

Introduction to plant systematics, evolution and ecology

Roswitha Schmickl

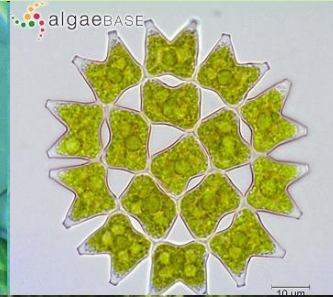
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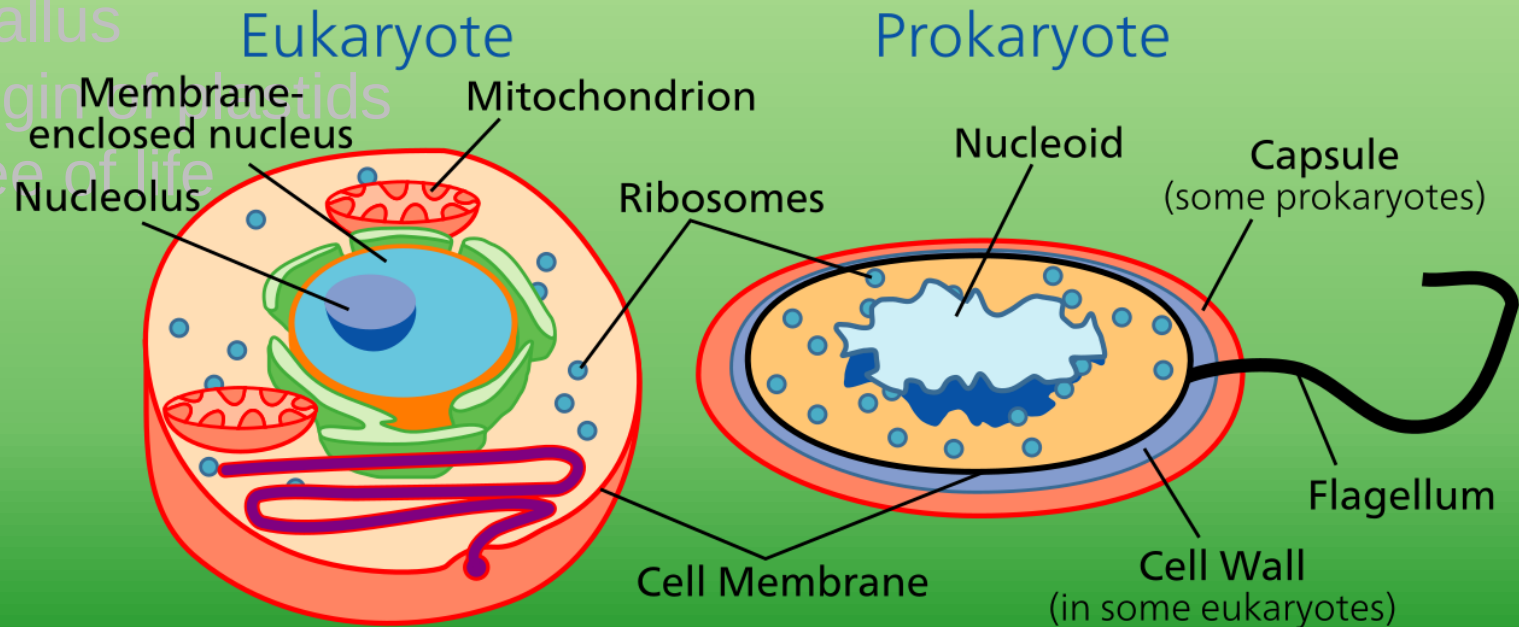


Before we start...

- Prokaryotic and eukaryotic cell
- Photosynthesis
- Life cycle
- Phylogenetic tree
- Thallus
- Origin of plastids
- Tree of life

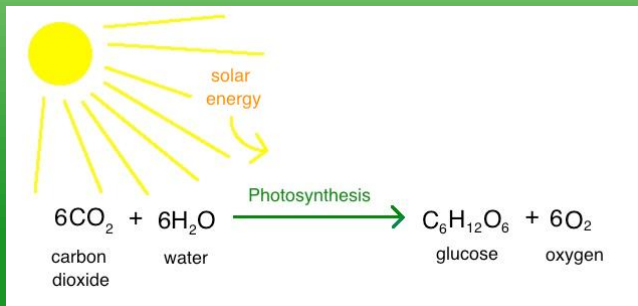
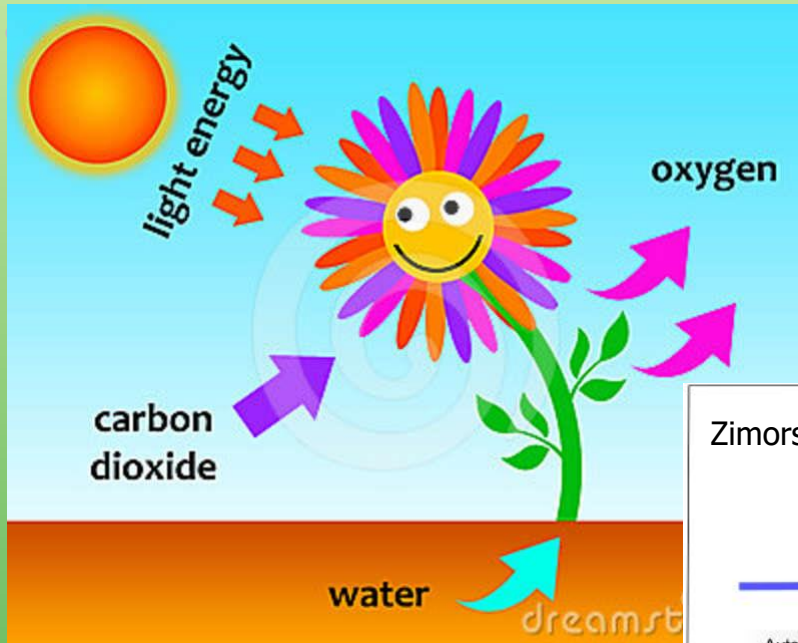
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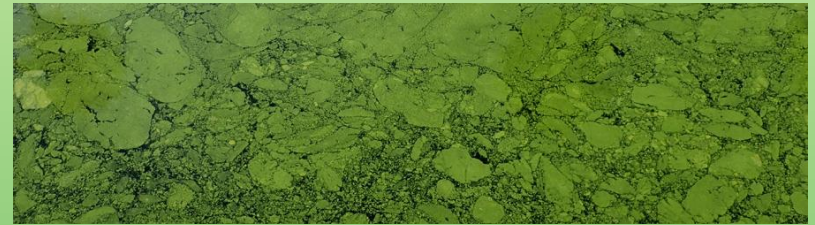
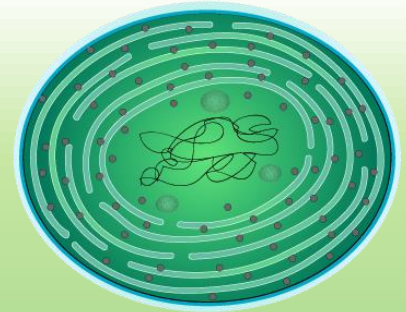


Before we start...

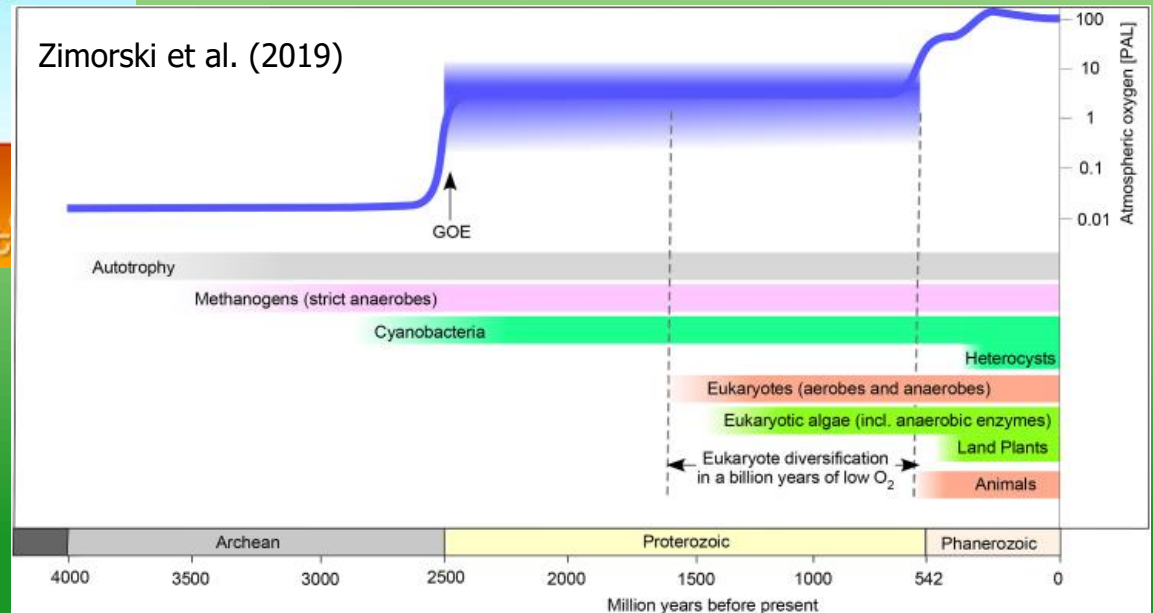
- Prokaryotic and eukaryotic cell
- Photosynthesis

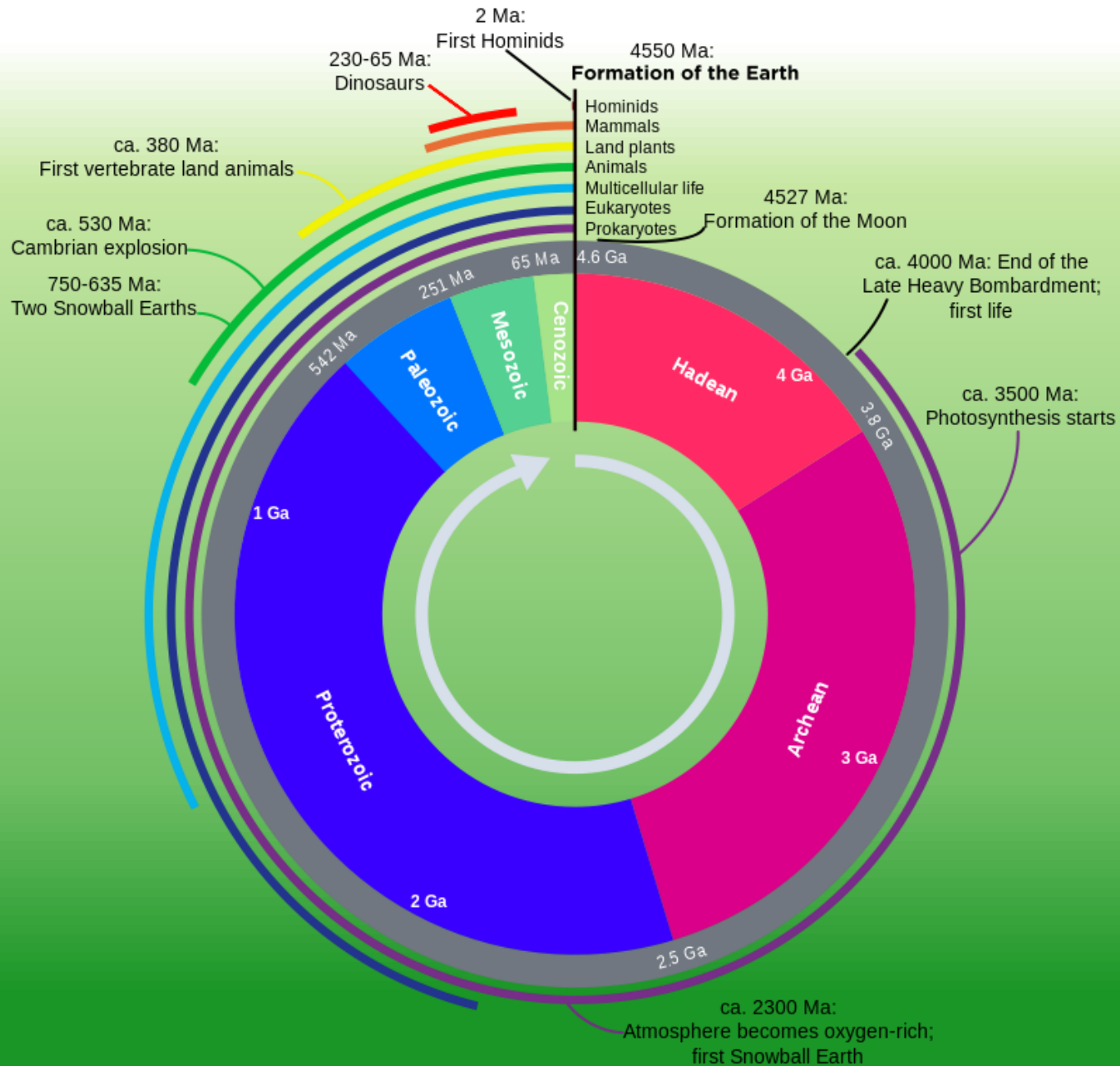


Cyanobacteria



Zimorski et al. (2019)

