Chlorophyta

Prasinophyta

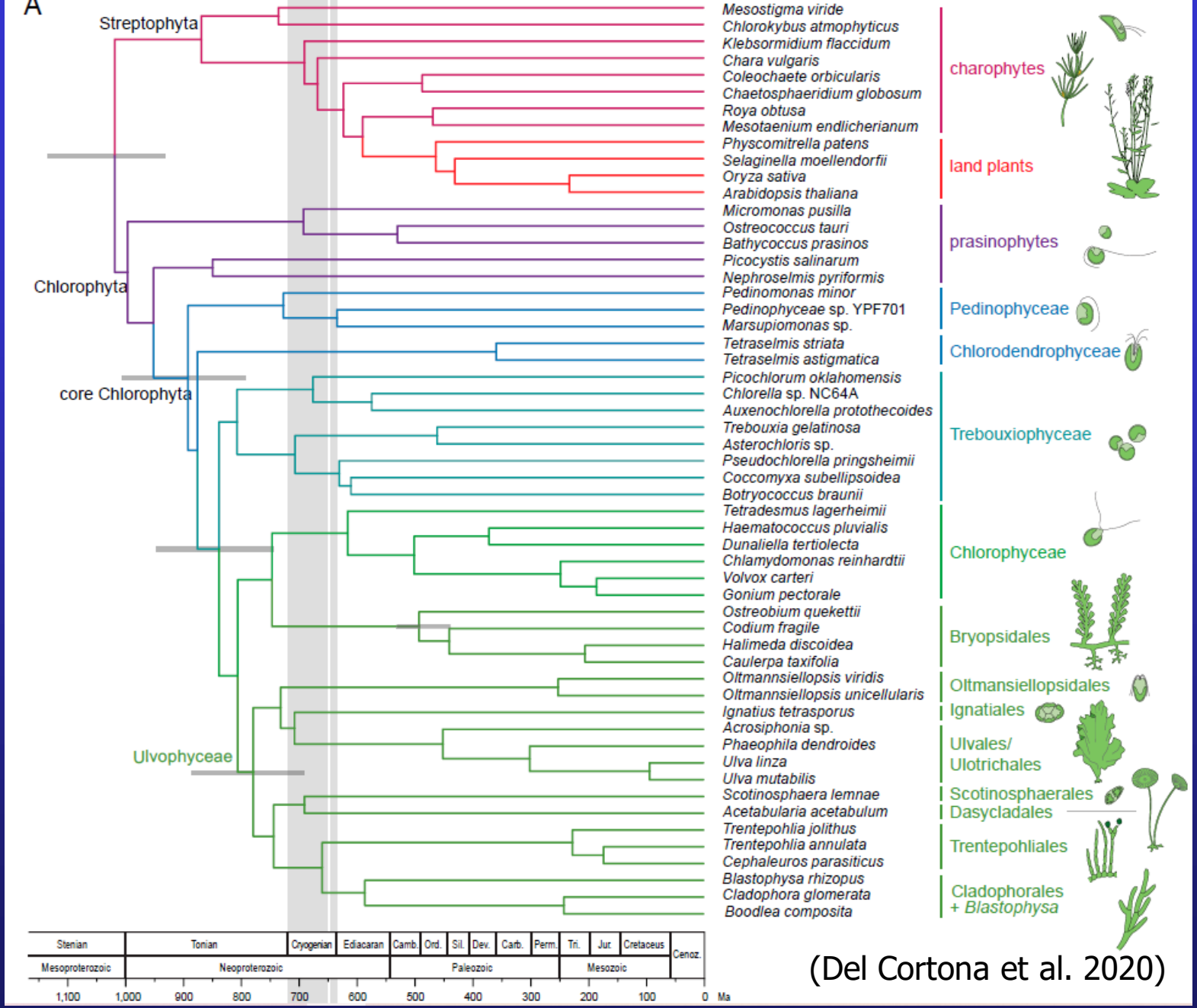
Ulvophyceae

Jak získala Chlorella chitin???

We presented evidence suggesting that Chlorella could have acquired components of its chitin biosynthetic pathway by horizontal gene transfer from a chlorovirus or a microorganism.

In the case of Chlorella, the acquisition of a chitinous cell wall may have conferred a protective barrier against other viral and bacterial parasites lacking the chitinase/chitosanase enzymes required to penetrate and/or escape the algal cell. This might have increased the fitness of Chlorella compared with its ancestors unable to synthesize chitin. This HGT might be the key event that promoted the radiation and success of the Chlorella genus (i.e., Chlorella may have achieved a cosmopolitan distribution because most of its previous parasites failed to penetrate its newly acquired chitinous cell wall).

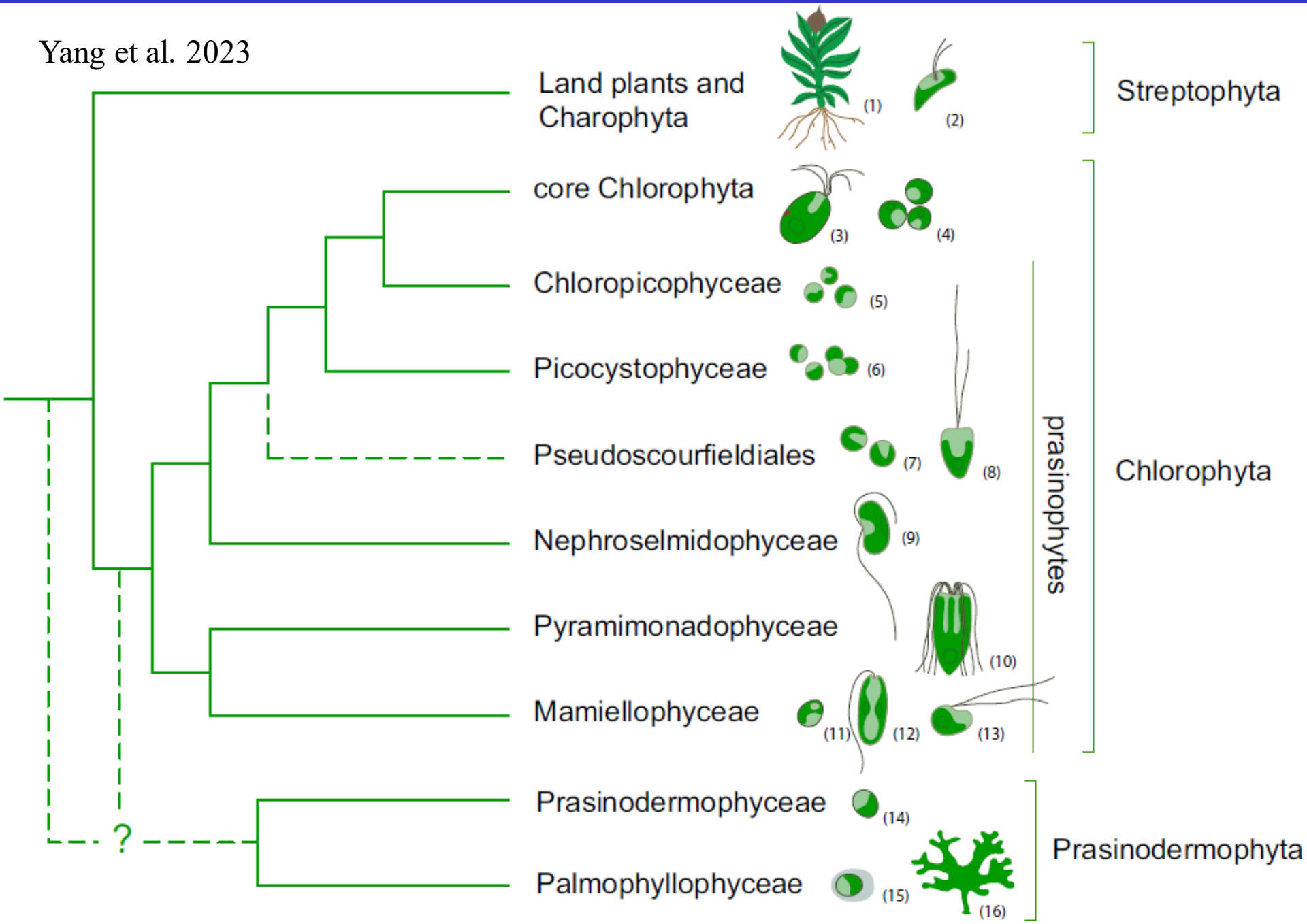
Blanc et al. 2010 The Plant Cell, Vol. 22: 2943–2955



(Del Cortona et al. 2020)

Time-calibrated phylogeny of the green algae. (A) The topology of the tree is based on the ML analysis inferred from a concatenated amino acid alignment of 539 nuclear genes

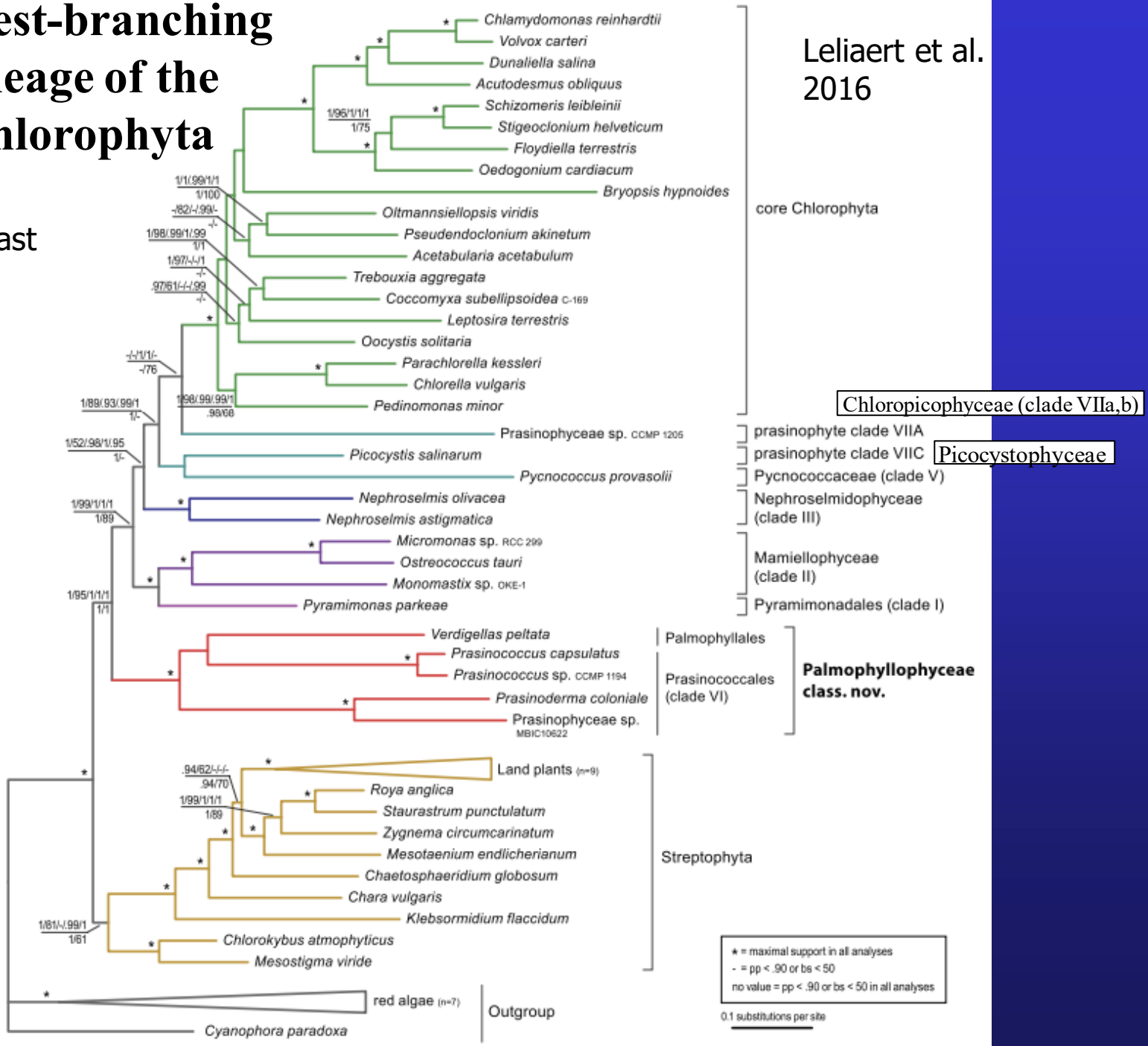
Yang et al. 2023

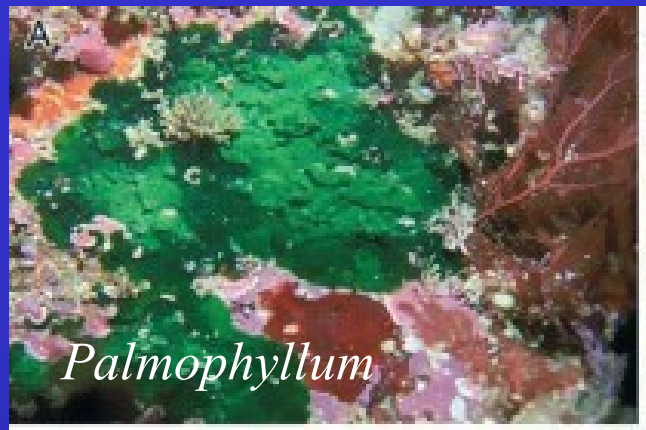


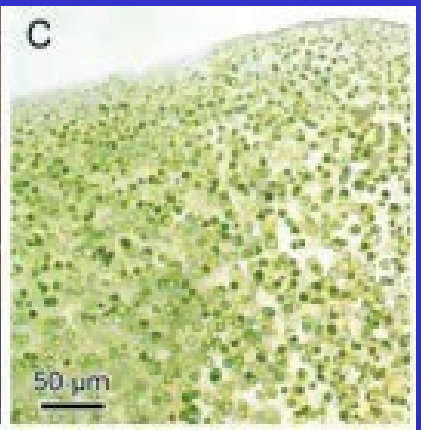
deepest-branching lineage of the Chlorophyta

Chloroplast genom

Leliaert et al. 2016

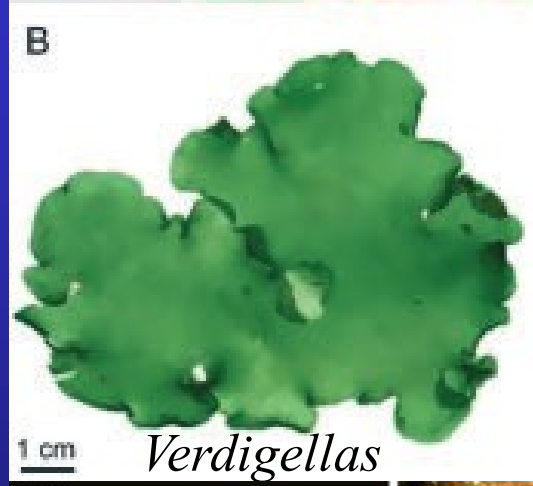


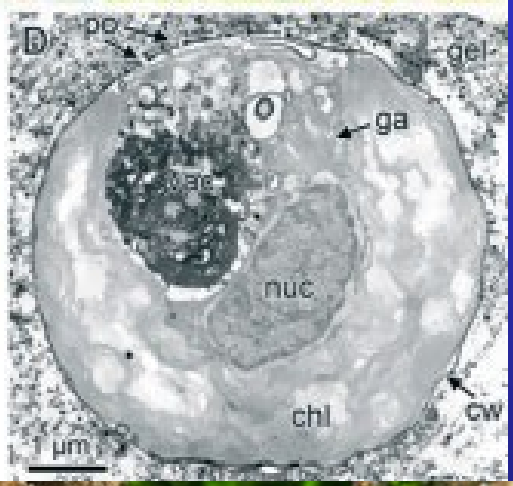


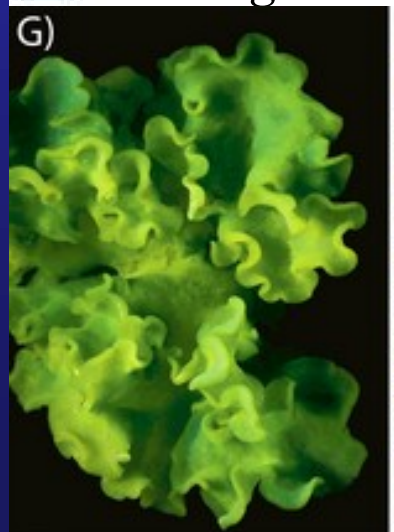


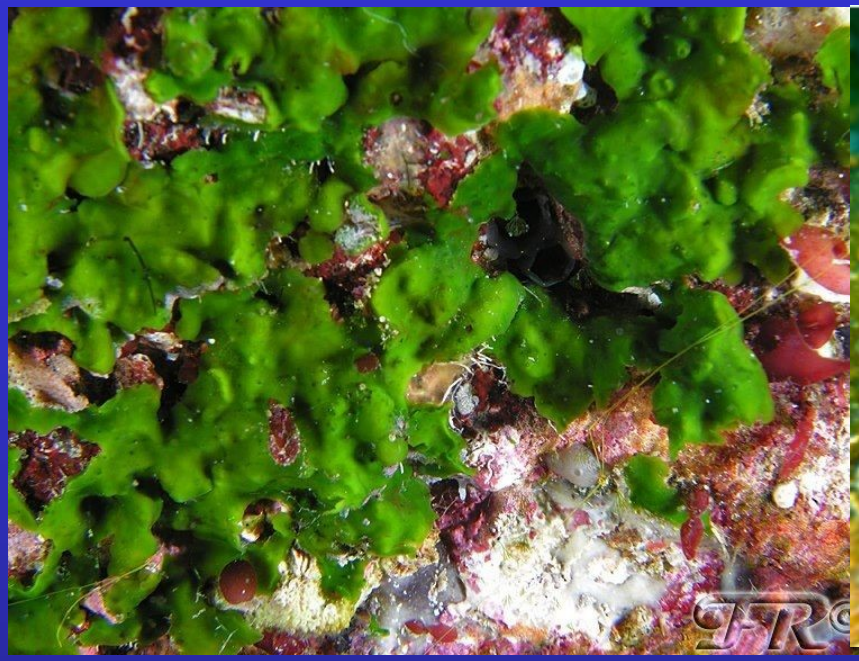
Palmophyllales

deep-marine group of algae







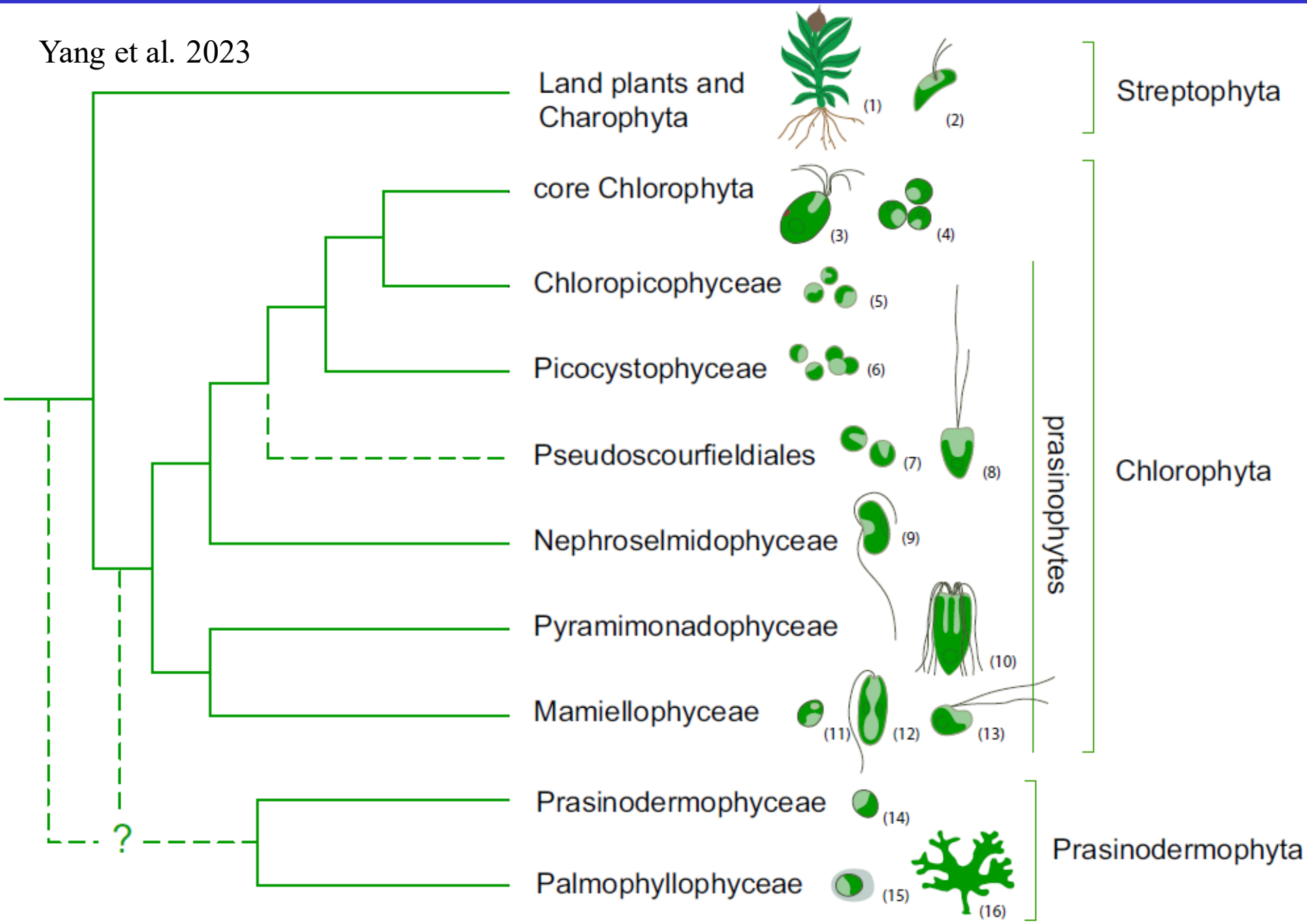


Palmophyllum crassum –
Mediterranien Sea

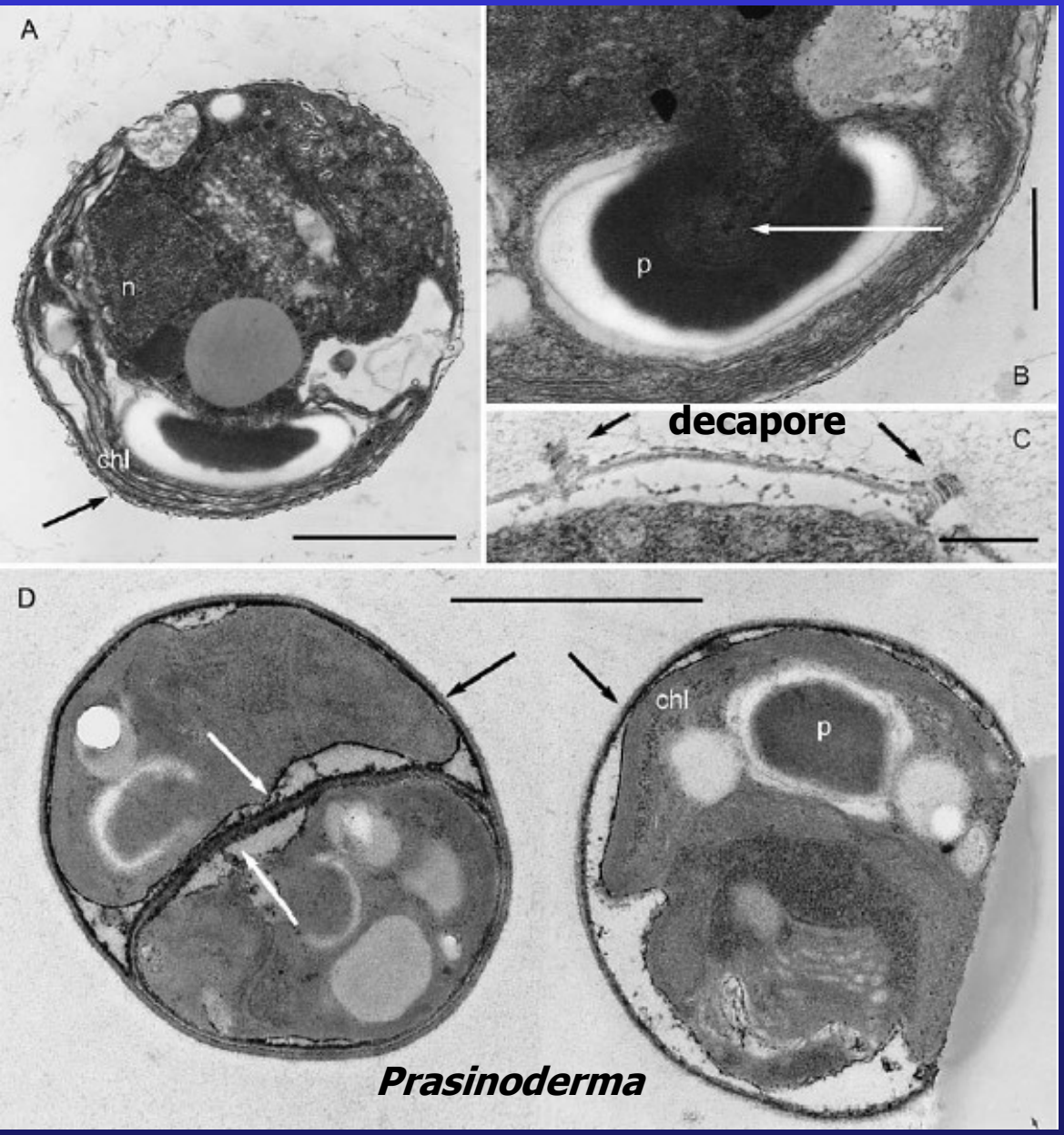
Palmoclathrus stipitatus.
This rare and remarkable alga has a stem that shows annular rings, out of which grows a delicate, cupshaped, perforated membranous blade. Individual plants up to 8 years of age have been recorded
South Australia

higher ch b/ch a ratio
no siphonaxanthin and siphonein

Yang et al. 2023



Palmophylophyceae



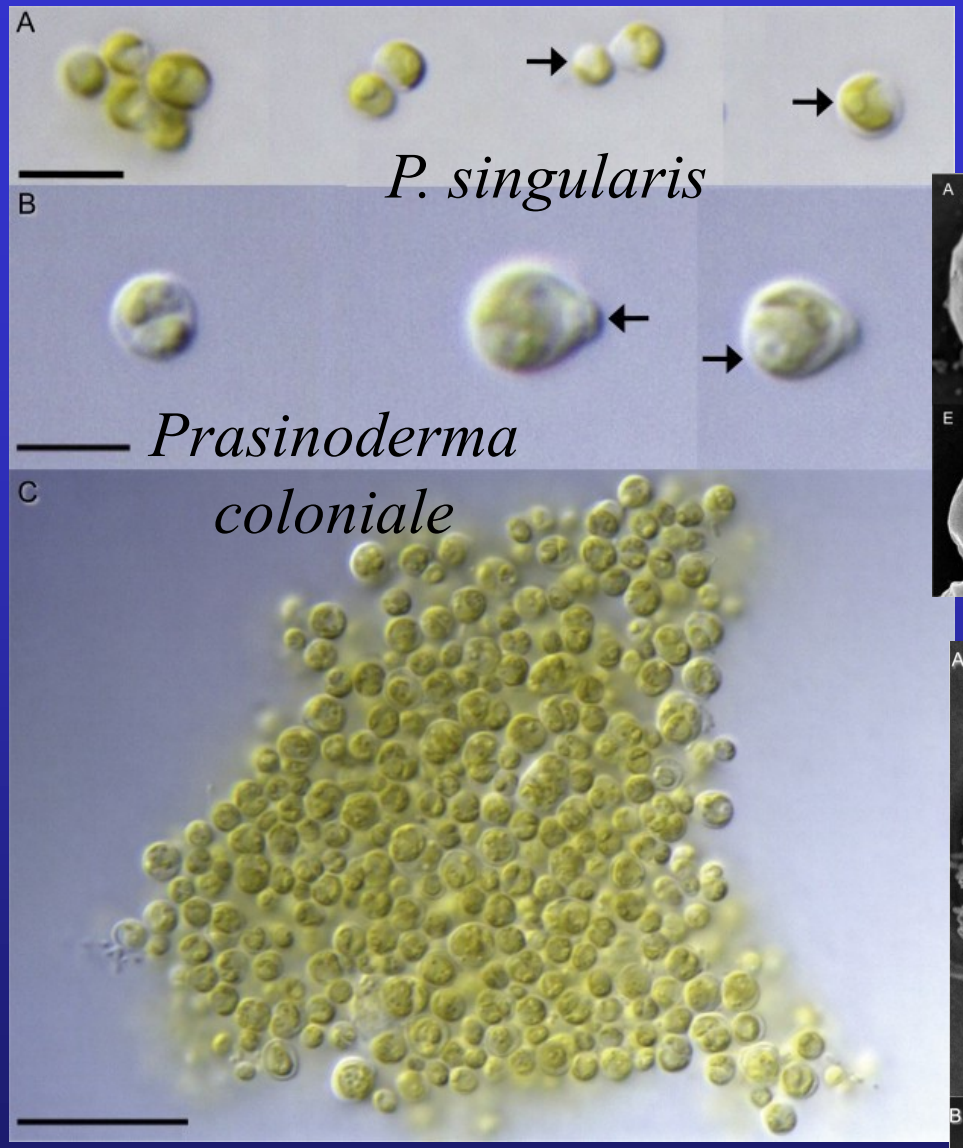
Prasinococcus cf *capsulatus*

Coccal (pico)planktonic prasinofyte - 3.5 to 5.2 µm

Asexual reproduction is achieved by unequal binary fission in which one of the daughter cells retains the parent wall, while the other is released with a newly produced cell wall

