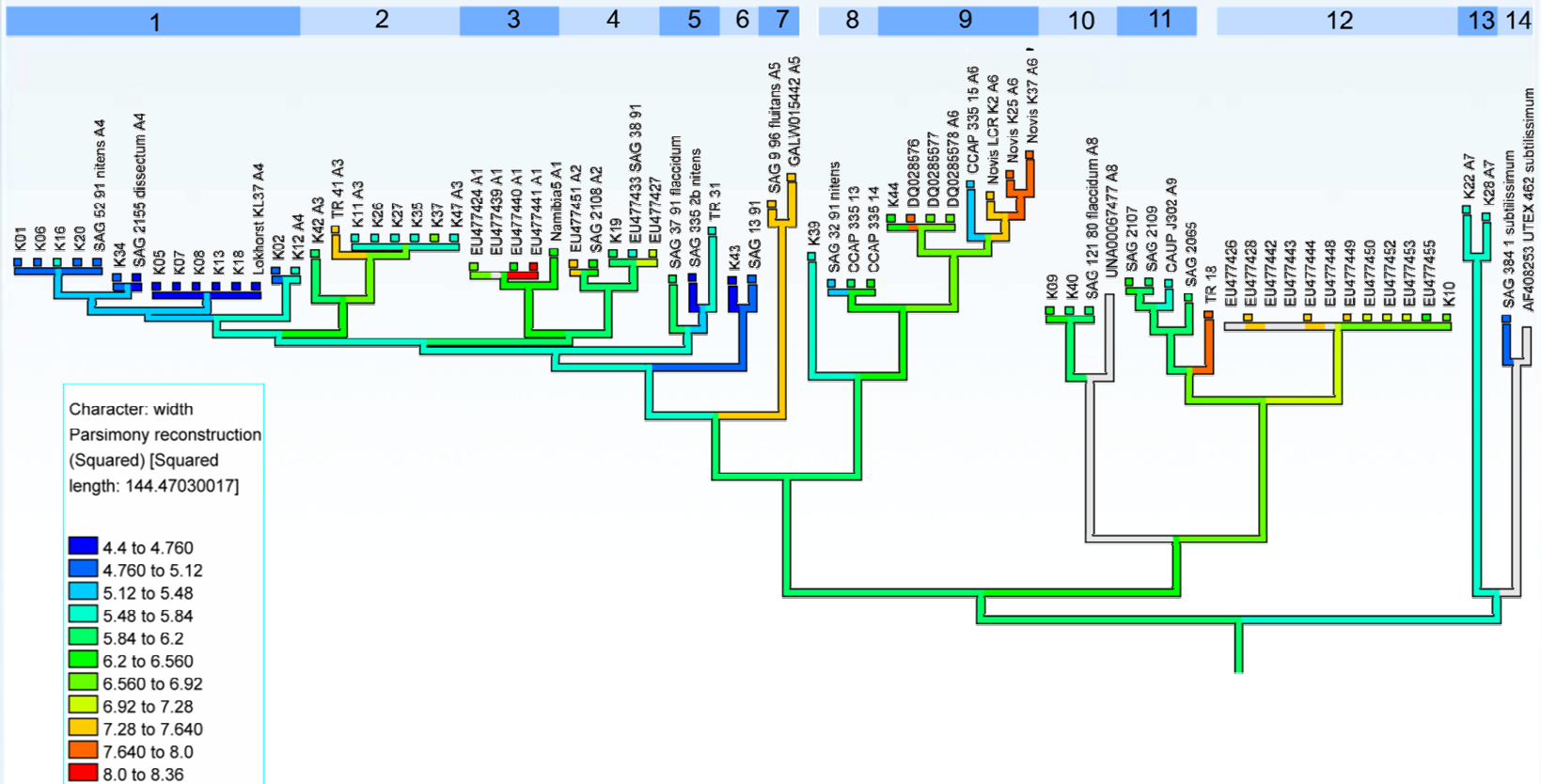
Klebsormidium

- Bayesian phylogeny of 62 strains (ITS + rbcL): clade E - 14 supported lineages
- Several traditionally defined species inferred (*K. flaccidum*, *K. nitens*, *K. dissectum*, *K. fluitans*, *K. scopulinum*, *K. acidophilum*, *K. subtilissimum*)



