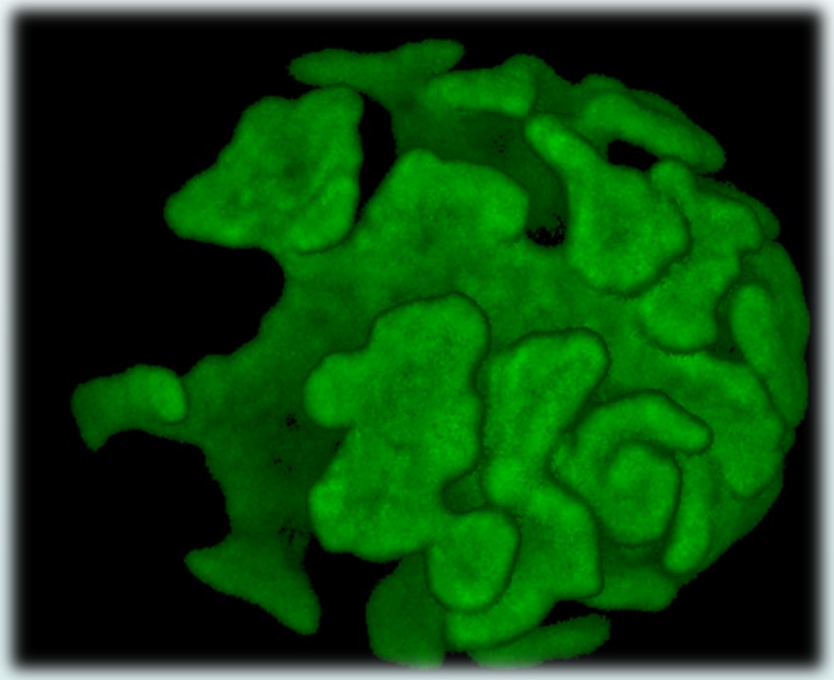
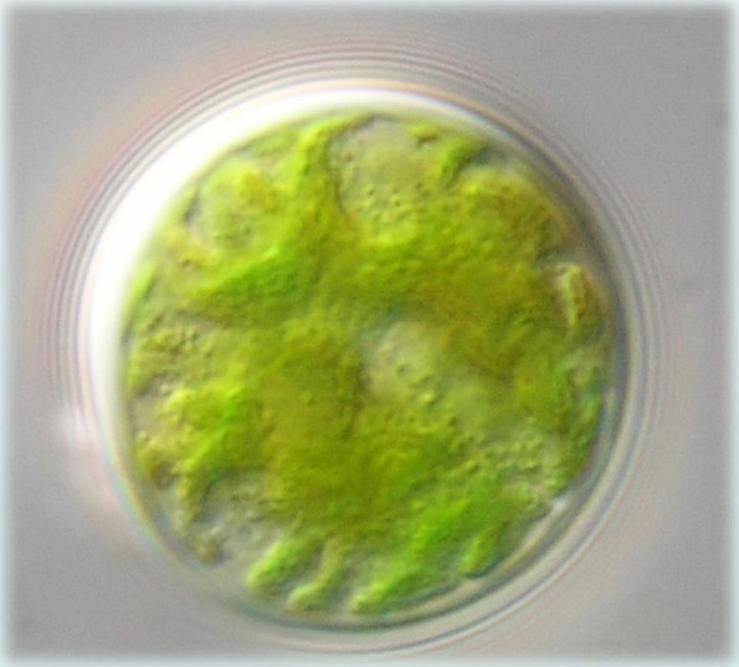
Druhový koncept zelených řas na příkladu symbiotického rodu *Asterochloris*