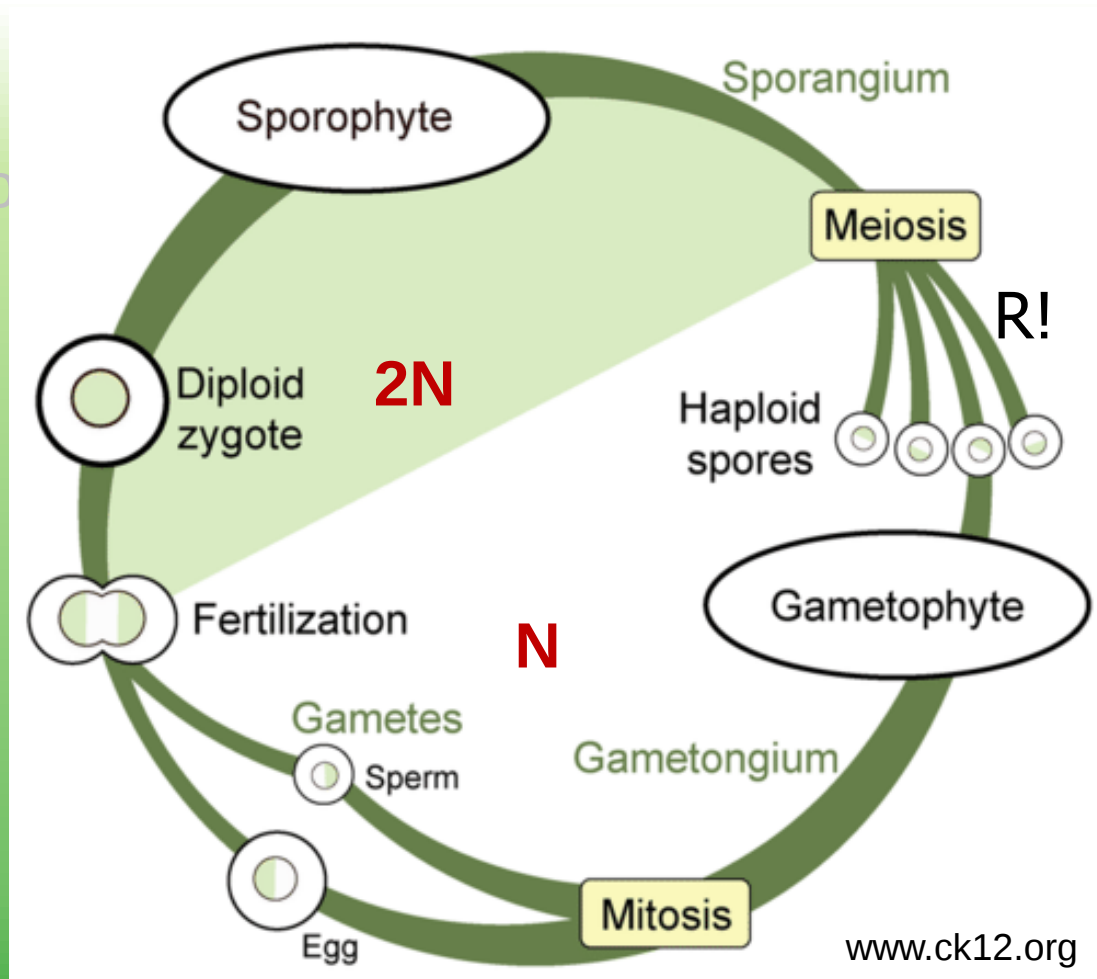
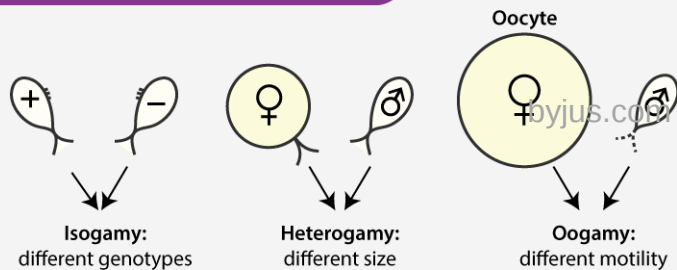




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THREE TYPES OF SYNGAMY



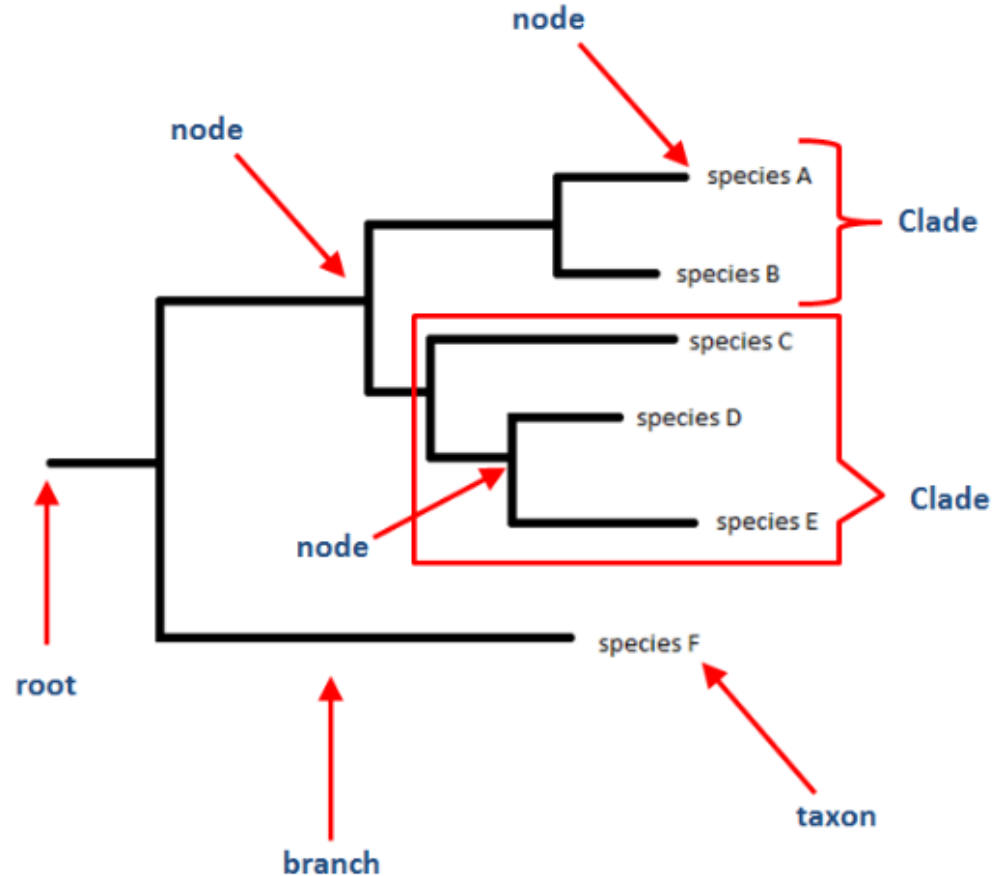
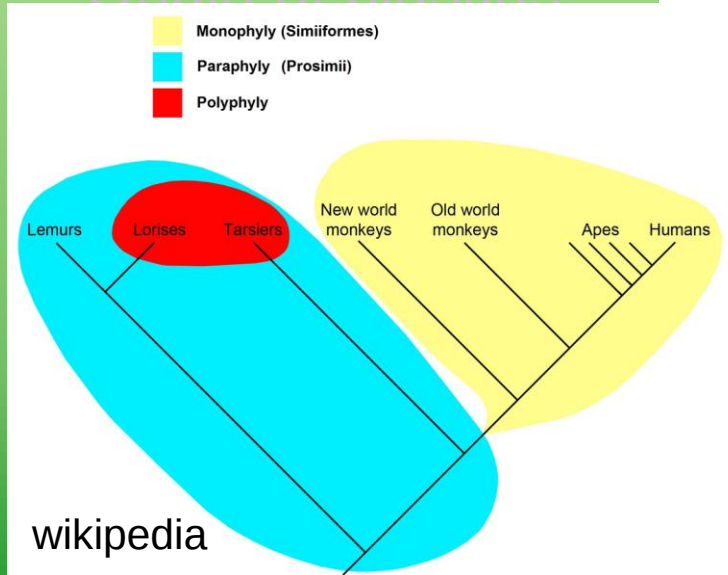
Haplontic: the only diploid stage is a zygote

Diplontic: the only haploid stage is a gamete

Haplo-diplontic: alternation of n and $2n$ stages

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Before we start...

- Prokaryotic and eukaryotic
- Photosynthesis
- Life cycle
- Phylogenetic tree
- **Thallus**
- Origin of plastids
- Tree of life



Need more images?

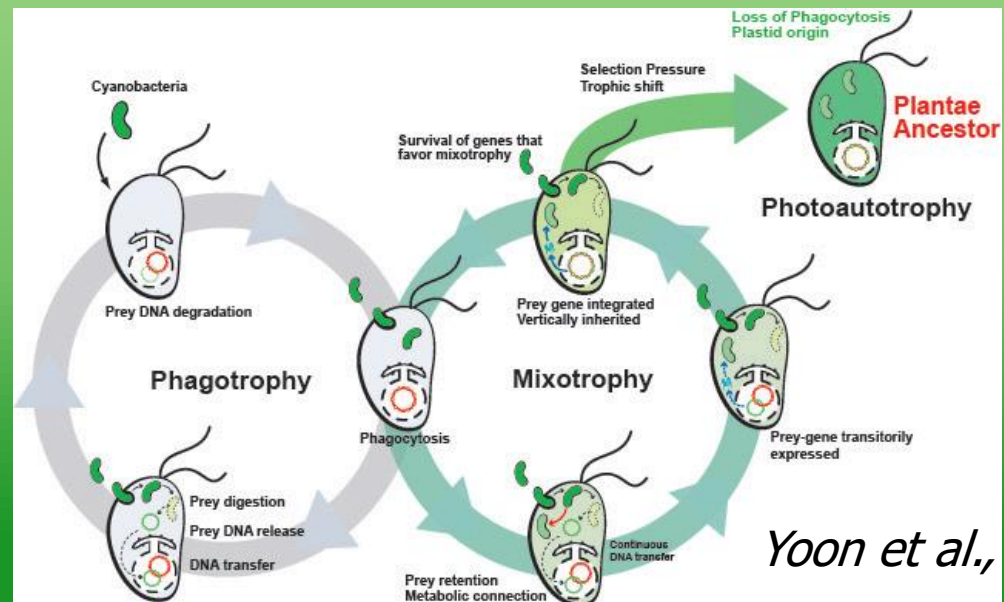
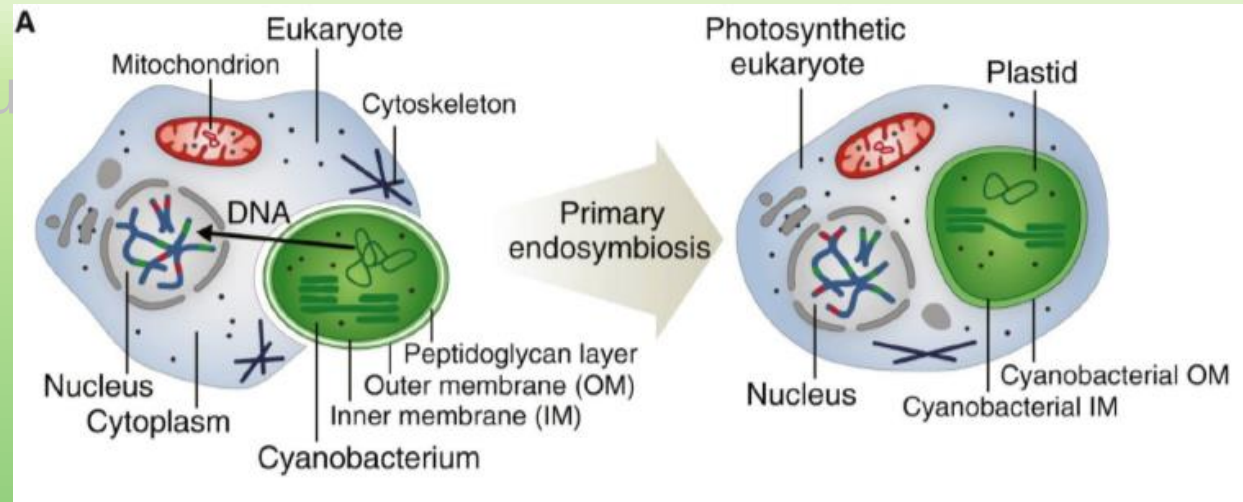
Request an icon!



Mind the
GRAPH

Before we start...