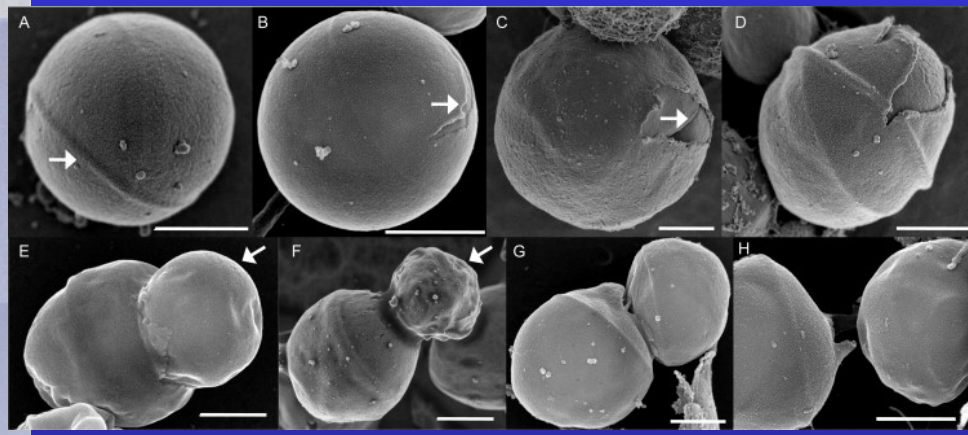
Guillou et al. 2004

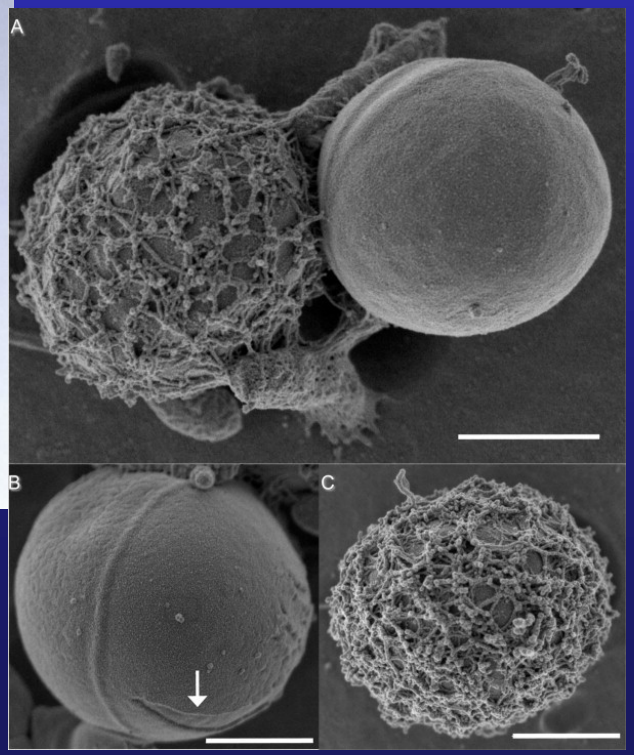
Prasinoderma



P. singularis

Prasinoderma coloniale



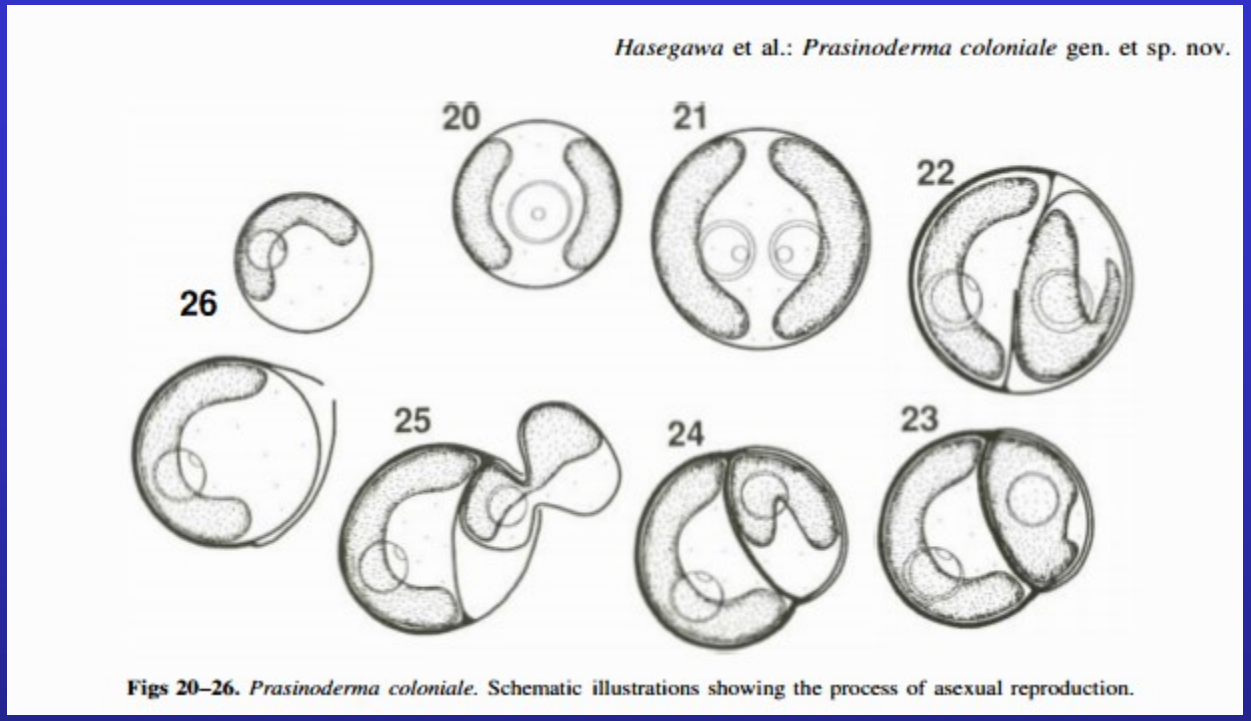


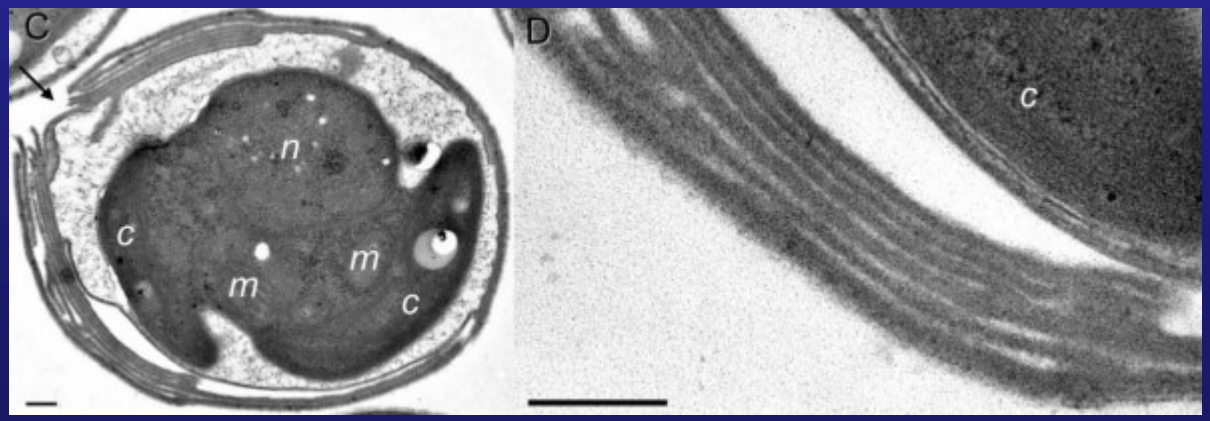
prasinoxan-thin, micromonol uriolide

Surface water of Pacific Ocean. Bioscope expedition 2004 (Jouenne et al. 2011)

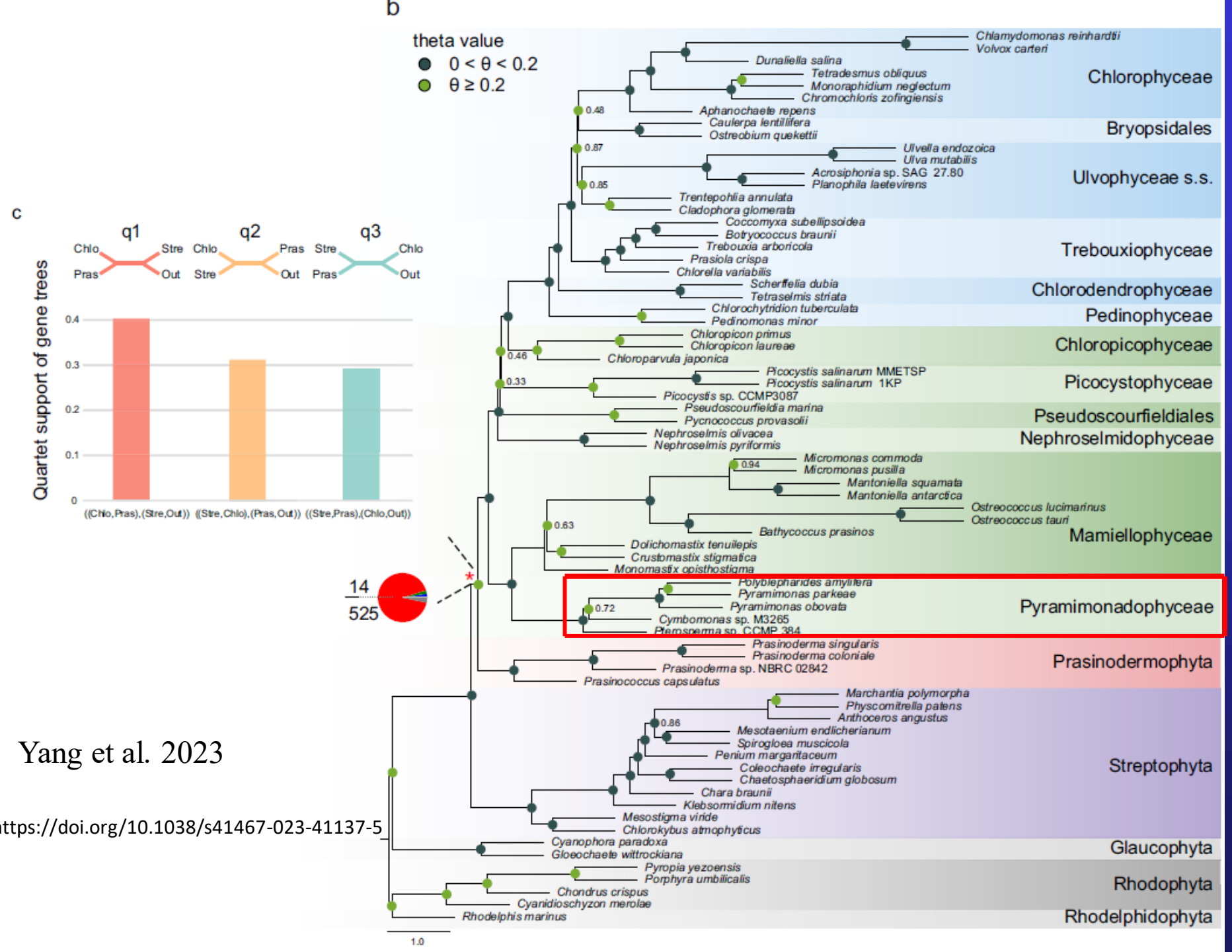
Prasinoderma coloniale

(HASEGAWA et al. 1996)





(Jouenne et al. 2011)

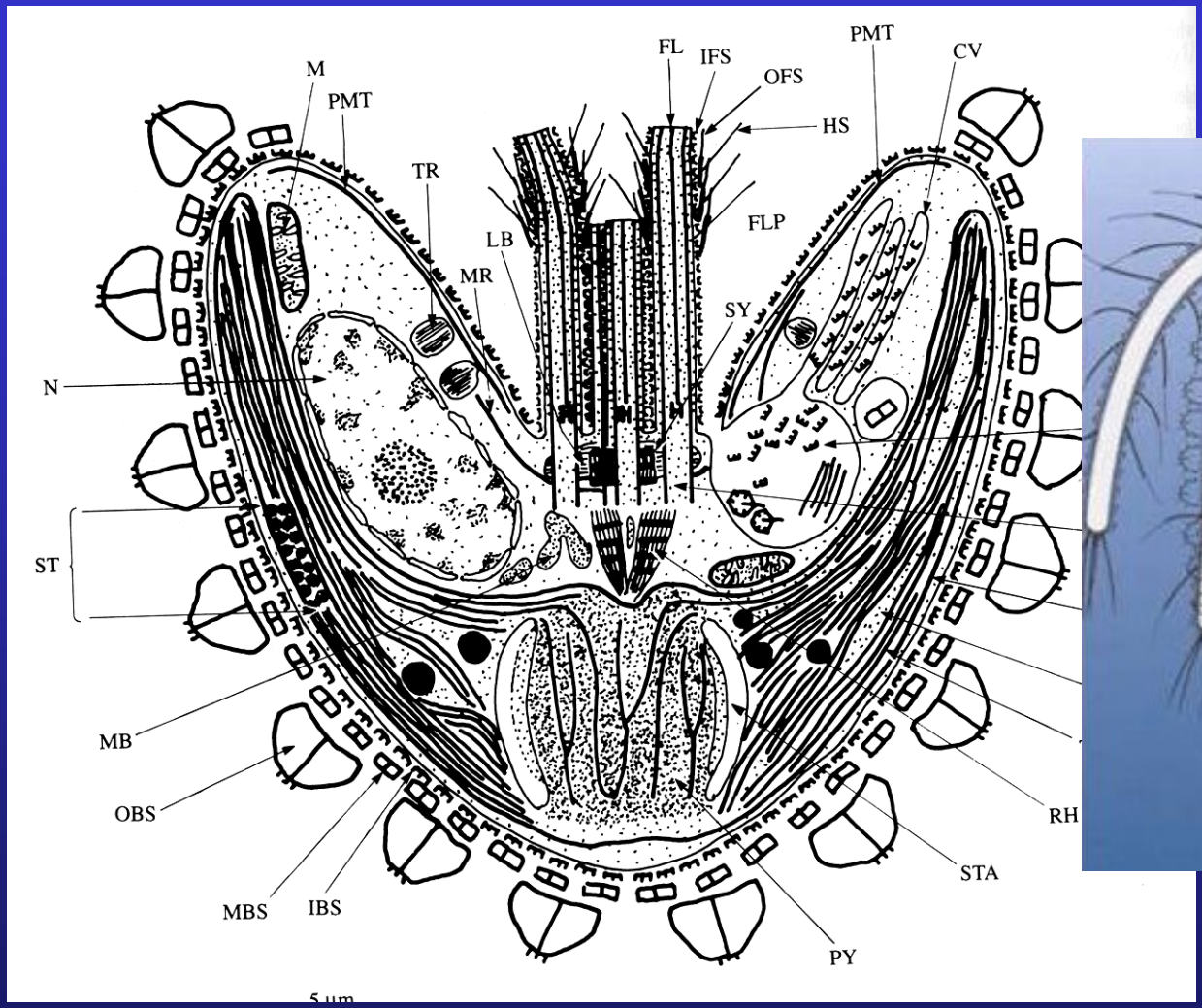


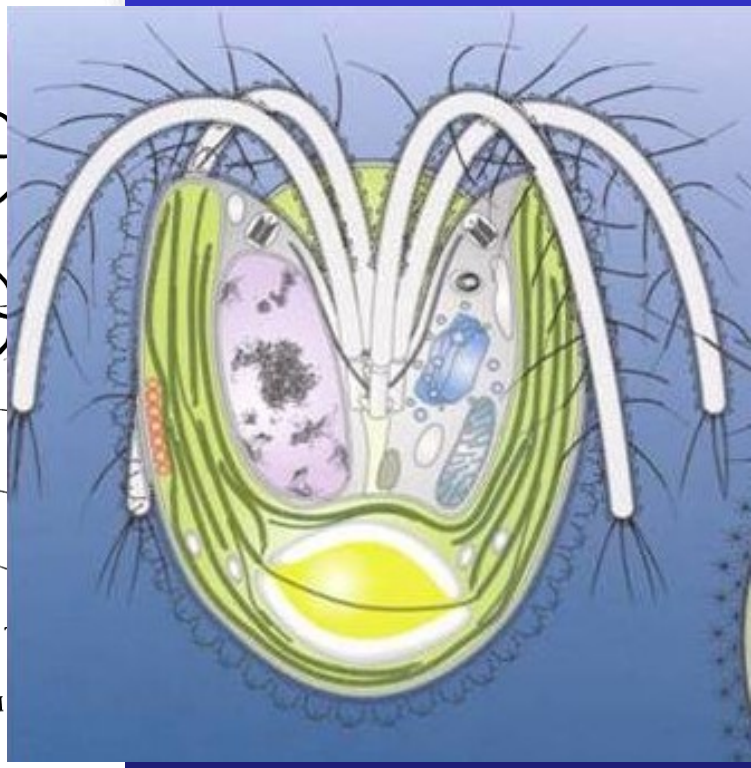
Yang et al. 2023

https://doi.org/10.1038/s41467-023-41137-5

Pyramimonadales

no prasinoxanthin
70 species





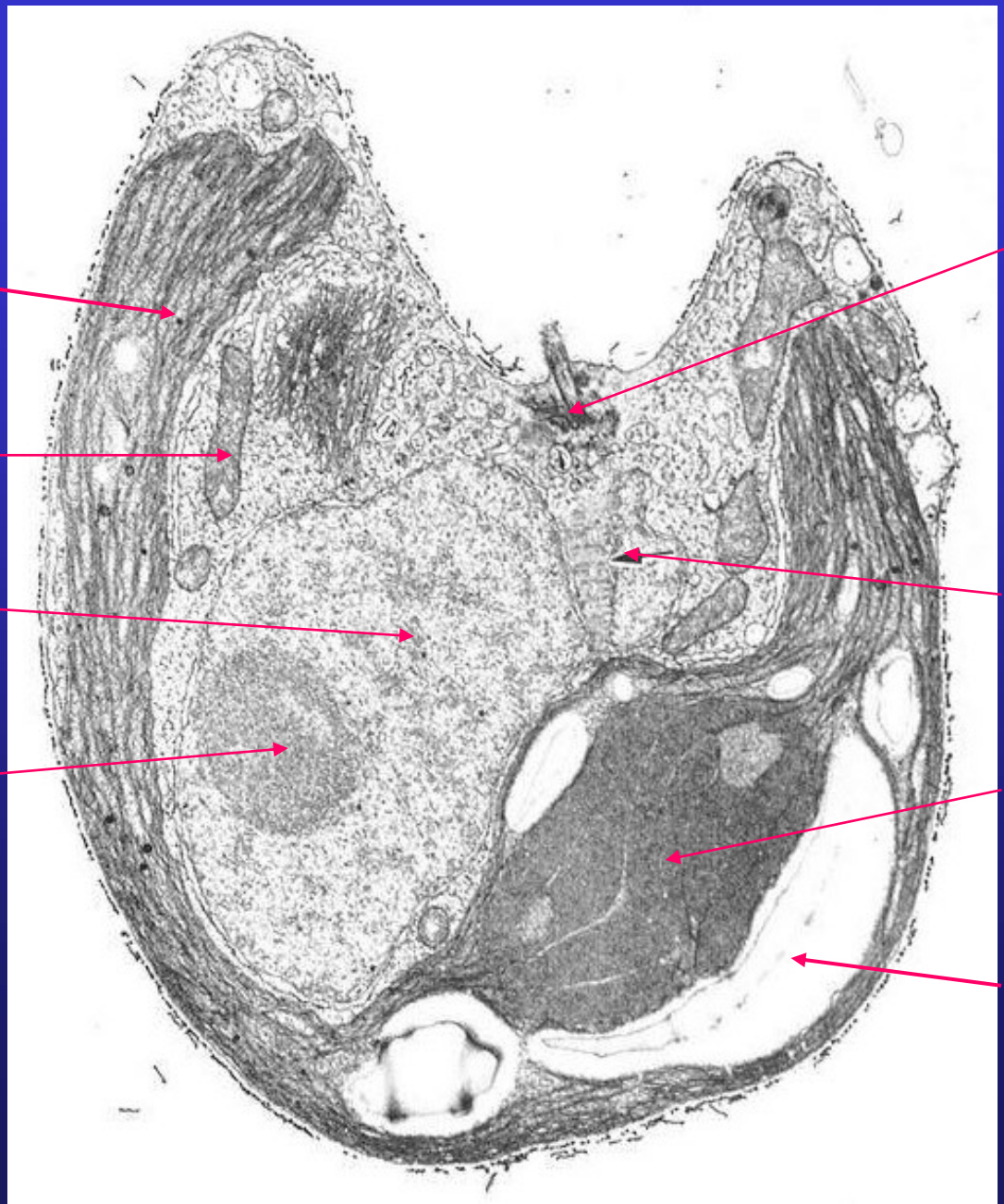
trichocysts- extracellular digestion

rhizoplast attached to the chloroplast surface (contraction ATP, Ca^{2+})

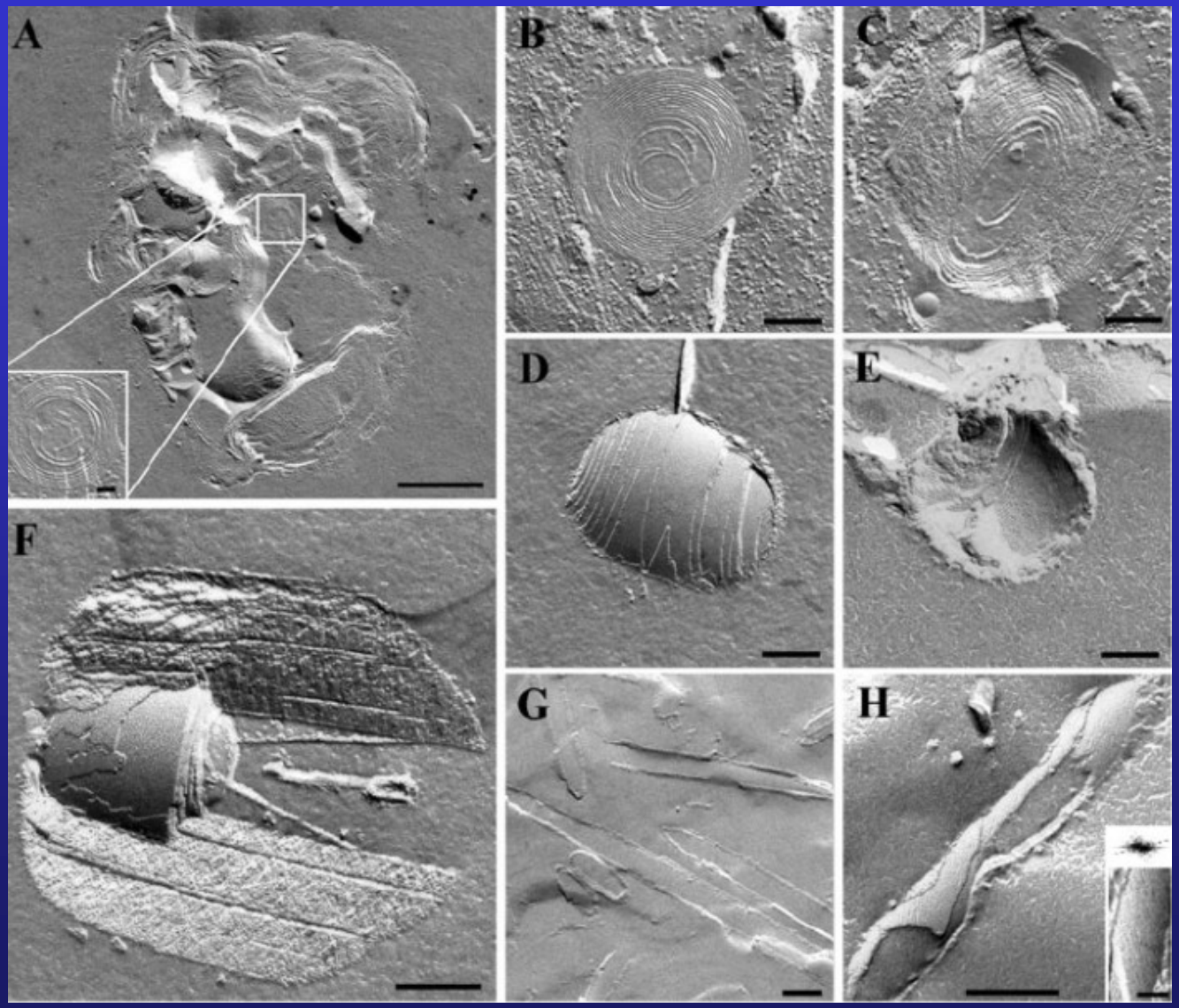
ultrastructure of *Pyramimonas*

Pyramimonadales

Cymbomonas



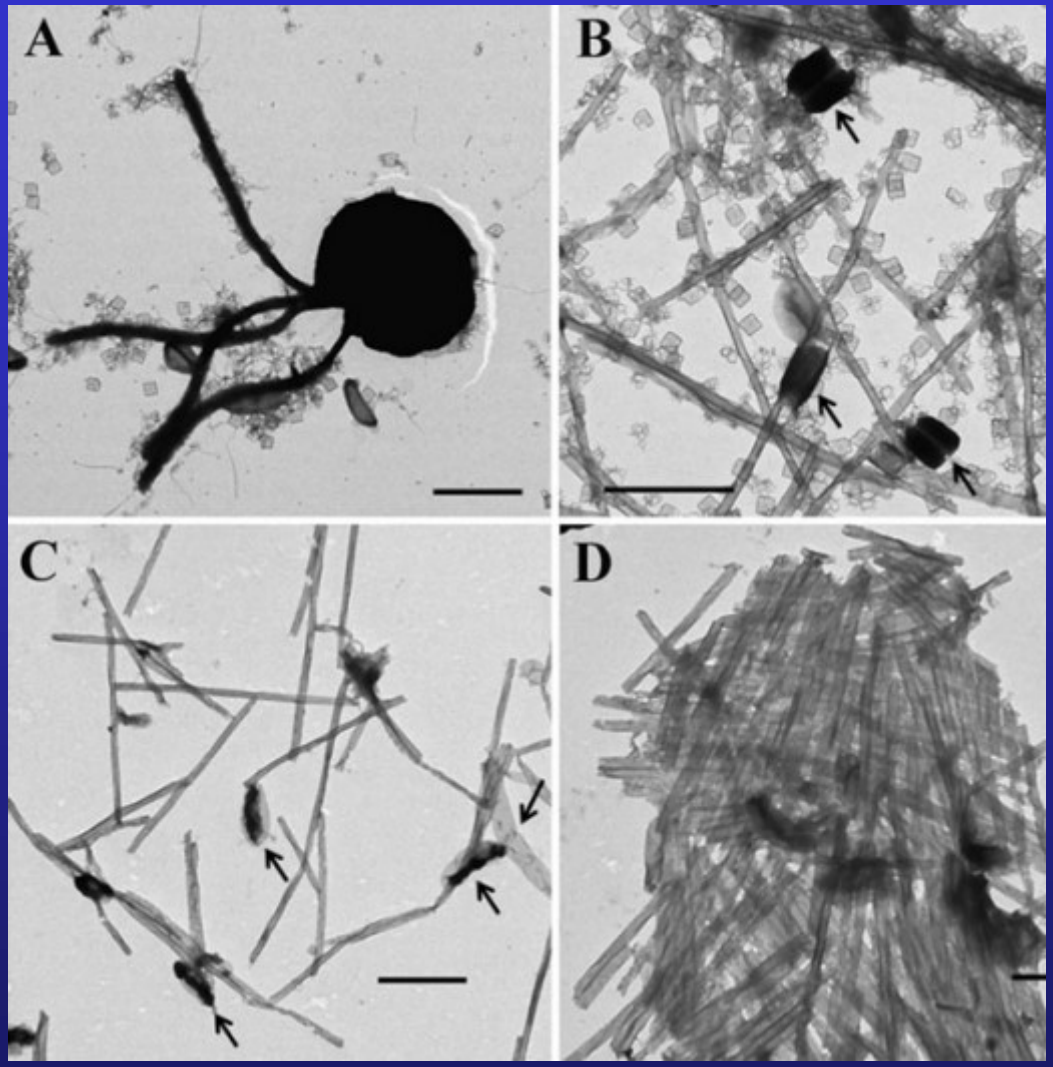
Ejectisomes



Discharged ejectisomes measured up to 26 µm
still furled measured up to 900 nm in width and 1 µm in length