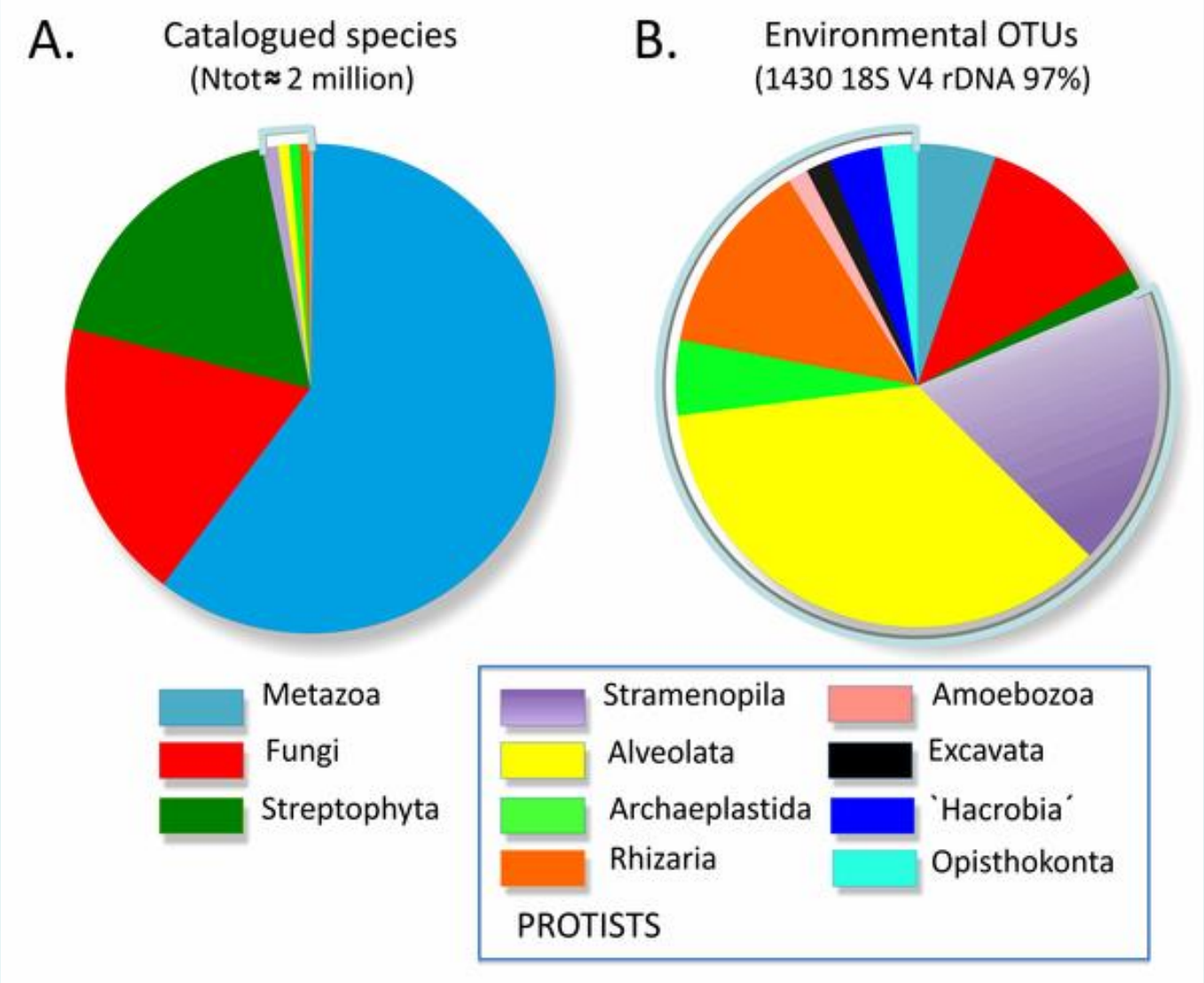




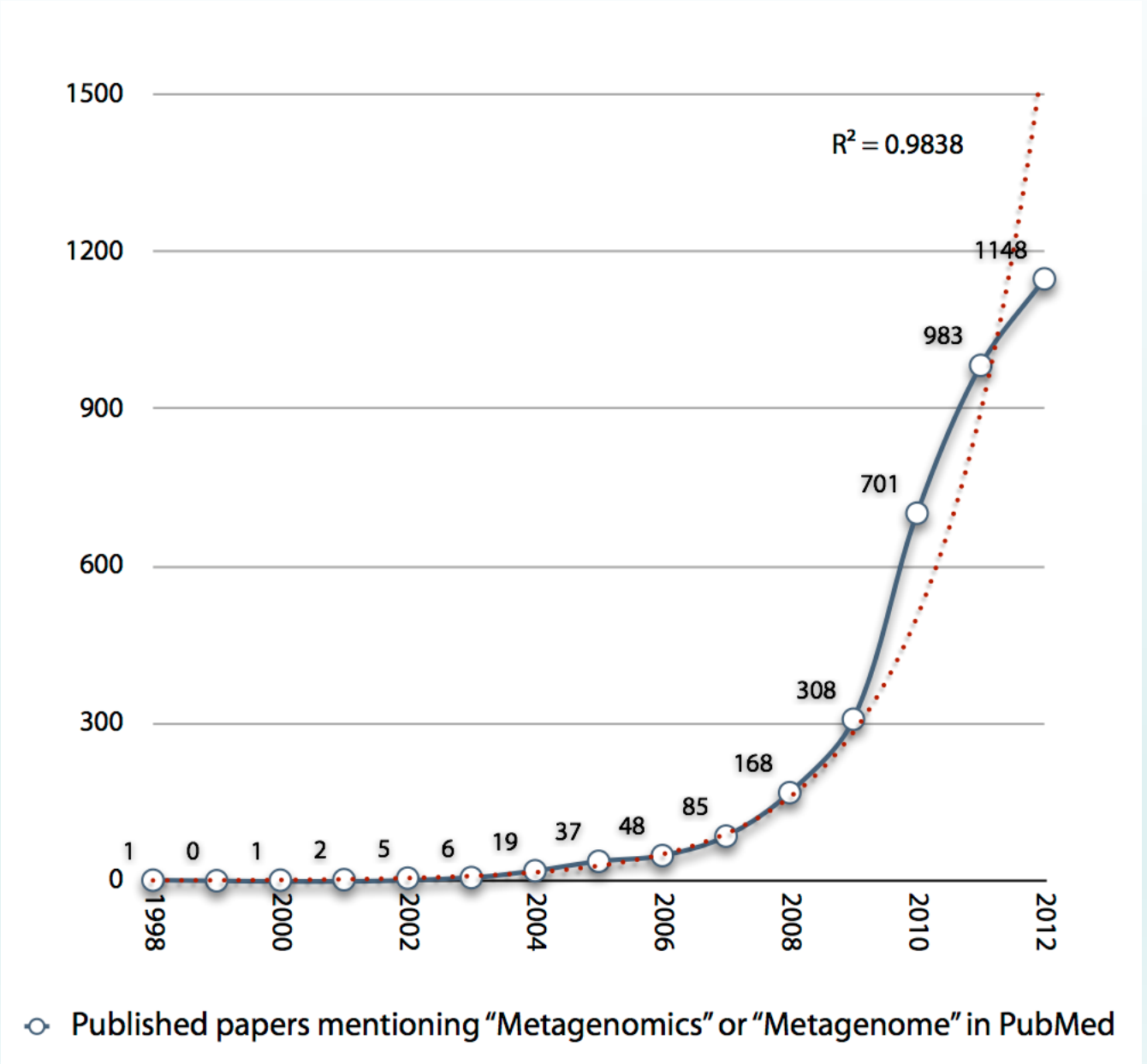
Pavel Škaloud, katedra botaniky PřF UK

Diverzita protist

- Pawlowski et al. (2012): miliony druhů protist

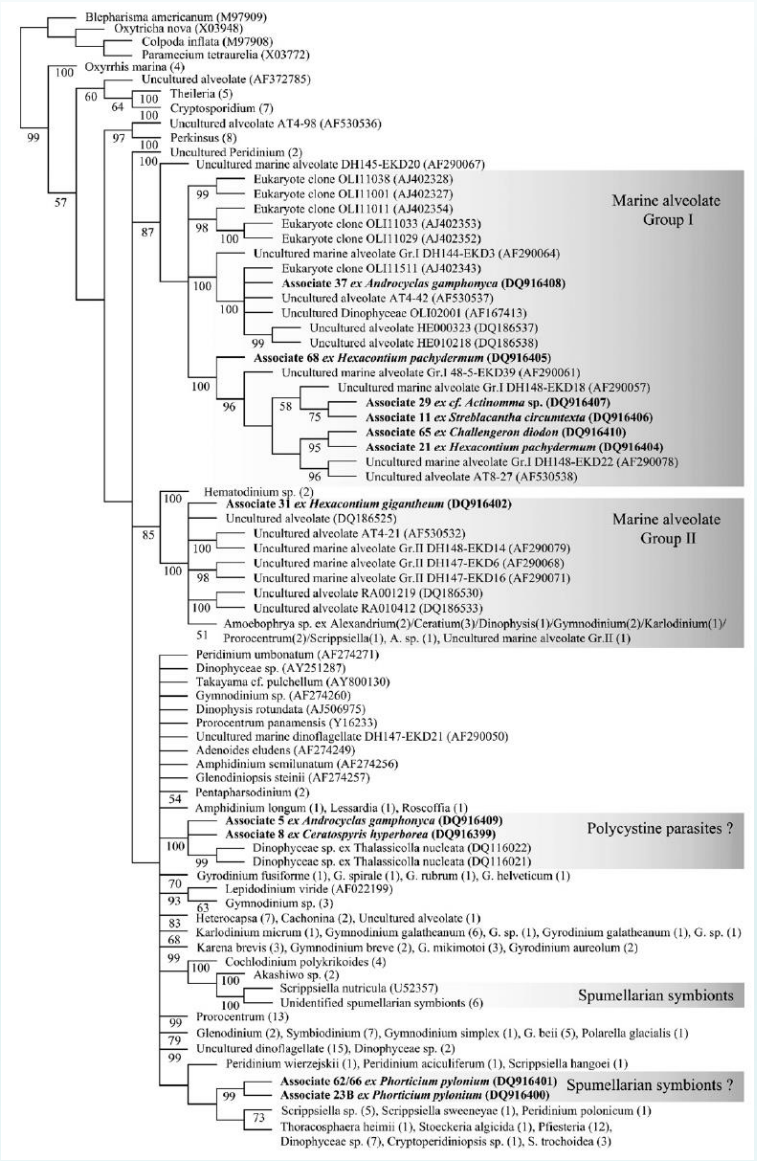


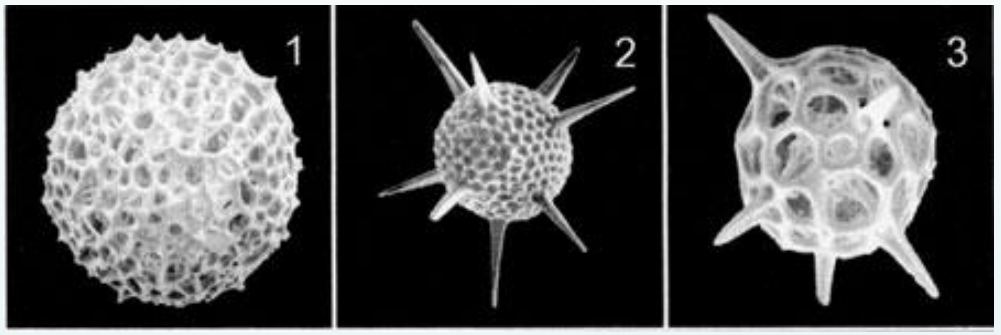
Environmenální sekvenace, metagenomika



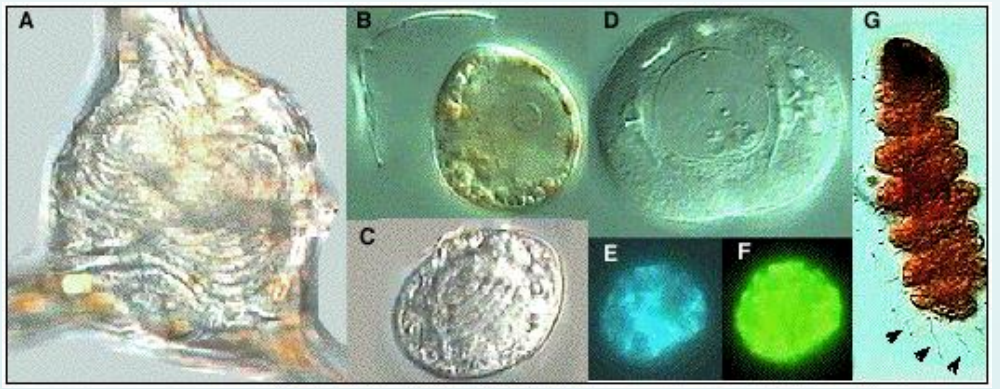
Studium diverzity protist

- Environmentální sekvenování SSU rDNA





MAGI – symbionti Radiolarií

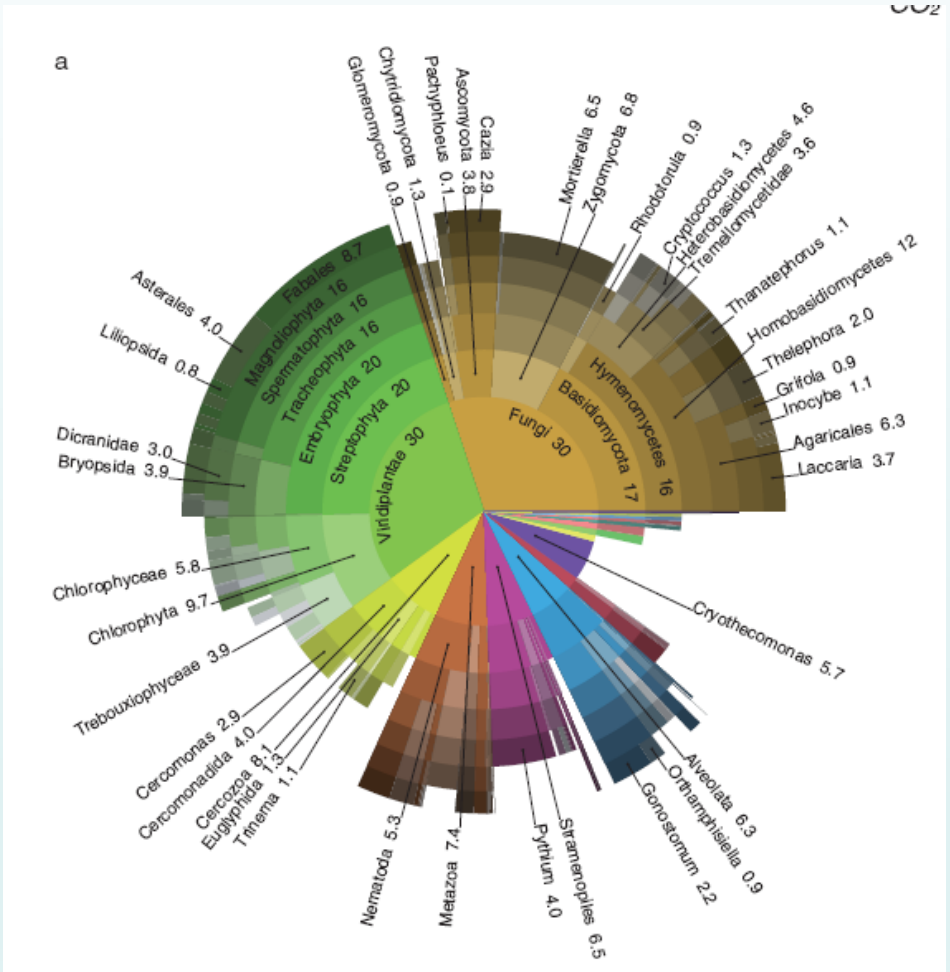


MAGII – paraziti obrněnek

Dolven et al. (2007): *Protist*

Studium ekologie protist

- Environmentální sekvenování SSU rDNA pomocí NGS



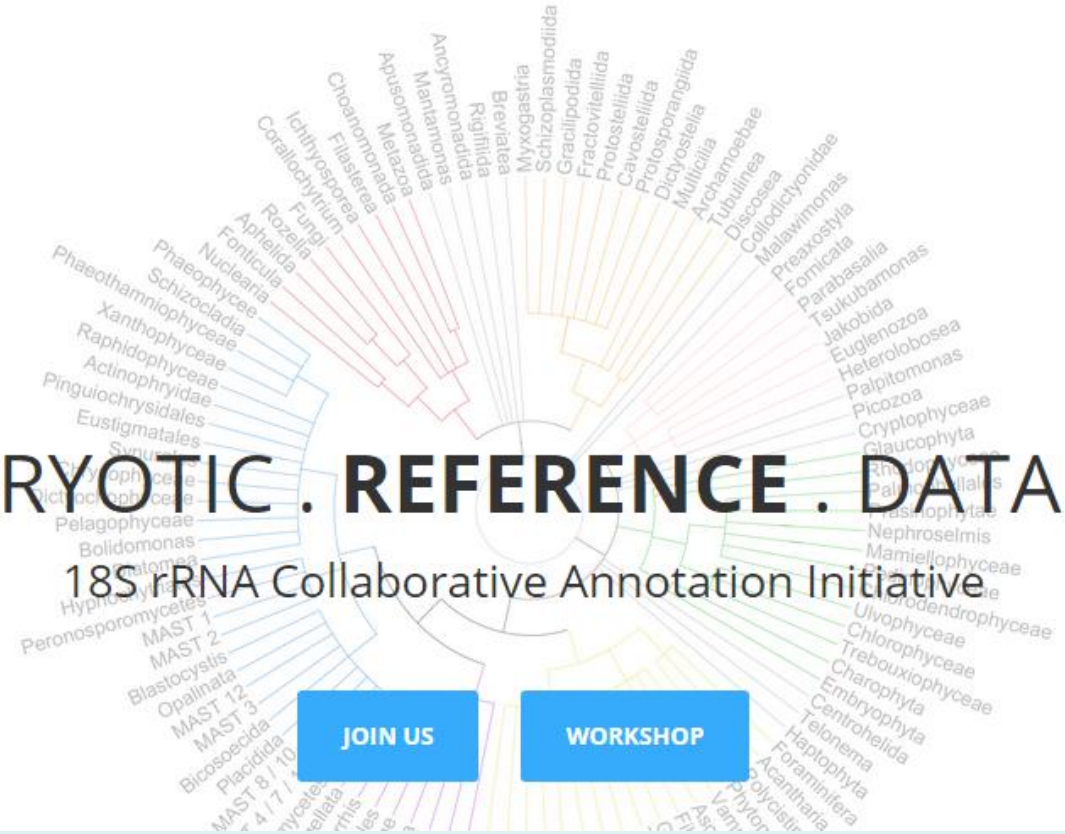
norm. CO_2

zvýšený CO_2

Lesaulnier et al. (2007): *Env. Microbiol.*