Klebsormidium

- Morphology – traditional features not fully suitable for the recognition of hidden species



Klebsormidium

- Ecology – clear ecological preferences to three habitat types



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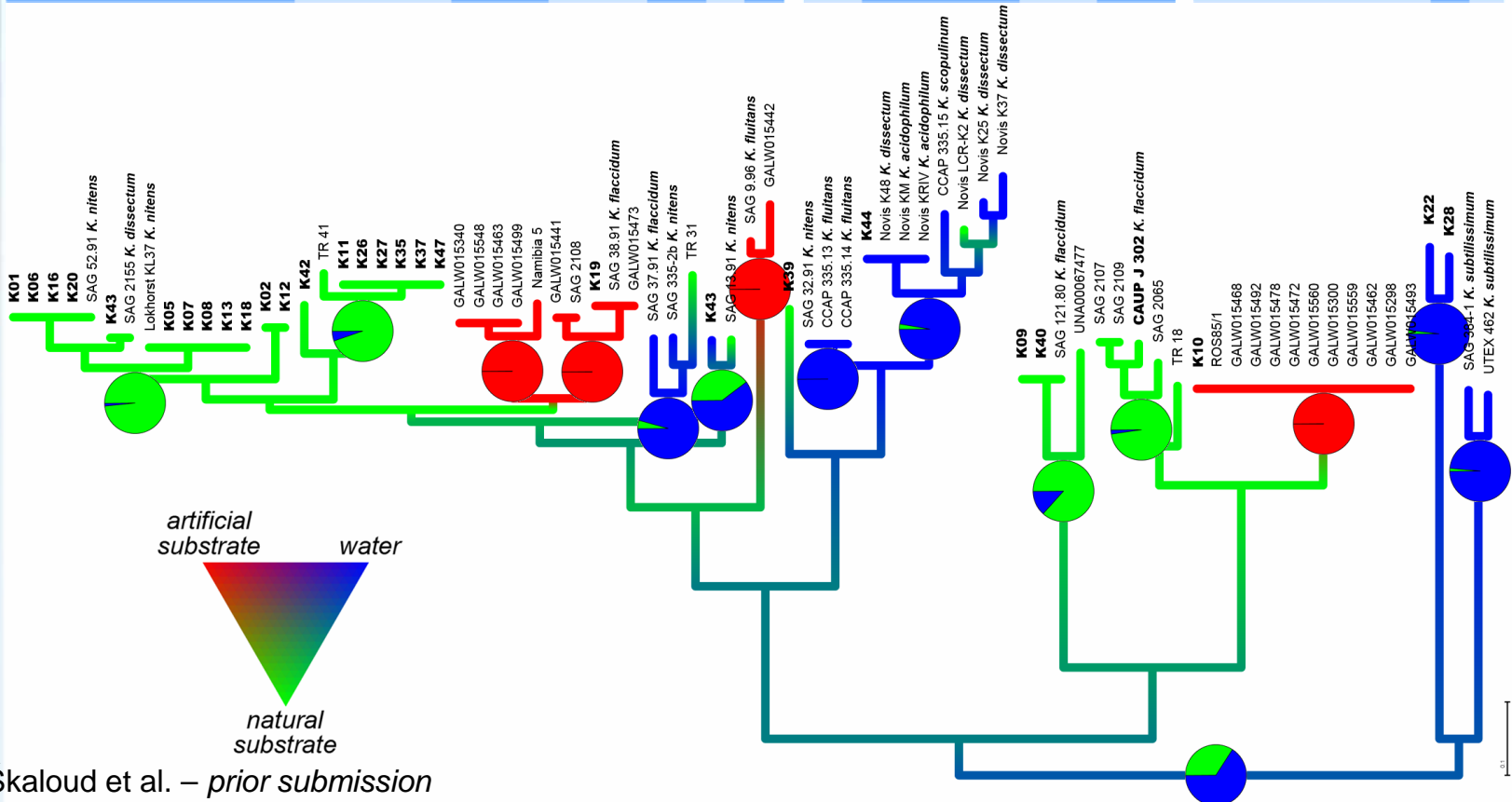
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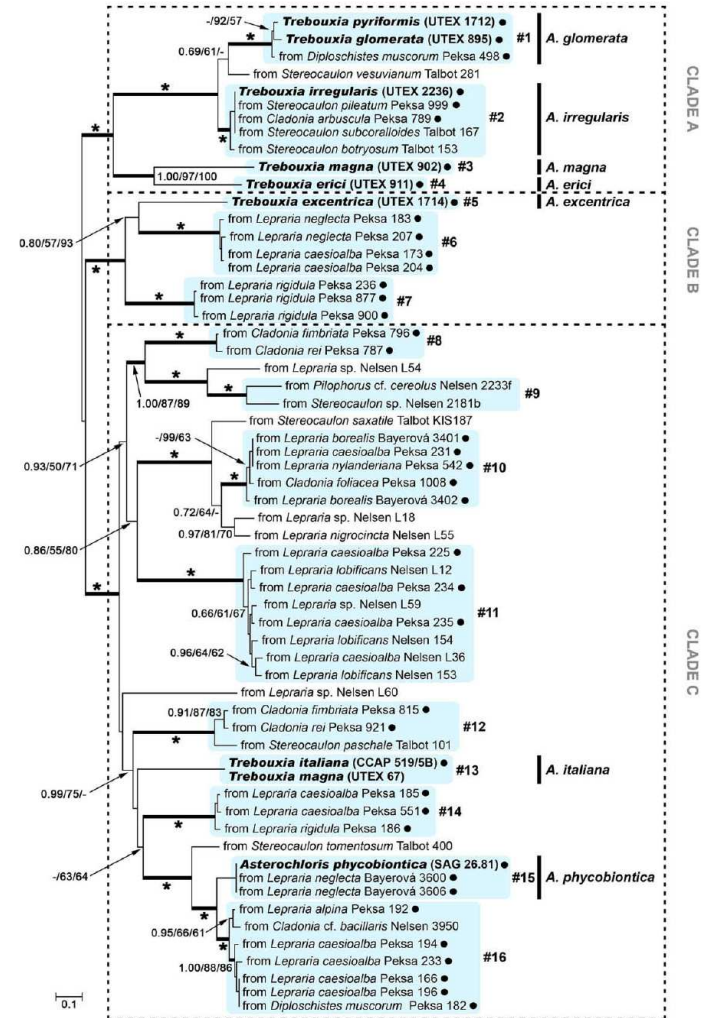
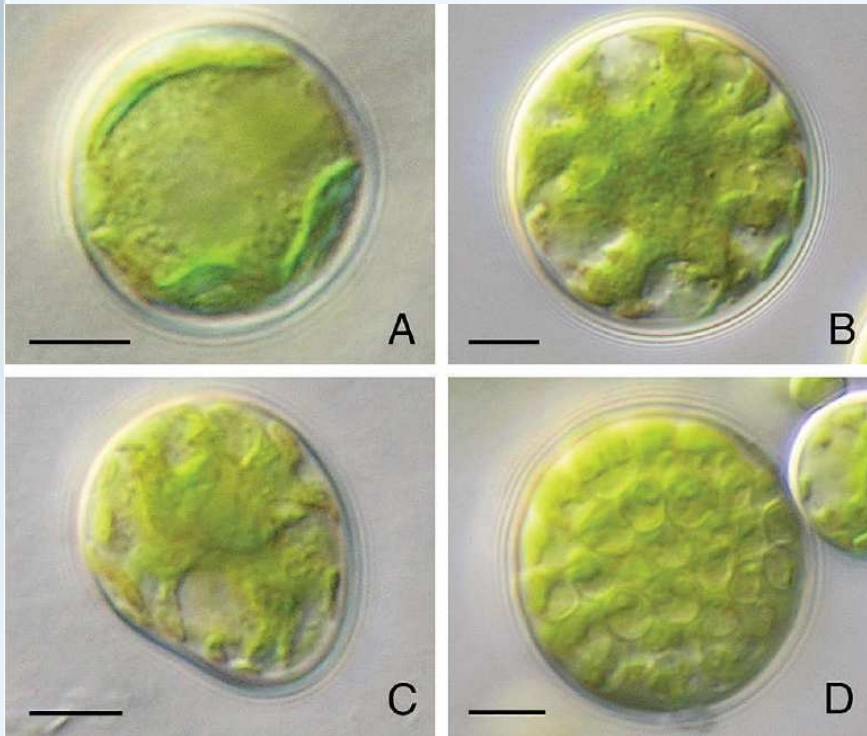
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Asterochloris