Rhiel et al.
Protoplasma 2013

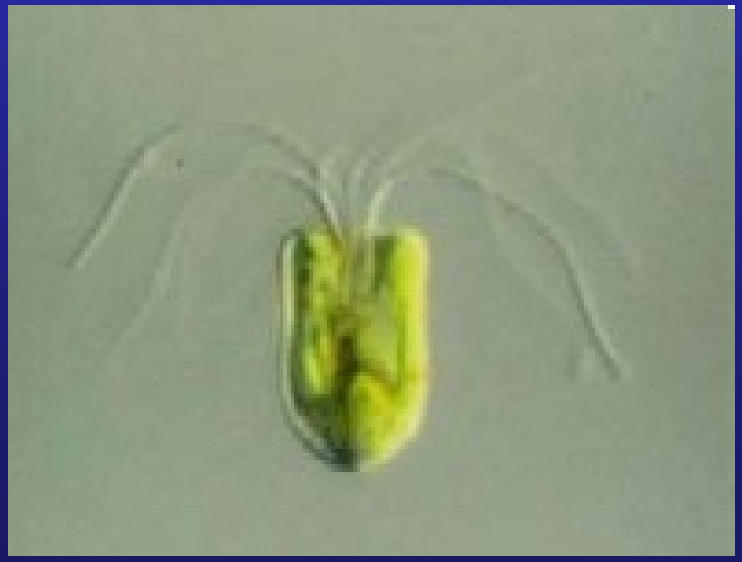
Micrographs of freeze-fractured ejectisomes of P. grossii. In freeze-fractured Pyramimonas cells

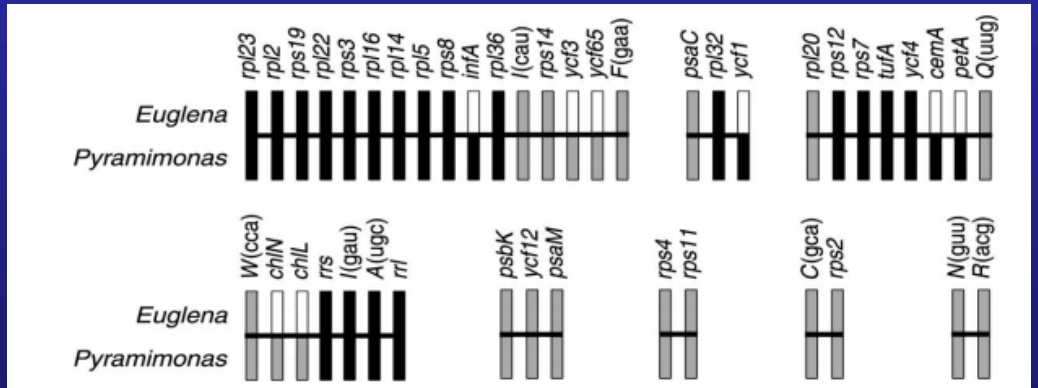


Micrographs of a cell of P. grossii (a) and of crude (b) and enriched (c, d) ejectisome fractions after negative staining.

***Pyramimonas parkeae* -** the closest relative to the euglena chloroplast

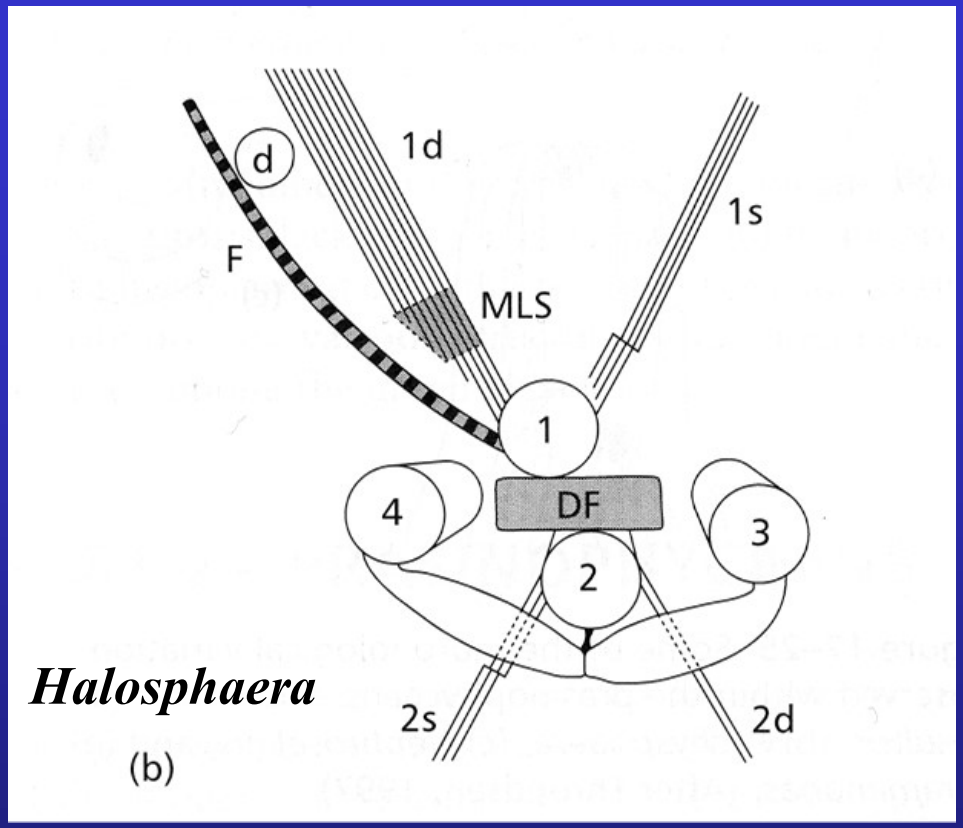
Plastid genoms share unique gene clusters



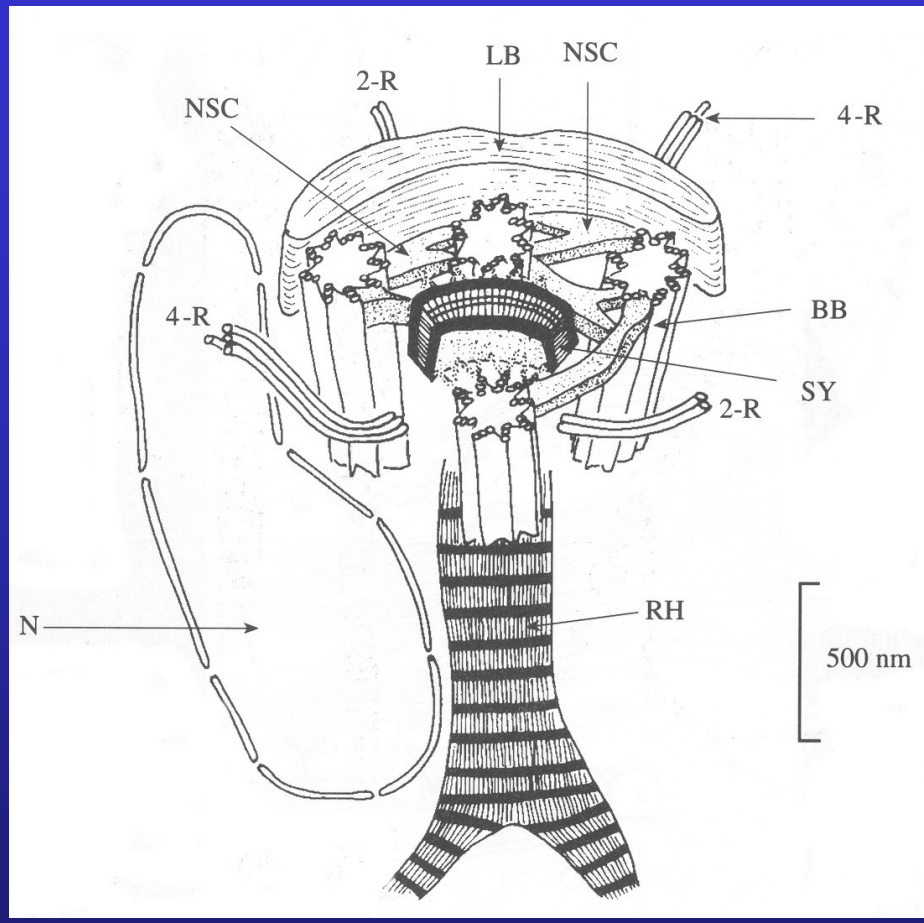


Obr. 1. Genové klastry unikátně sdílené cpDNA organismů *Euglena* a *Pyramimonas* podle Turmelové et al. (2009). Černě vybarvená políčka naznačují ancestrální uspořádání těchto klastrů (vyskytující se i u jiných zelených řas), šedá políčka odkazují na derivované oblasti (specifické pro *Euglena* a *Pyramimonas*) a prázdná políčka označují chybějící geny.

Flagellar apparatus



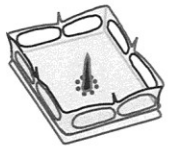
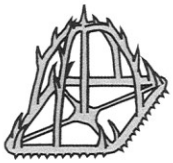
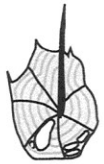
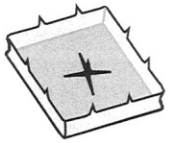
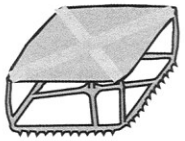
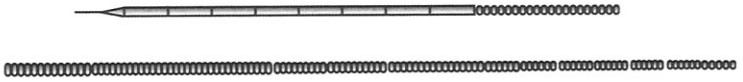
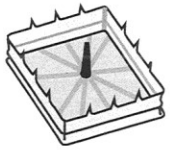
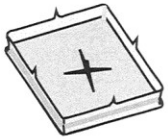
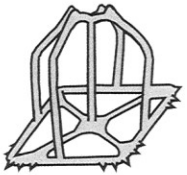
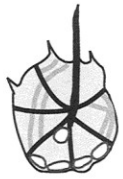
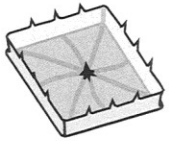
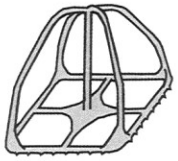
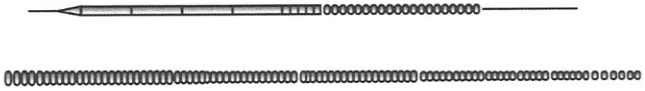
Halosphaera



Pyramimonas

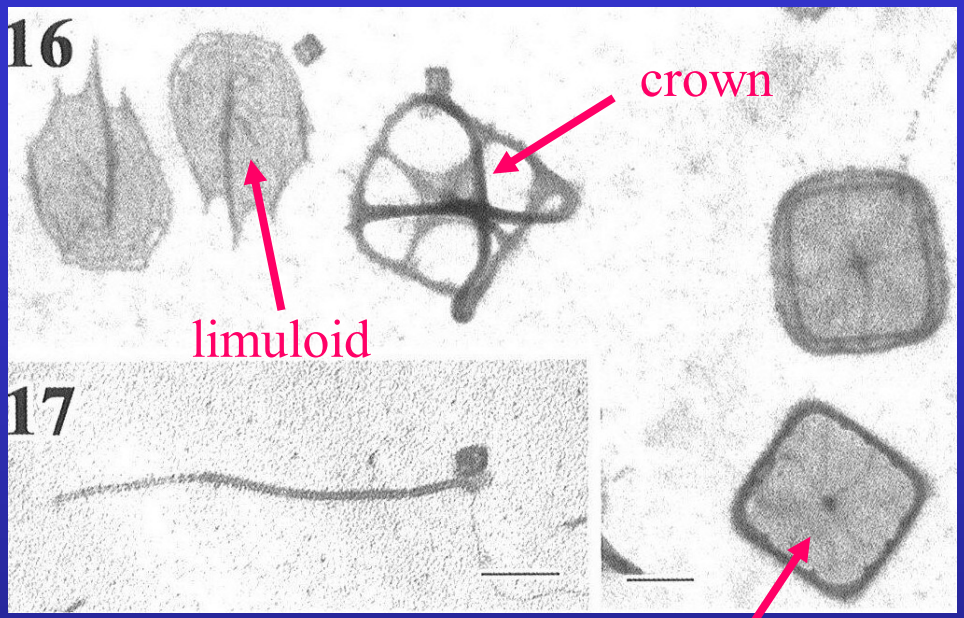
Organic scales

Table 3. Comparison of the body (box and crown) scales and the flagellar (limuloid and hair) scales among species of *Pyramimonas* subgenus *Punctatae*.

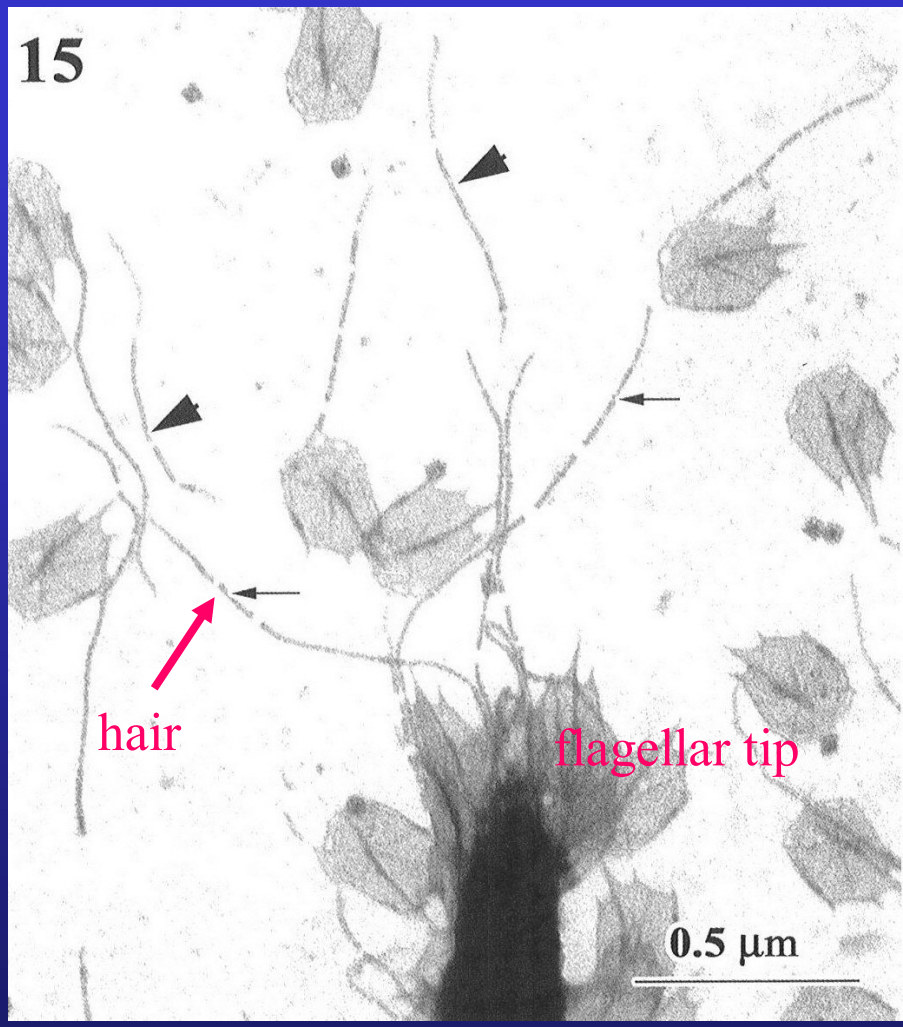
species	body scales		flagellar scales	
	box scale	crown scale	limuloid scale	hair scale
P. formosa[1]				
P. mucifera[2]				
P. olivacea[3]				
P. robusta[4]				
P. aurea[5]				

[1]Sym & Pienaar 1999; [2]Sym & Pienaar 1991, Pienaar & Sym 1997; [3]McFadden *et al.* 1987, Pienaar & Sym 1997; [4]Pienaar & Sym 1997; [5]this study

Organic scales



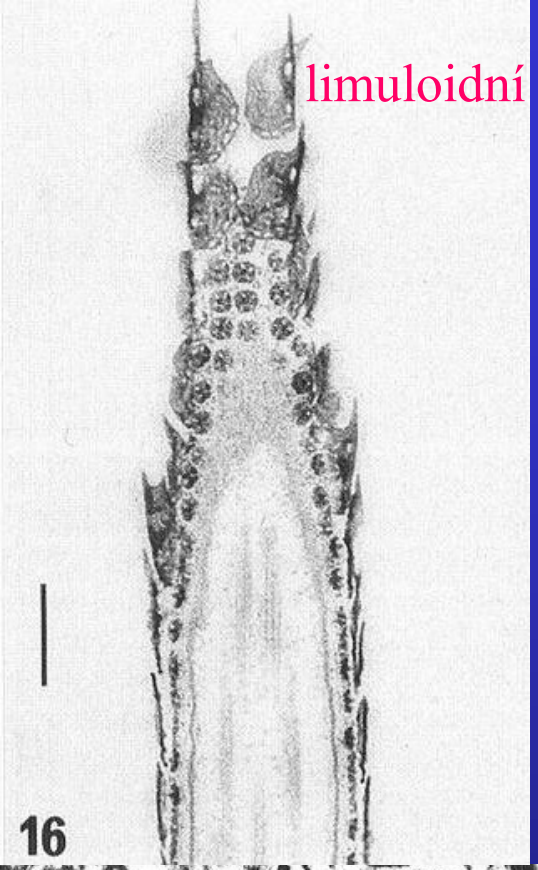
Pyramimonas aurea

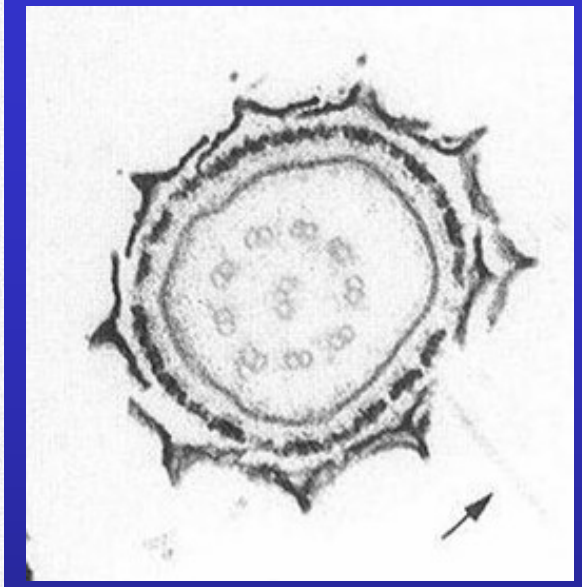


carbohydrate similar to pectin

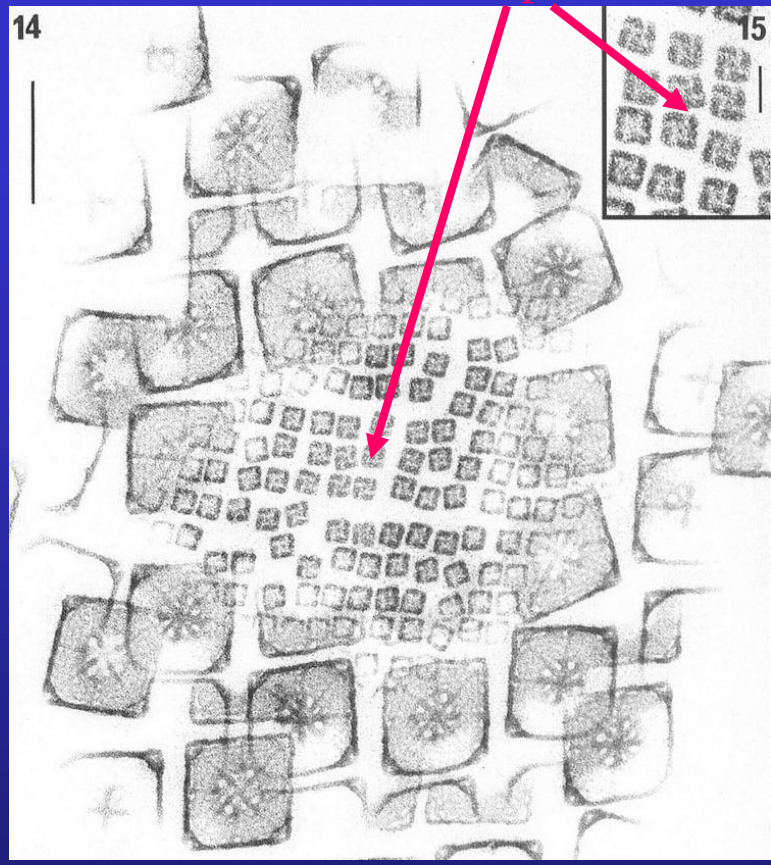
Organic scales

limuloidní





small square



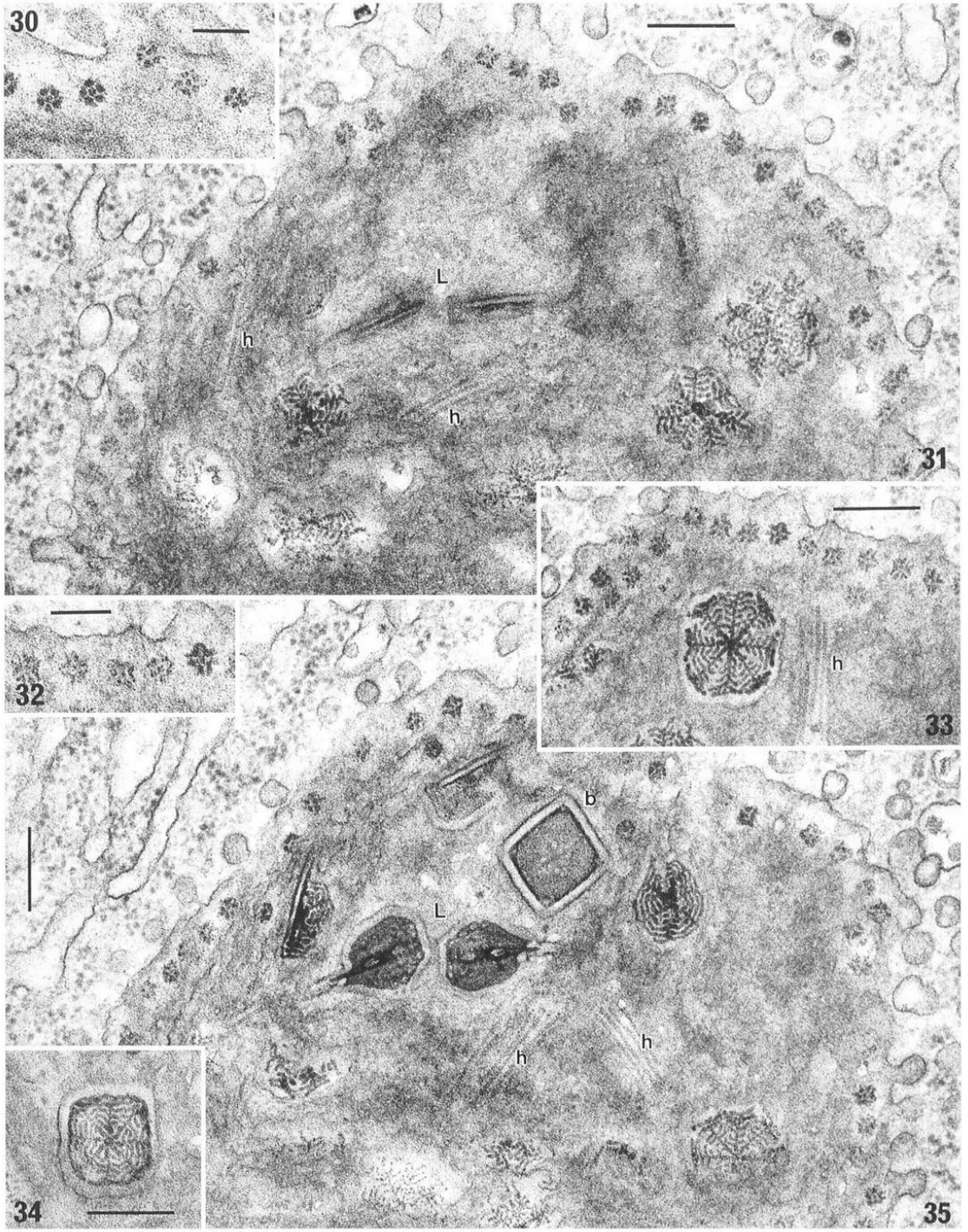
Cymbomonas tetramitiformis

box

Šupiny produkovány GA – všechny typy tělových i bičíkových šupin mohou být podukovány v jedné GA cisterně, vylučovány na povrch v oblasti inserce bičíků (flagellar pit)