EUKREF

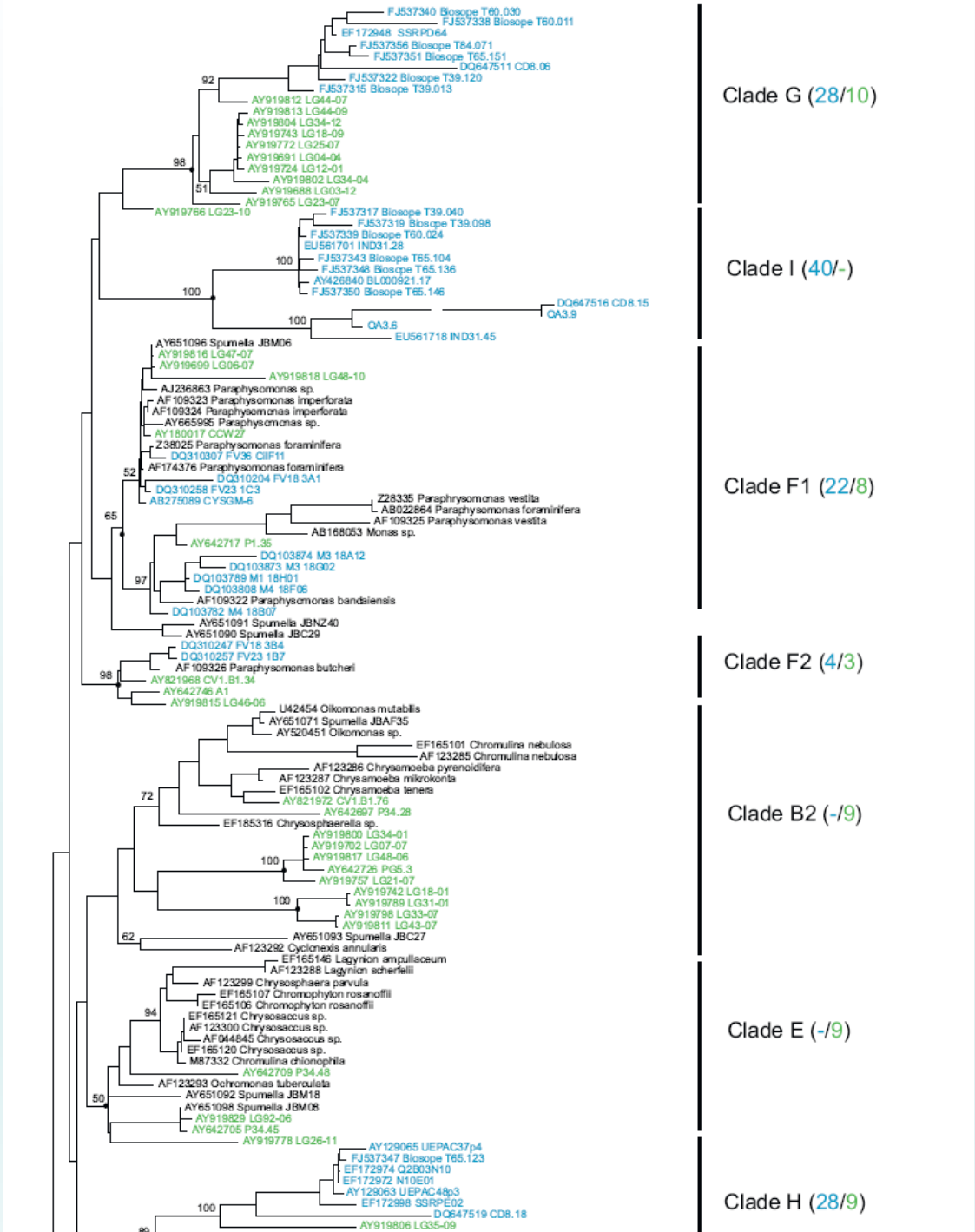
HOME WORKSHOPS RESOURCES CALENDAR OUR TEAM



EUKARYOTIC . **REFERENCE** . DATABASE

18S rRNA Collaborative Annotation Initiative

JOIN US WORKSHOP

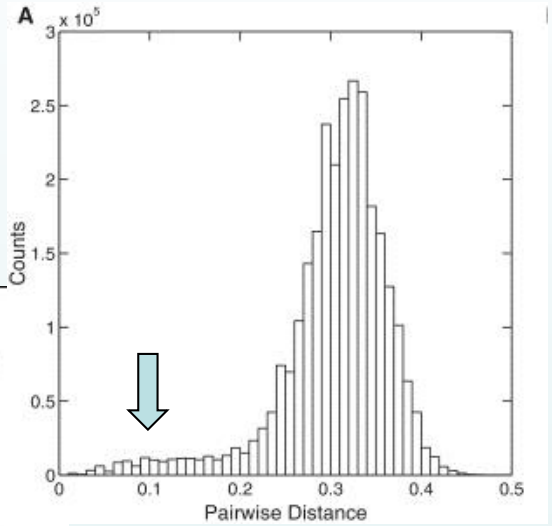


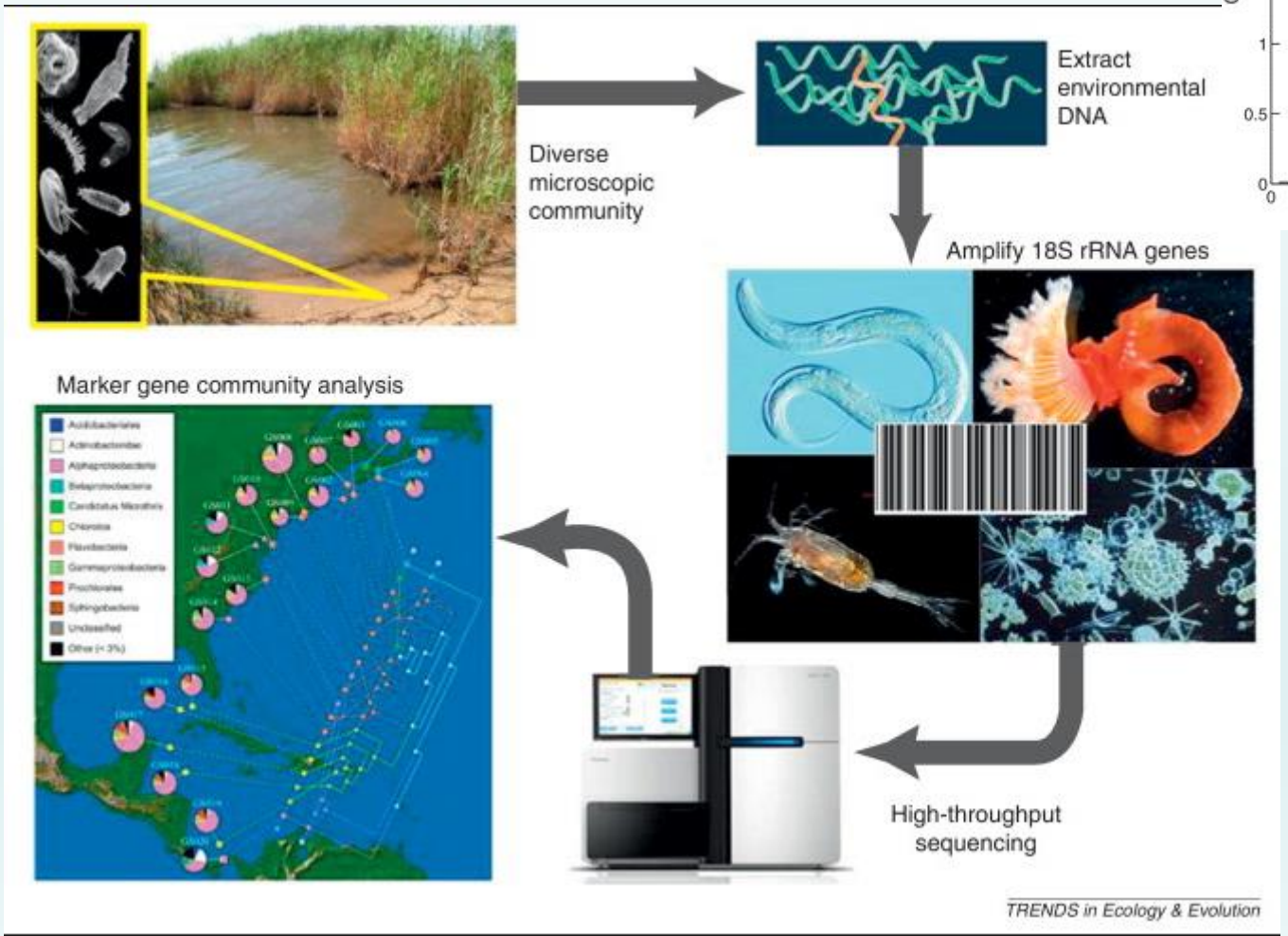
- Reálná diverzita chrysomonád
  - modře moře
  - zeleně sladká voda
- Jak definovat druh?

del Campo & Massana (2011): *Protist*

Studium diverzity protist

- OTU (operational taxonomic unit)
  - na základě podobností SSU rDNA sekvencí

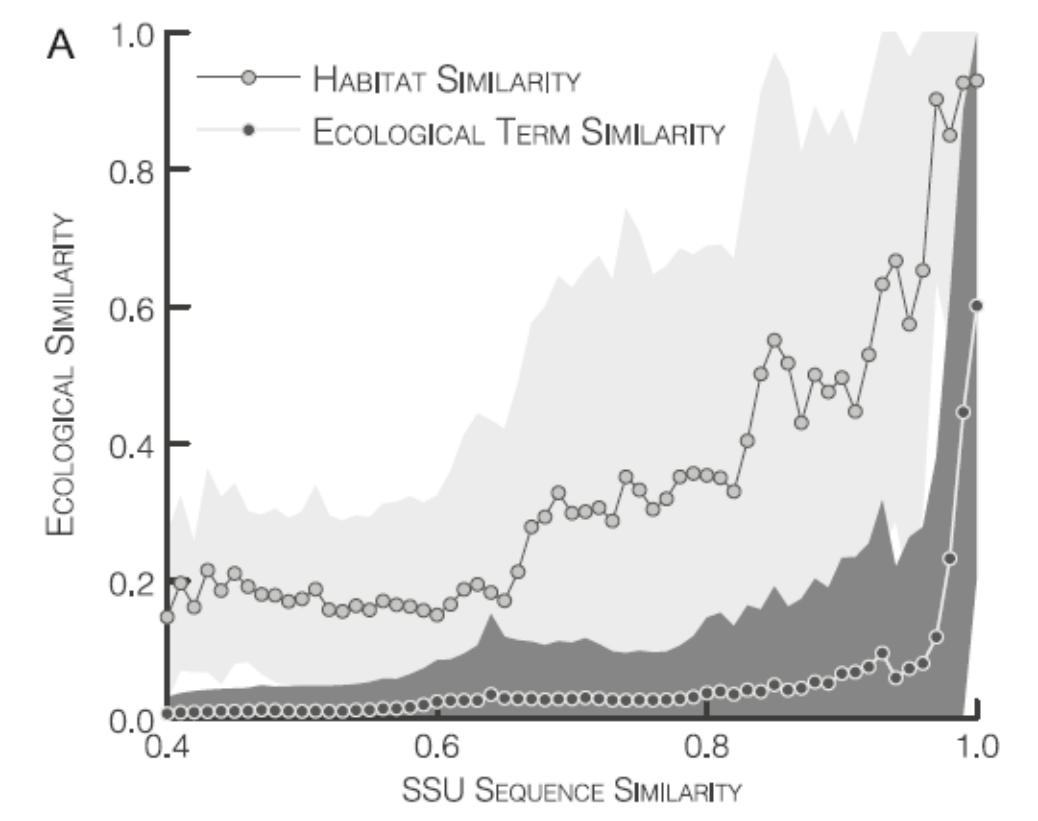




Studium diverzity protist

- OTU (operational taxonomic unit)
  - na základě podobností SSU rDNA sekvencí

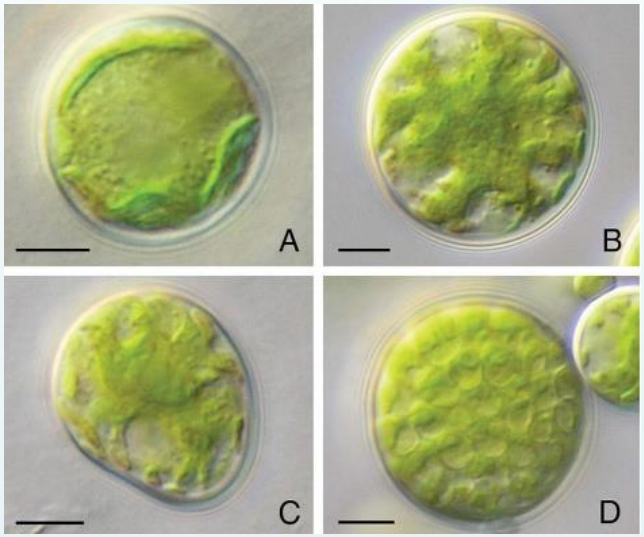
- Je tato metoda vhodná pro definici druhů?