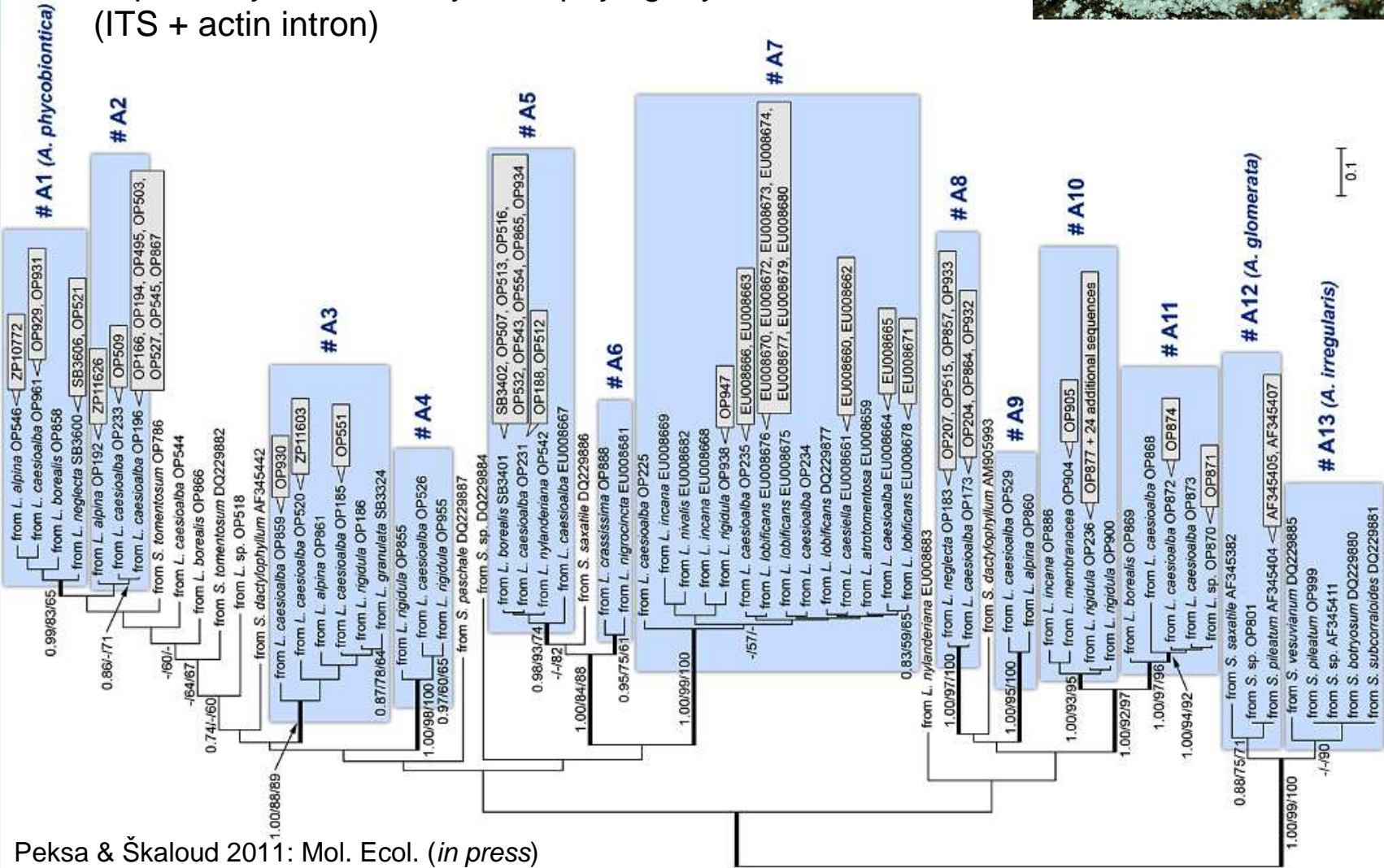
- Large cryptic diversity within the genus
- Only 15% of isolated photobionts could be assigned with certainty to previously described species.