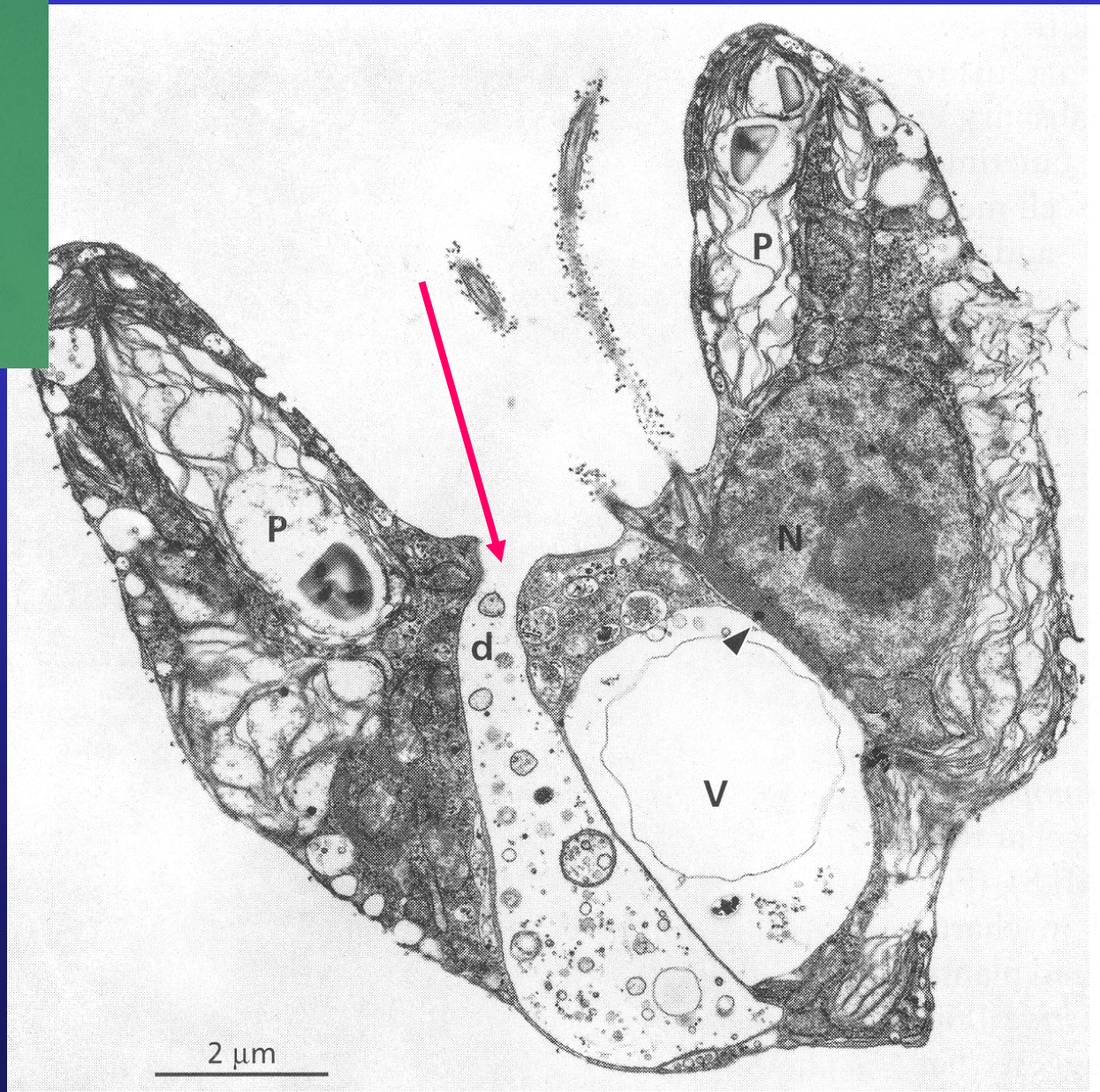
x křemičité šupiny chrysofyt

Cymbomonas

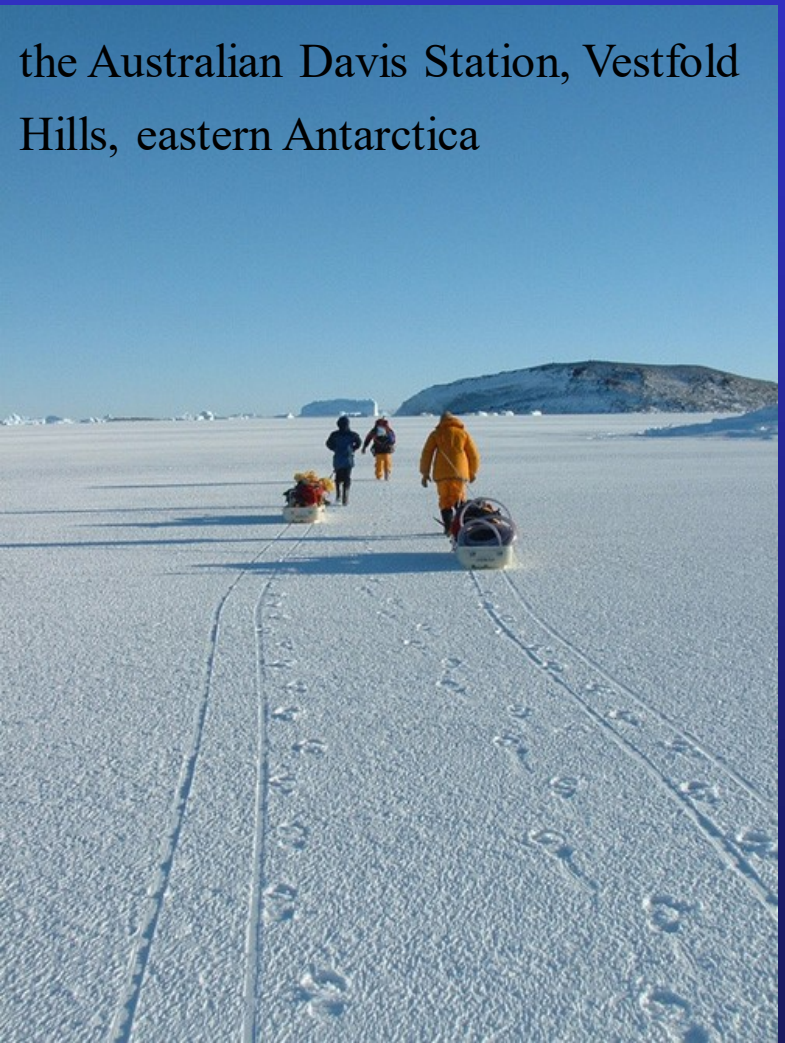


Organic scales

Halosphaera – specializovaný kanál, kterým se šupiny uvolňují, vestigiální cytopharinx ancestrální fagotrofní buňky

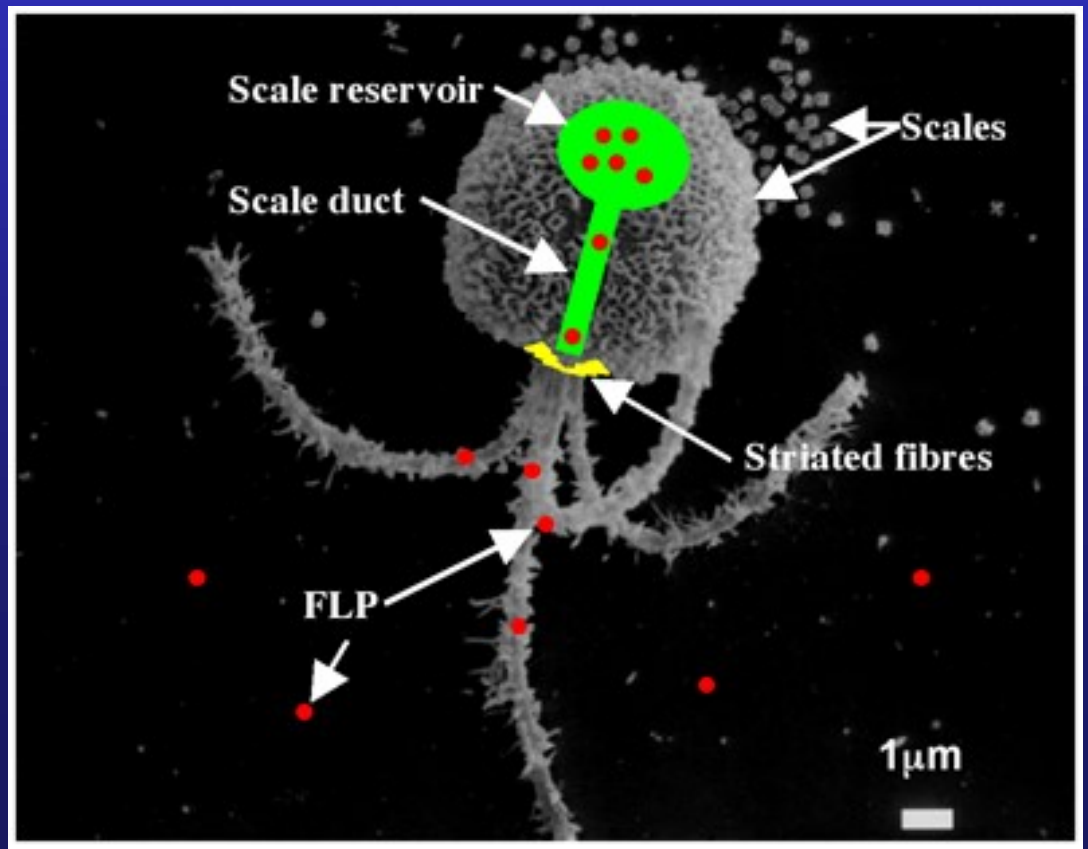


mixotrofie „zapnuta“ pouze za extrémních podmínek (total winter darkness and again when ice thickness was maximal and PAR levels in the water column low) – trophic plasticity

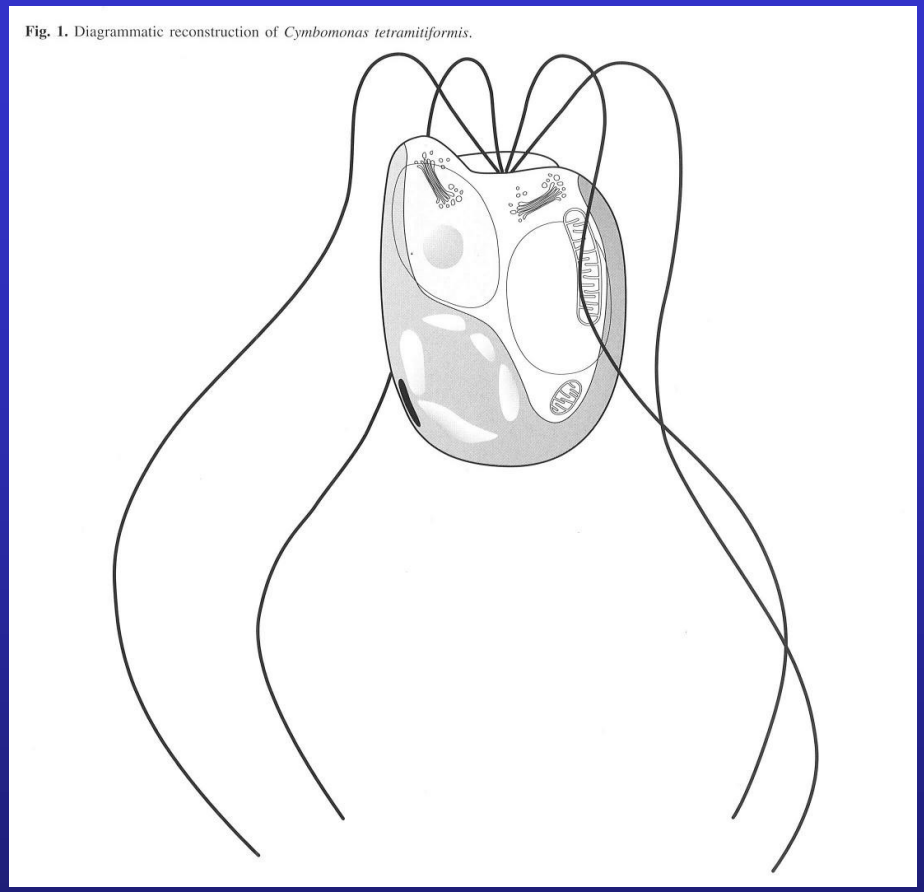


the Australian Davis Station, Vestfold Hills, eastern Antarctica

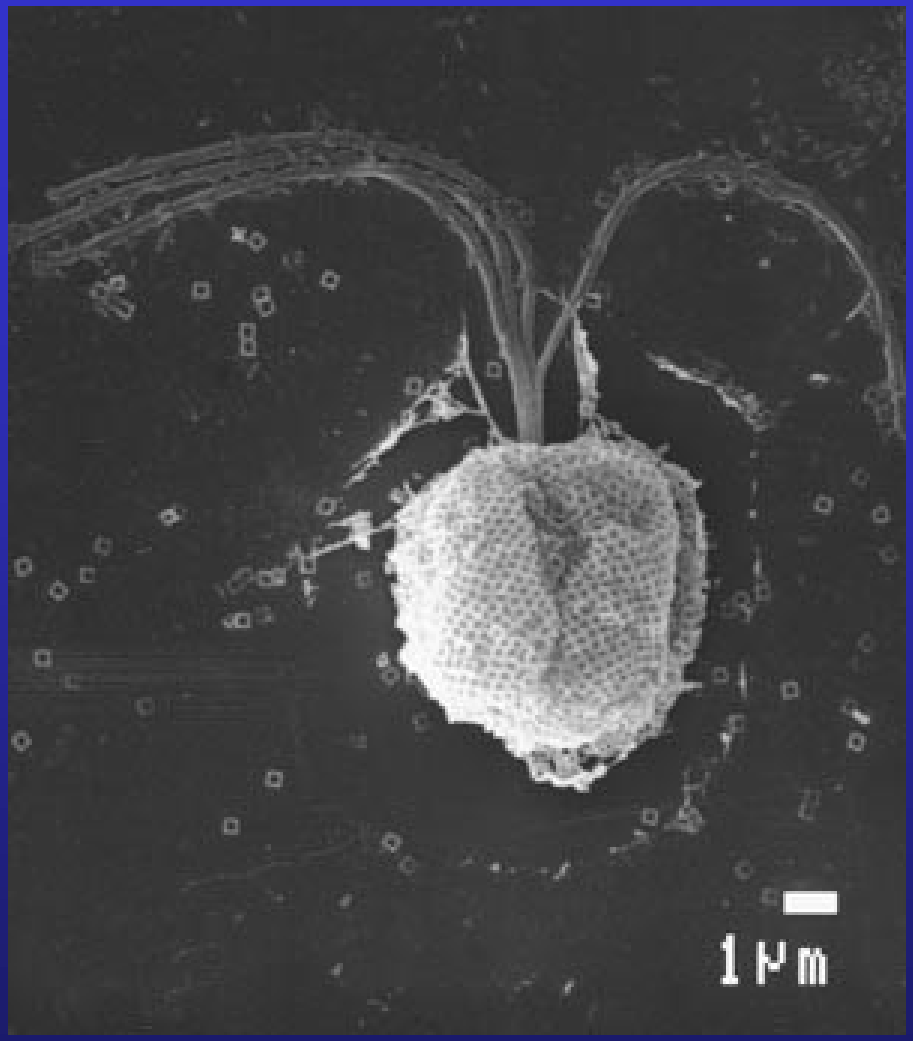
Diagrammatic representation of *Pyramimonas gelidicola* ultrastructure illustrating scale duct and reservoir thought to be involved in prey uptake. FLP, fluorescently labelled prey.



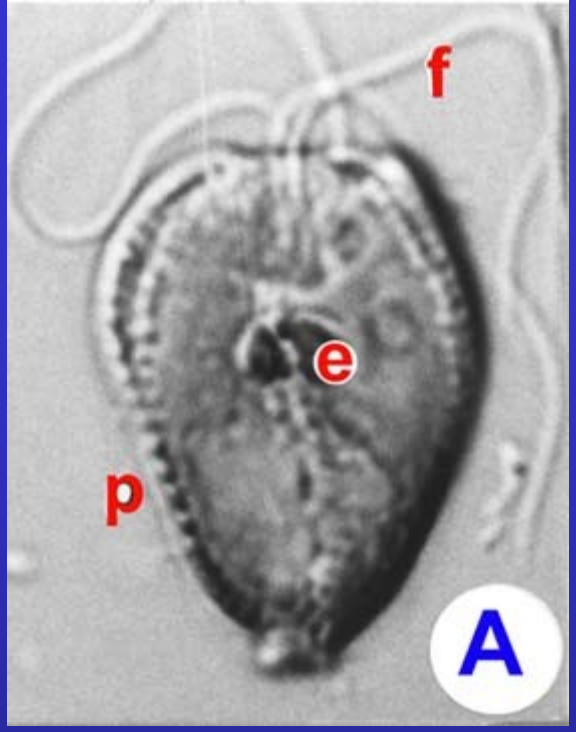
Pyramimonadales



Cymbomonas tetramitiformis

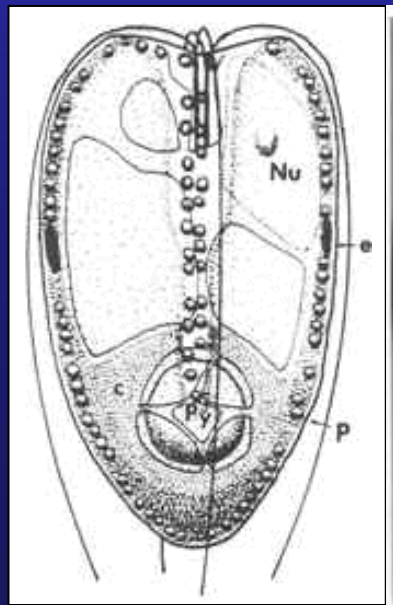


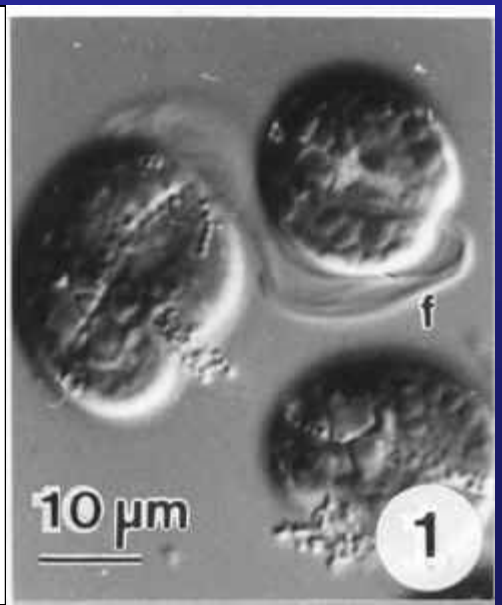
Pyramimonas sp.



Pyramimonas mucifera

bentic species, produces slime – adaptation to bentic environment

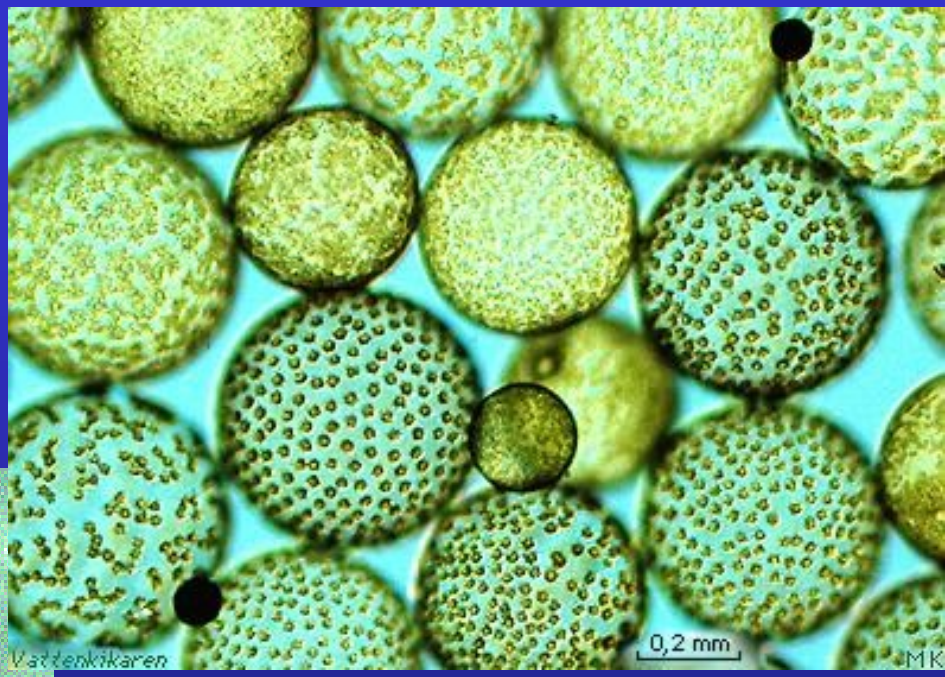


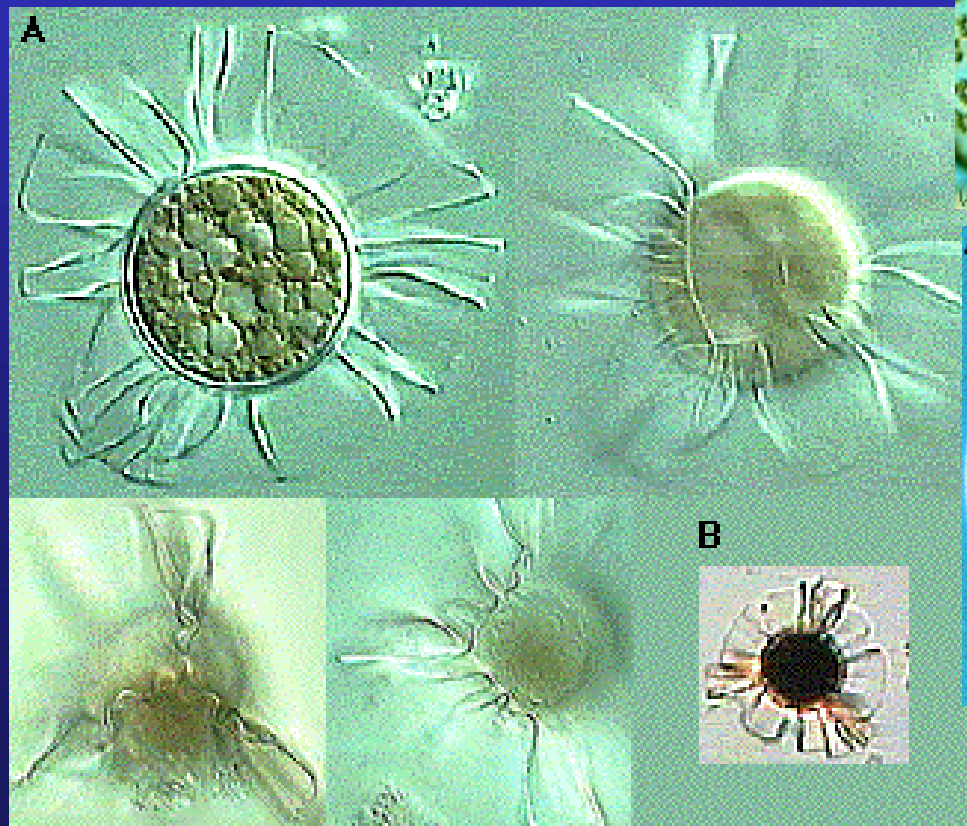


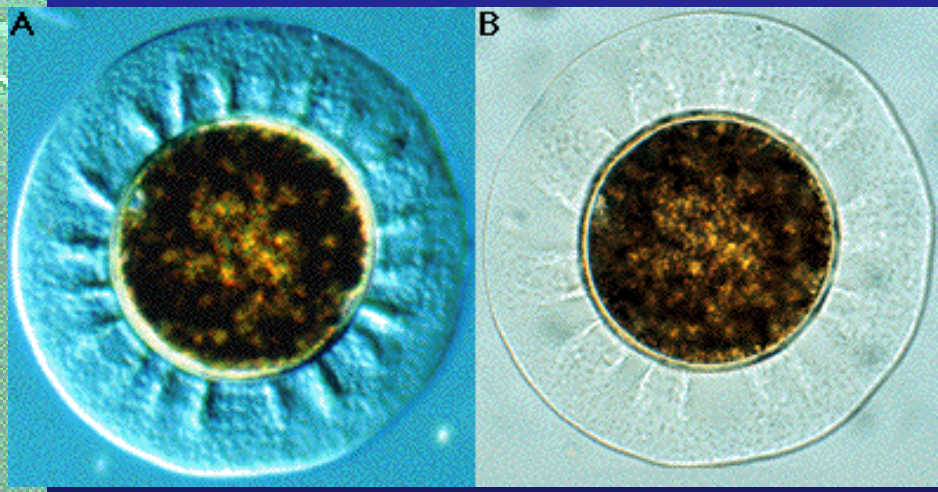
Phycoma

- asexual cysts, resistent outer cell wall
- fossil records from Precambrium (250-540 mya)

Halosphaera





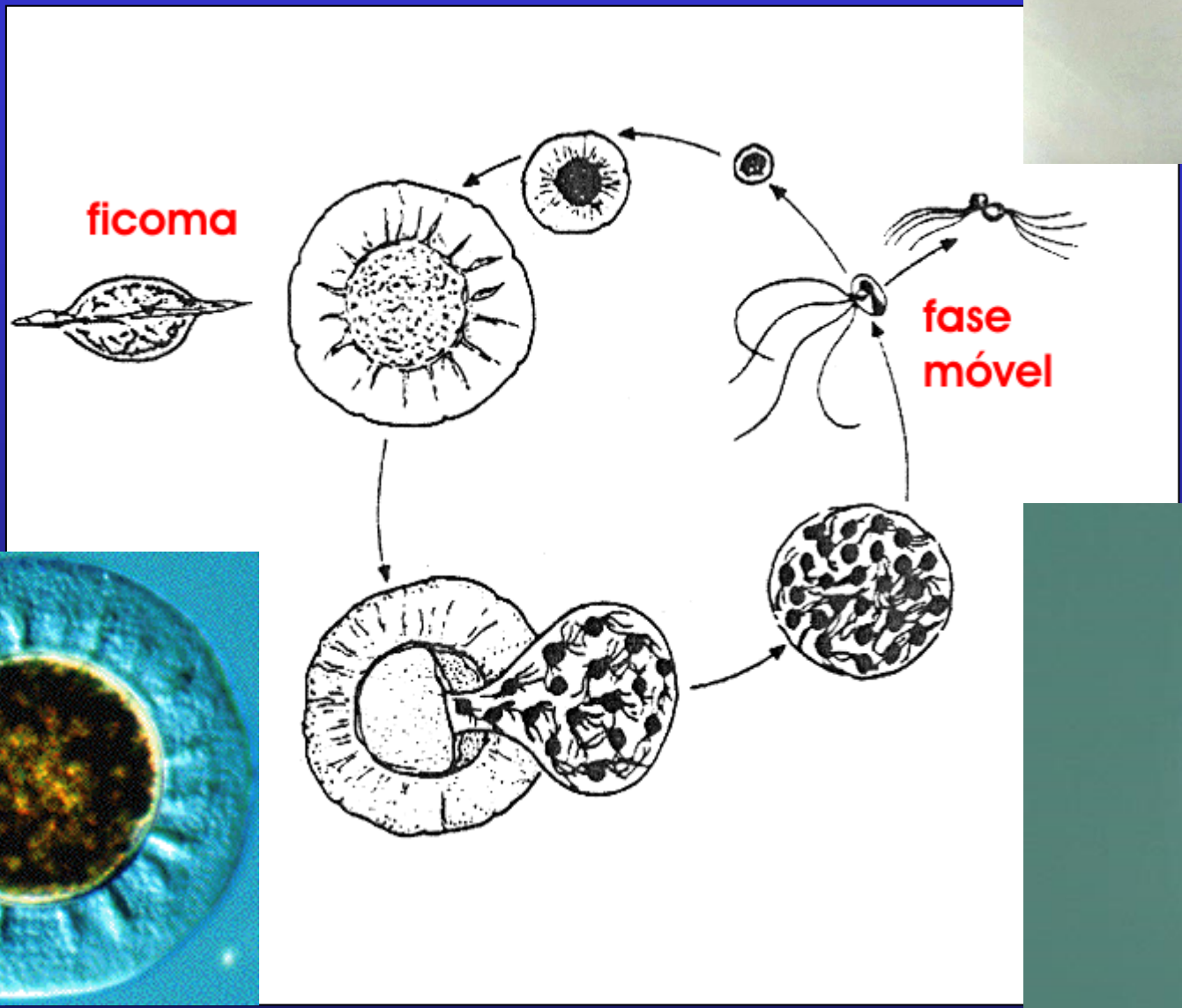


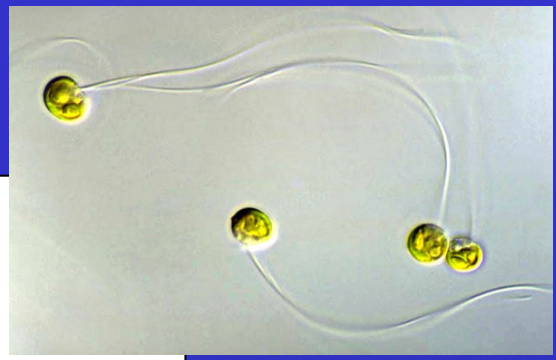
Pterosperma

Pyramimonadales

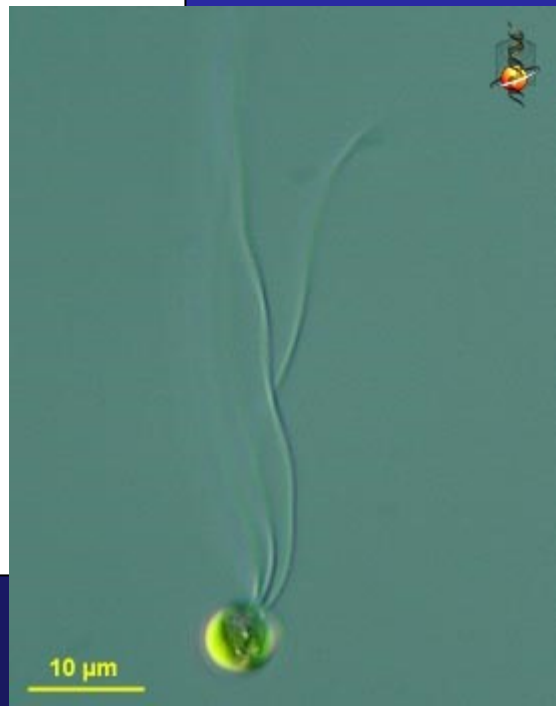
Halosphaera – během jara a počátkem léta se mohou phycomata hromadit v povrchových vrstvách (nesena proudy a větrem) a působí vegetační zákal – zelená olejovitá voda.