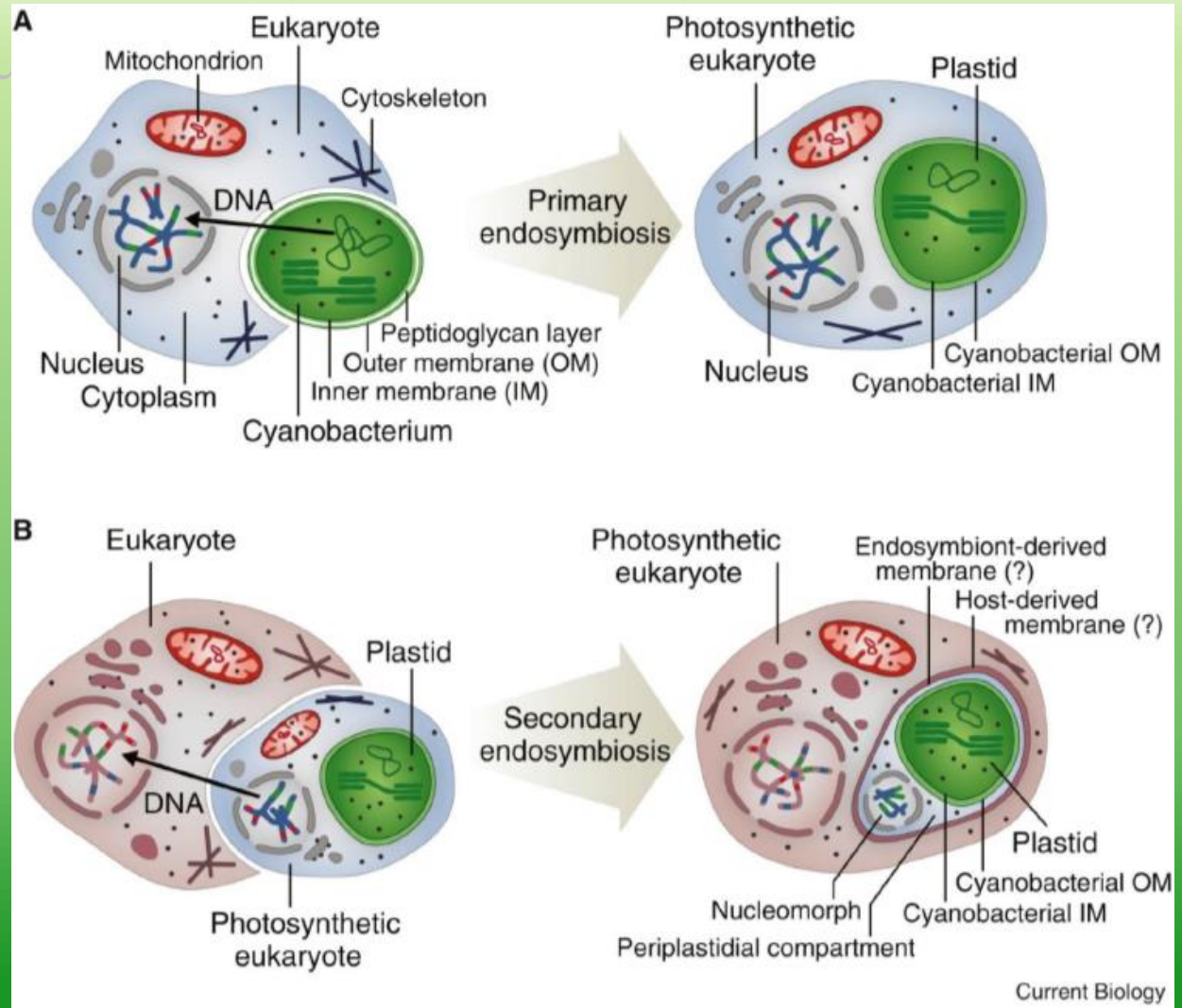
- Prokaryotic and eukaryotic cells
- Photosynthesis
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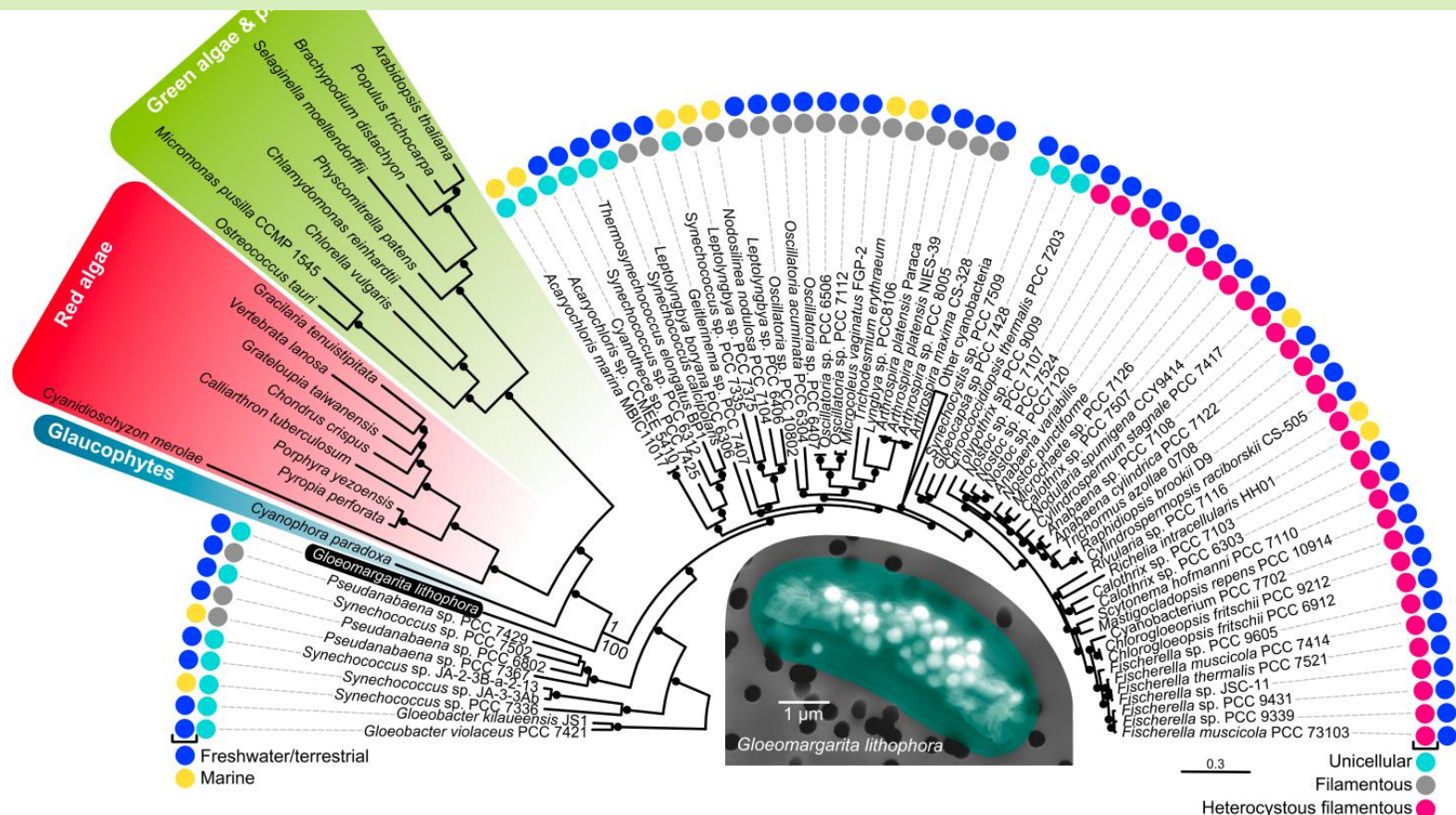
Yoon et al., 2006

Before we start...

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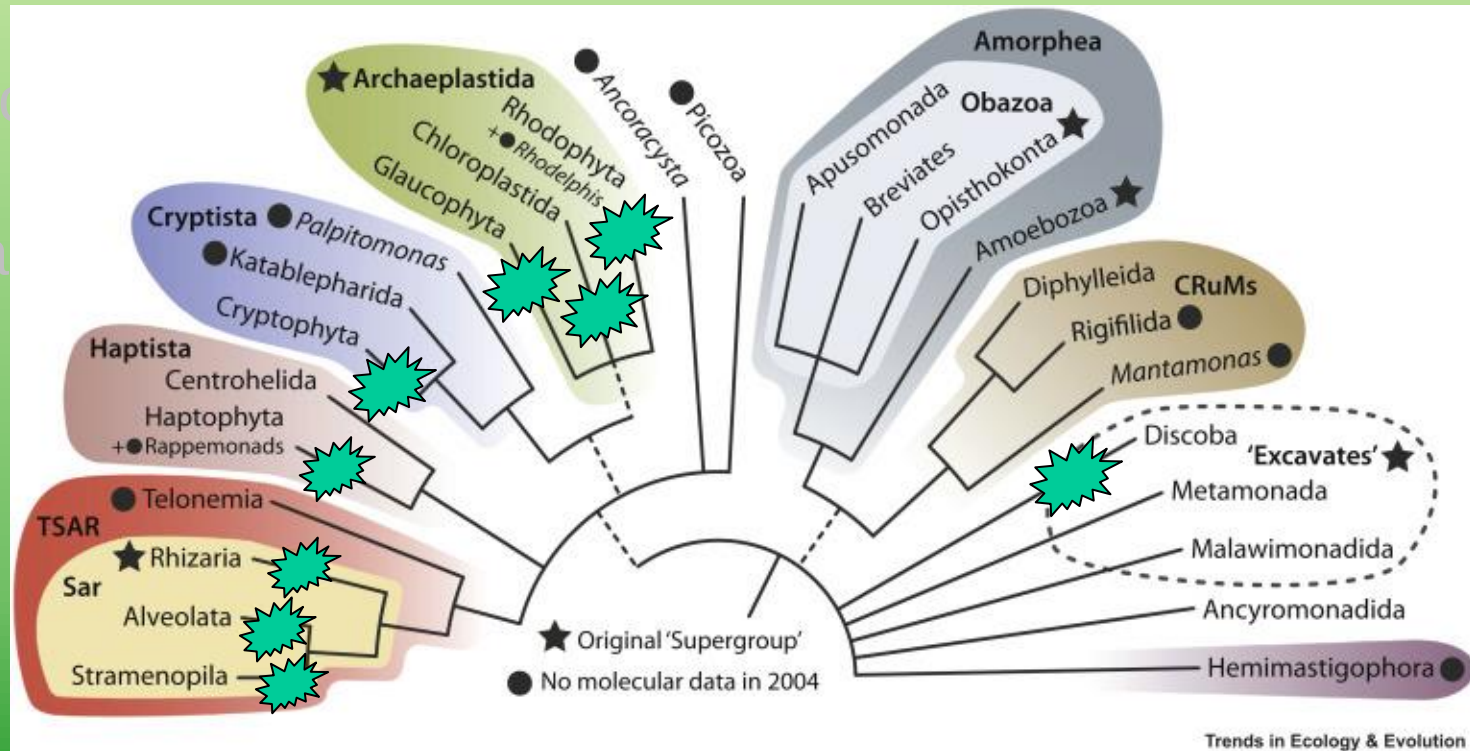
Gloeomargarita lithophora – freshwater origin of plastids?



Ponce-Toledo et al. (2017)

Before we start...

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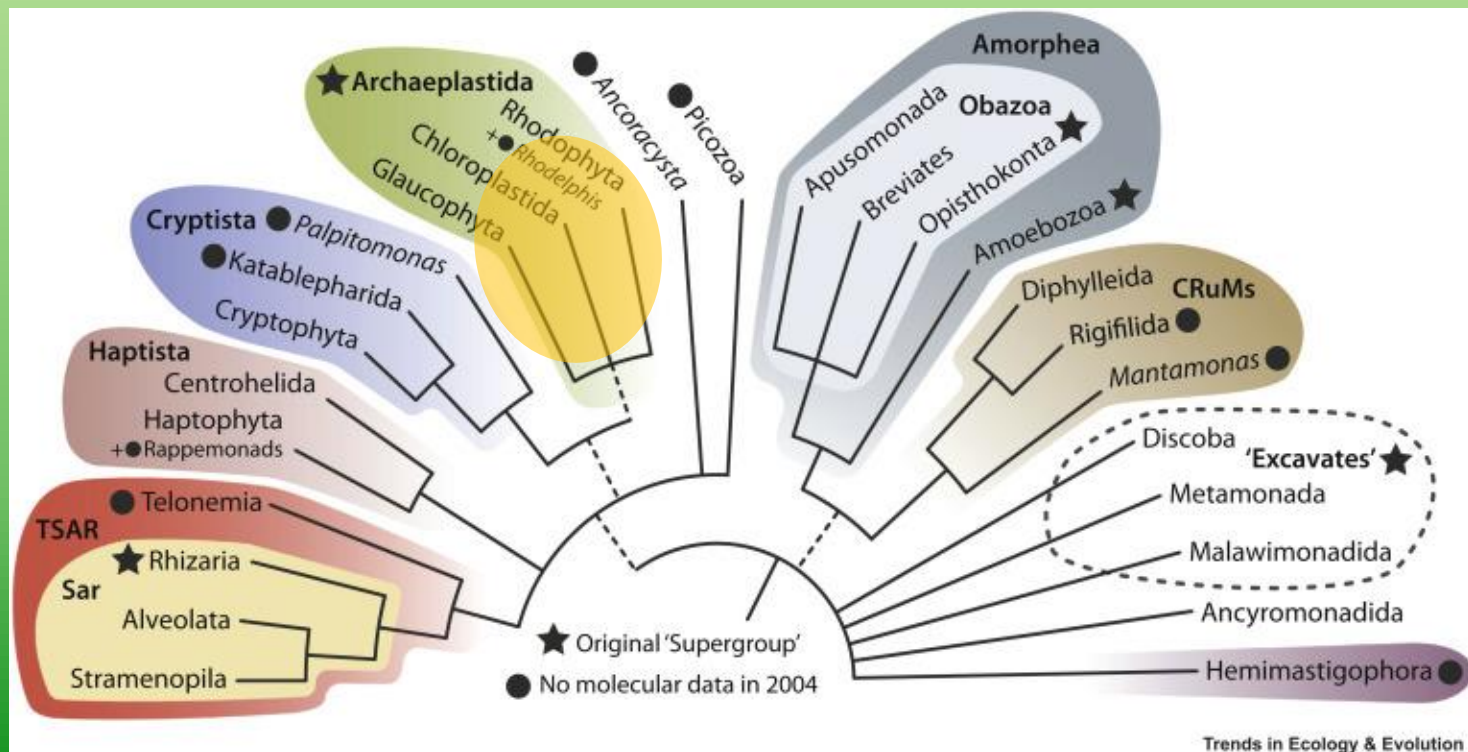
★ lineage with photosynthetic members

Burki et al. (2019)

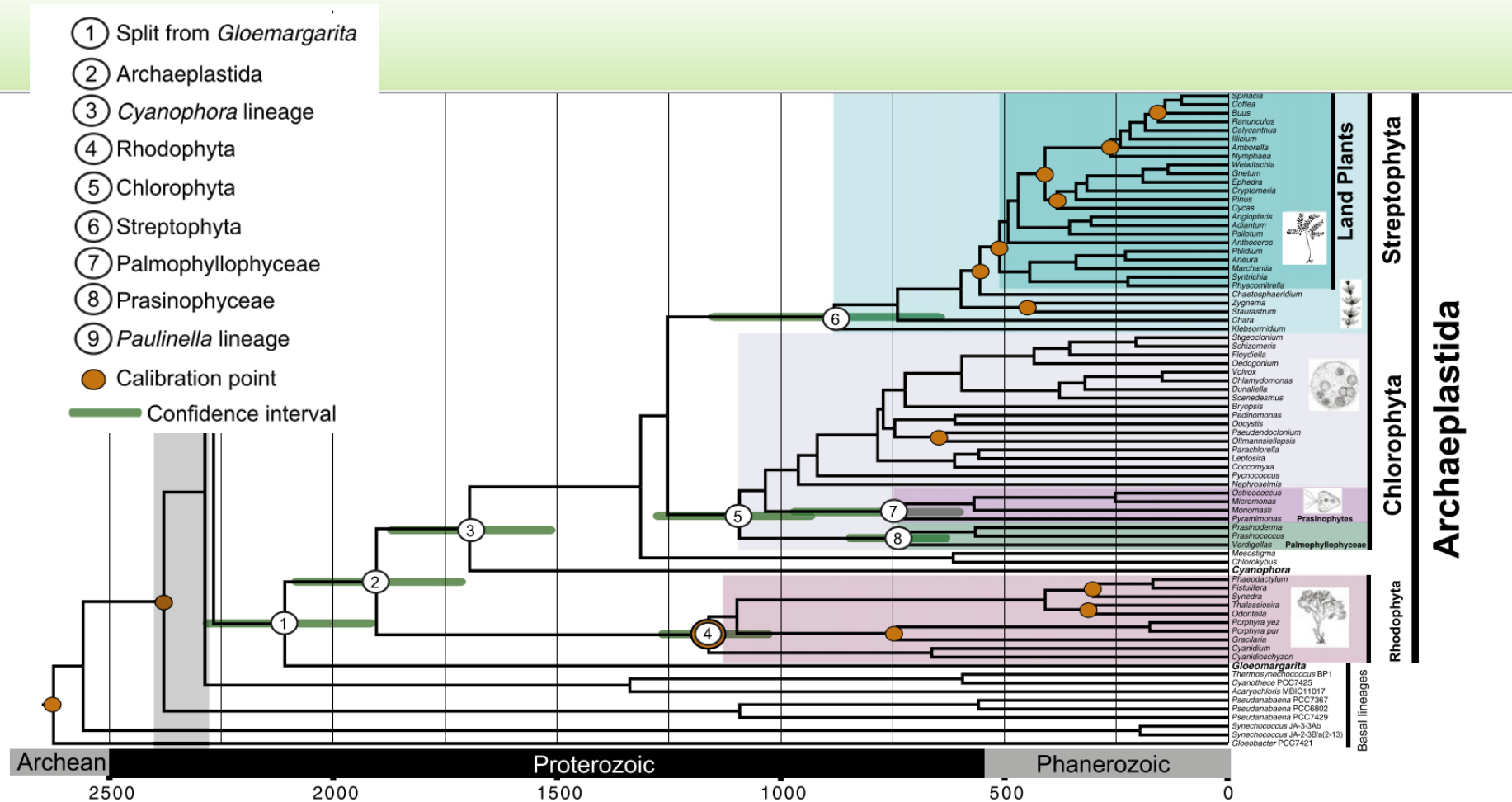
What are the plants?