Asterochloris



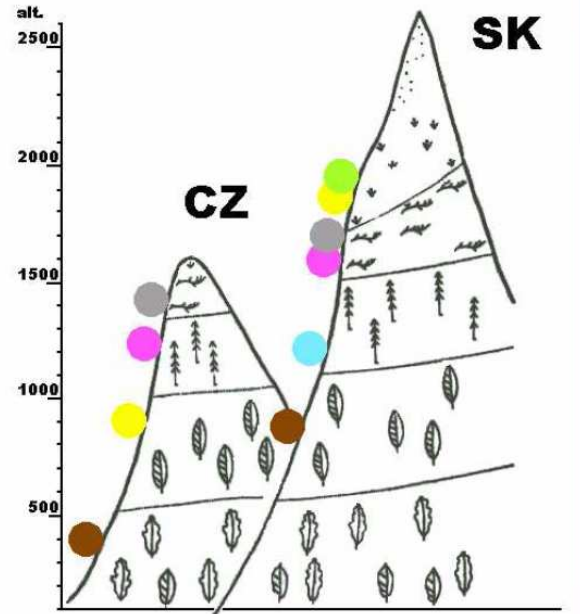
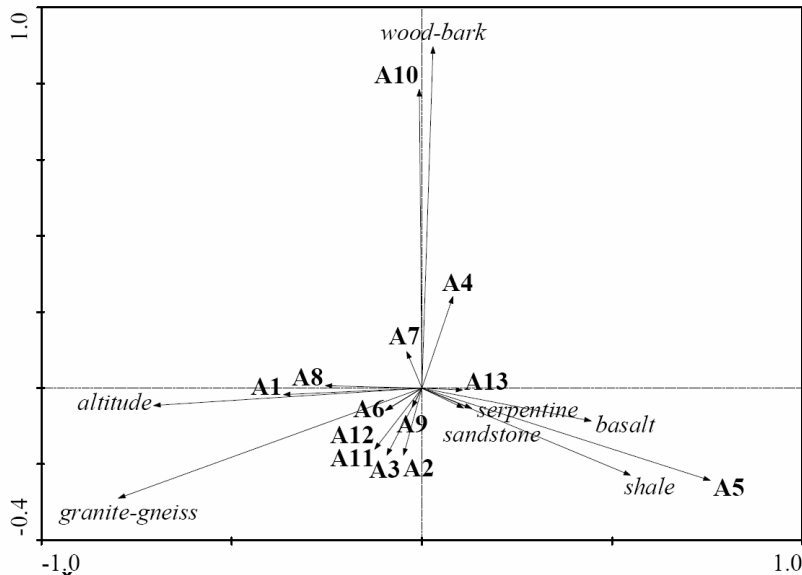
- Lepraria symbionts: Bayesian phylogeny of 107 thalli (ITS + actin intron)