Pyramimonadales



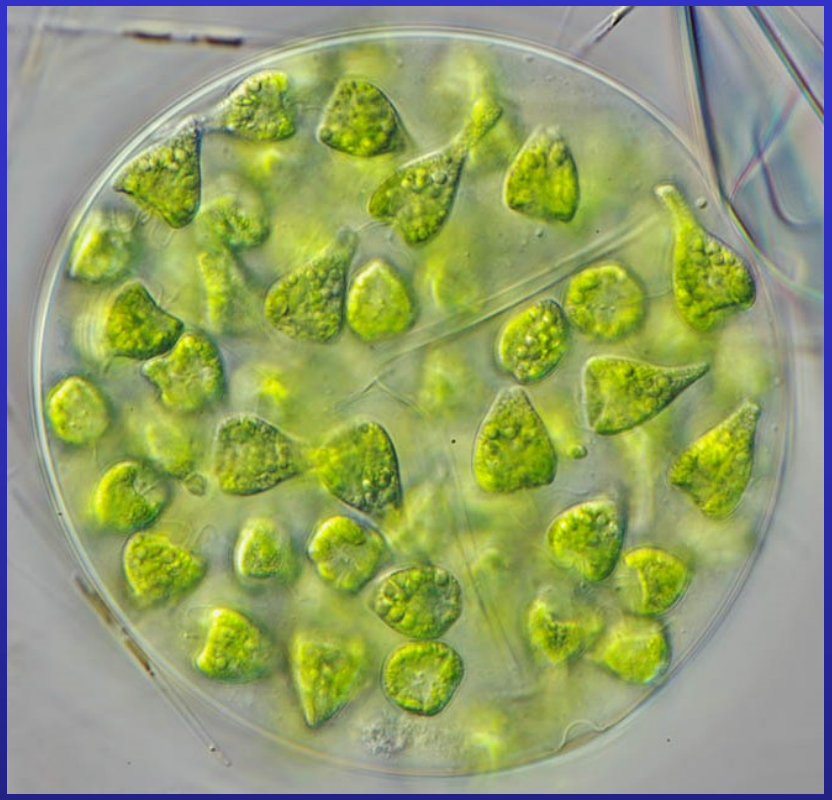


lipidy
sporopolenin



Pterosperma – live cycle

Pyramimonadales



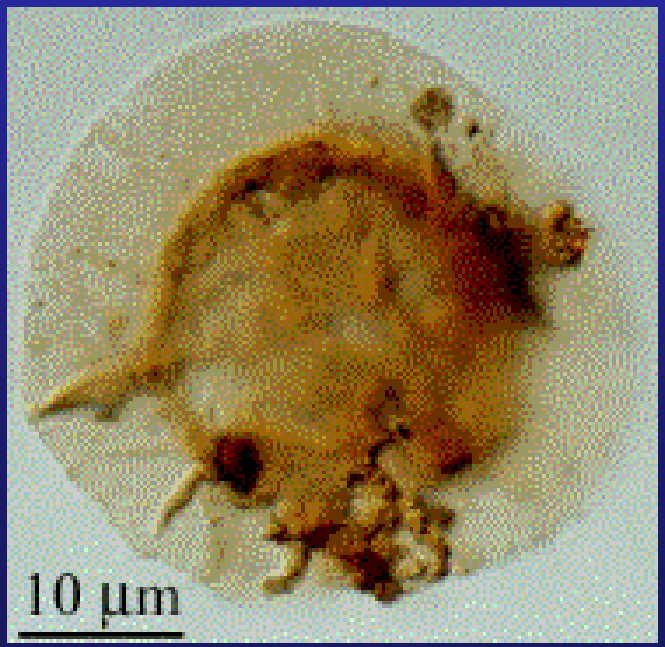
Phycoma (=asexual cyst)
calm winter seas

Halosphaera - fagotrophy,
mixotrophic nutrition

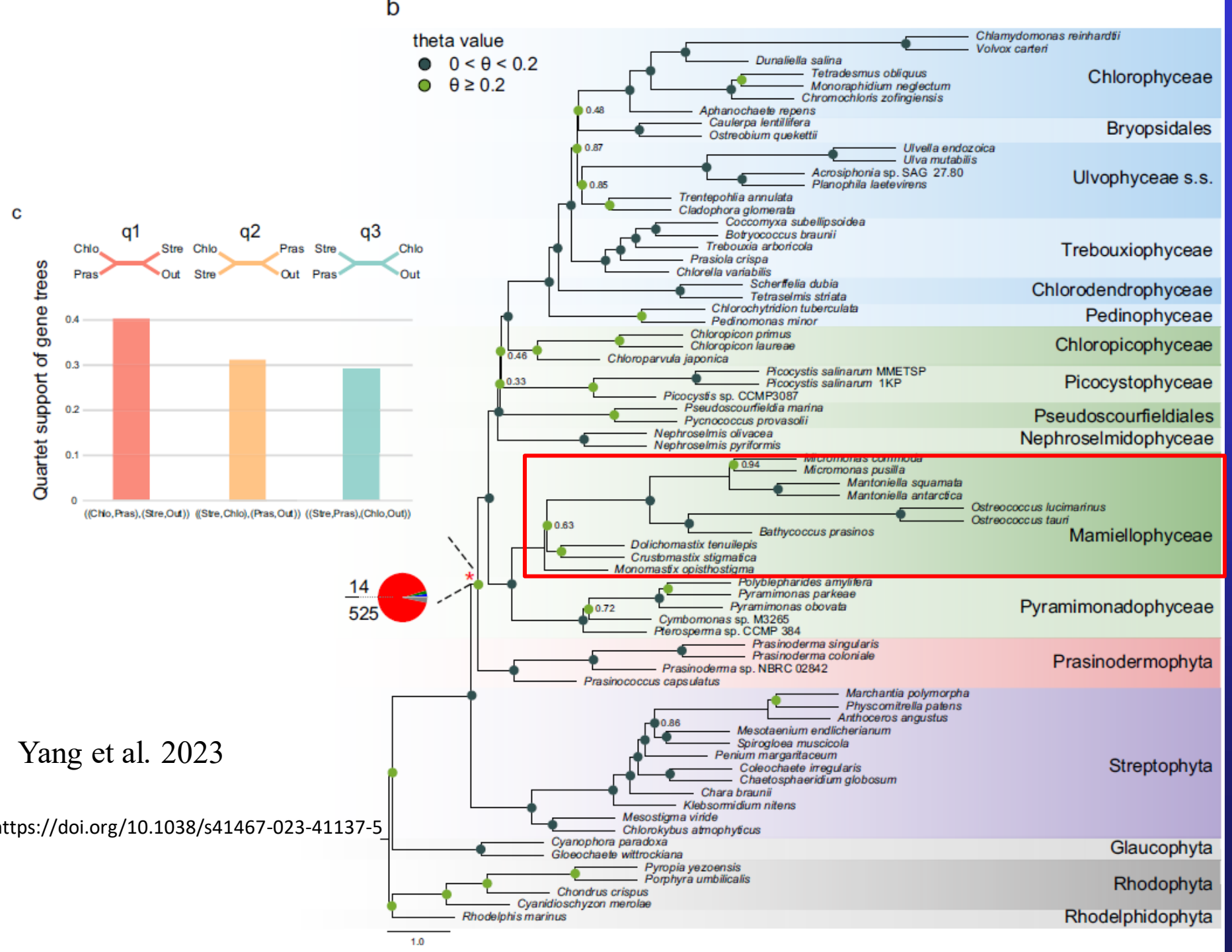
Fossil species

Tasmanites

600 mya - Precambrium



Pterospermella



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https://doi.org/10.1038/s41467-023-41137-5

Monomastigales

trychocysts=
ejectosomes

Light micrographs of *Monomastix opisthostigma*

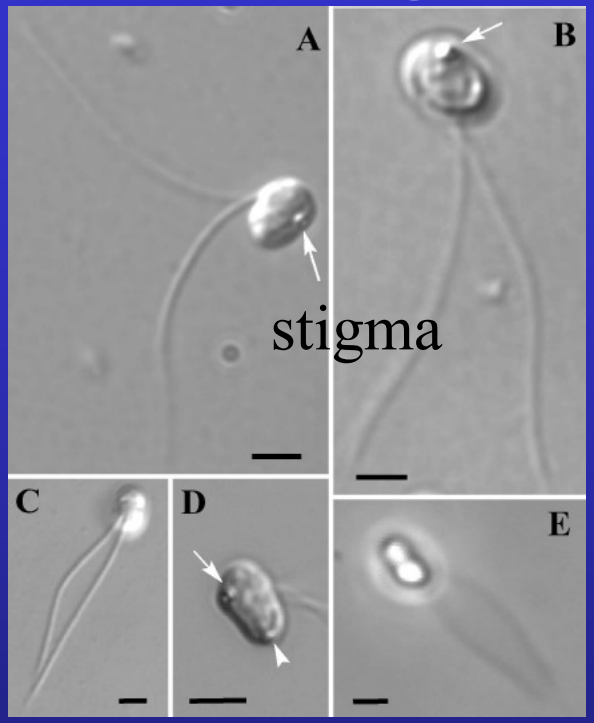
basal lineage – large cells up to 20 µm

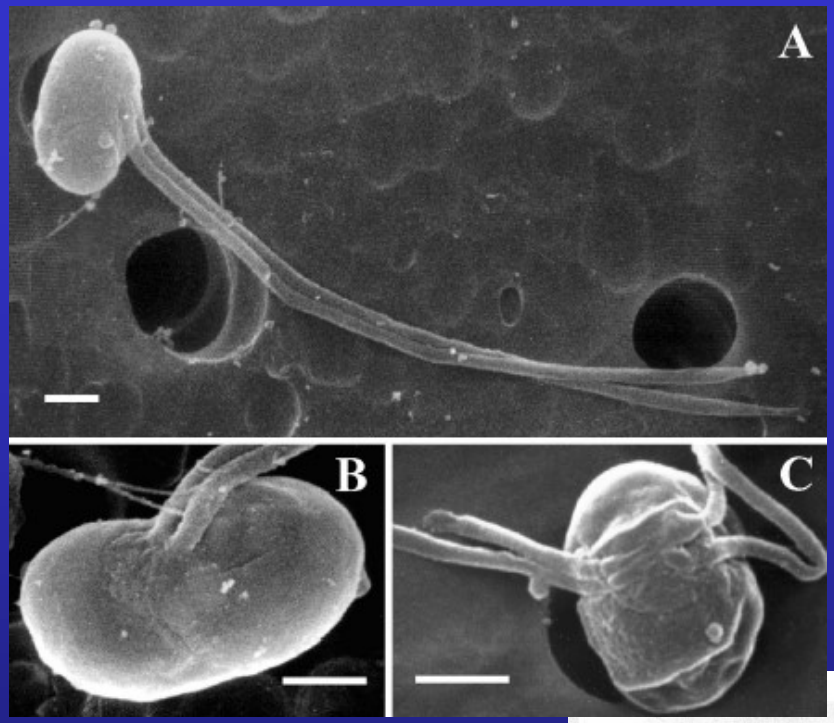
Dolichomastigales and the Mamiellales cells are usually no longer than 5 µm and in two lineages (Bathycoccaceae and *Micromonas*) are reduced to the size of the smallest eukaryotes (1 µm; Courties et al. 1994). Cell size reduction is accompanied by loss of the flagellar apparatus and eyespot (Bathycoccaceae) and/or the scaly covering (*Ostreococcus* and *Micromonas*).

Dolichomastigales

Crustomastix stigmatica

Zingone et al.2002

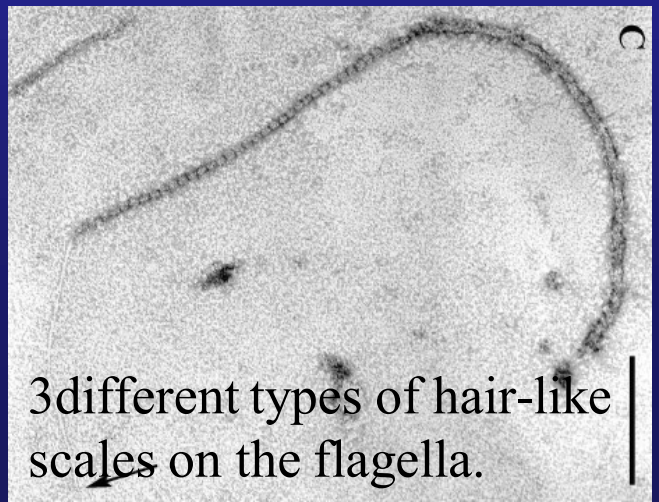


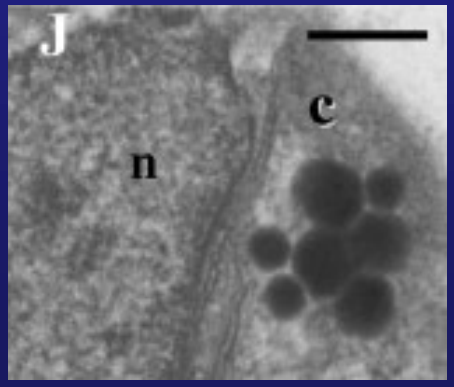


3-5 µm, scales on long flagella, stigma; isolated from Mediterranean Sea

dividing cells

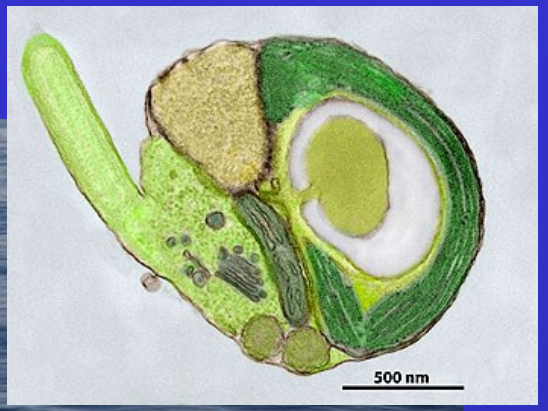
No flat scales



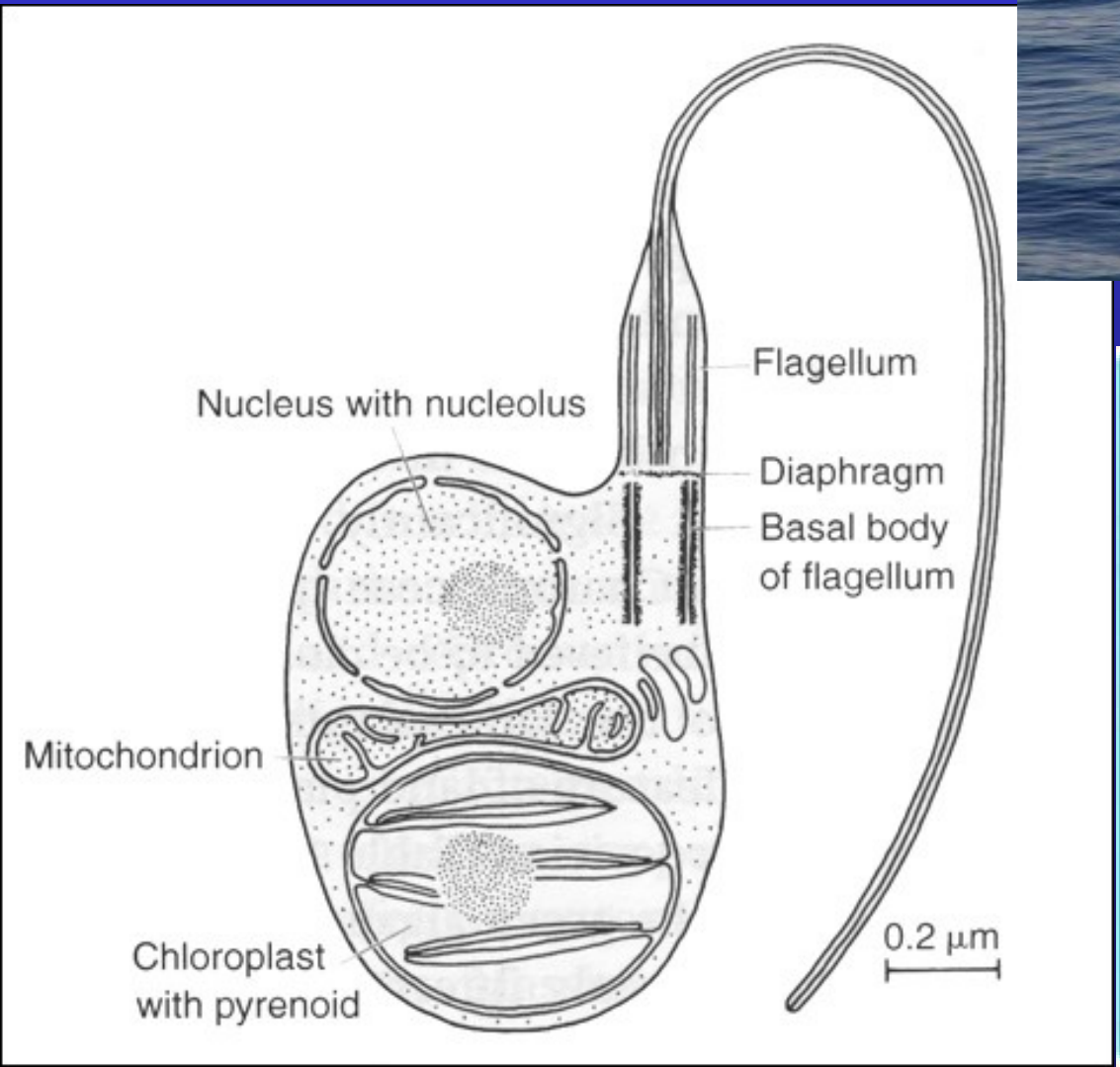


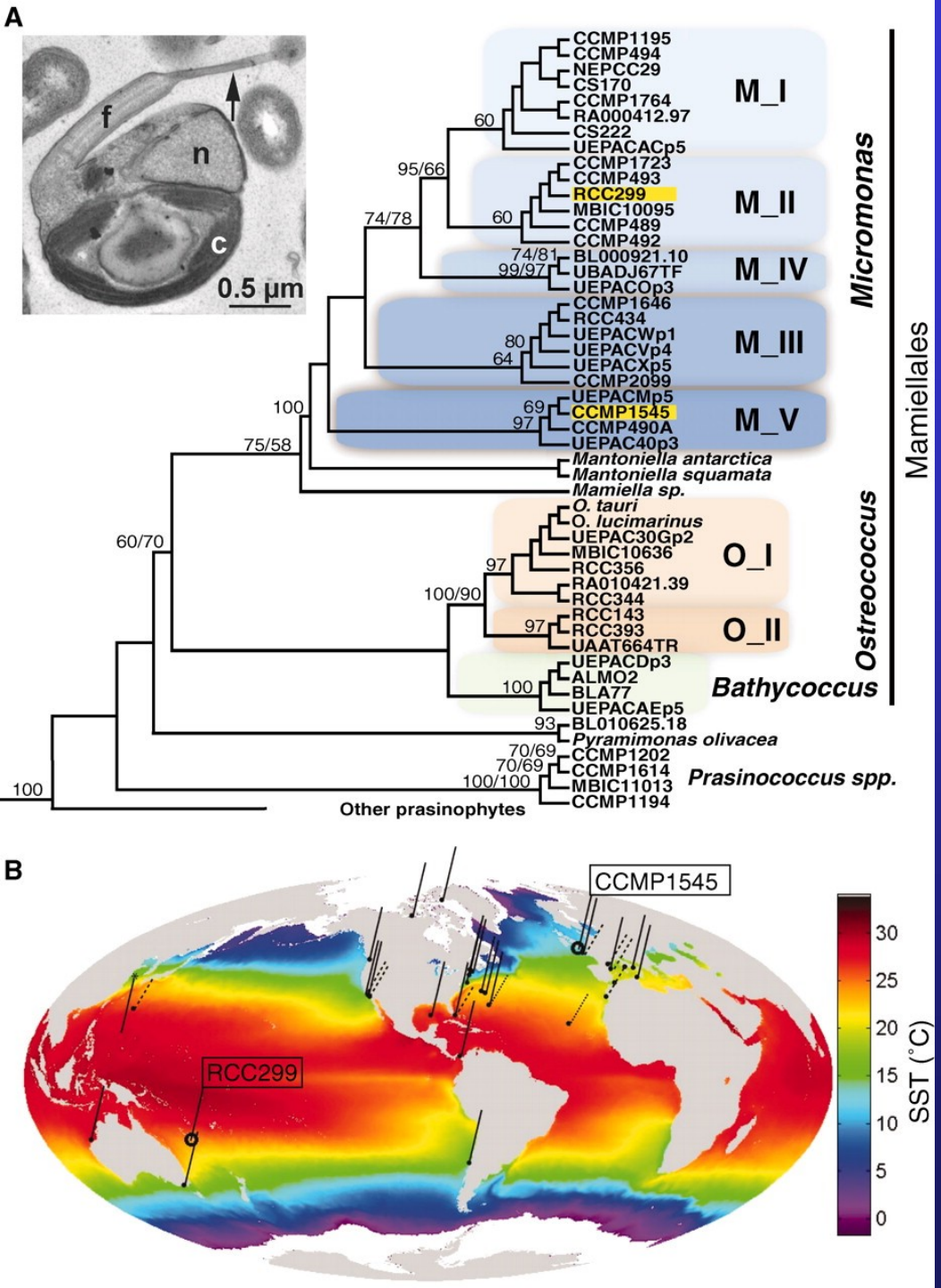
Mamiellales

Micromonas pusilla –
without scales



oceanic picoplankton

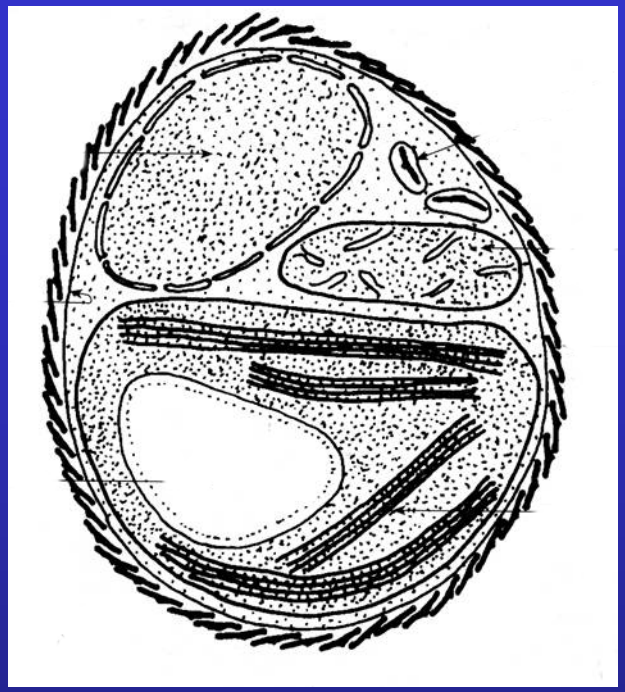


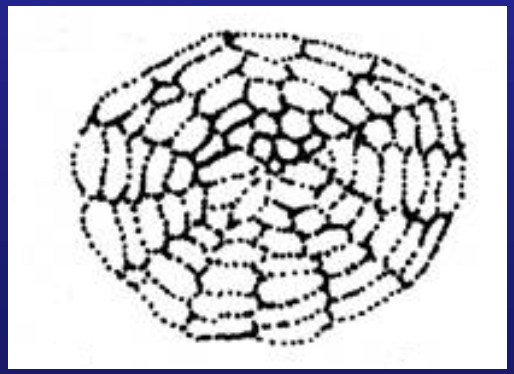


Micromonas phylogeny and distribution NJ tree. (**B**) Mean sea surface temperature (SST) for 2006 measured with global high-resolution SST (GHRSST) blended infrared and microwave SSTs, and locations where *Micromonas* (solid lines and circles around the isolates used in this work) and *Ostreococcus* (dashed lines) 18*S* rDNA sequences have been recovered. *Micromonas* appeared in all temperature regimes.