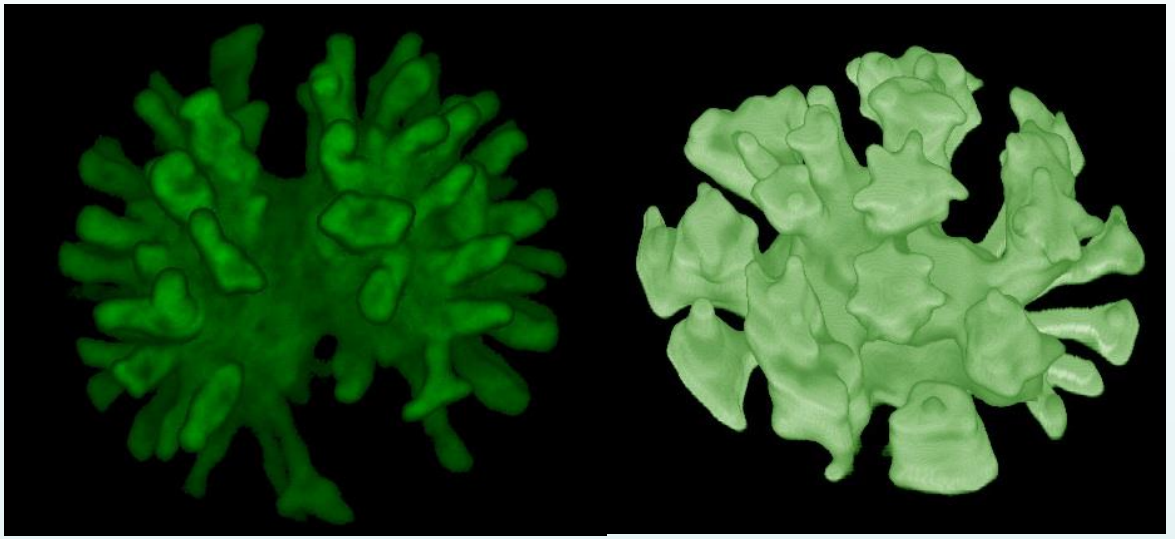


Schmidt et al. (2014): *PLOS Coput. Biol.*

Asterochloris

- jeden z nejrozšířenějších lišejníkových symbiontů

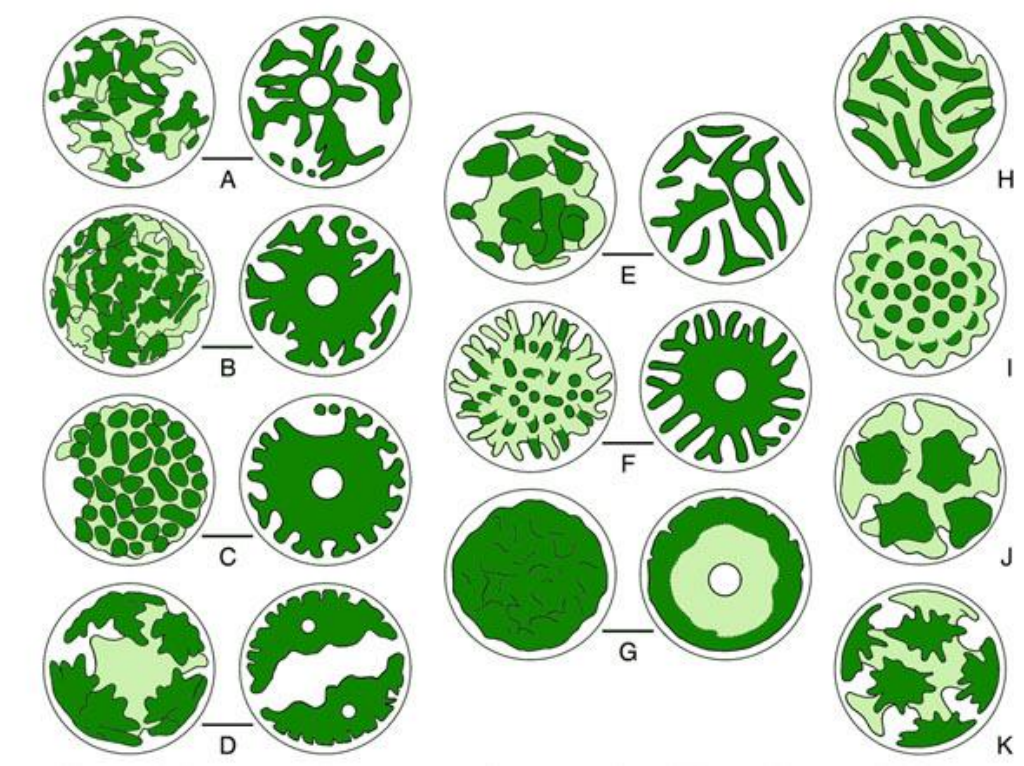


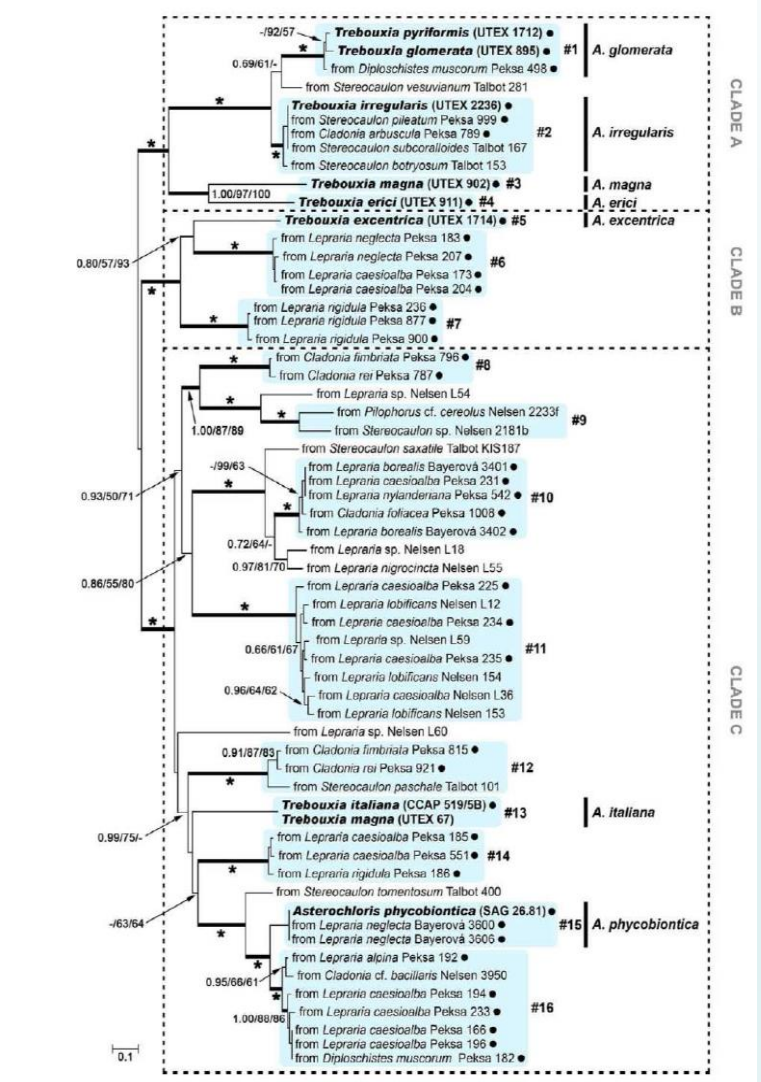


Škaloud & Peksa (2010): Evolutionary inferences based on ITS rDNA and actin sequences reveal extensive diversity of the common lichen alga *Asterochloris* (Trebouxiophyceae, Chlorophyta). *Mol. Phyl. Evol.* 54: 36-46.

Skrytá diverzita v rámci rodu *Asterochloris*

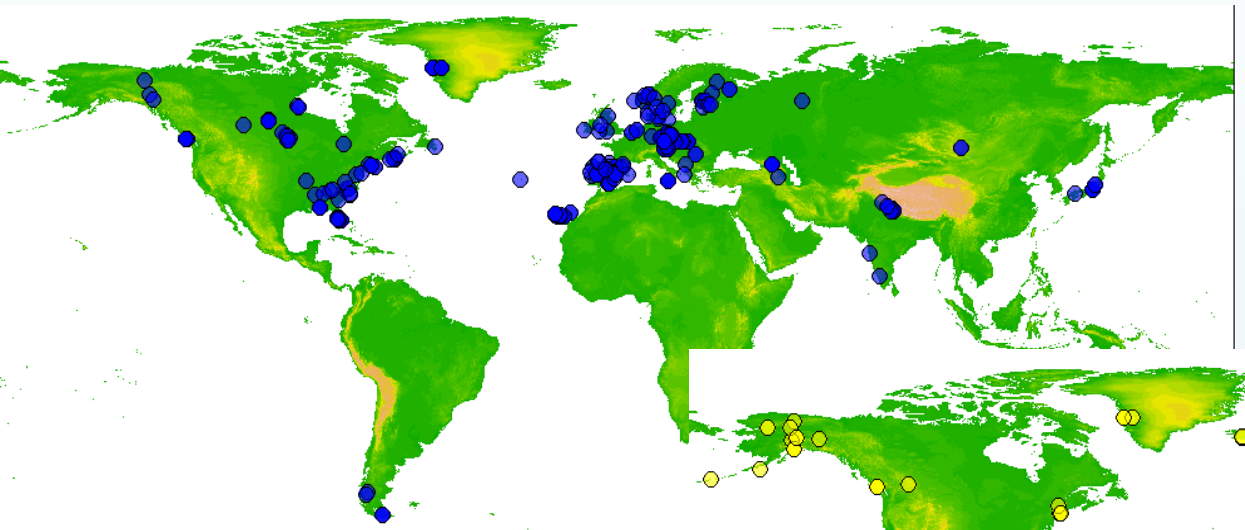
- *Asterochloris* – pouze 15 % izolovaných fotobiontů přiřazeno k již popsaným druhům
- mezi liniemi odhaleny jemné morfologické rozdíly ve struktuře chloroplastu



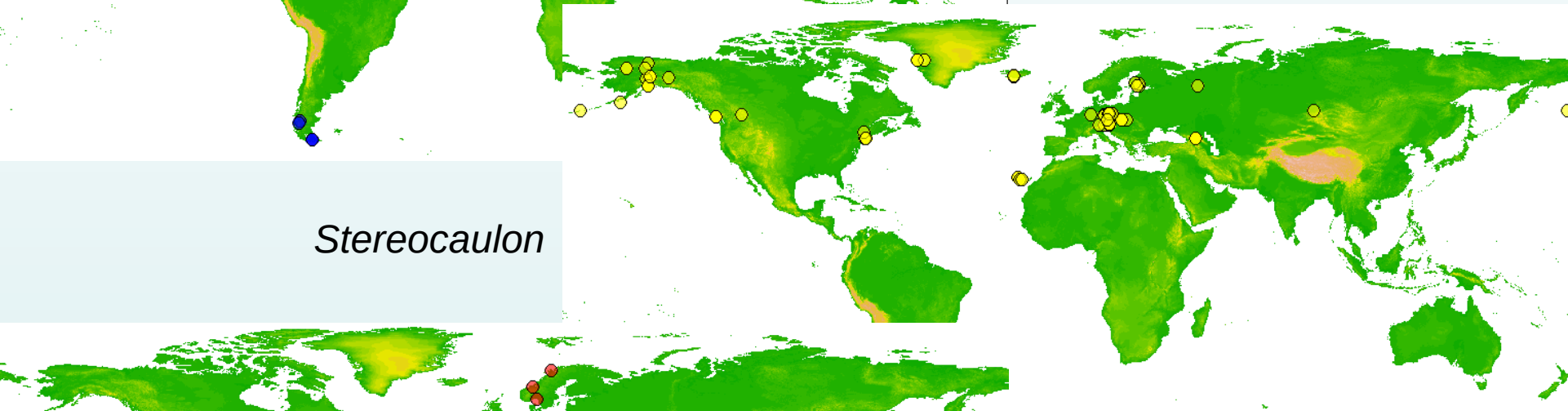


Škaloud & Peksa (2010): Evolutionary inferences based on ITS rDNA and actin sequences reveal extensive diversity of the common lichen alga *Asterochloris* (Trebouxiophyceae, Chlorophyta). *Mol. Phyl. Evol.* 54: 36-46.