Photosynthetic organisms with primary plastids, (mostly) with cell walls

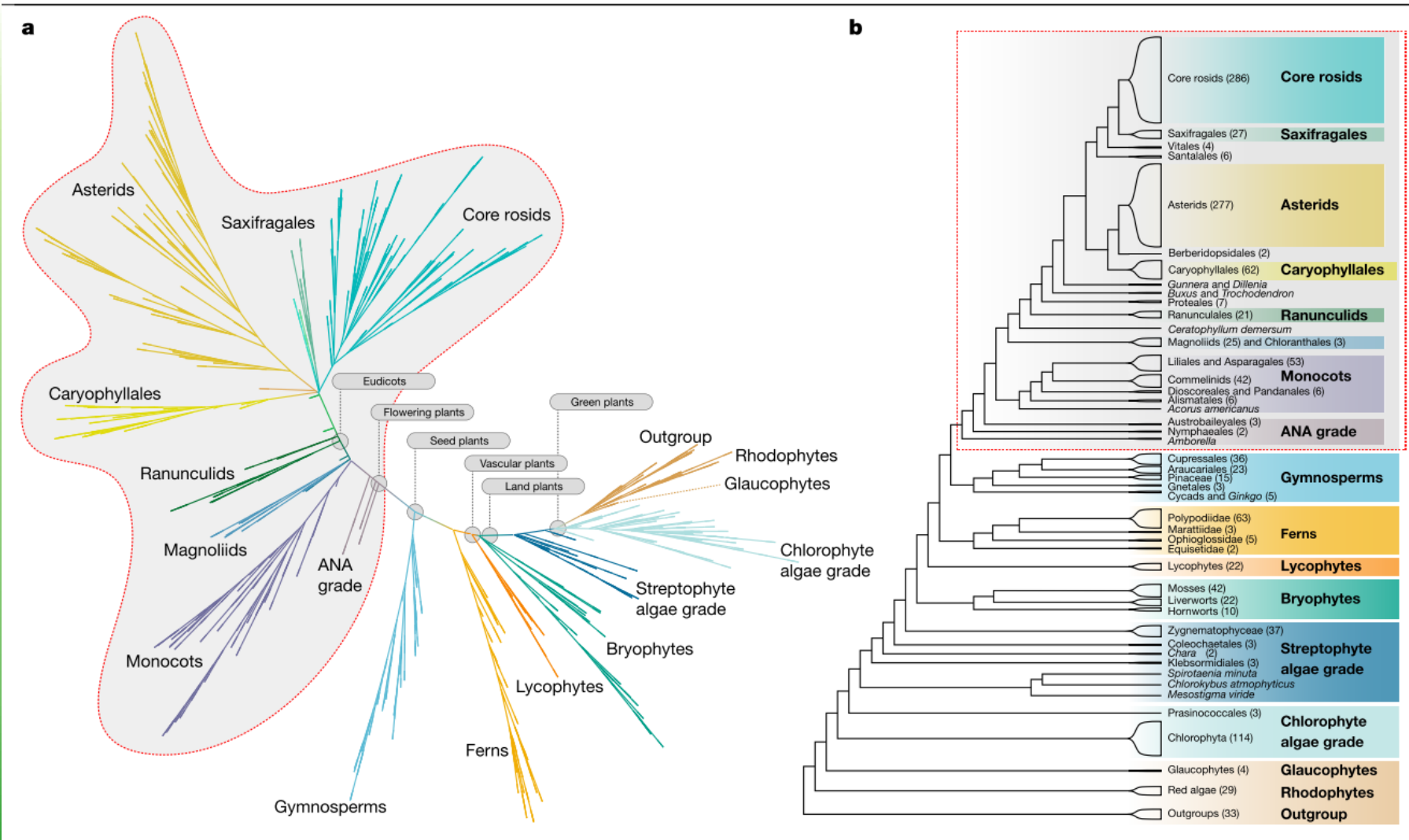
3 main lineages



Sánchez-Baracaldo et al. (2017)

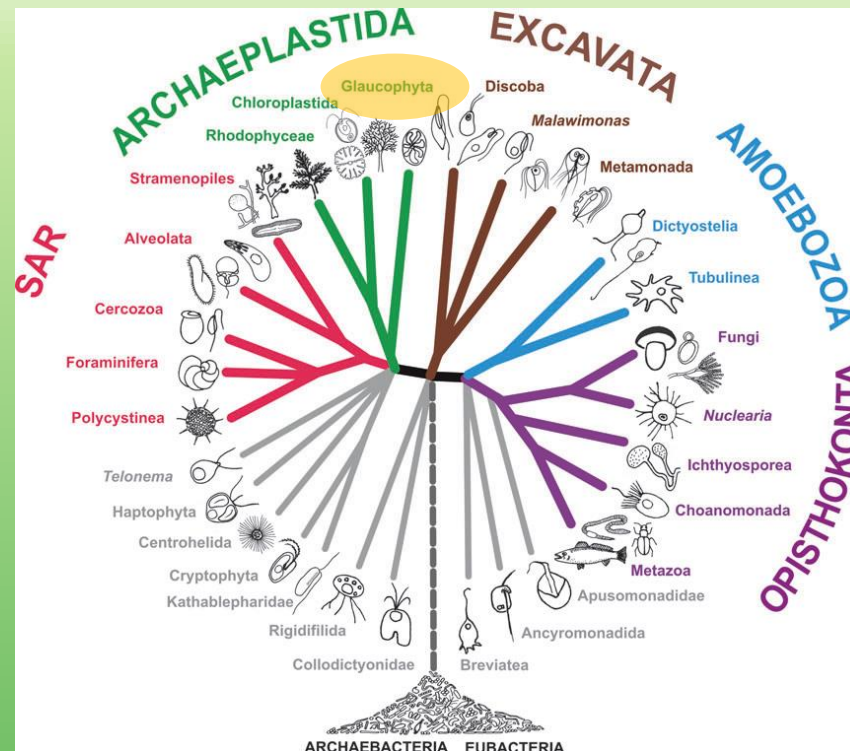


Evolution of Archaeplastida



Leebens-Mack et al. (2019)

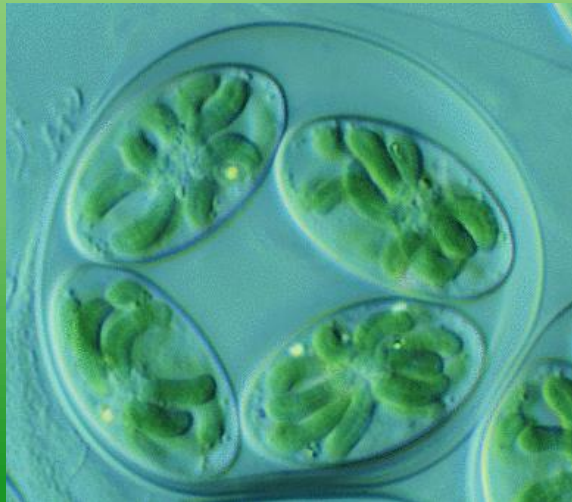
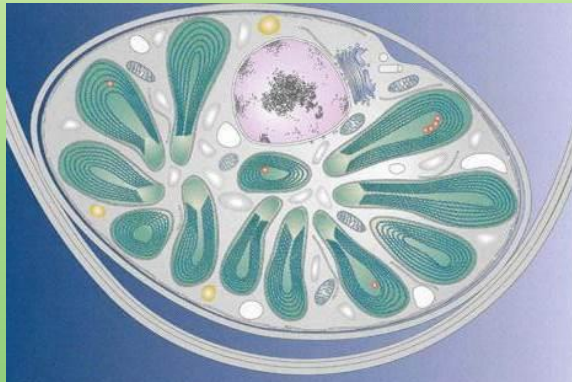
Glaucophyta



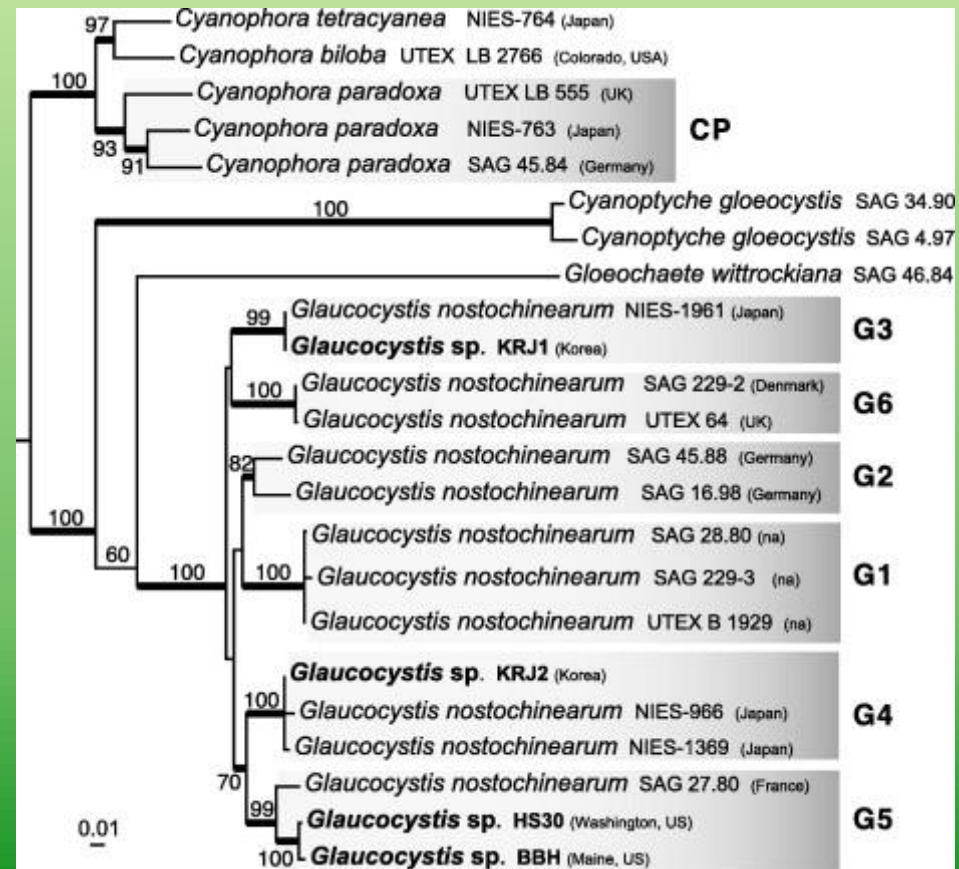
few species, freshwater, asexual, slow evolution, cyanelles with peptidoglycan wall, chlorophyll a, phycobilisomes, starch in cytoplasm

Glaucophyta

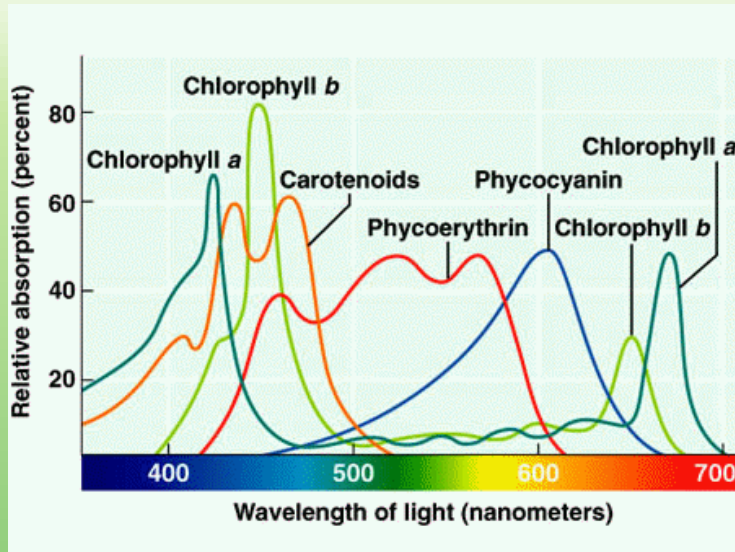
cyanelle (muroplast) with
peptidoglycan layer



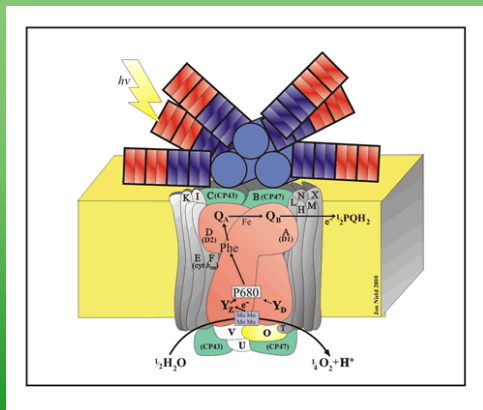
cryptic diversity (Chang et al. 2014)