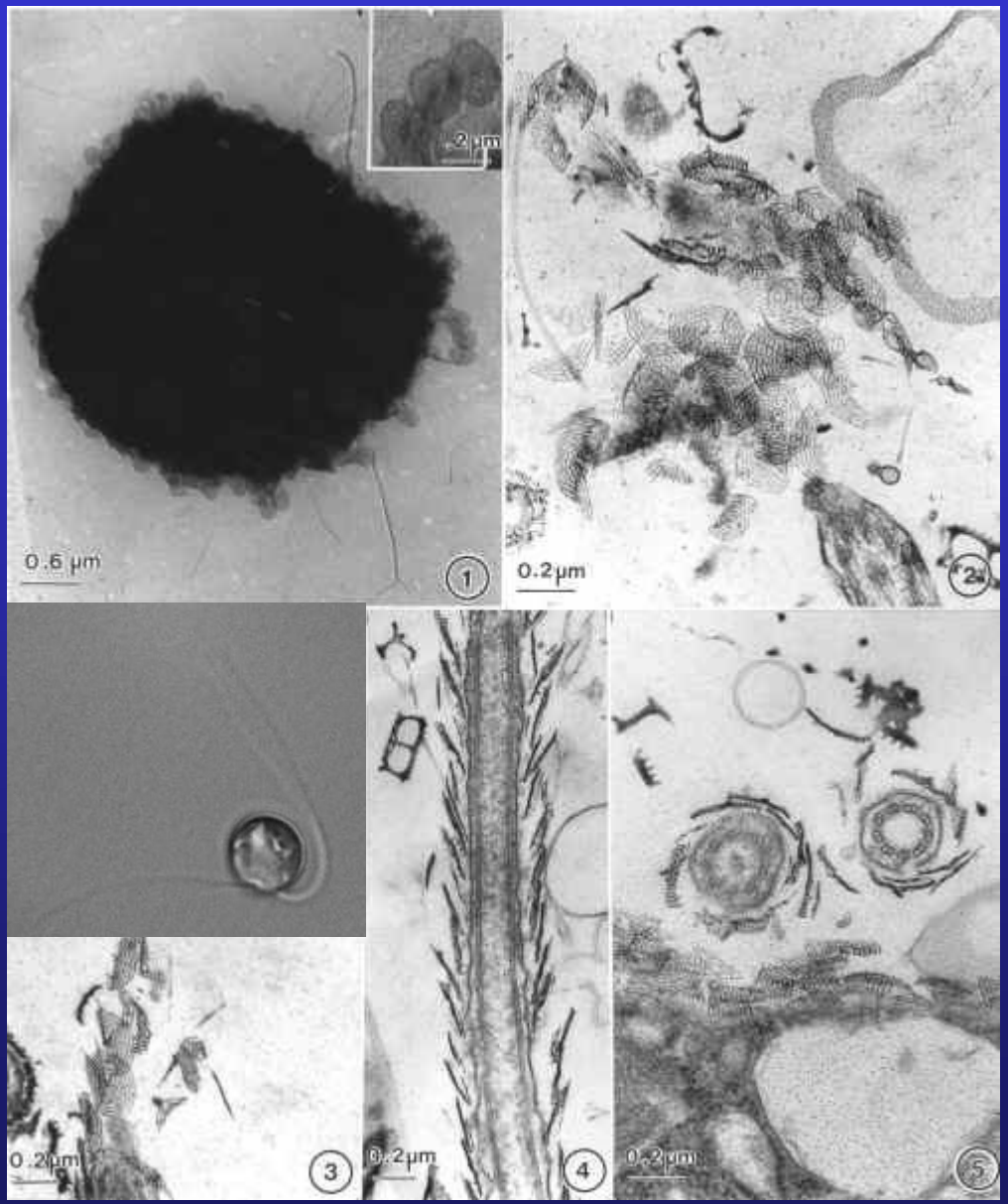
Worden *et al. 2009*

Mamiellophyceae



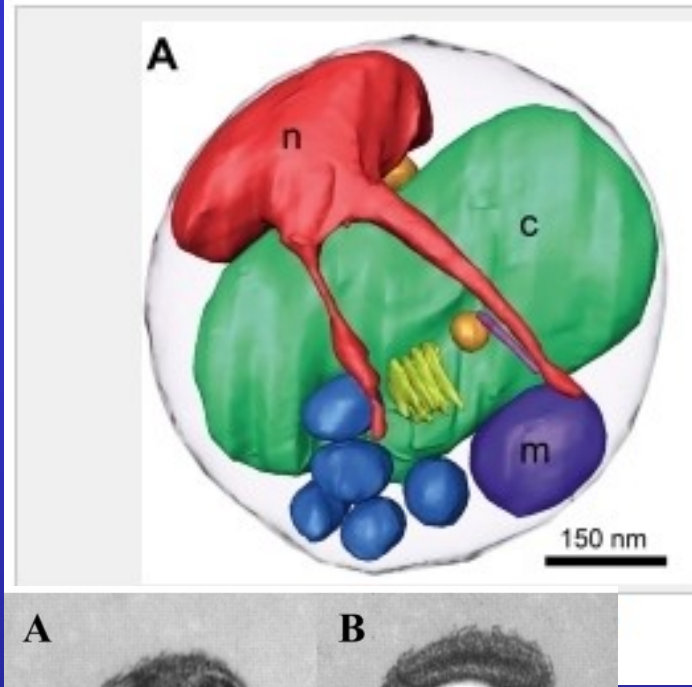


Bathycoccus – lost of flagellum
North Atlantic



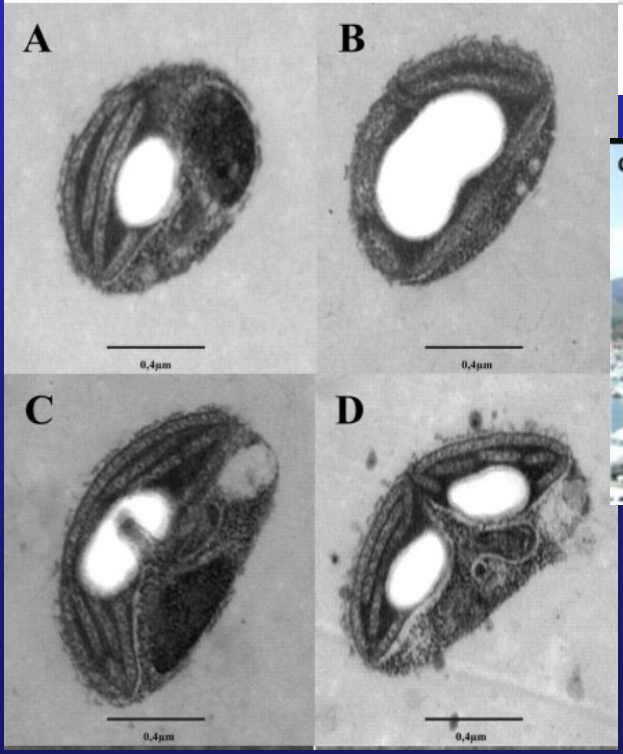
Mamiella gilva

Mamiellales

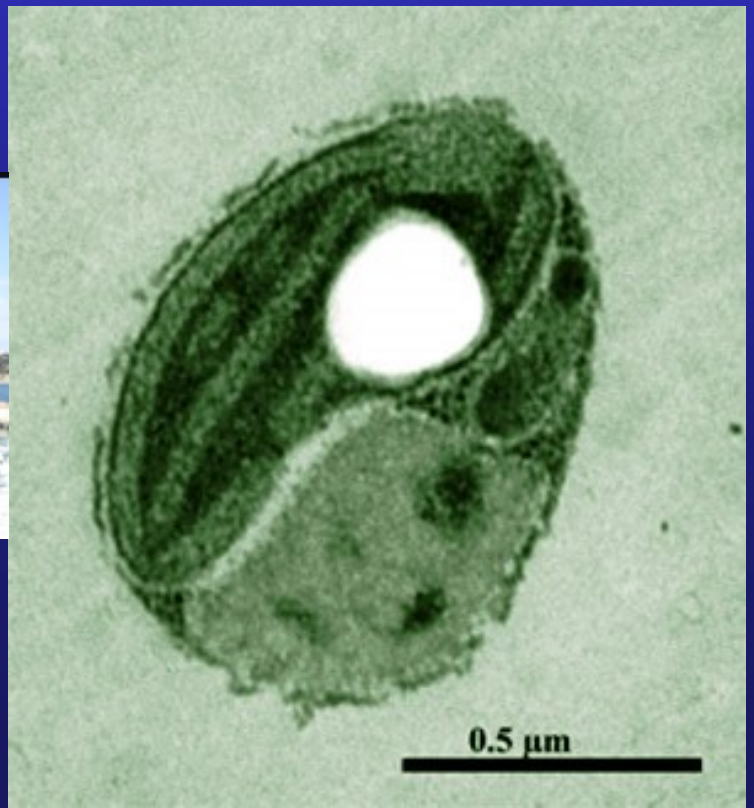


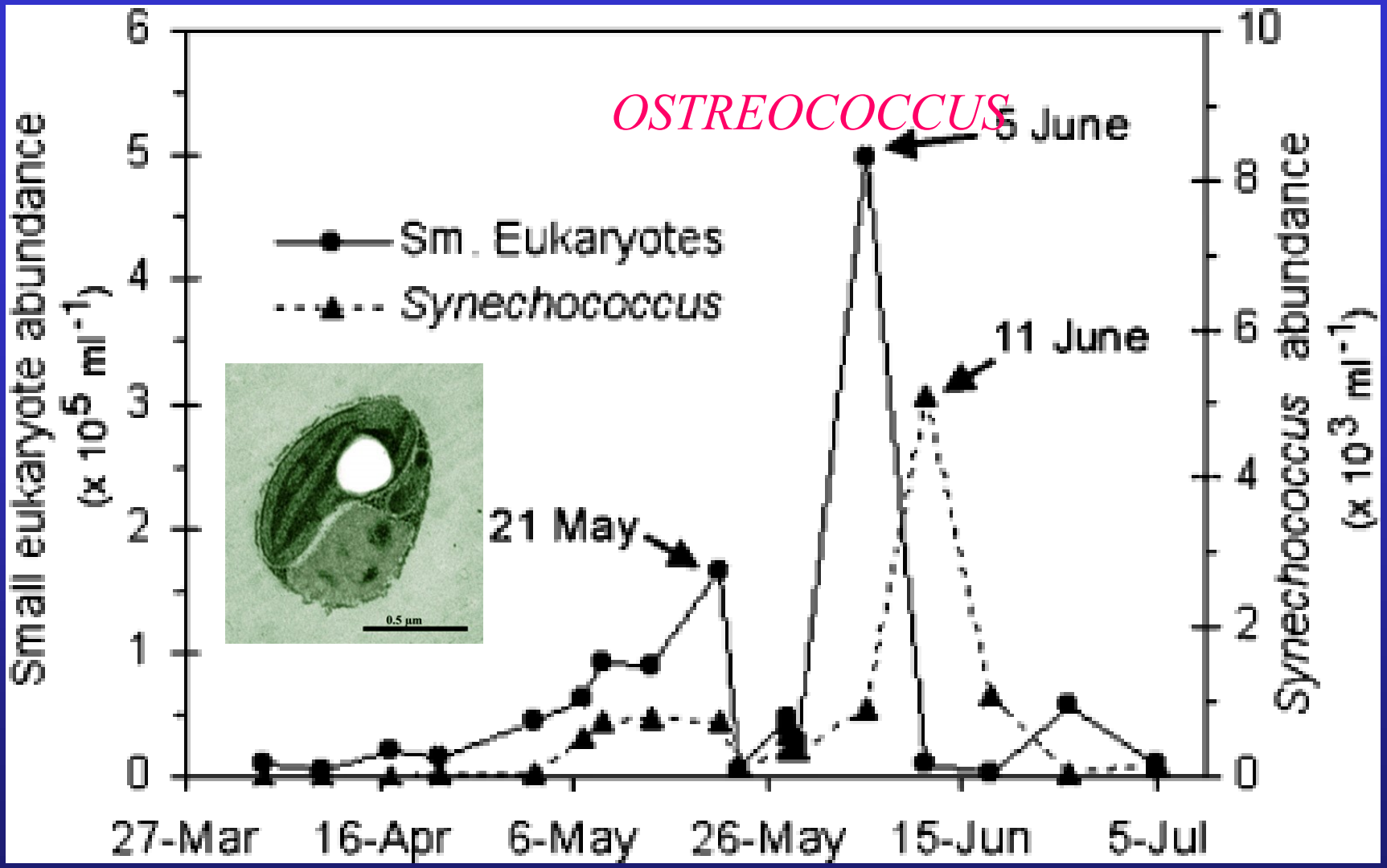
Ostreococcus belongs to the is reported as a globally abundant, single-celled alga thriving in the upper (illuminated) water column of the oceans.

Blooms in the sea, the smallest eukaryotic genom (12 Mbp)

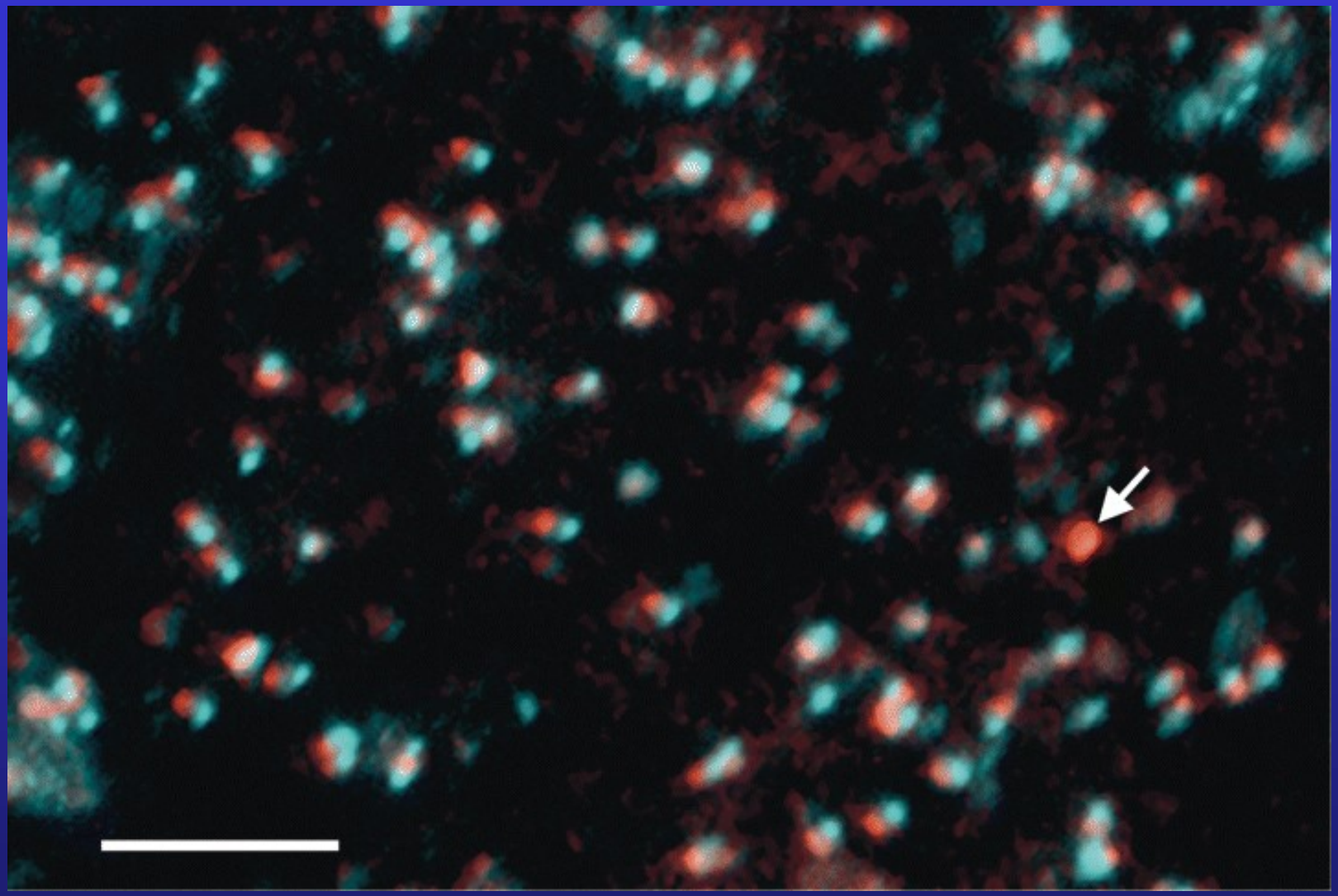


diploid human g. 6.27 Gbp





1. Abundances of small eukaryotes and *Synechococcus* cells over the 2001 study period in West Neck Bay, New York as counted by flow cytometry. Major bloom events are indicated. Note difference in scales.



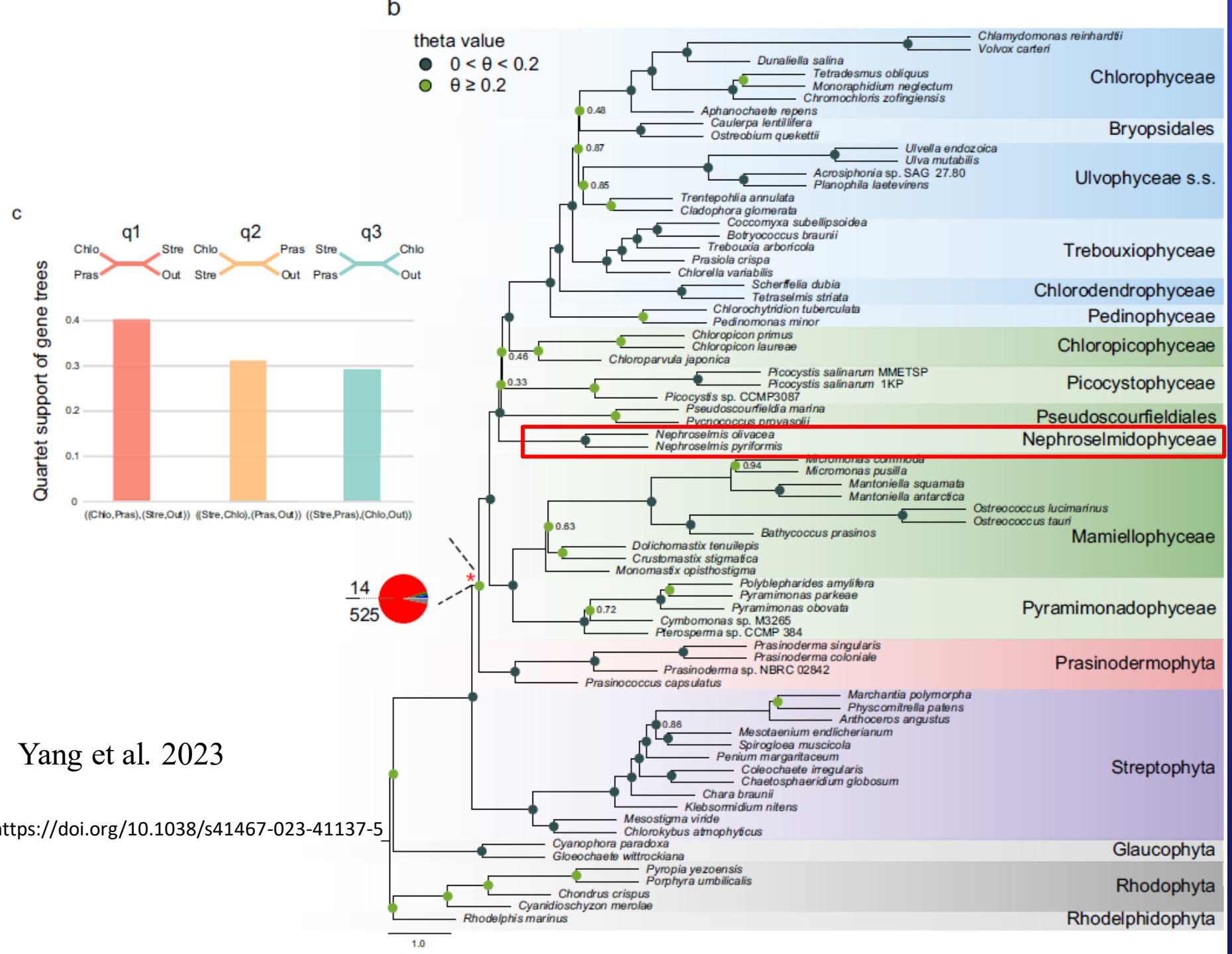
Color composite epifluorescence micrograph showing DAPI-stained *Ostreococcus*-like cells with nuclei (cyan) and chloroplasts (red autofluorescence). A single *Synechococcus* cell (arrow) is also present. Scale bar, 10 μm.

O'Kelly et al. 2003

Mamiellophyceae

Do they reproduced sexually???

Ostreococcus as well as *Micromonas* may contain meiotic genes and thus reproduce sexually (Derelle et al. 2006; Worden et al. 2009), but experimental proof for sexual reproduction in the Mamiellophyceae is still lacking.



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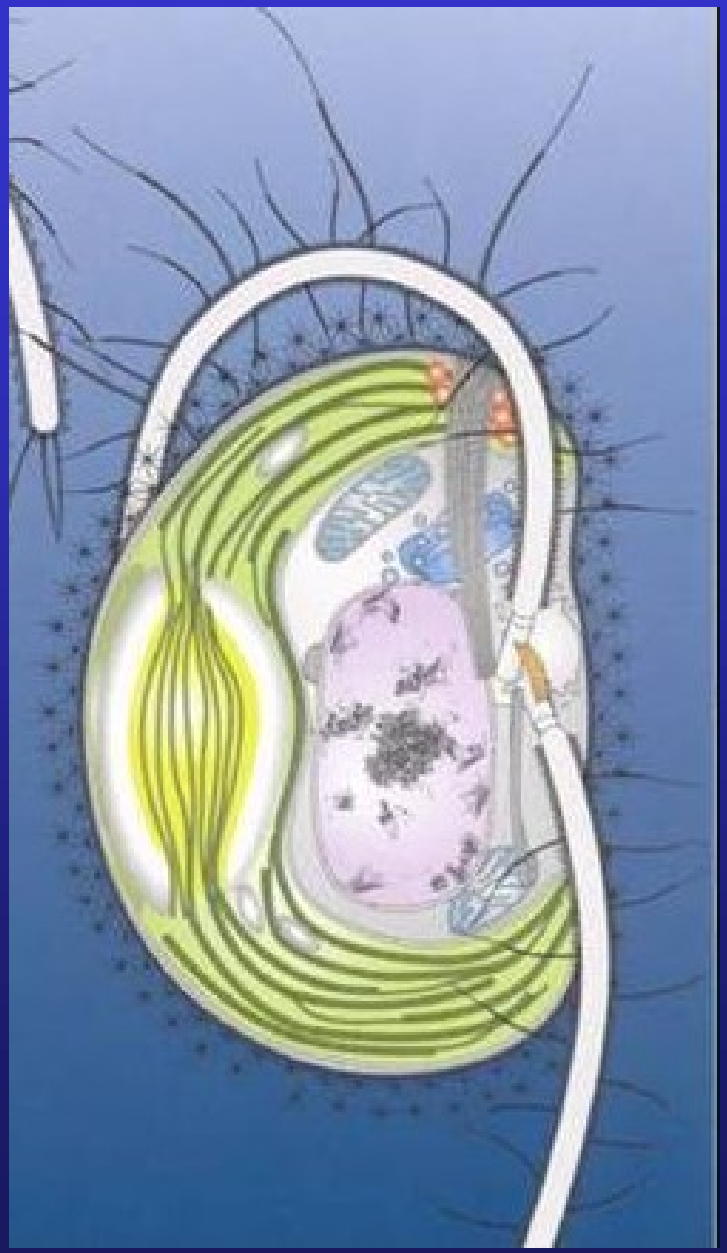
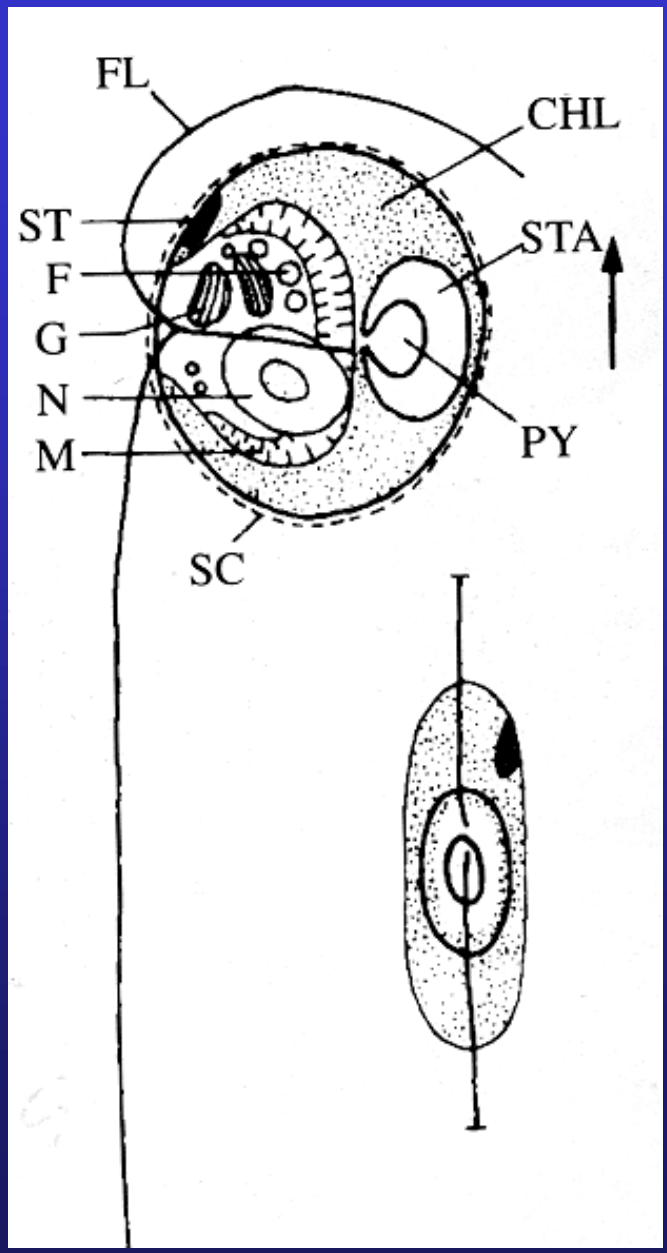
https://doi.org/10.1038/s41467-023-41137-5