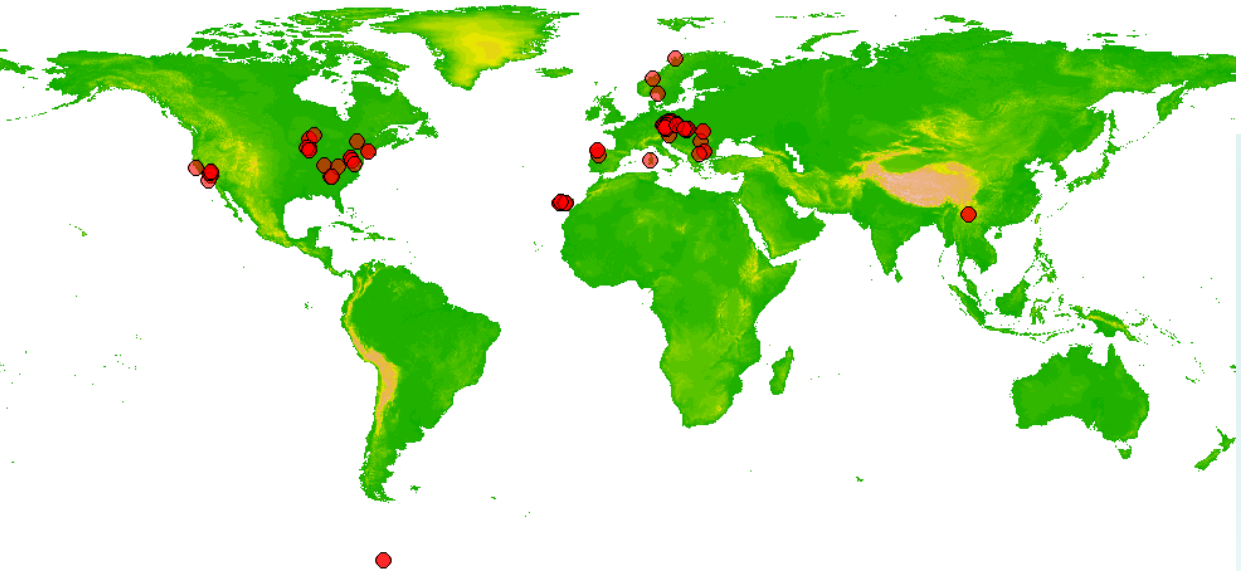
Asterochloris – definice druhů



Cladonia



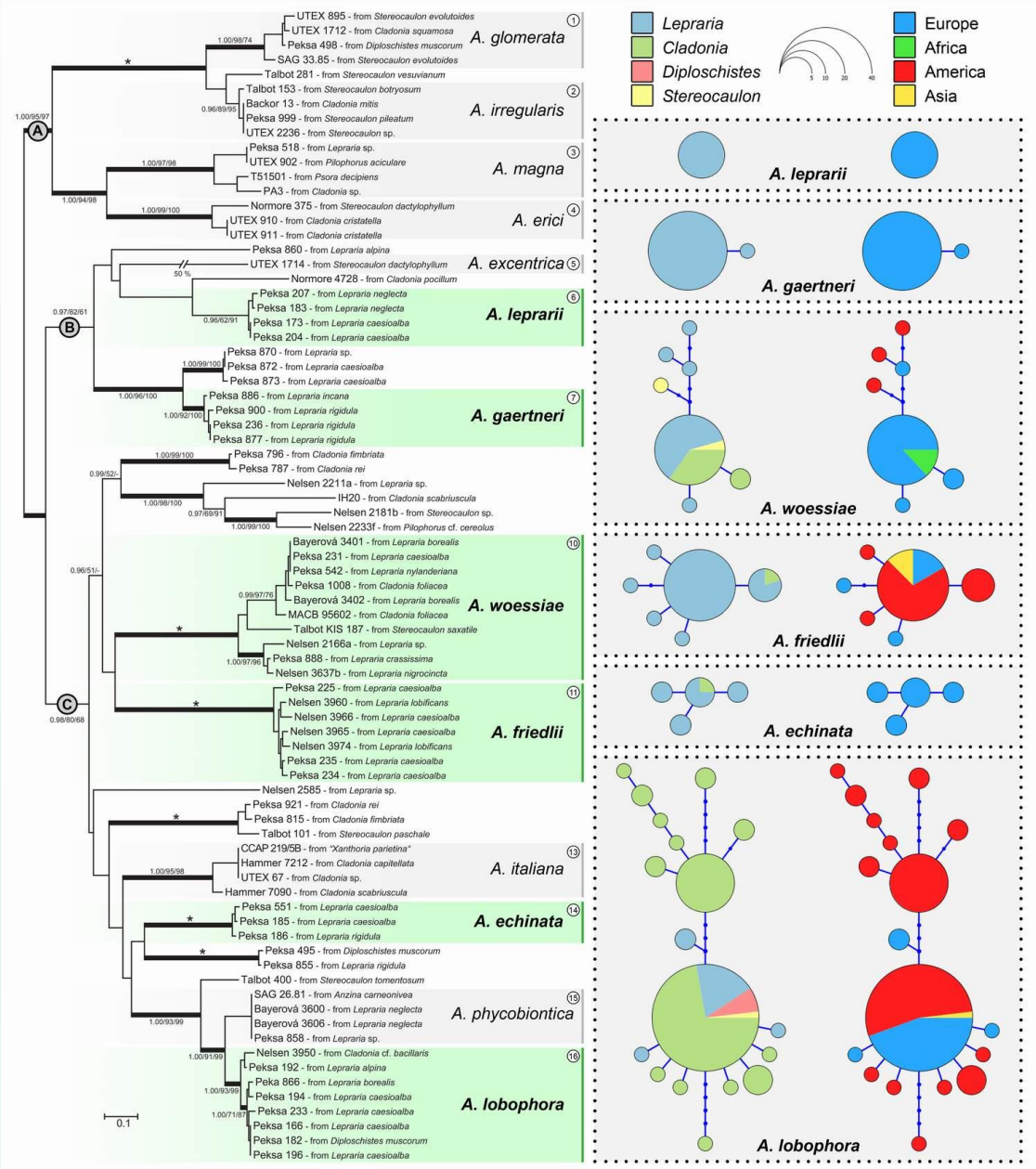
Stereocaulon



Lepraria

Asterochloris – definice druhů

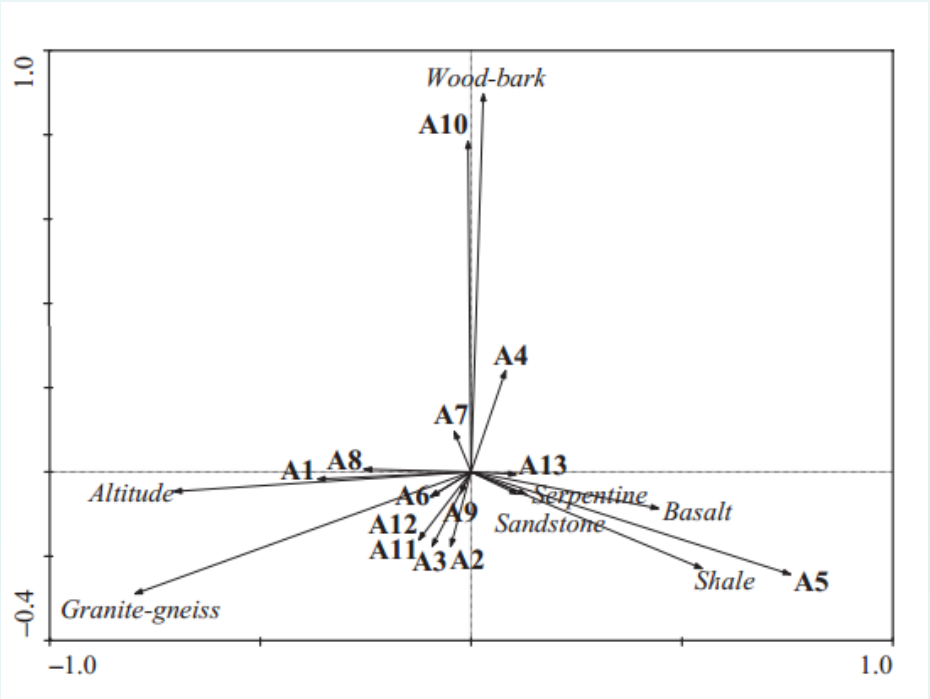
- molekulární data (ITS rDNA + actin)

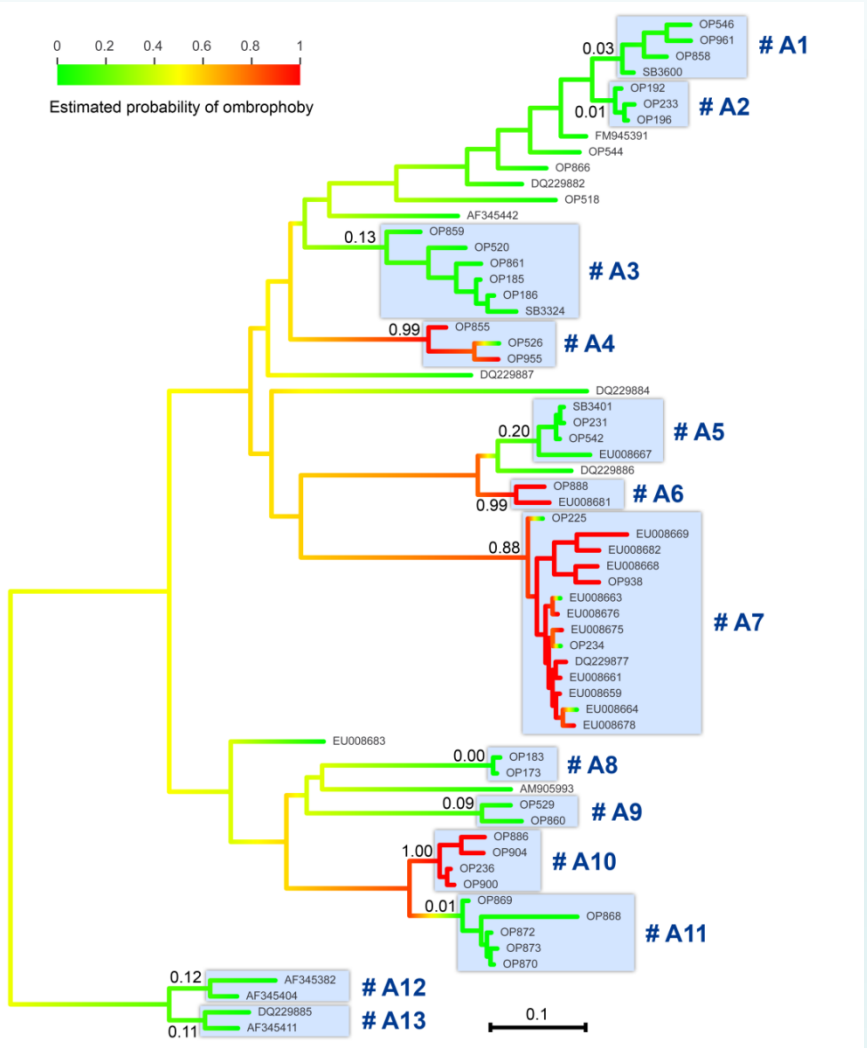


Asterochloris – definice druhů

- ekologie...
  - substrátová specifita, nadmořská výška, ombrotrofie

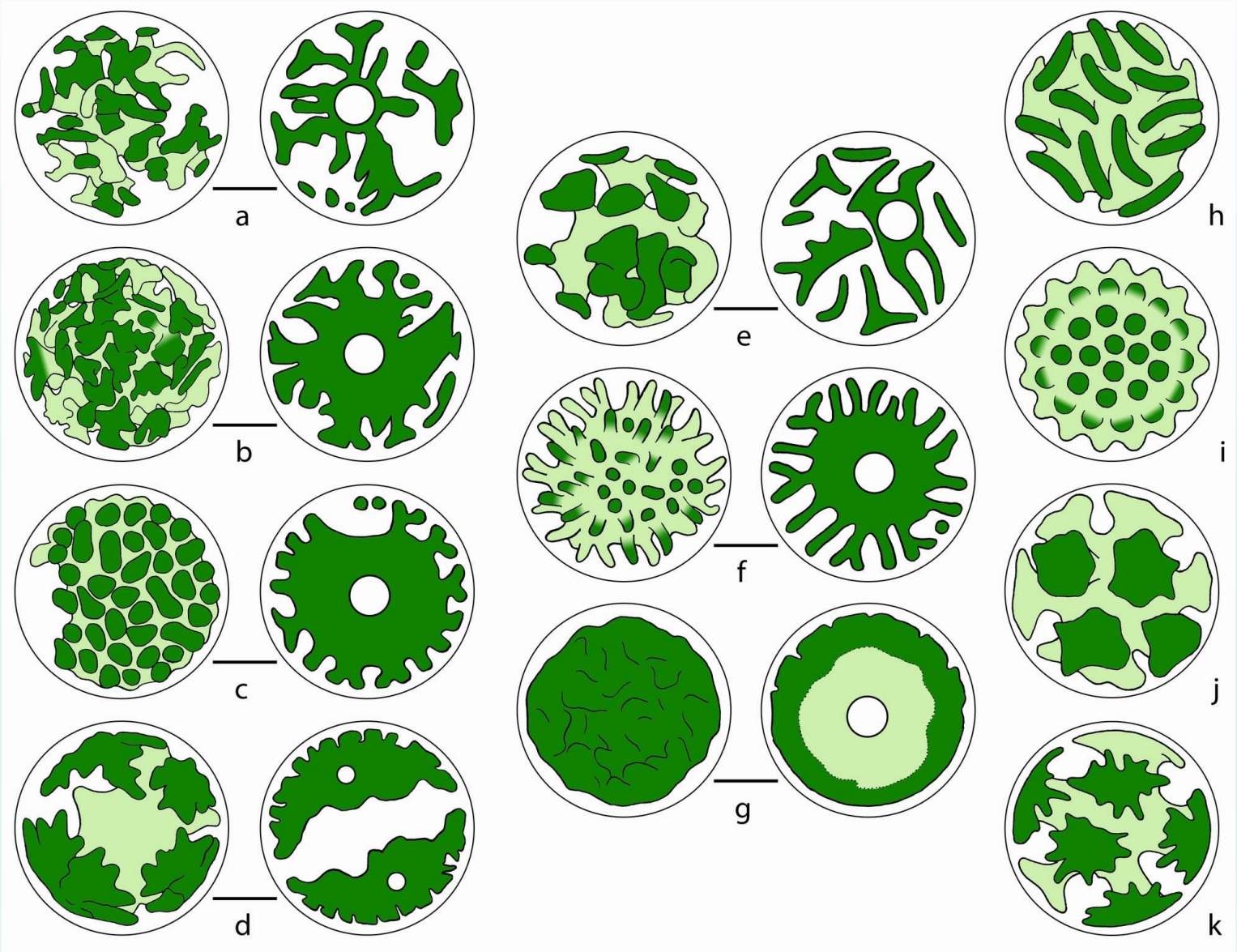
Trait	Pagel's λ		
	λ	Likelihood ratio	*P*-value
Exposure to rain	0.946	1.53	<0.0001
Altitude	0.045	1.01	<0.0001
Substrate type	0.652	1.05	0.0011