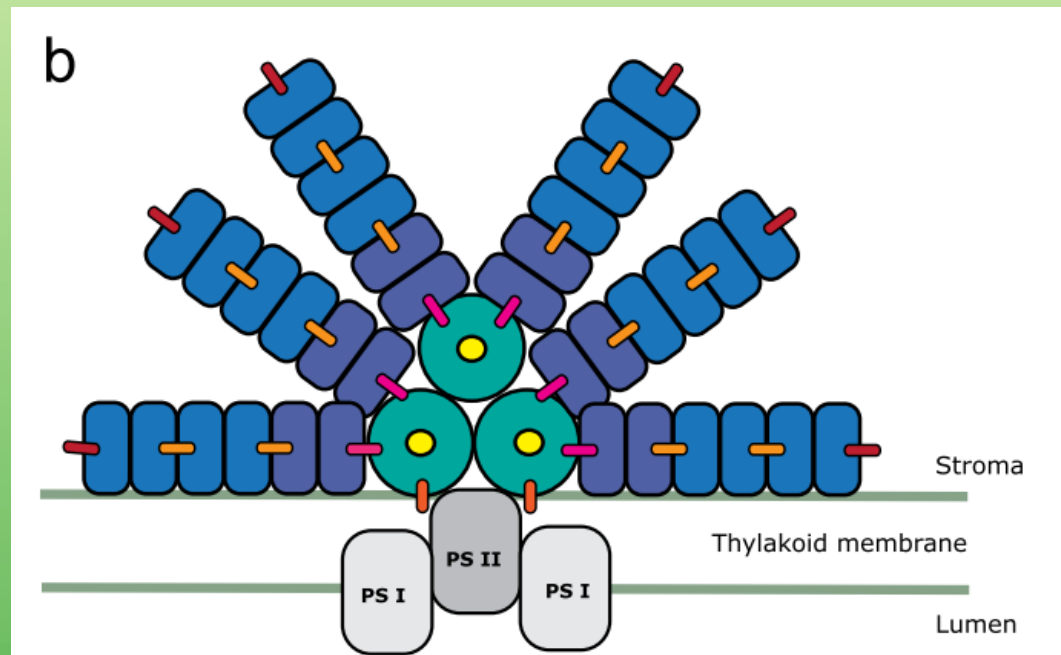
Glaucophyta



photosynthetic pigments

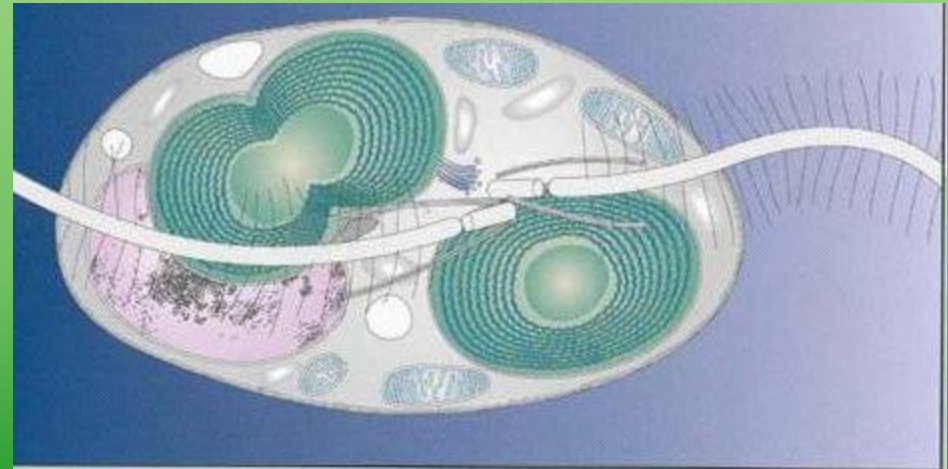
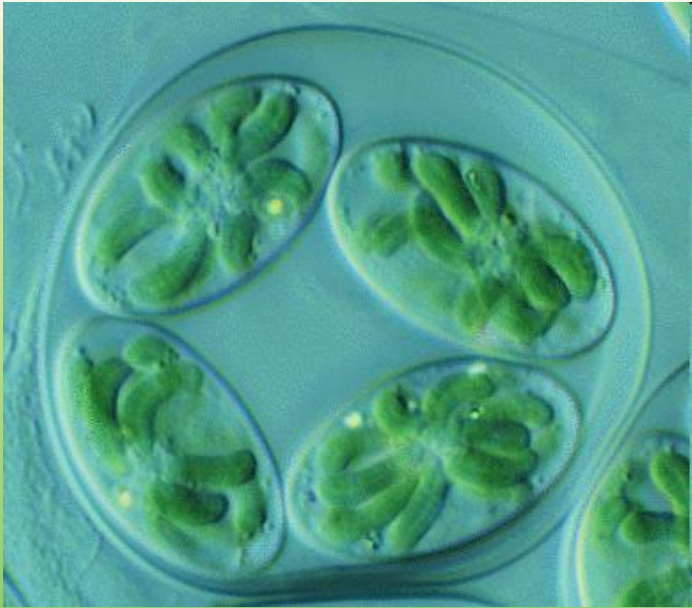


Cyanobacterial phycobilisome



Jackson et al. (2015)

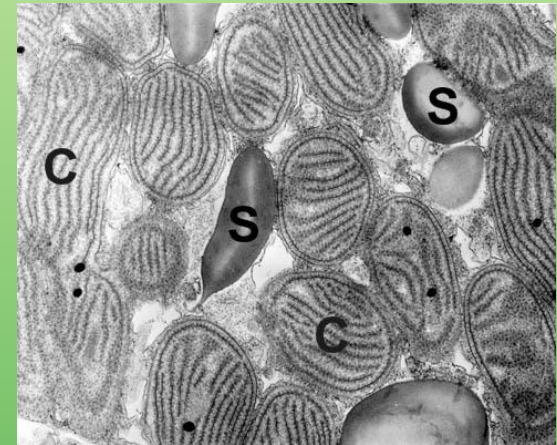
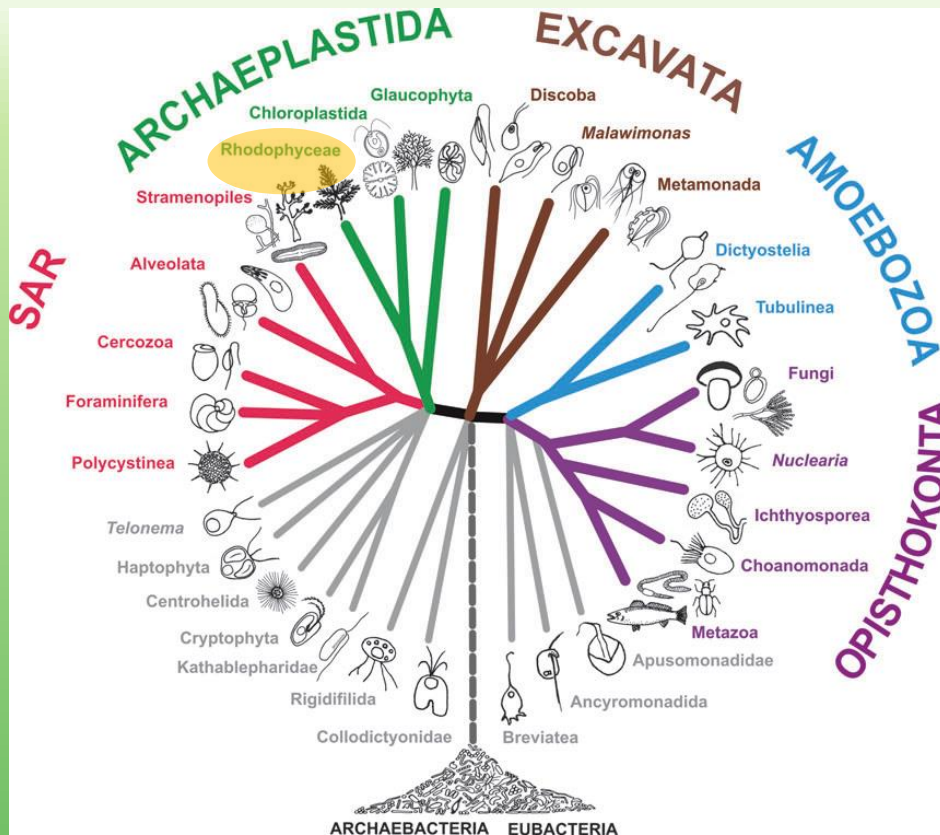
Glaucophyta



Glaucocystis nostochinearum

Cyanophora paradoxa

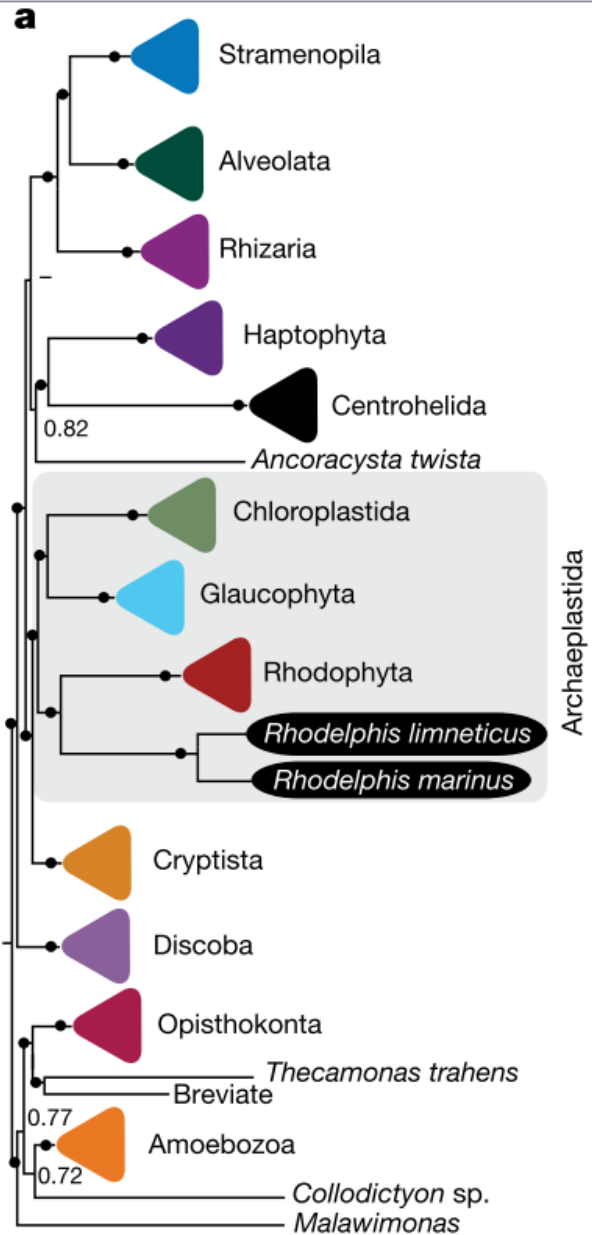
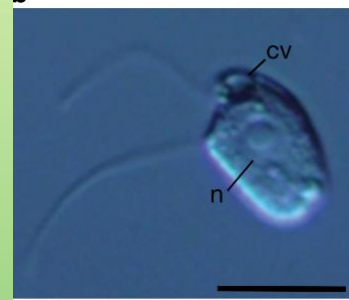
Rhodophyta



more than 6000 species, mostly marine, no flagellate stages, complex life cycles, oogamy, chlorophyll *a*, phycobilisomes, starch in cytoplasm

Rhodophyta

Rhodelphis

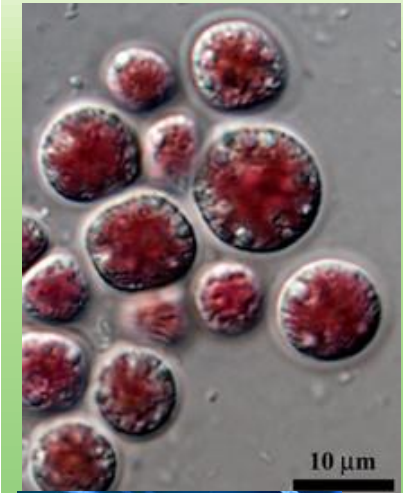


Gawryluk et al. (2019)

Phylum RHODOPHYTA

(Class)

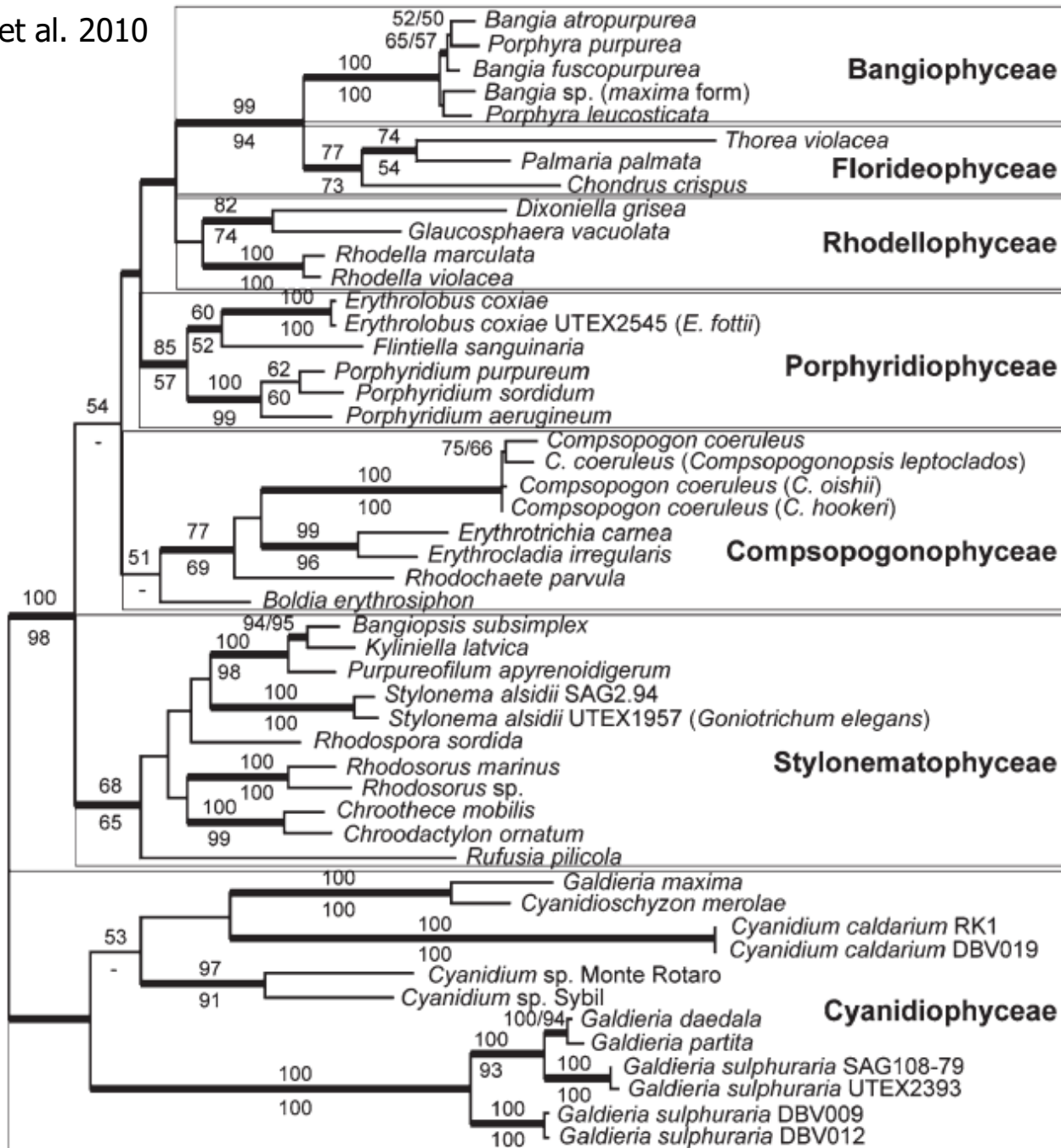
(Subphylum)