Nephroselmidophyceae

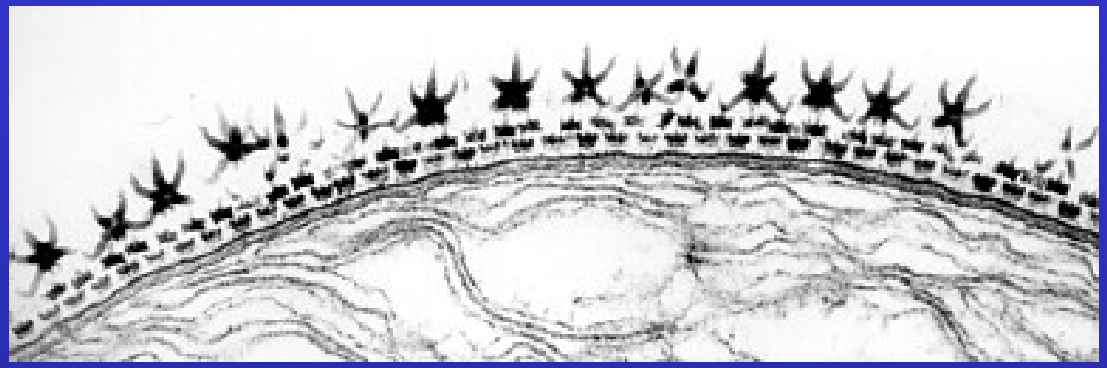
Nephroselmis



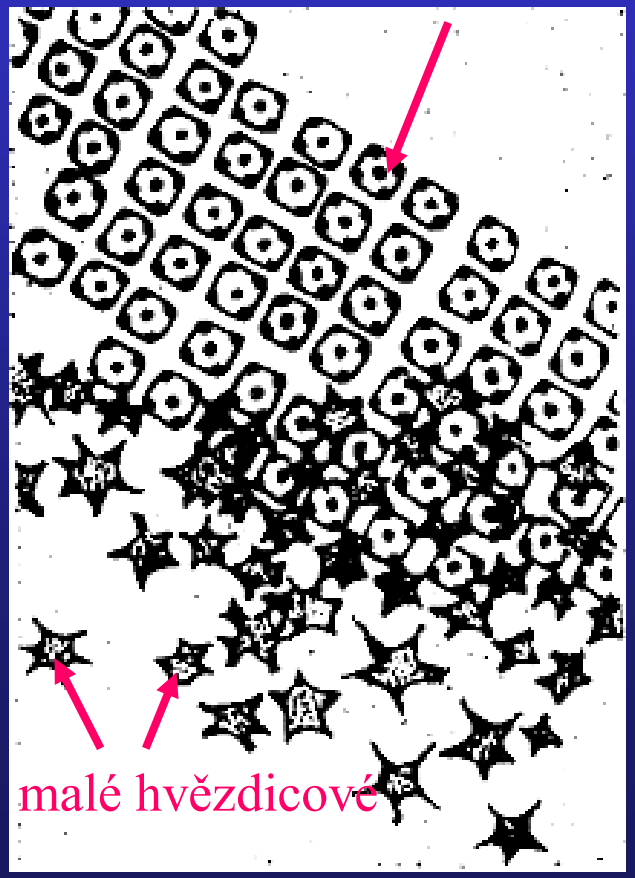


Organic scales

Nephroselmis

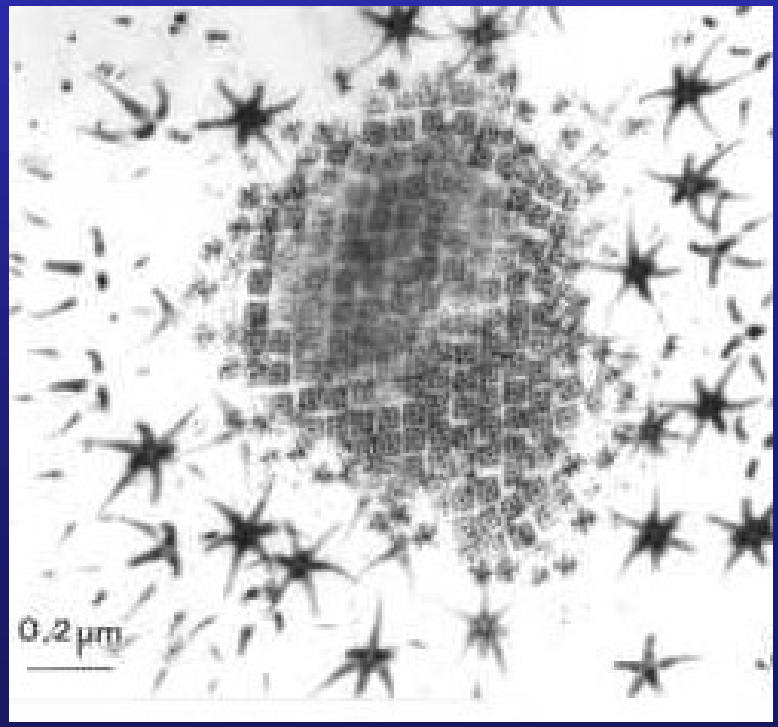


malé čtvercové



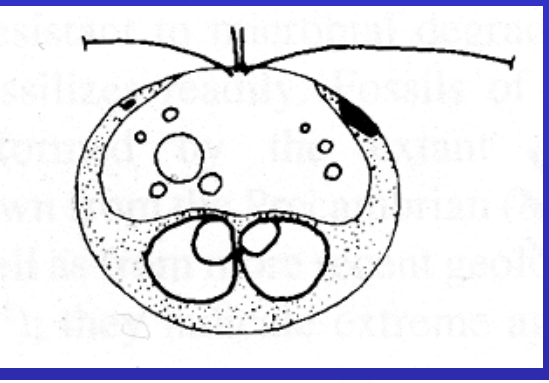
malé hvězdicové

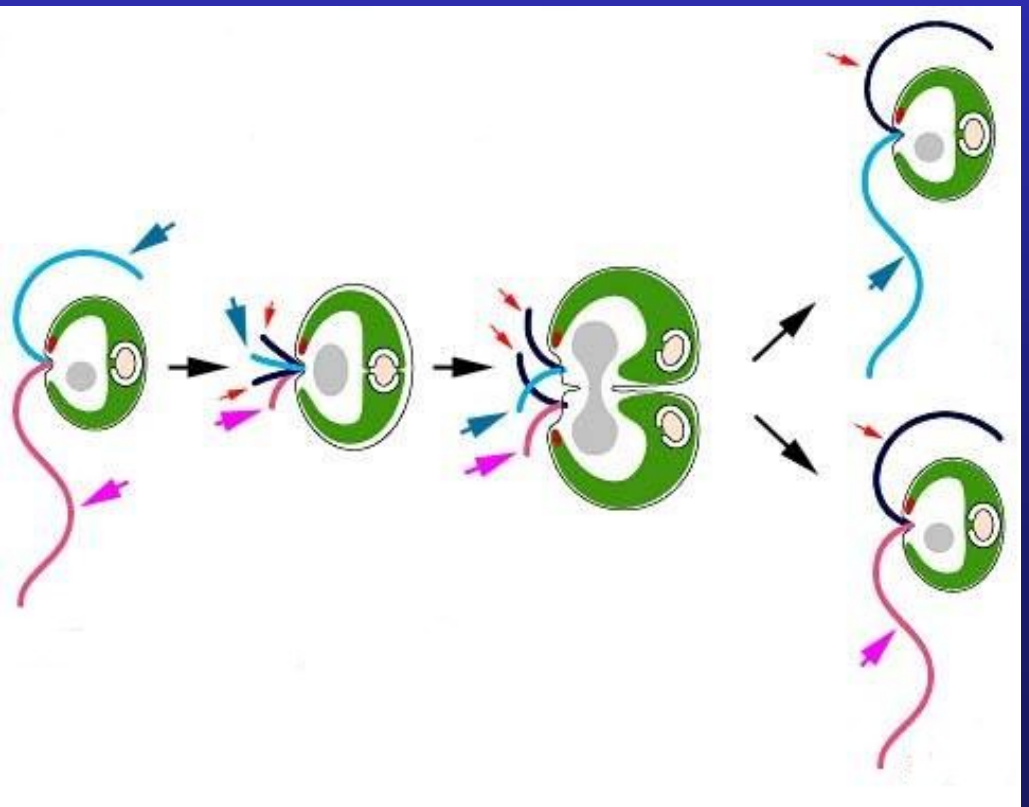
velké hvězdicové



Mitosis and cytokinesis

- schizotomy

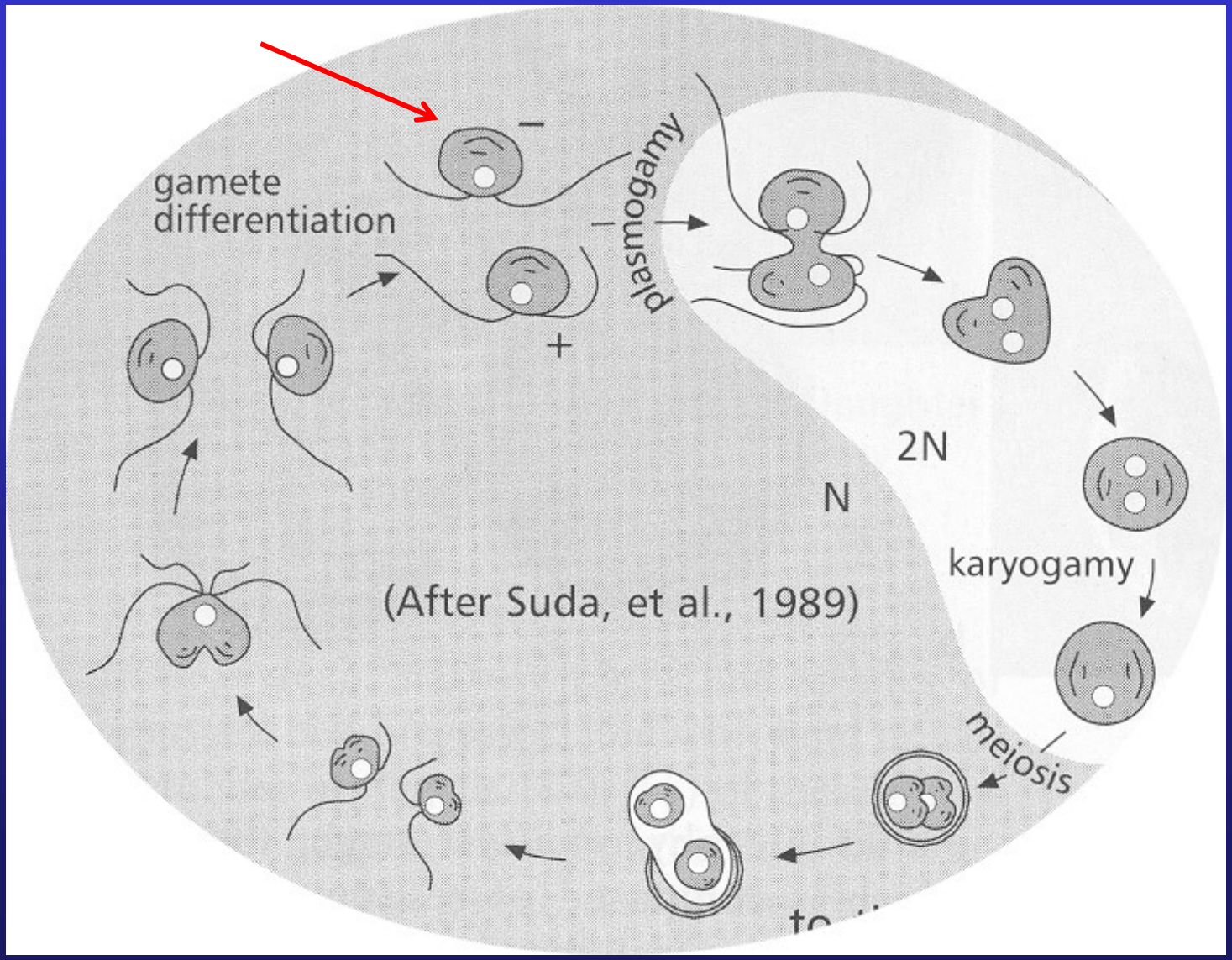




Nephroselmis rotunda

Sexual reproduction

Haplontic life cycle, izogamy, heterothalism



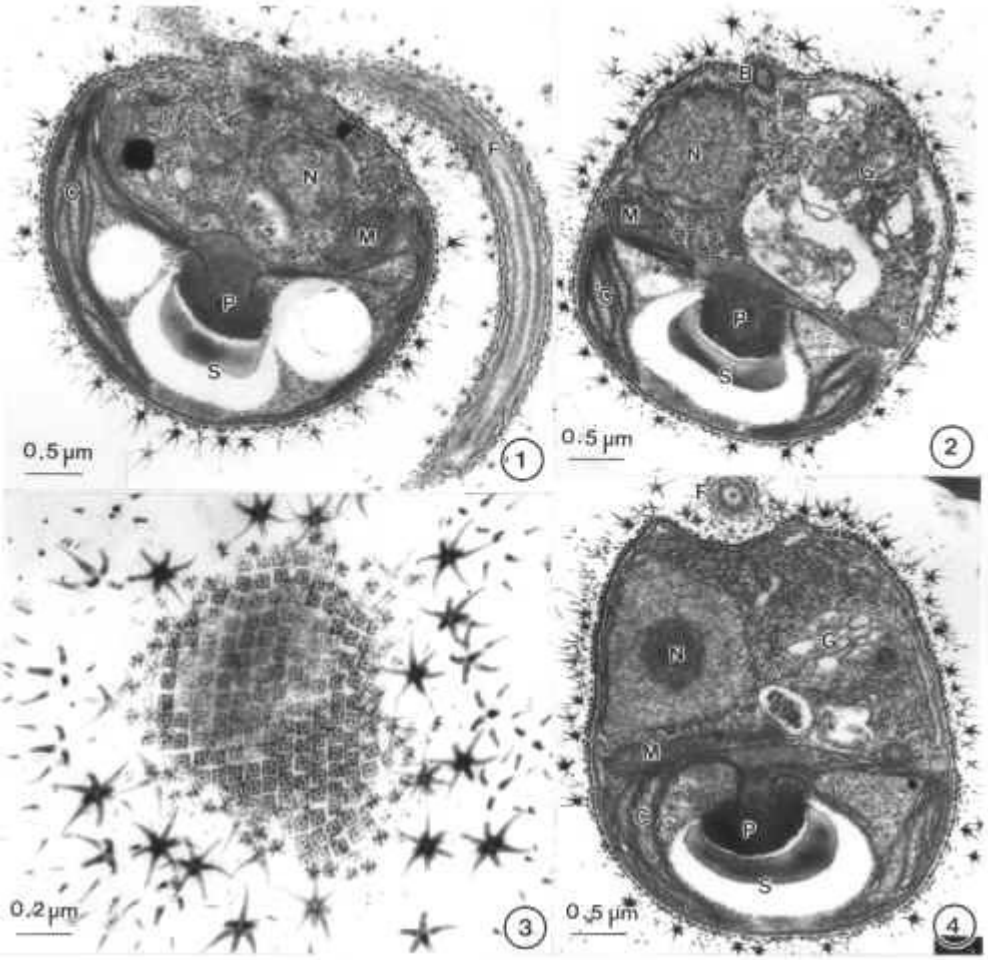
Nephroselmis olivacea

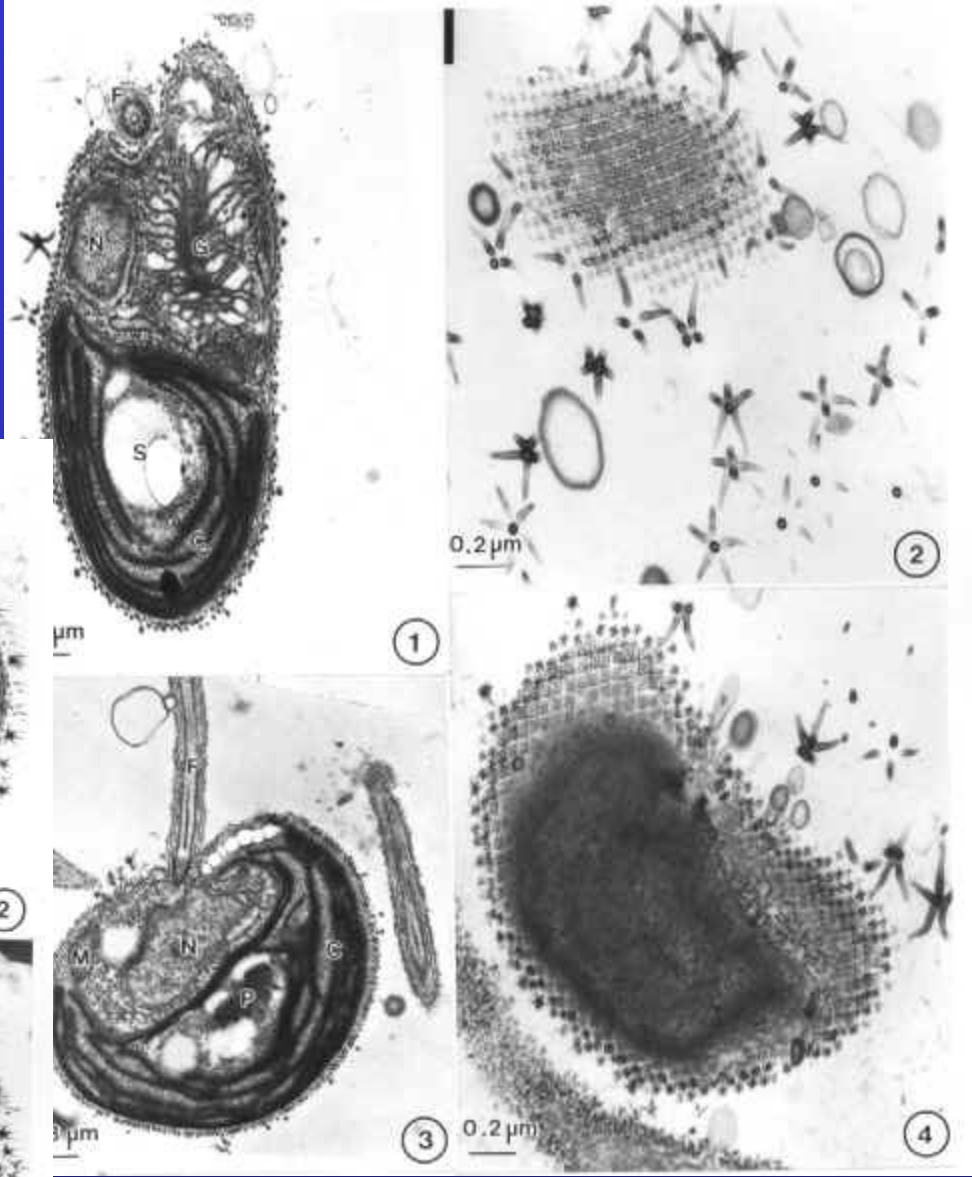
Nephroselmis - ultrastructure

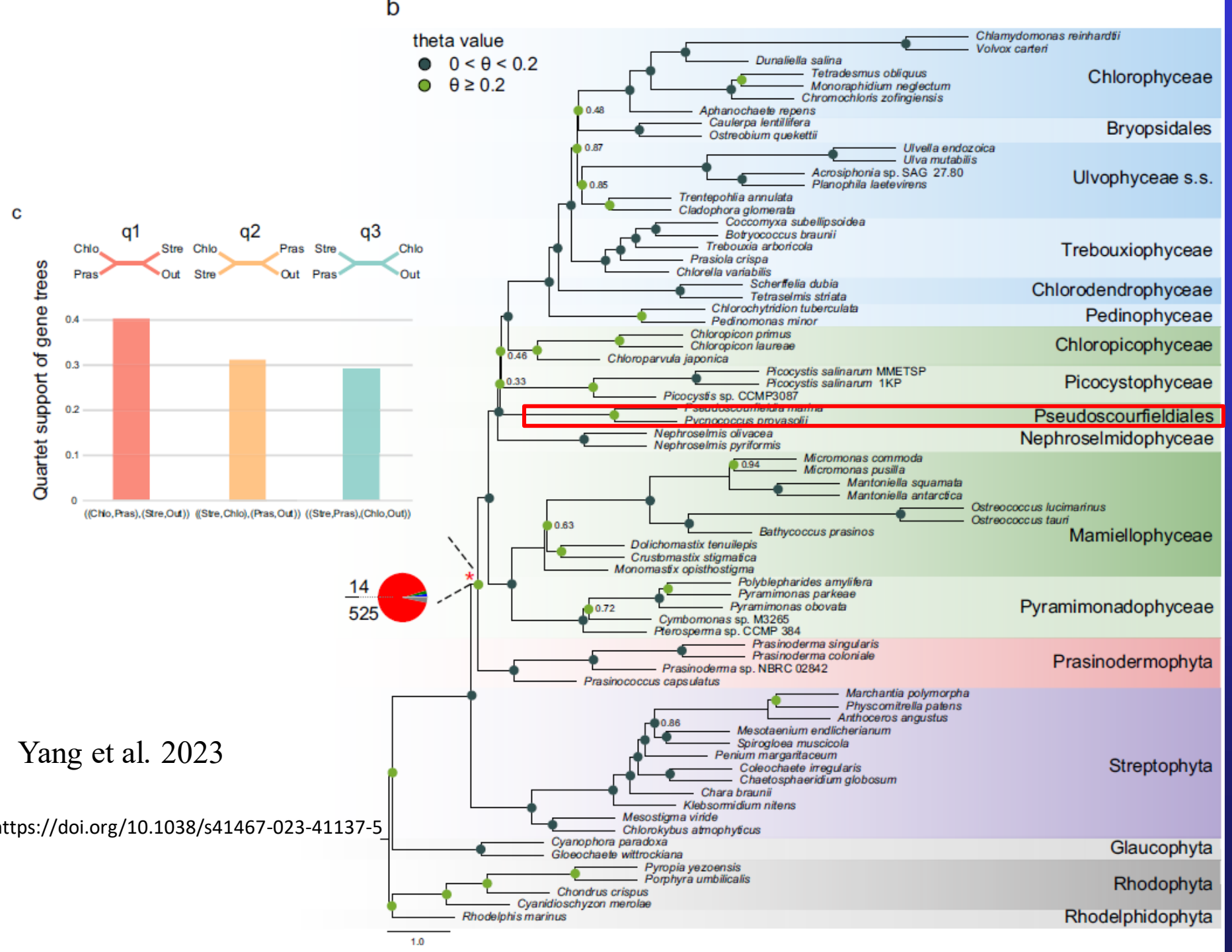
malé čtvercové

malé hvězdicové

velké hvězdicové







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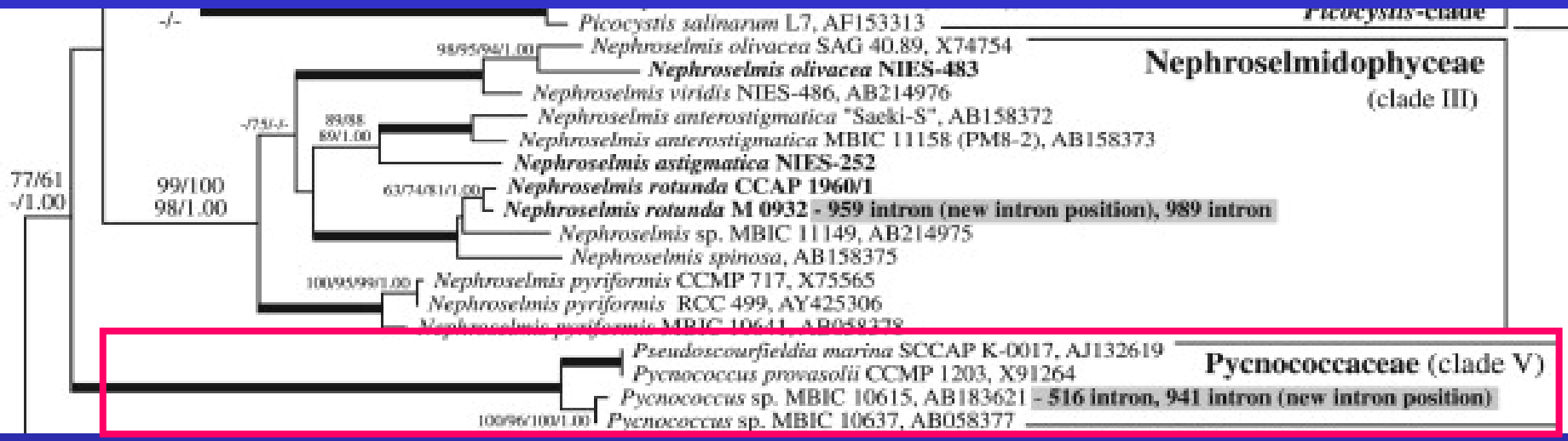
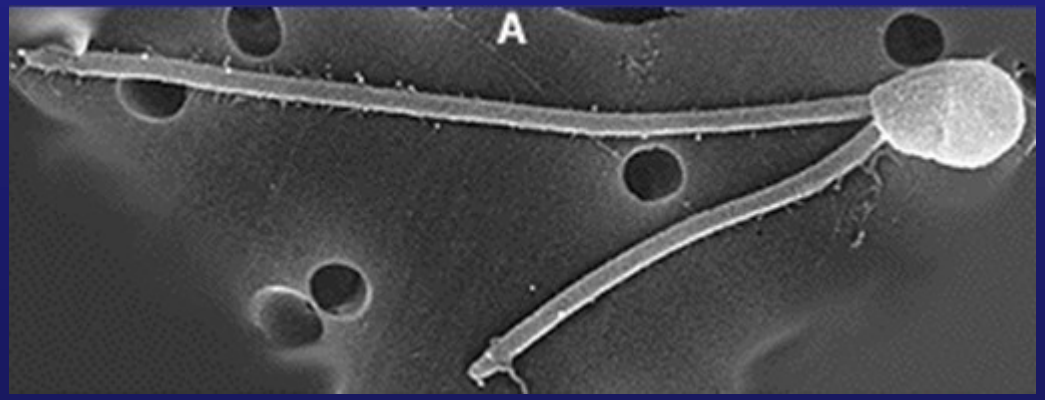
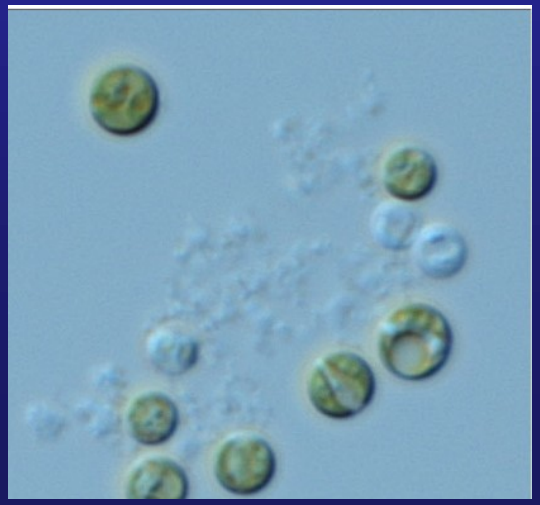
https://doi.org/10.1038/s41467-023-41137-5

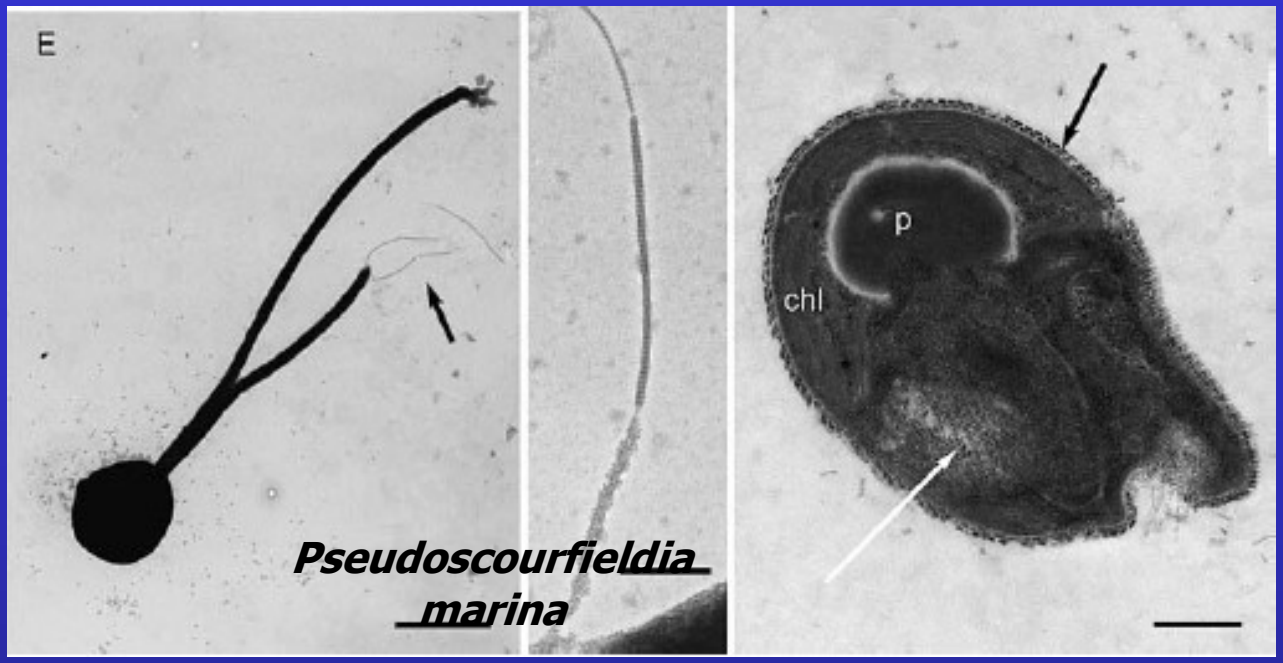
Pseudoscourfieldiales



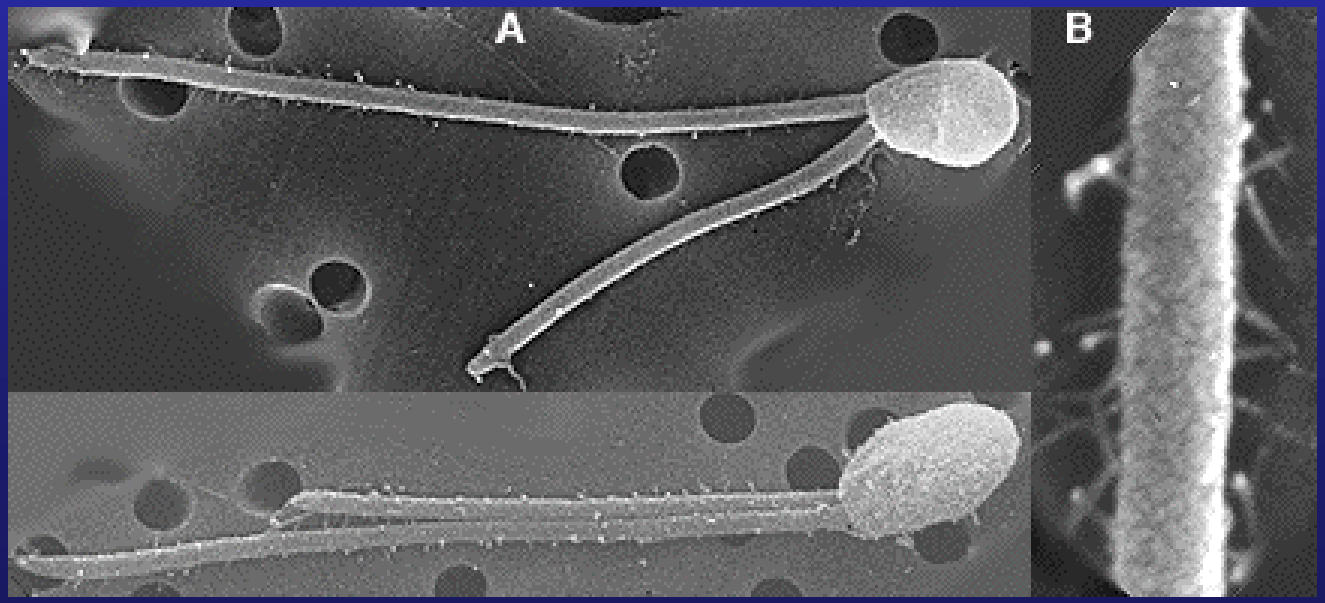
Pseudoscourfieldia marina and *Picnococcus provasolii* are genetically identical and presumably represent different life history stages of a single taxon; unpubl.