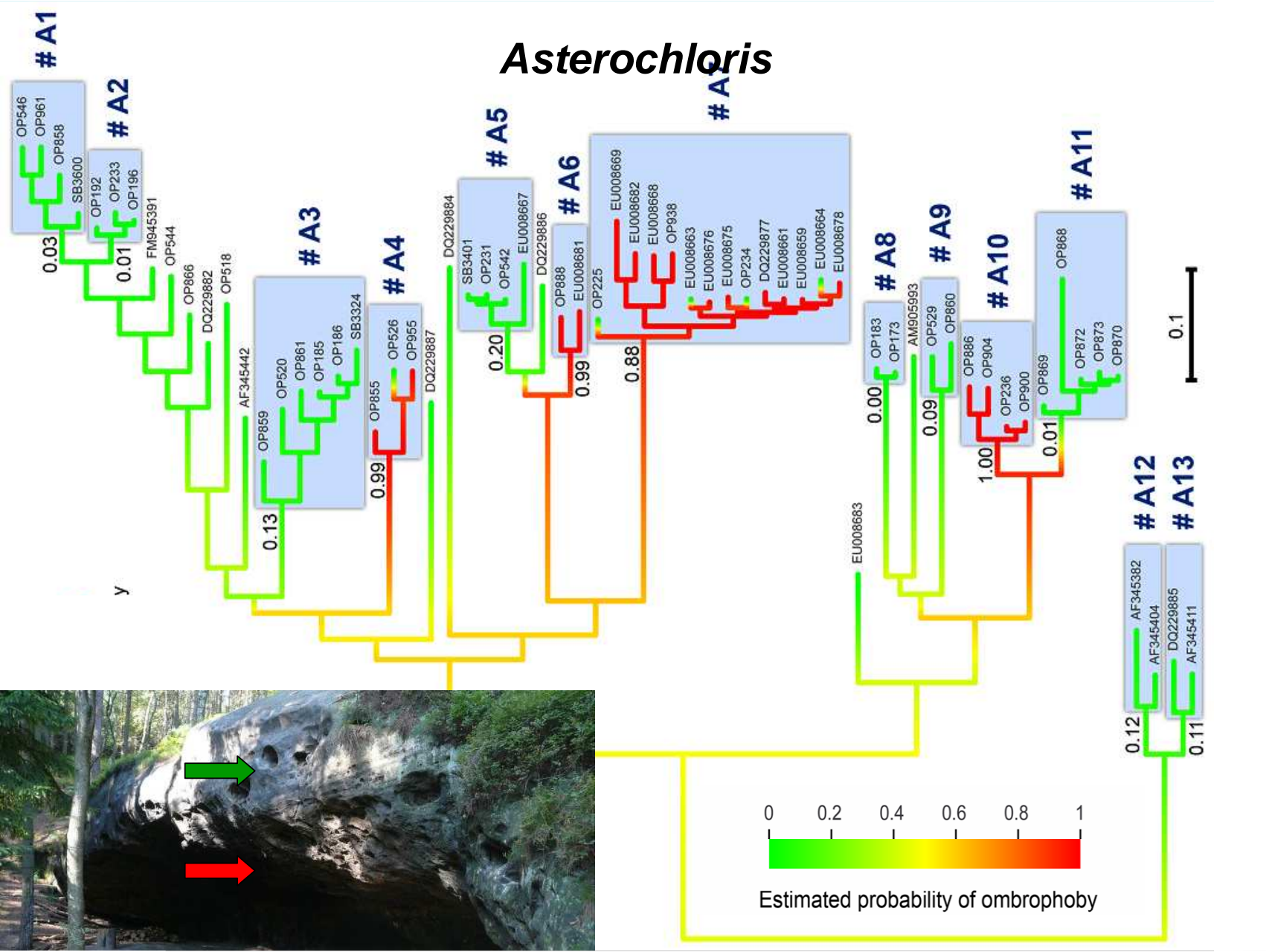
Asterochloris

- Phylogenetic signal: Randomization tests showed significant ecological similarity of related strains for all tested traits:

Trait	Pagel's lambda		K statistics		Ecological similarity
	λ	Likelihood ratio	p-value	K value	p-value
Exposure to rain	0.946	1.53	< 0.0001	0.2126	0.001
Altitude	0.045	1.01	< 0.0001	0.0832	0.005
Substrate type	0.652	1.05	0.0011	0.1168	0.002

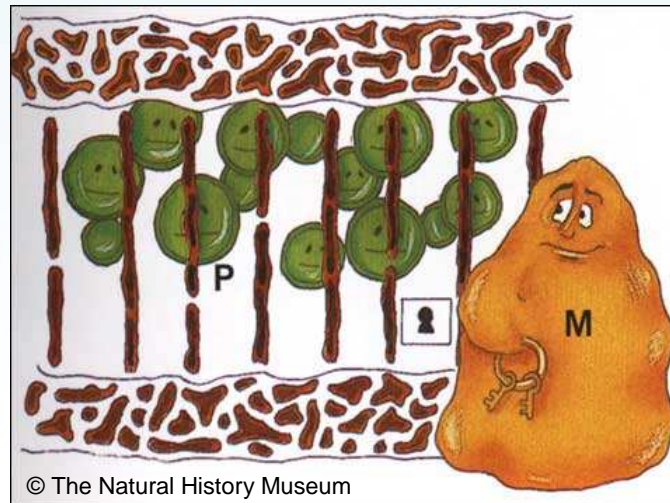


Asterochloris



Conclusions

- Ecological data could be well used to recognize the cryptic species of green microalgae (defining cryptic species in green algae makes sense)
- Algal preferences may limit the ecological niches available to lichens - the mycobiont cultivates the alga as a monoculture within its thallus, analogous to a farmer cultivating a food crop. However, the initial photobiont “selection” by the mycobiont may be predetermined by the habitat rather than by the farmer.



Acknowledgements

- Czech Grant Agency (Project No. 206/09/P291)