RHODOPHYTINA

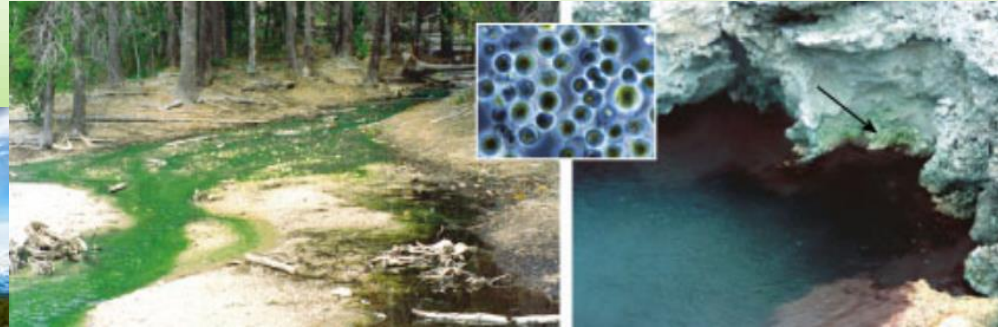
CYANIDIOPHYTINA

Yoon et al. 2010

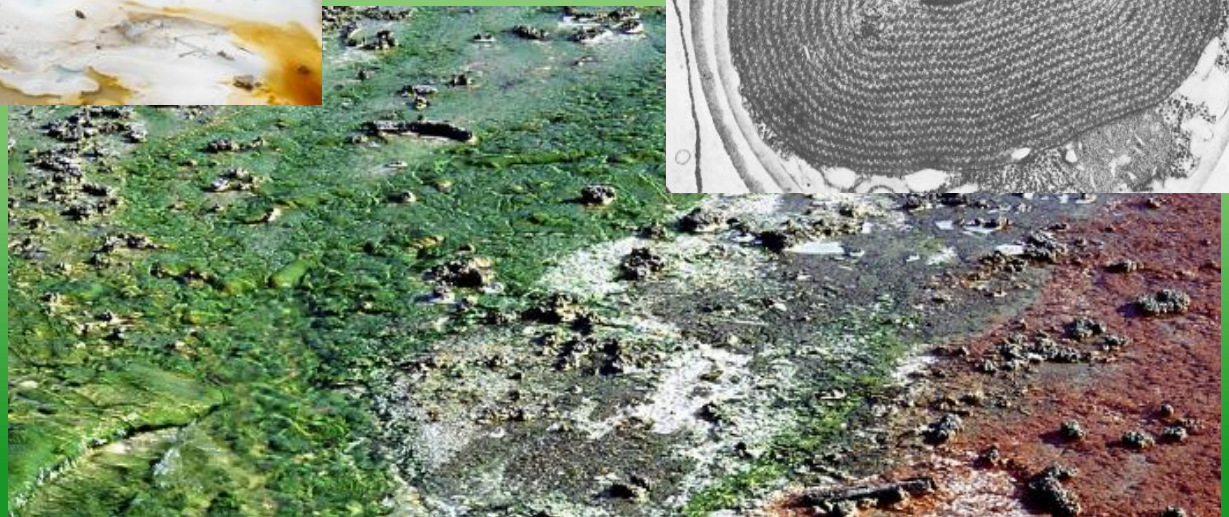
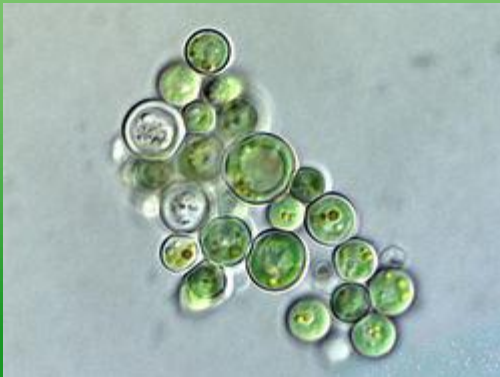
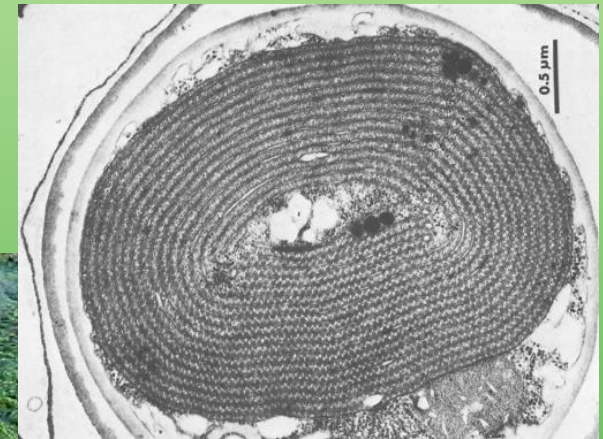


Rhodophyta - Cyanidiophyceae

Cyanidium caldarium

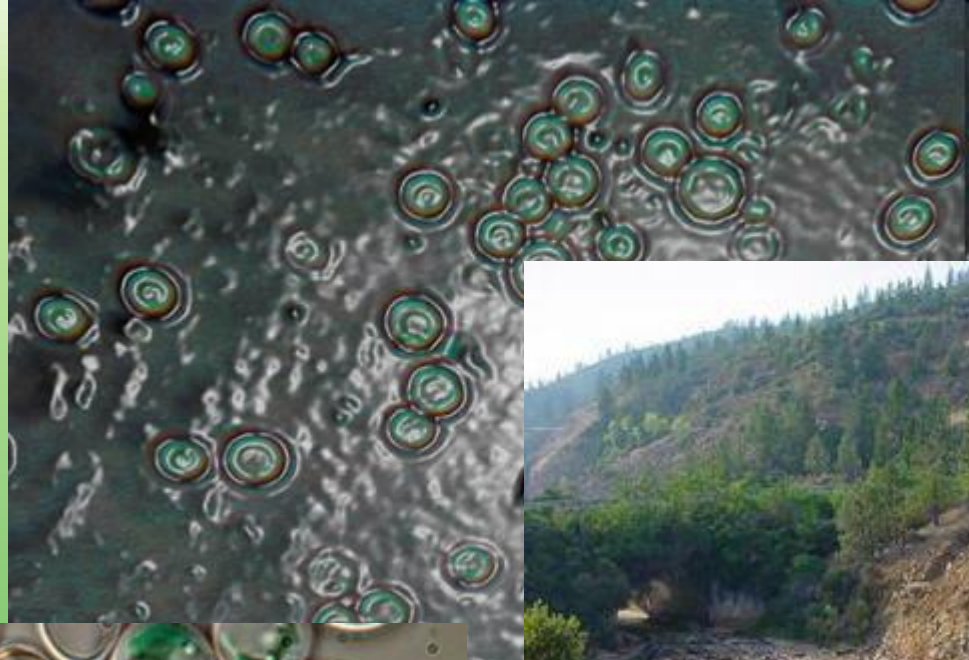
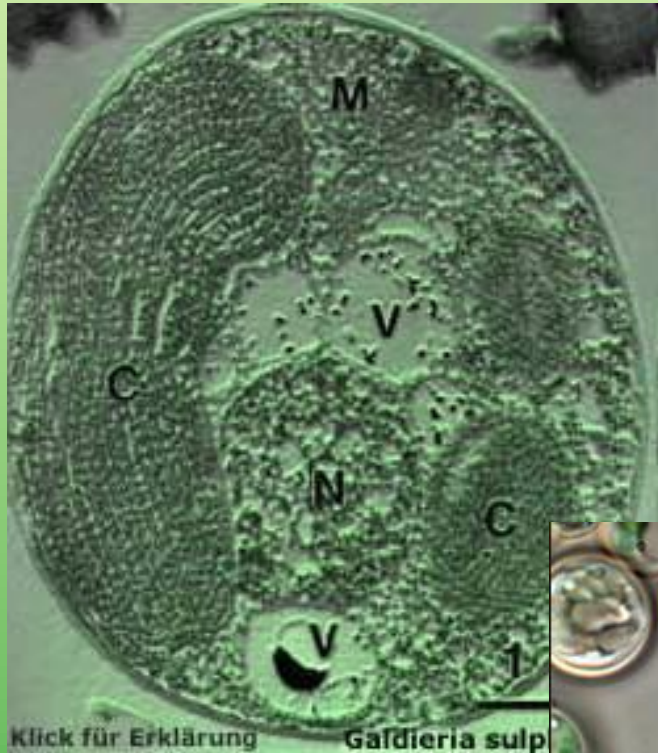


Yellowstone



Rhodophyta - Cyanidiophytina

Galdieria



Extreme habitats
pH 0.8 - 1, temperature up to 56°C

acidic thermal springs in Naples

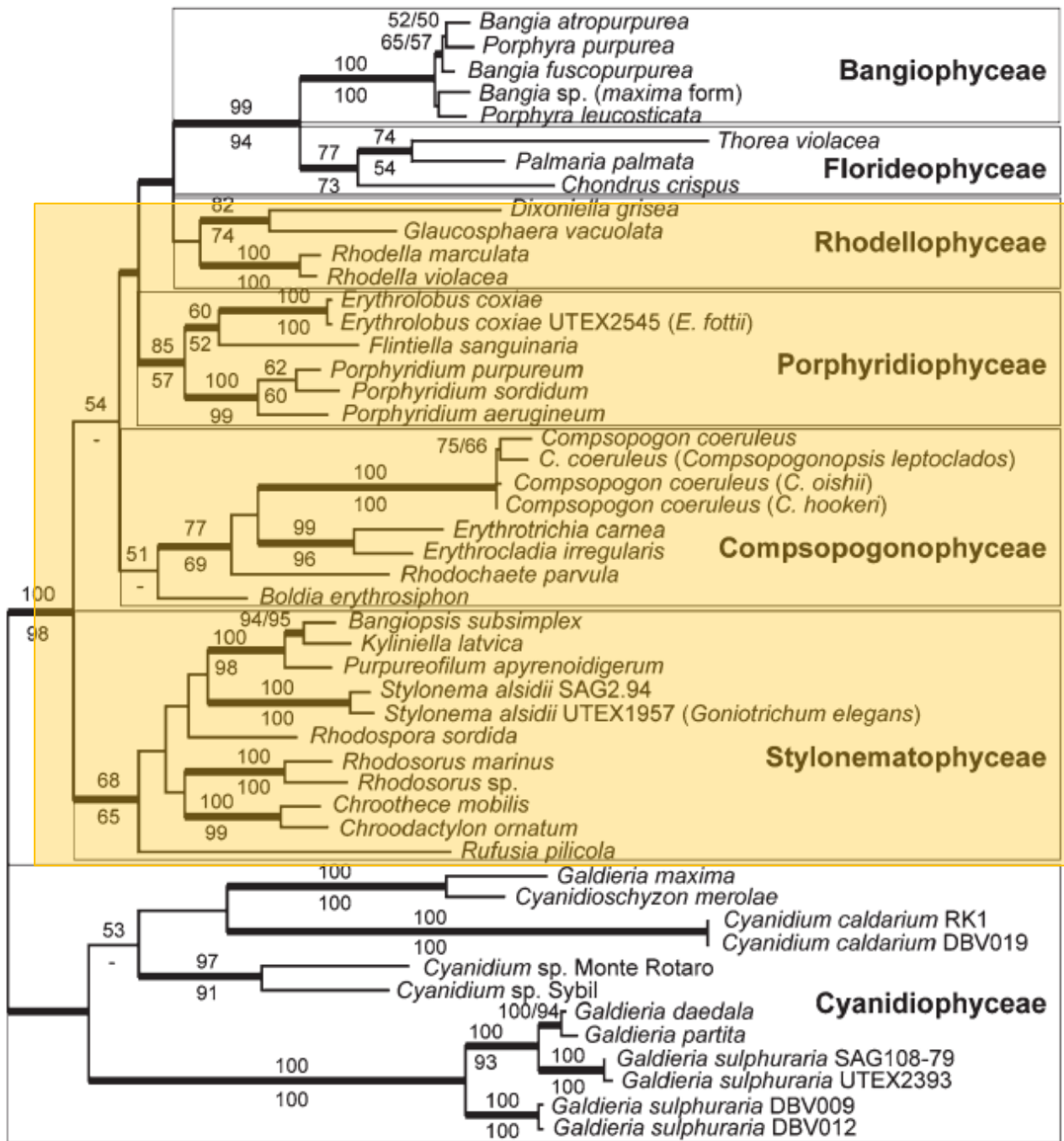
Phylum RHODOPHYTA

(Class)

(Subphylum)