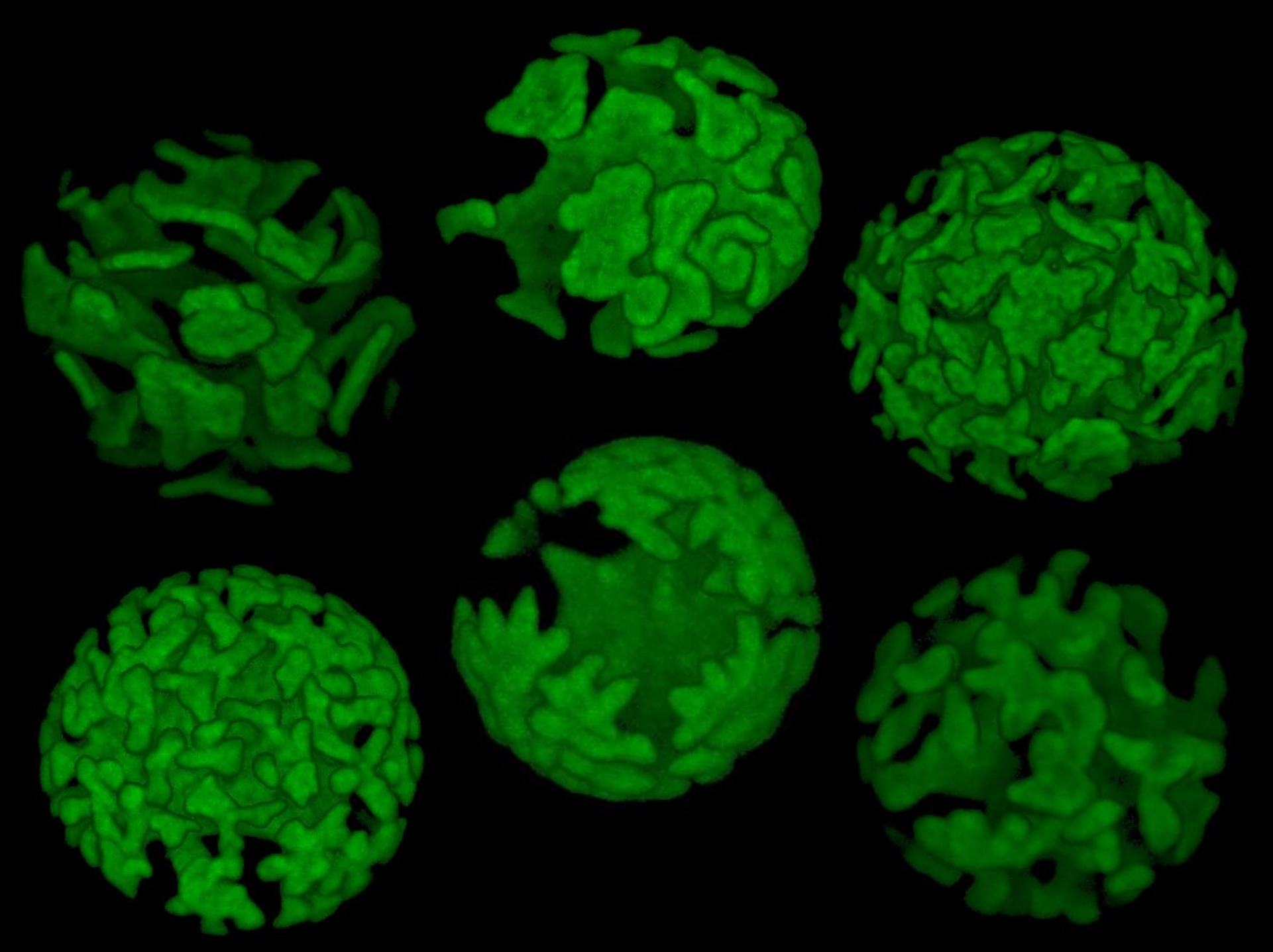




Asterochloris – definice druhů

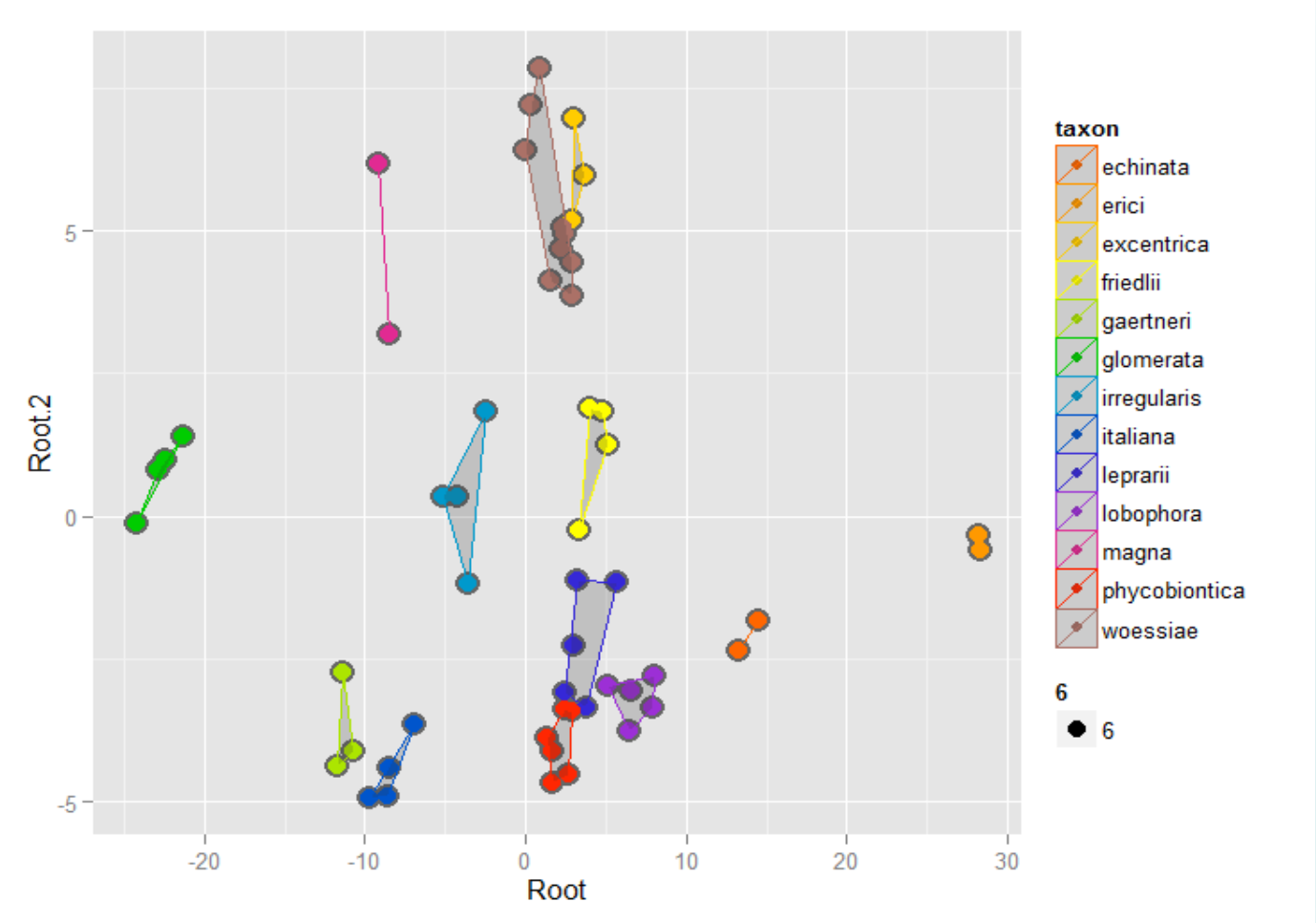
- morfologie chloroplastu

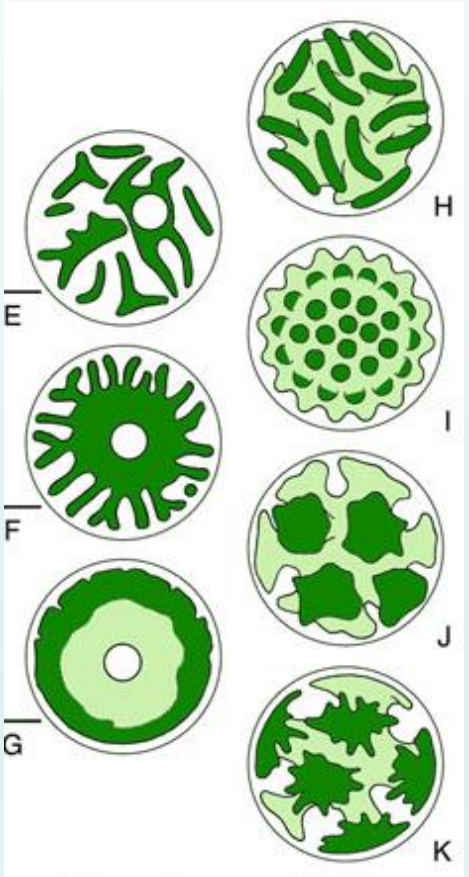




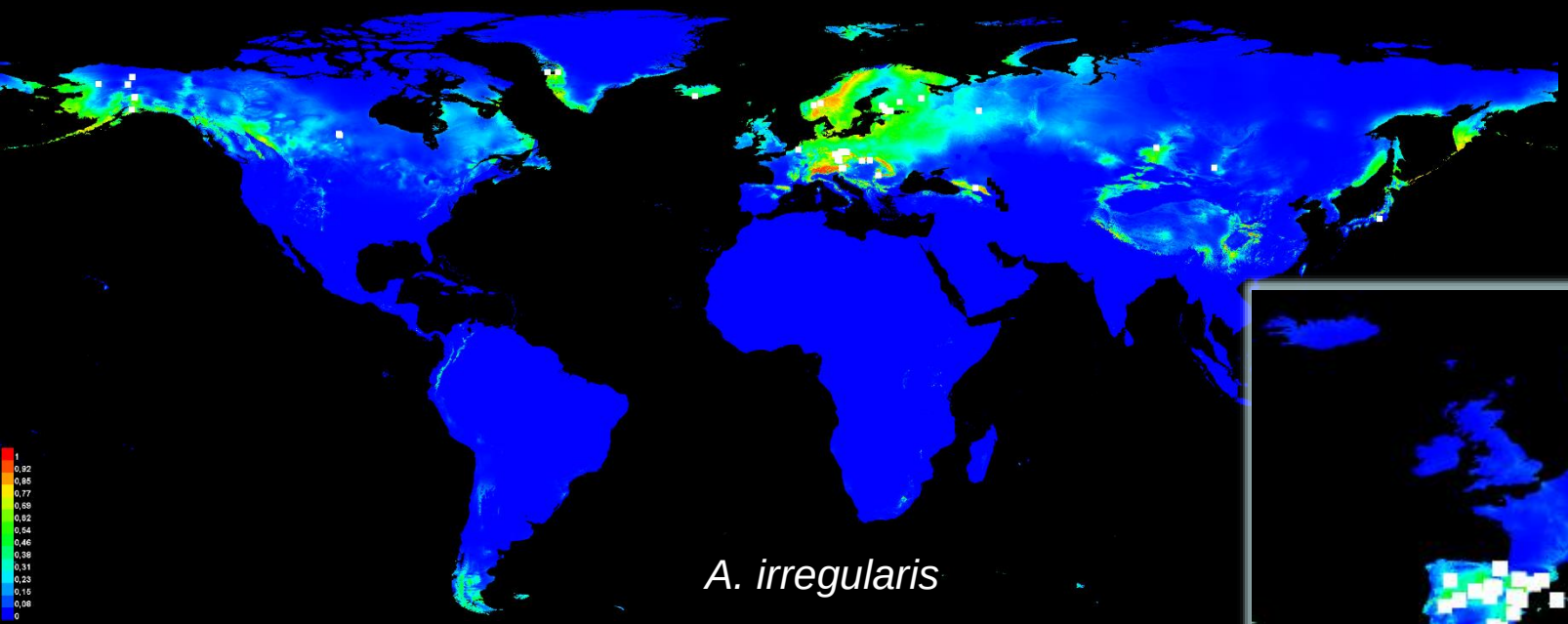
Asterochloris – definice druhů

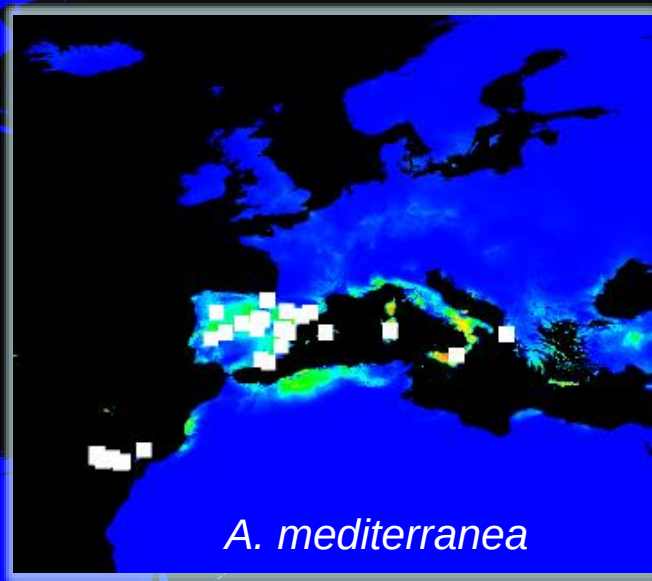
- morfologie...
  - General Discriminant Analysis (tvar buněk, velikost buněk, tvar chloroplastu, počet spor)

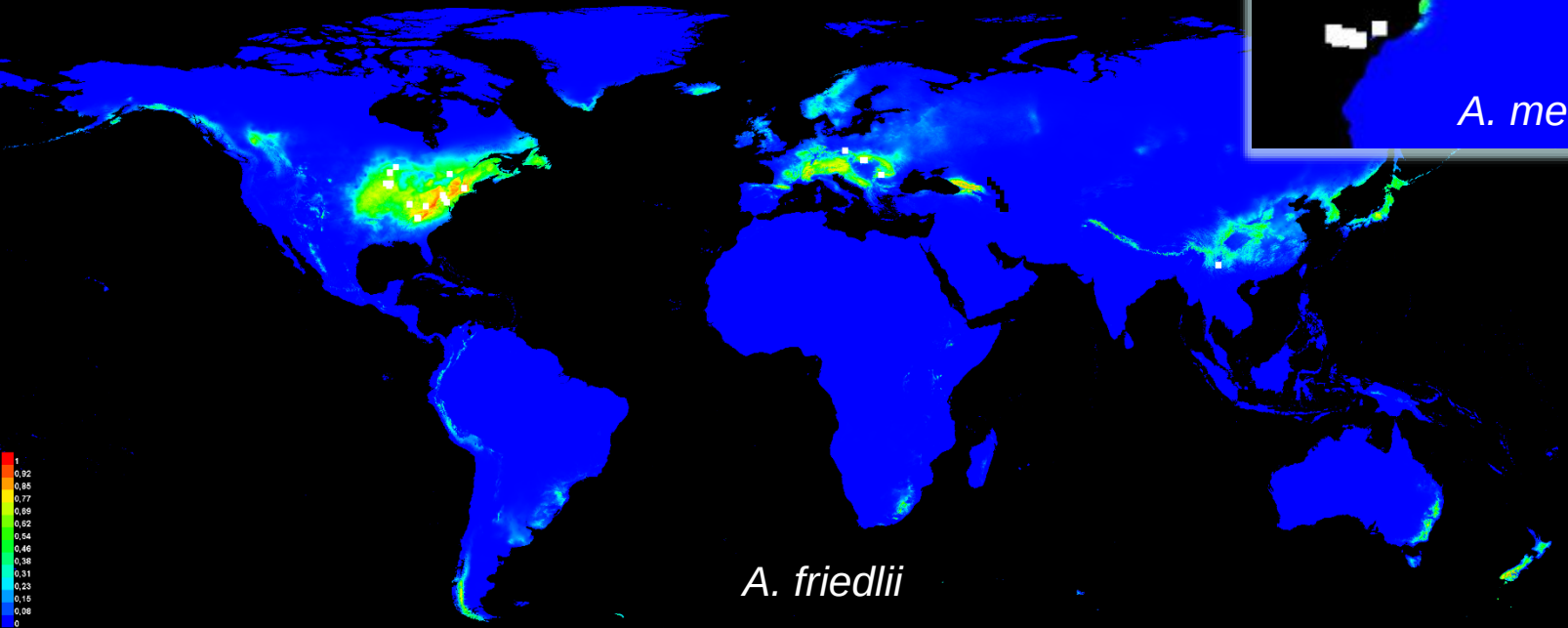




- biogeografie...