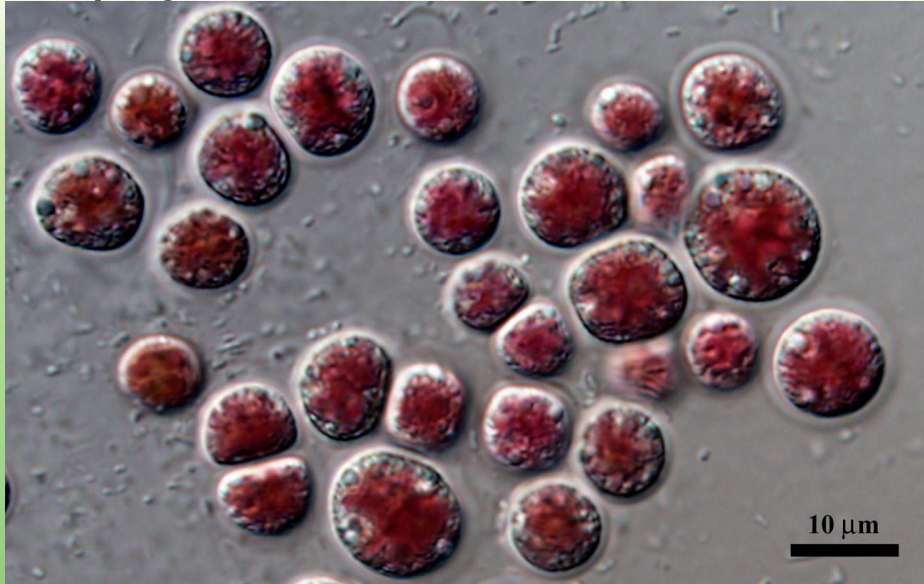
RHODOPHYTINA

CYANIDIOPHYTINA



Rhodophyta

Porphyridium



PUFAs

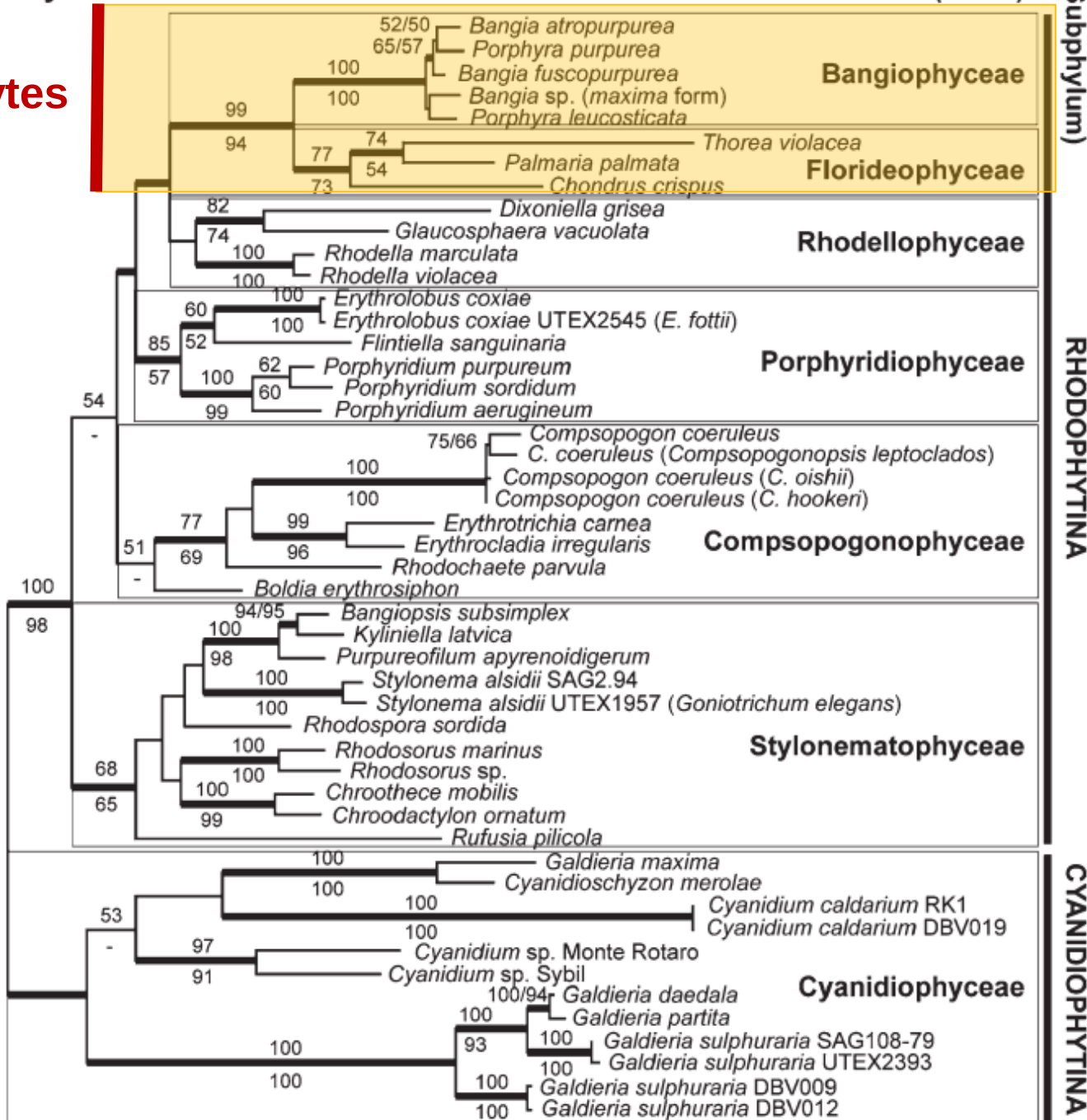
Compsopogon



core
rhodophytes

Phylum RHODOPHYTA

(Class)



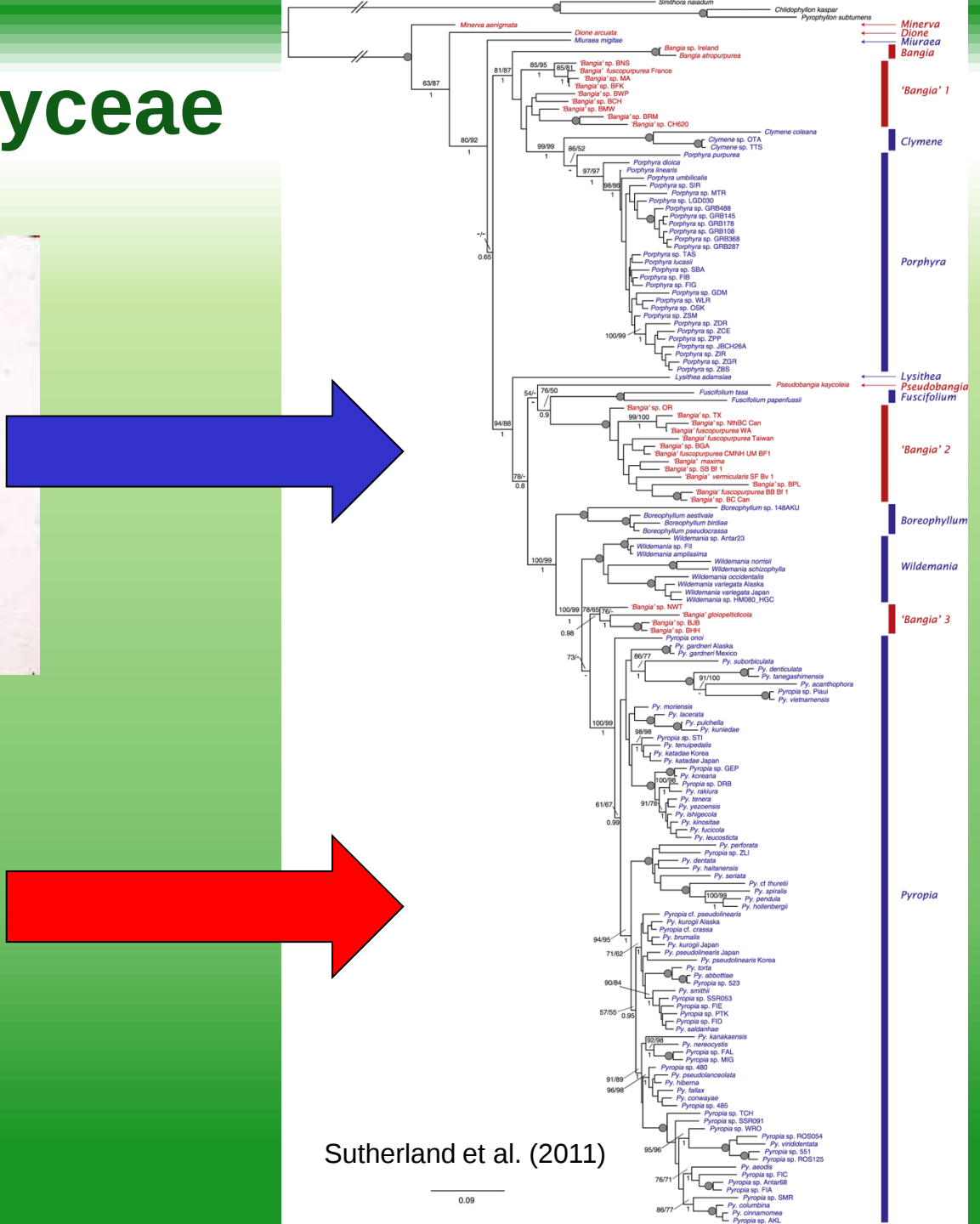
RHODOPHYTINA

CYANIDIOPHYTINA

Bangiophyceae



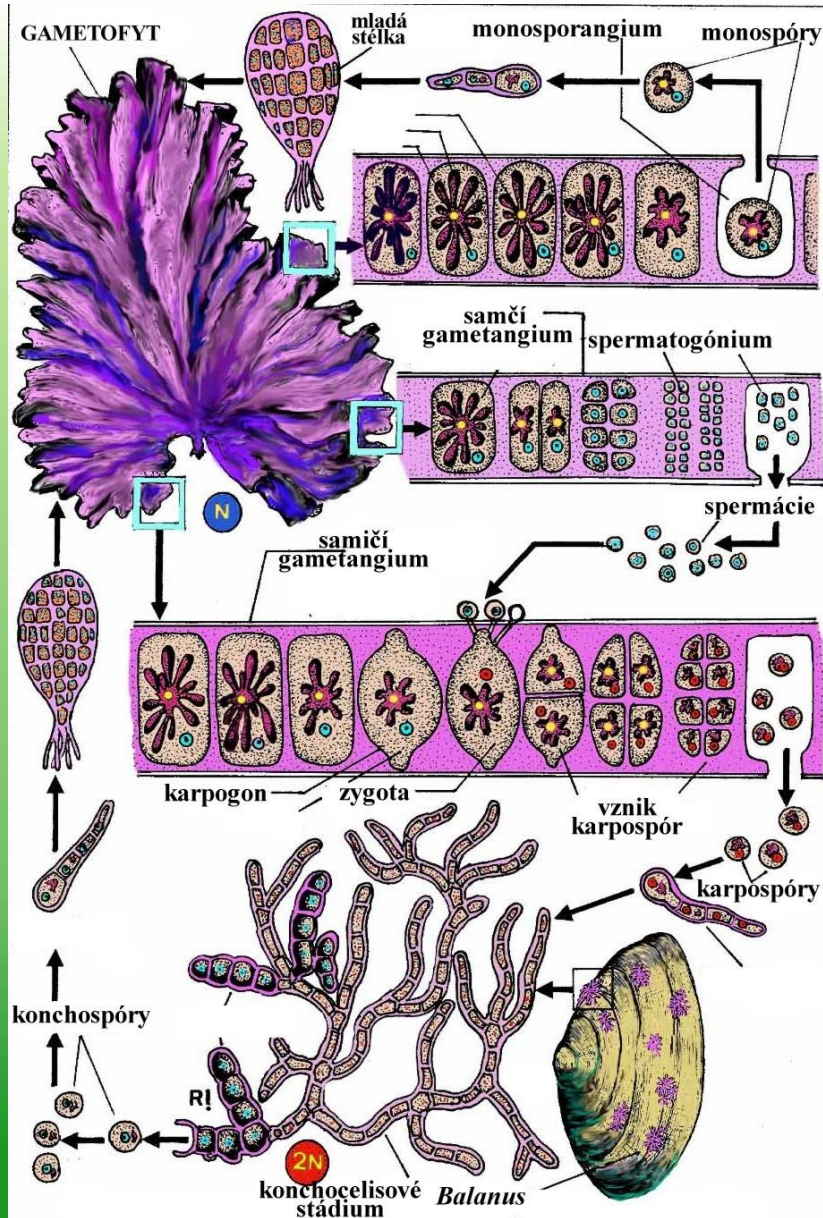
“Bangia”



Sutherland et al. (2011)

Porphyra – “Nori”

Bangiophyceae



Diploid “conchocoelis” stage on bivalves

Bangiophyceae



Harvest of *Porphyra* in mariculture

Kumamoto Prefecture, Uto City

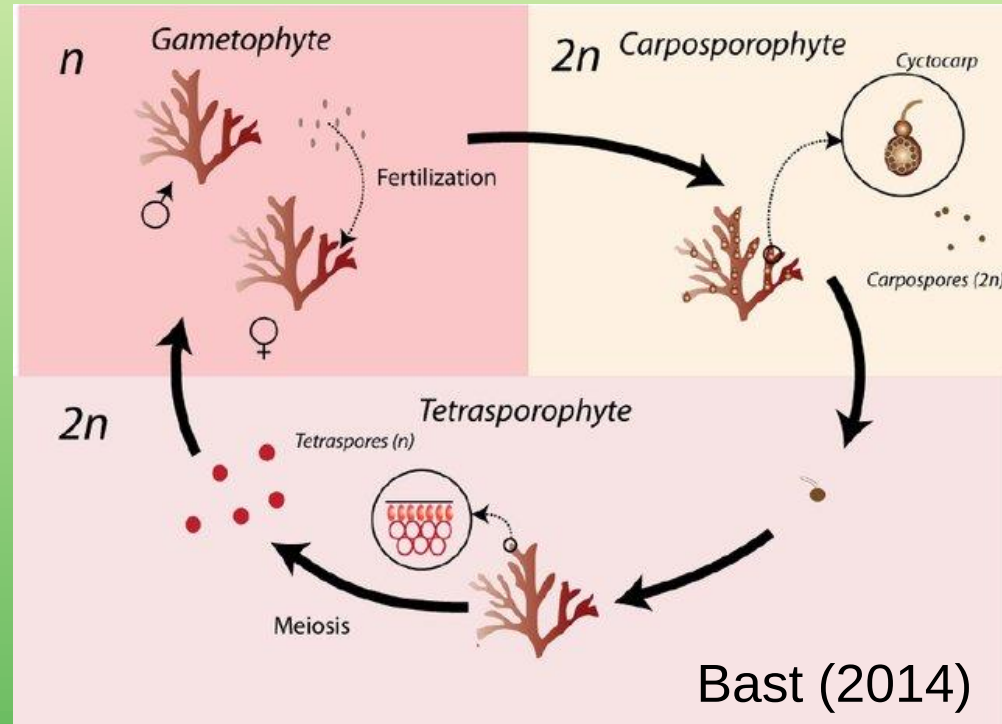
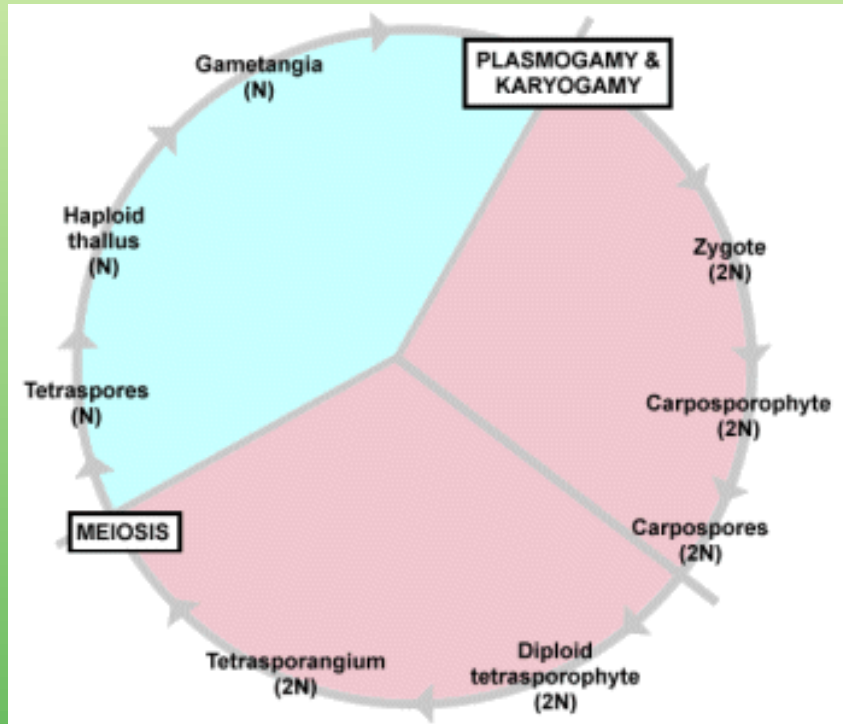