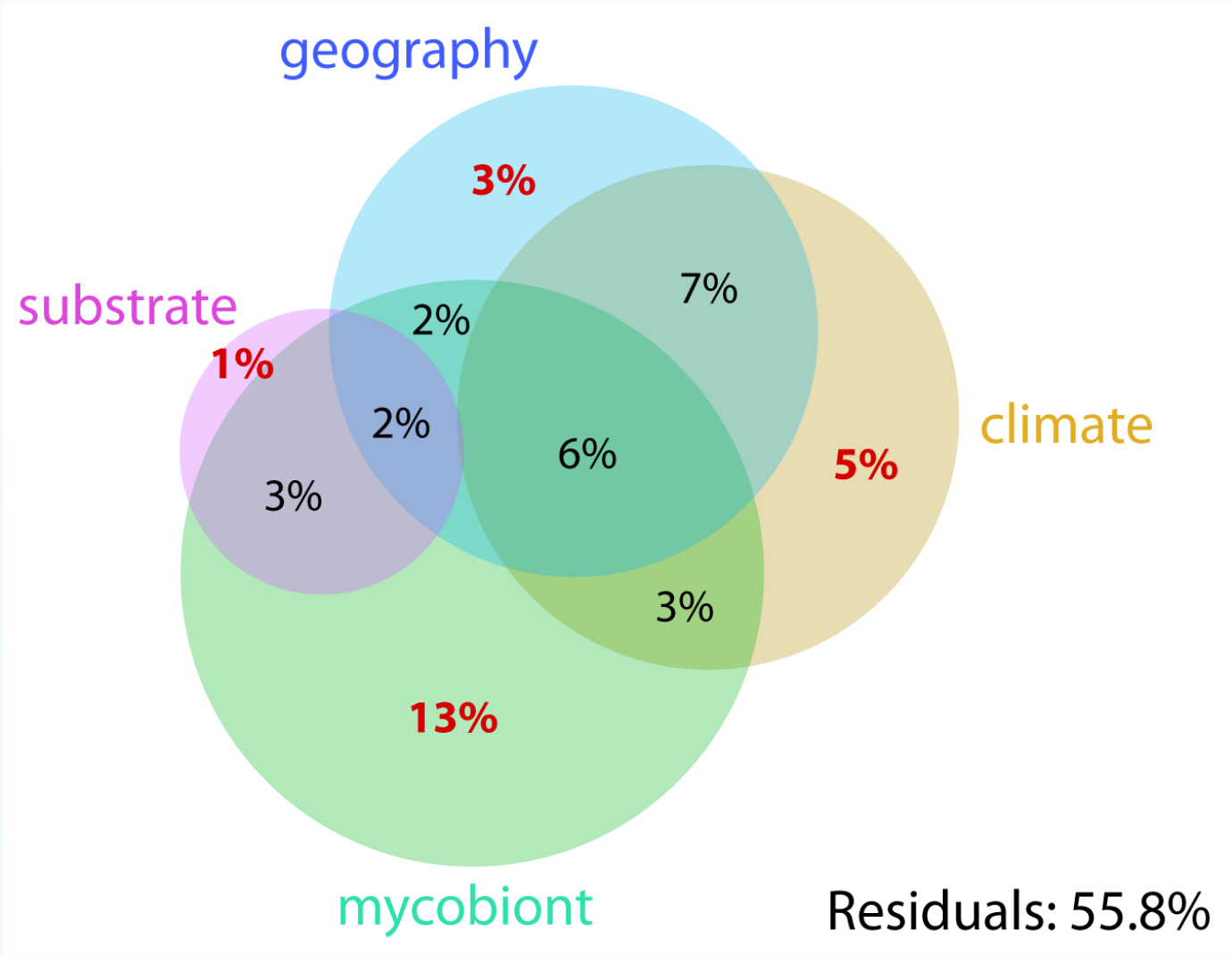


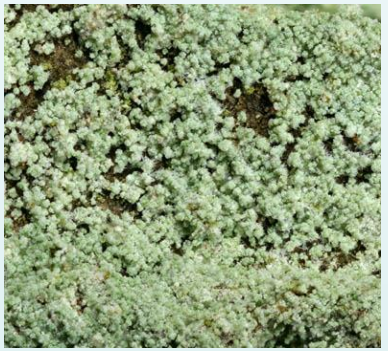




Asterochloris – definice druhů

- preference k mykobiontům

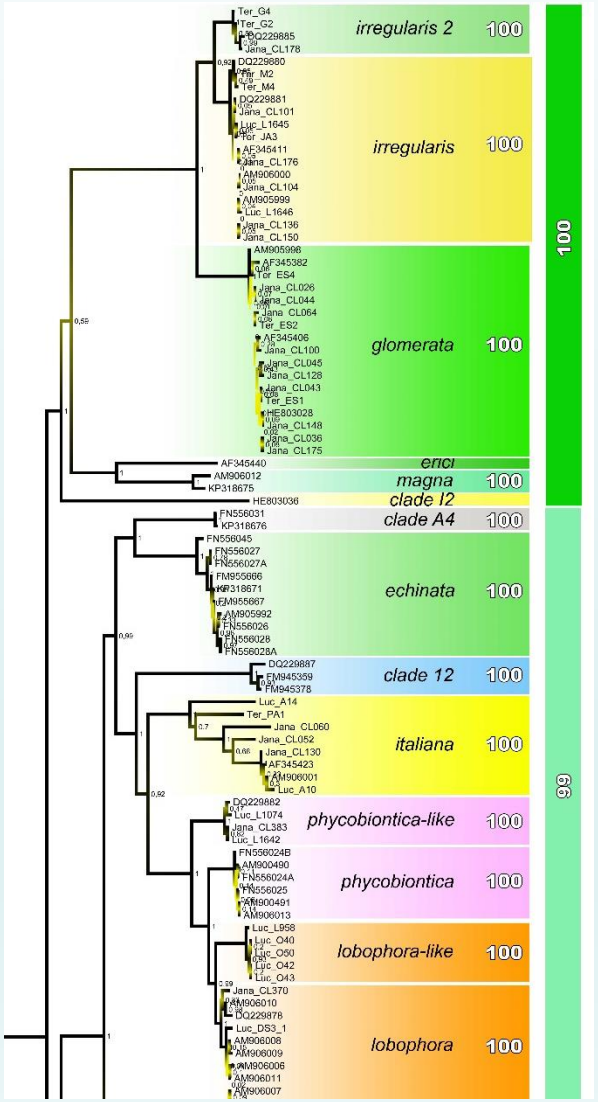


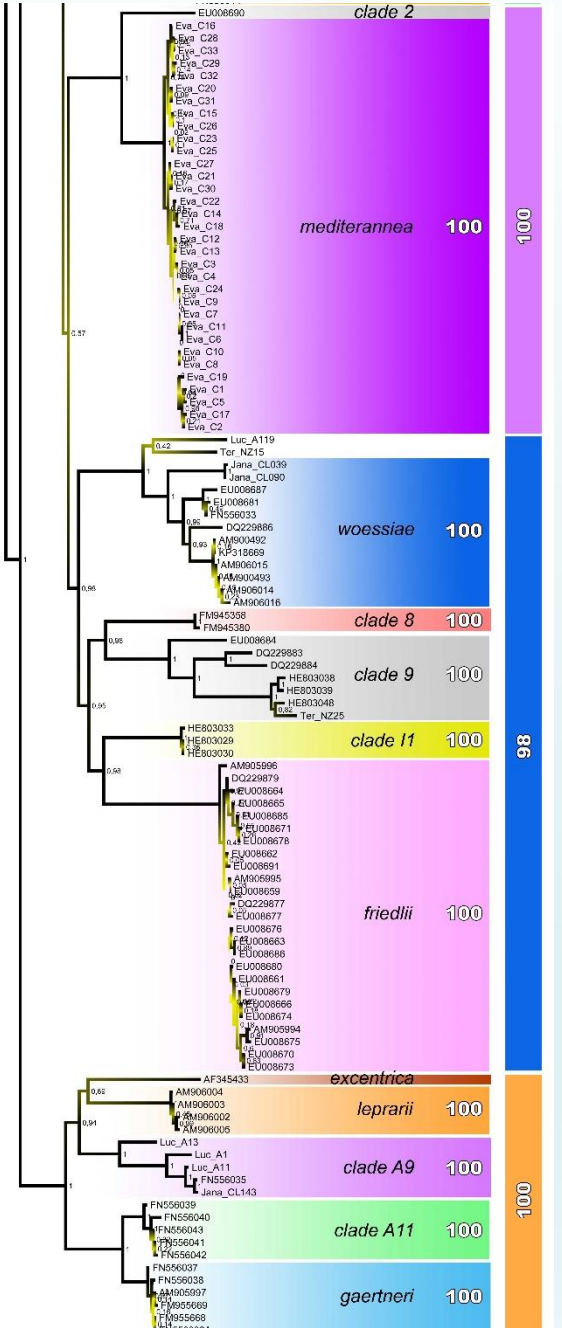


Asterochloris – definice druhů

- 26 dobře podpořených linií
- 13 formálně popsaných druhů

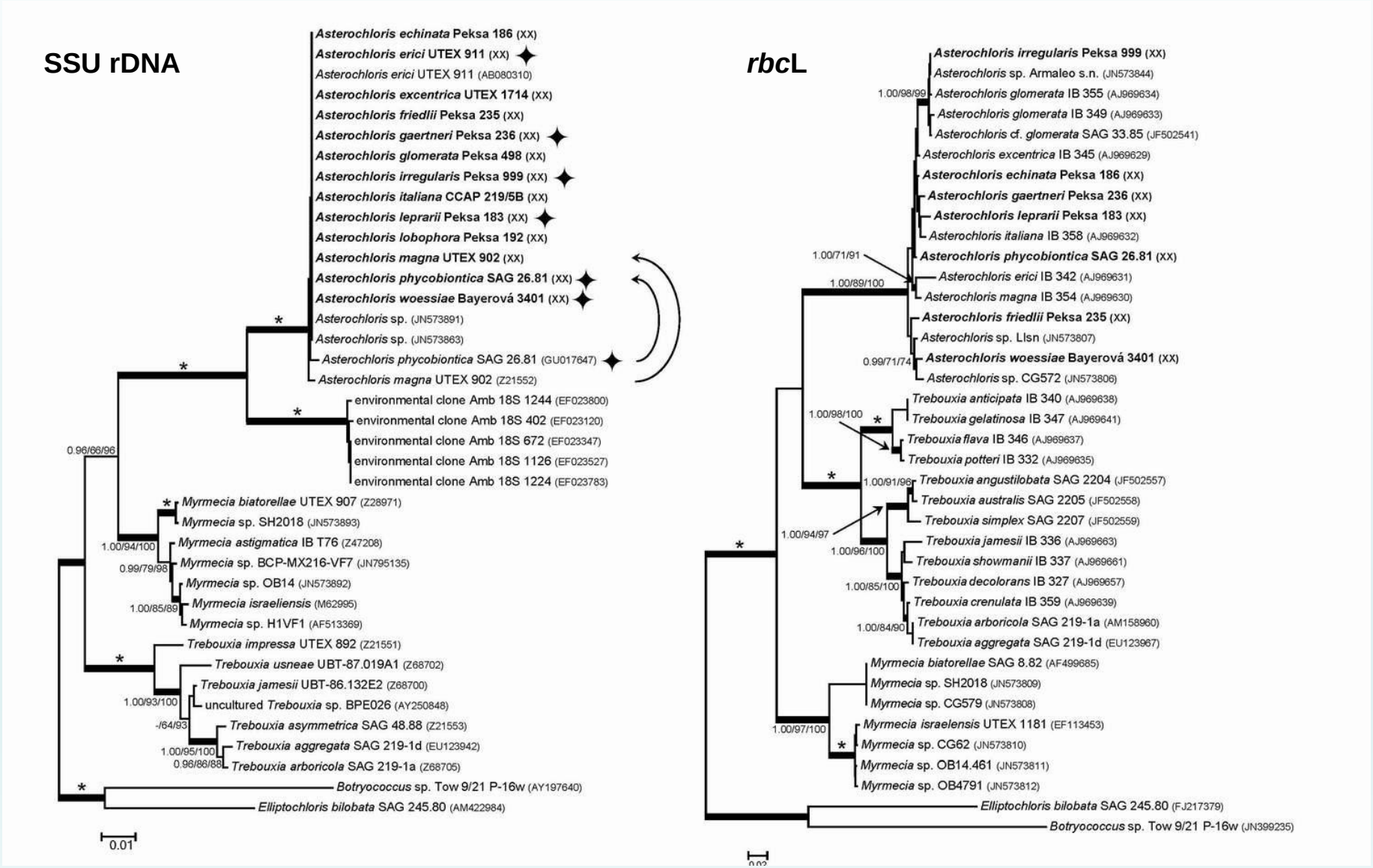
- druhy se liší:
  - morfologií
  - ekologií
  - rozšířením
  - preferencí k mykobiontům





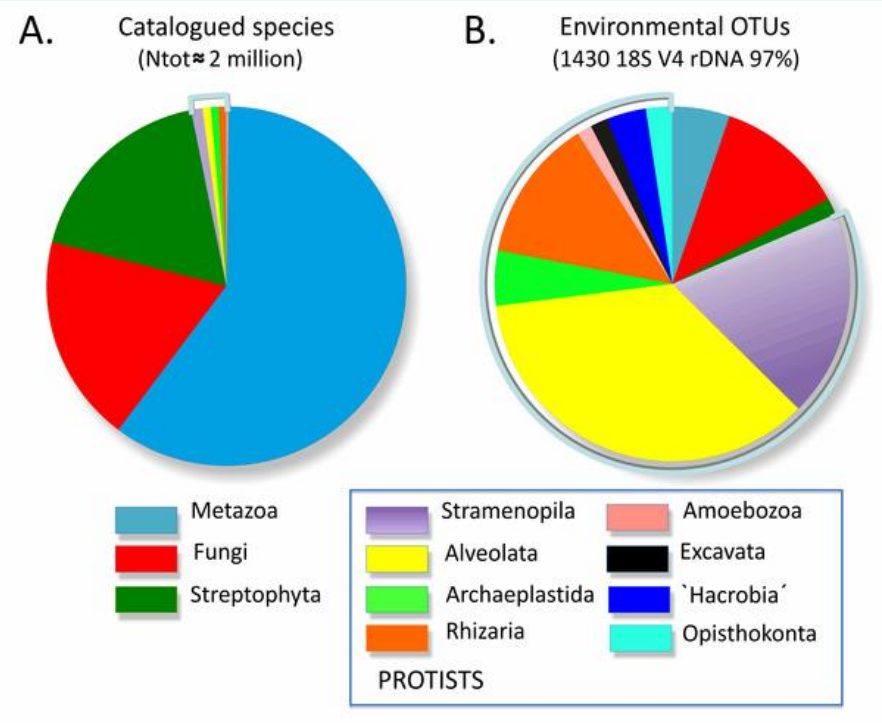
Asterochloris – definice druhů

- molekulární data



Definice druhů

- Separátní, dobře definované druhy mohou mít shodnou SSU rDNA sekvenci!
- Celkové množství druhů může být mnohonásobně vyšší, než jsou naše aktuální odhady