Dr. Kathleen Drew-Baker
(1901-1957)



Florideophyceae

triphasic life cycle



Florideophyceae

Hildenbrandia

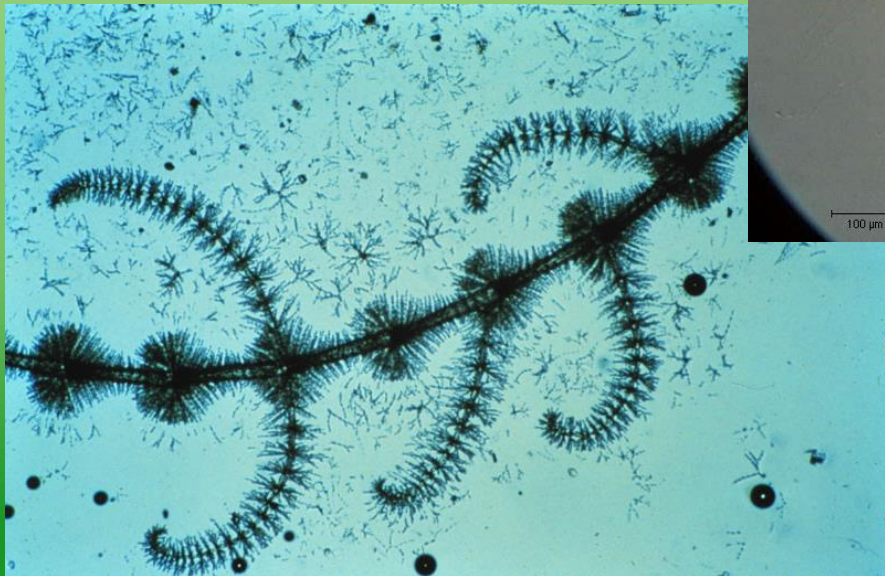
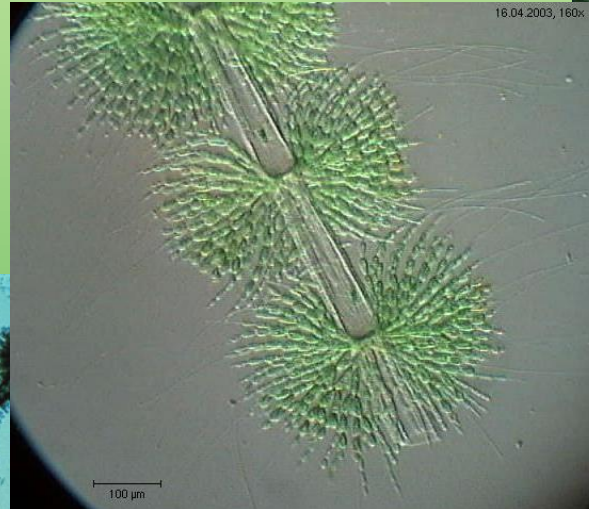
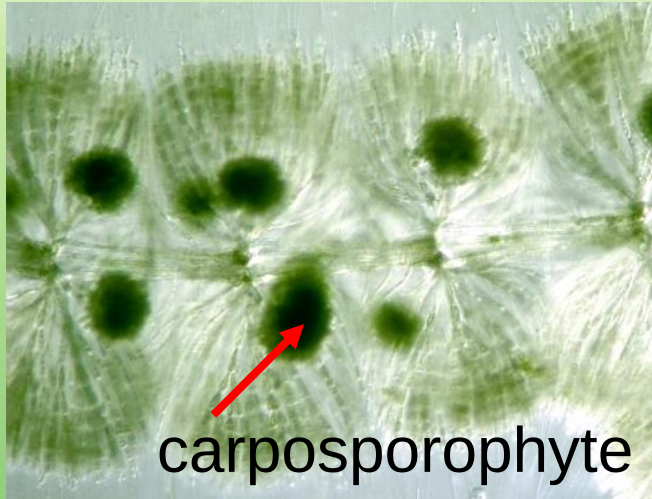


Freshwater, indicators of oligotrophy



Florideophyceae

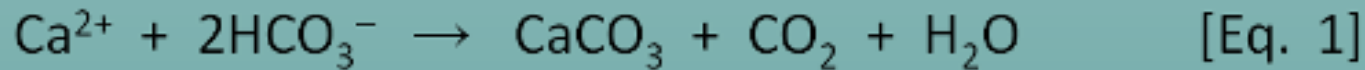
Batrachospermum



Florideophyceae

Corallinales – „coralline rhodophytes”

CALCIFICATION:



calcium ion + 2 bicarbonate ions = calcium carbonate + carbon dioxide + water



Rhodoliths



Corallina beach Hawaii



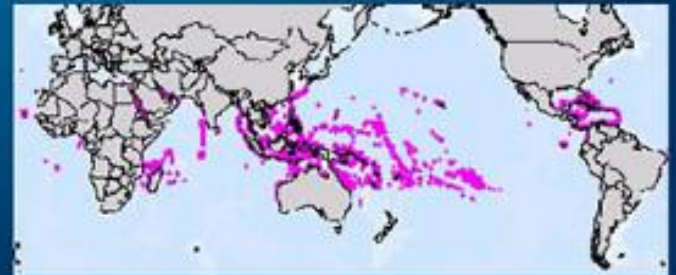
Coral reef composition

- corals with *Symbiodinium*
- corallina type rhodophytes, primary producer
- fish

Climax ecosystem, vulnerable to disturbances (e.g. eutrophication)



Global distribution of coral reefs



Corallines:

**Geniculate
(articulated)**

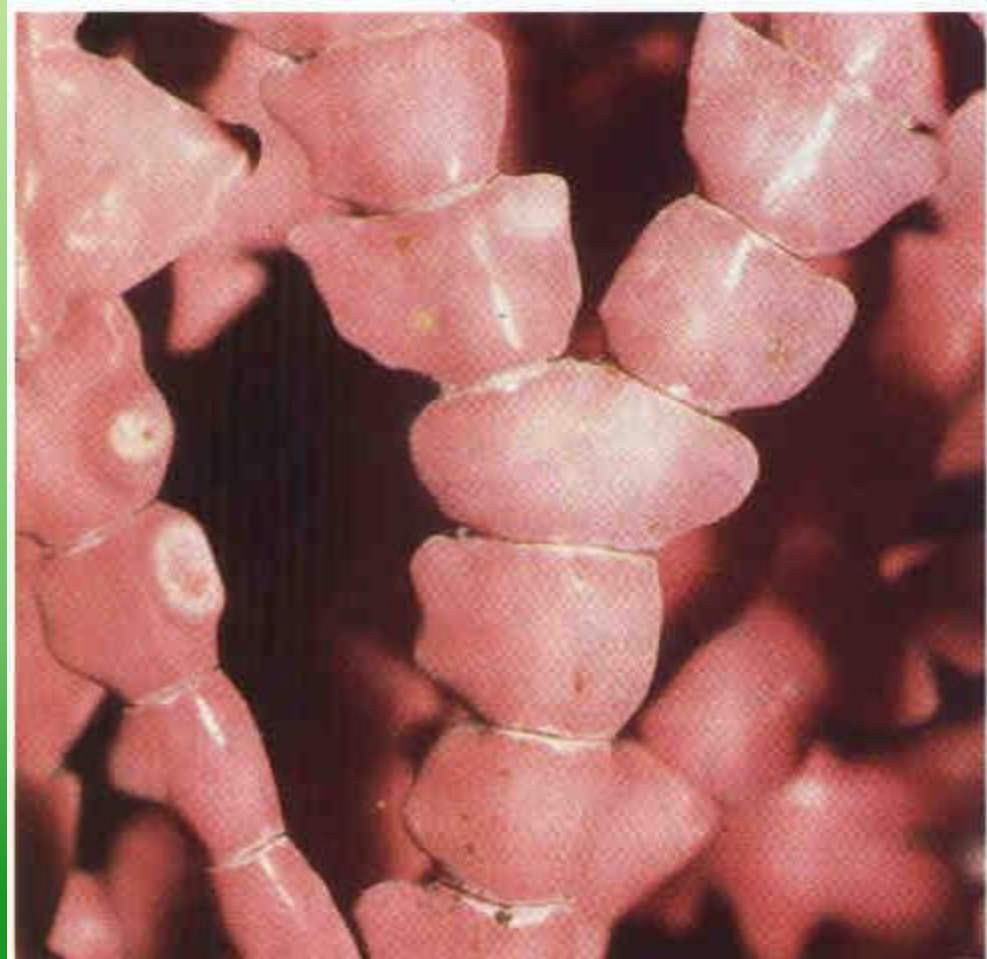


**Non-geniculate
(crustose)**



Corallina

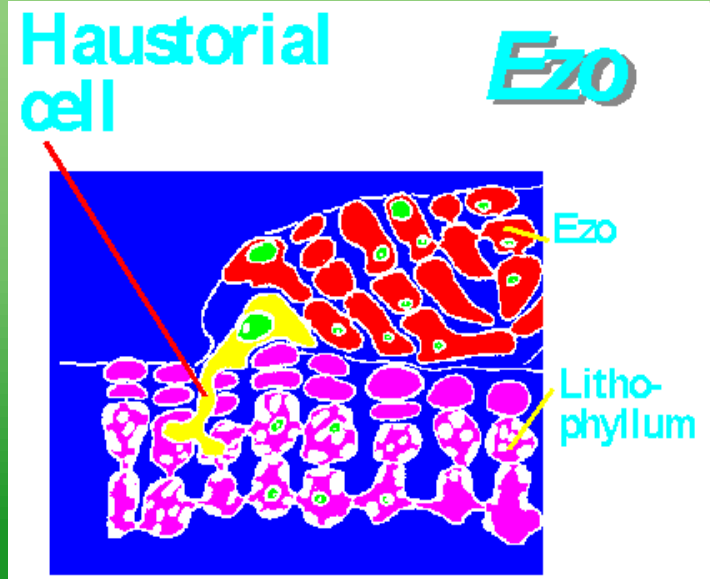
subtropical and tropical



Lithophyllum



Hydrolithon

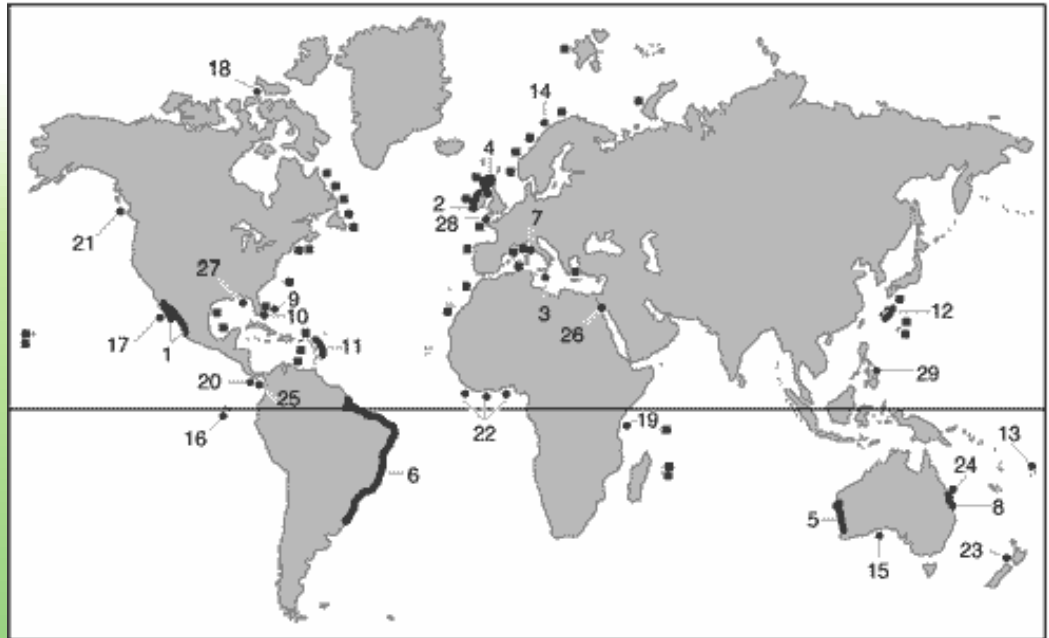


Ezo

rhodolith beds (maërl)



Phymatolithon
Lithothamnion



Florideophyceae

Gracilaria



Gelidium sesquipedale (Fot. A. Santolaria)



Gelidium



Chondrus



Agar, agarose, carrageenan