- Automatické odlišení druhů na základě podobnosti v SSU rDNA je nepoužitelné pro hodnocení rozšíření, diverzity a ekologické role protist



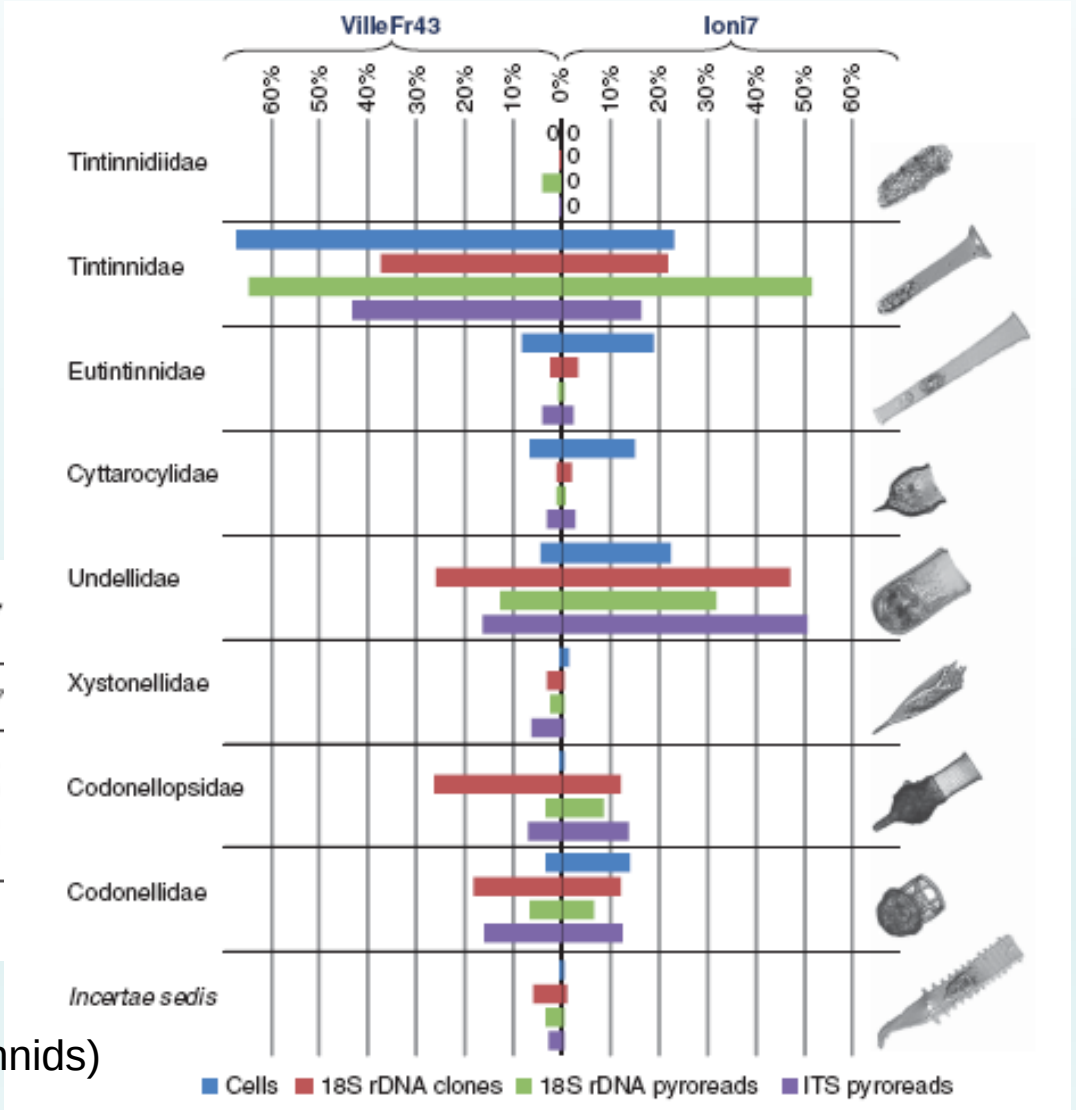
Definice druhů

- Kromě SSU rDNA je nutné využít i variabilnější úseky (ITS rDNA)
- Dobrá definice druhů musí být založena i na studiu morfologie / ekologie / fyziologie / distribuce...

Table 1 Number of tintinnid cells, clone sequences and pyroreads retained for comparison from the VilleFr-43 and Ioni-7 samples

	VilleFr-43	*Ioni-7*
Cells	465	208
Clone sequences	200	200
18S rDNA pyroreads	10504	8734
ITS pyroreads	10504	8734

Abbreviations: ITS, internal transcribed spacer; rDNA, ribosomal DNA.



Bachy et al. 2013, ISME Journal (tintinnids)


Děkuji za pozornost