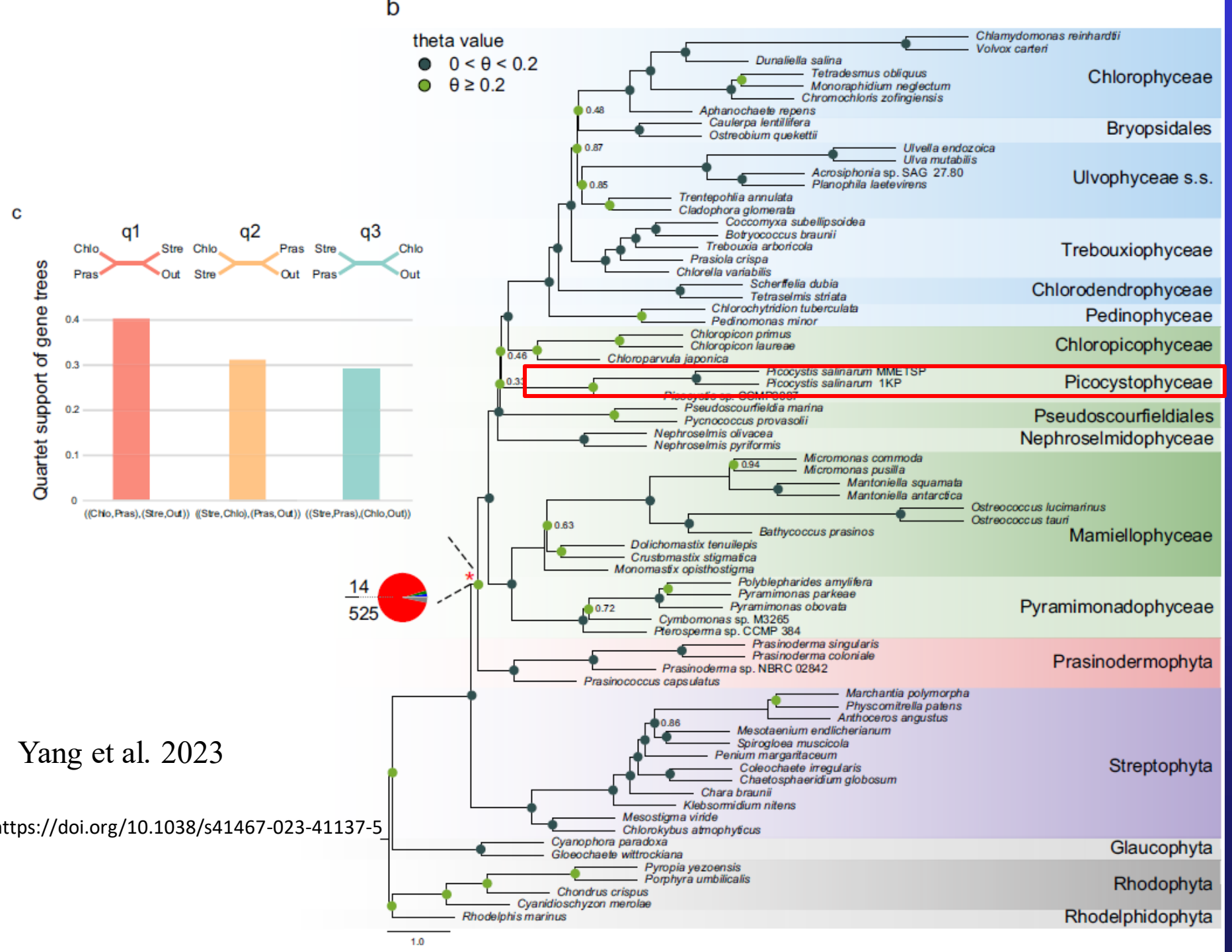






Guillou et al. 2004

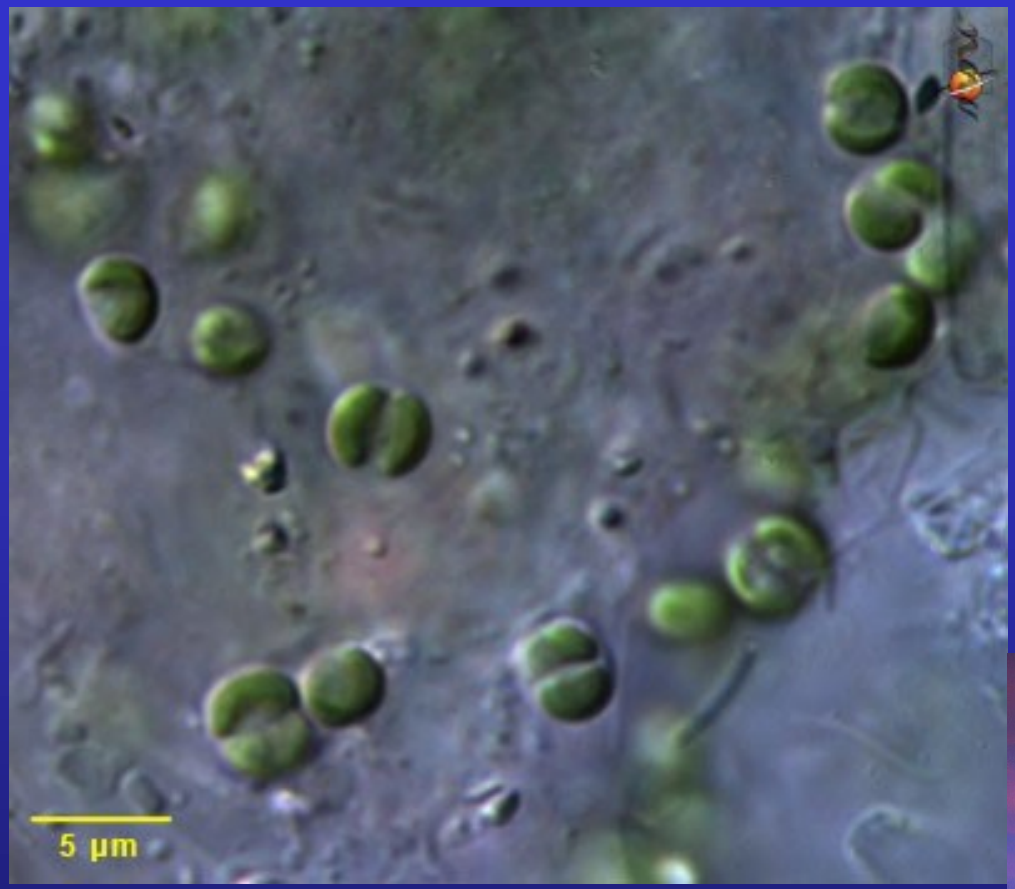




Yang et al. 2023

https://doi.org/10.1038/s41467-023-41137-5

Picocystophyceae - *Picocystis salinarum* halophytic

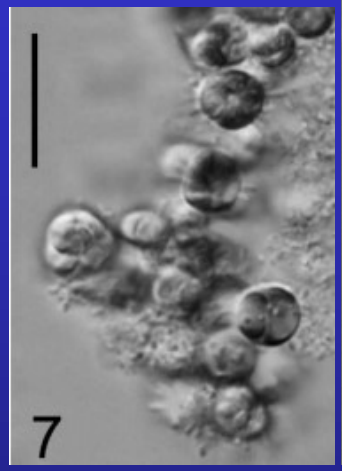


Layered cell wall containing polyarabinose, mannose, galactose and glucose

Mono Lake California

Krienitz et al. 2012

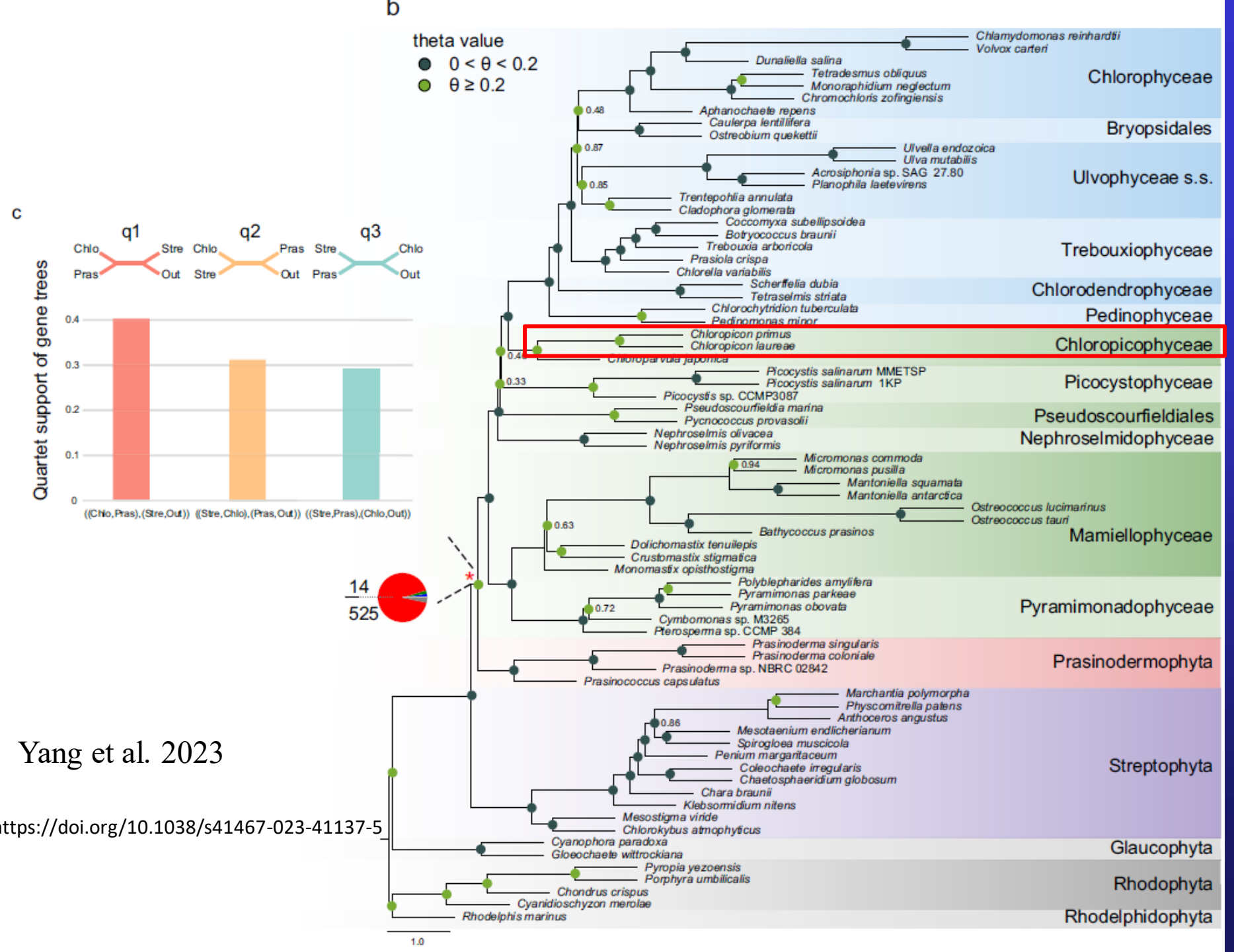
Picocystis salinarum (Chlorophyta) in saline lakes and hot springs of East Africa



Picocystis occasionally replaces the dominant cyanobacterium (*Limnospira fusiformis*), which is the main food resource of Lesser Flamingos, in soda lakes of Bogoria and Nakuru

Východní Afrika – alkalická „soda lakes“

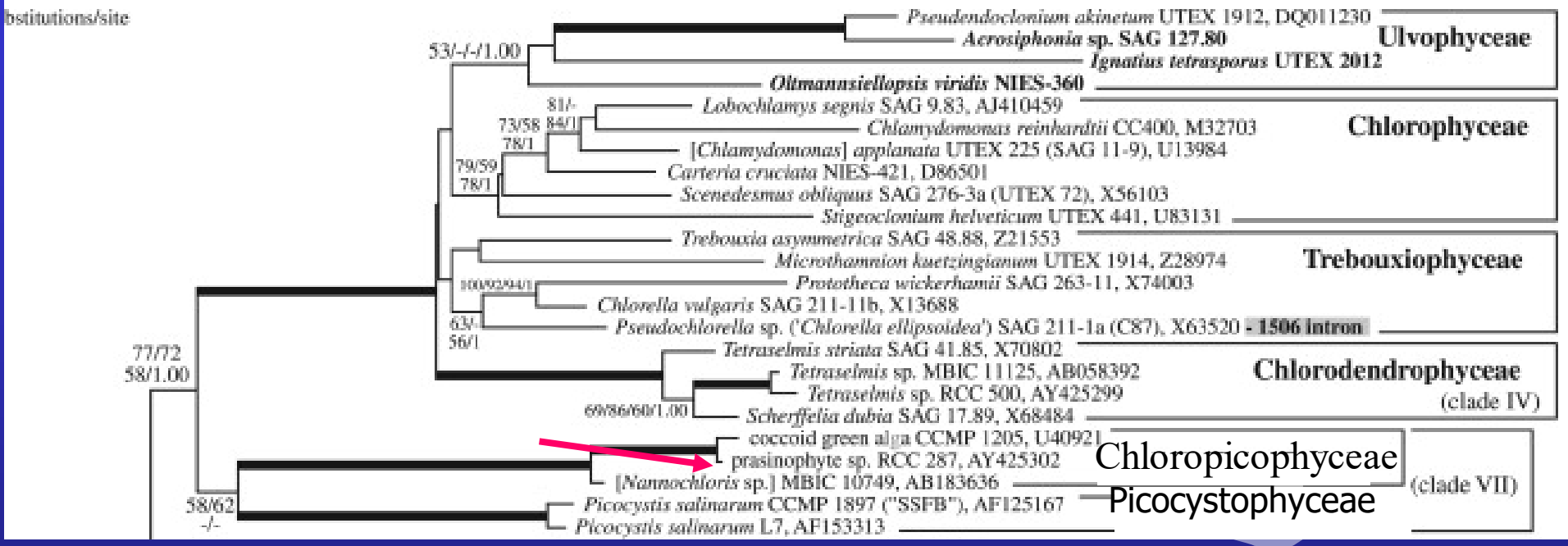
např. jezero Bogoria

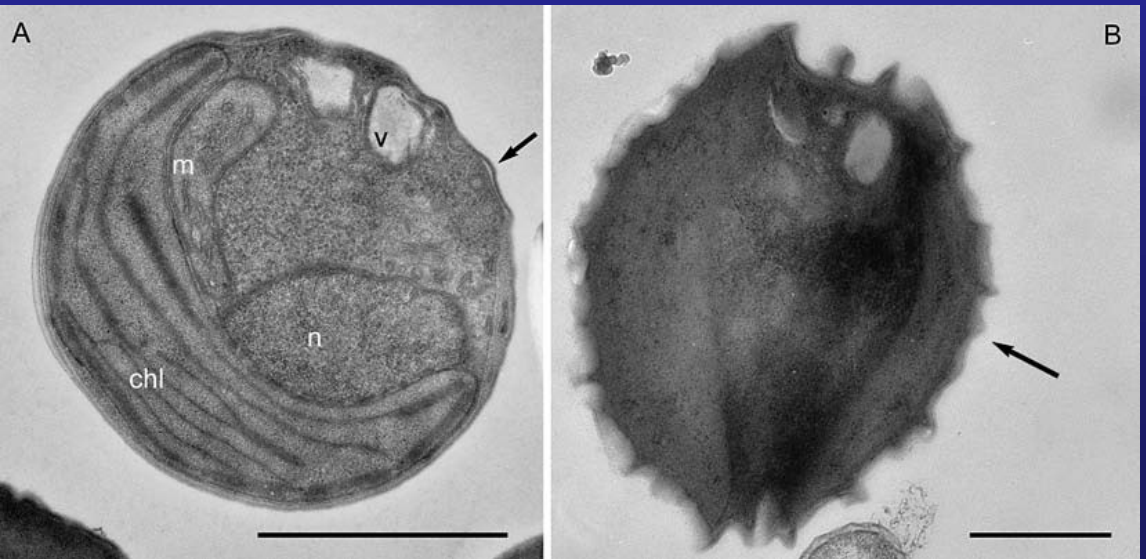


Yang et al. 2023

https://doi.org/10.1038/s41467-023-41137-5

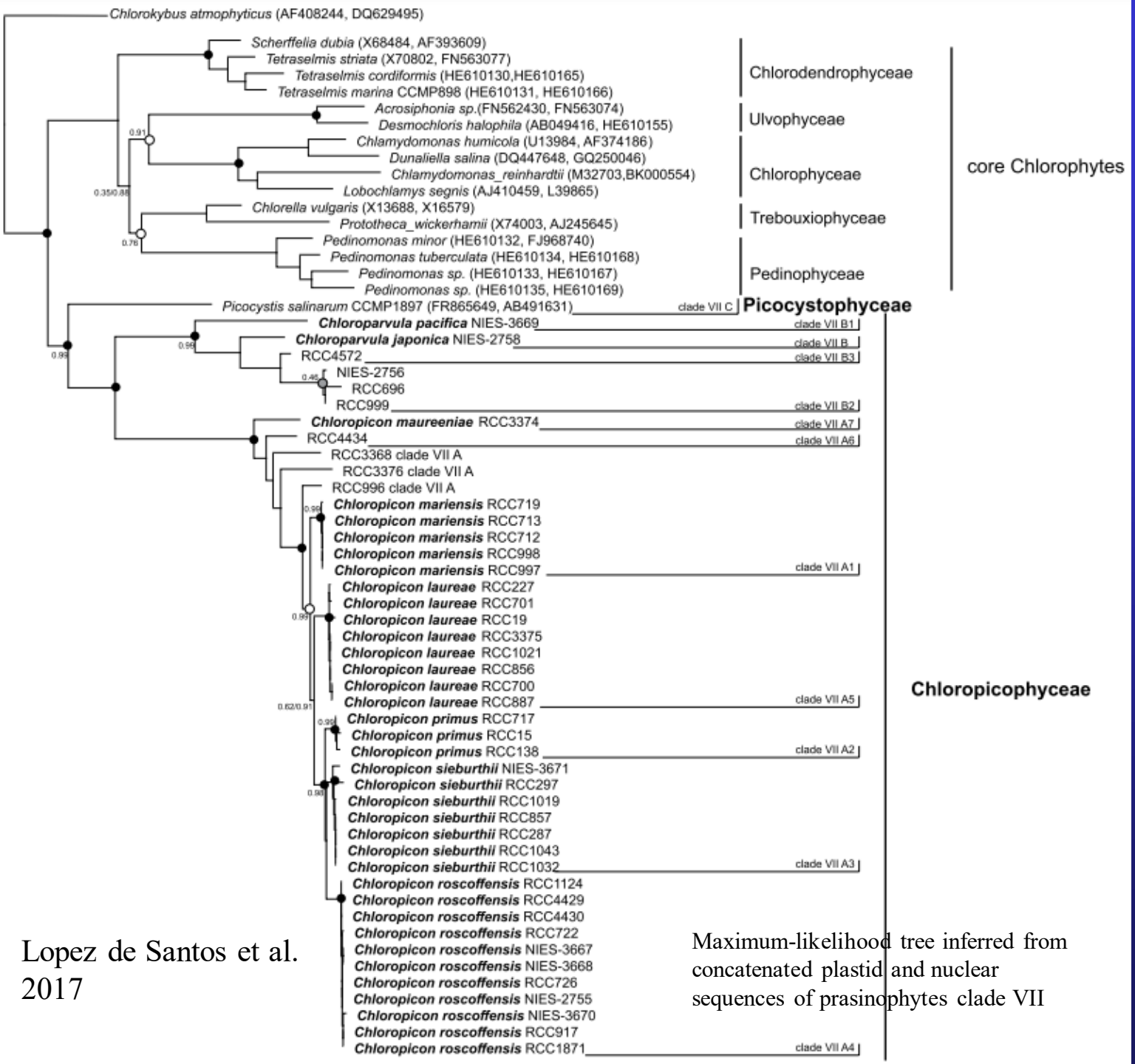
Chloropicophyceae





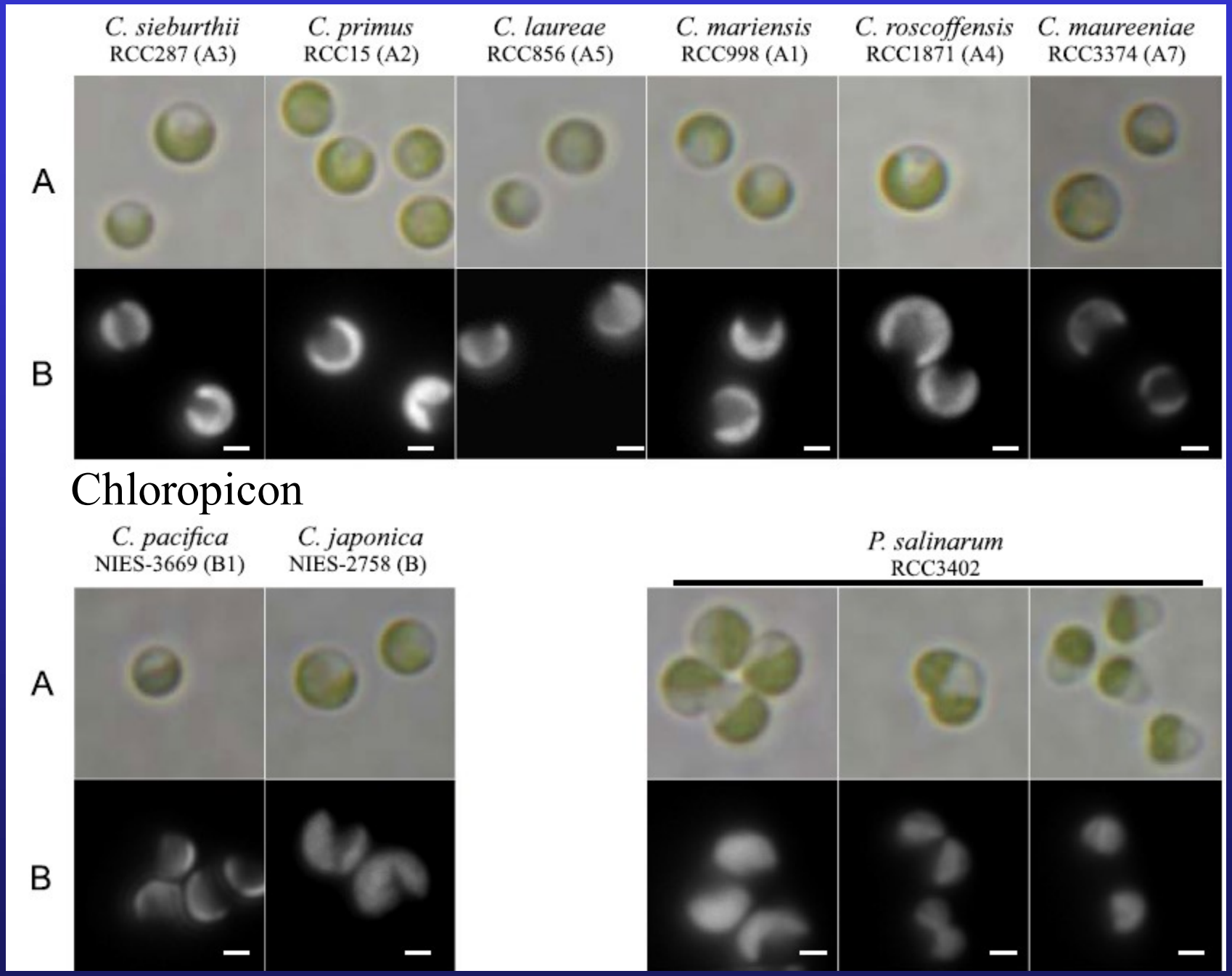
Chloropicon sieburthii

a diameter of 1.5–4 µm, found in oligotrophic marine waters

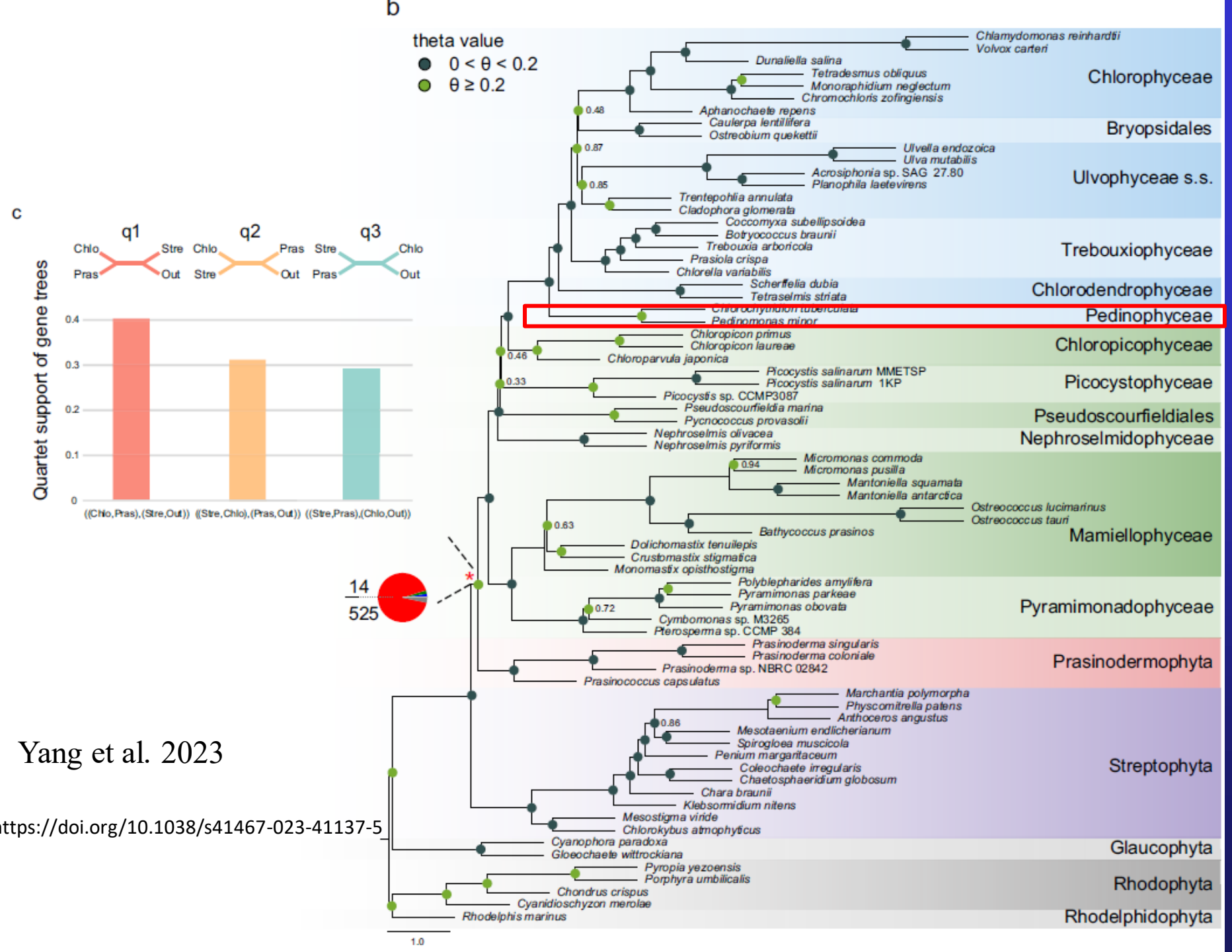


Lopez de Santos et al. 2017

Maximum-likelihood tree inferred from concatenated plastid and nuclear sequences of prasinophytes clade VII


C. sieburthii
RCC287 (A3)
C. primus
RCC15 (A2)
C. laureae
RCC856 (A5)
C. mariensis
RCC998 (A1)
C. roscoffensis
RCC1871 (A4)
C. maureeniae
RCC3374 (A7)
A
B
Chloropicon
C. pacifica
NIES-3669 (B1)
C. japonica
NIES-2758 (B)
P. salinarum
RCC3402
A
B

Core chlorophytes:
Ulvophyceae/Chlorophyceae/Trebouxiophyceae/Chlorodendrophyceae/
Pedinophyceae



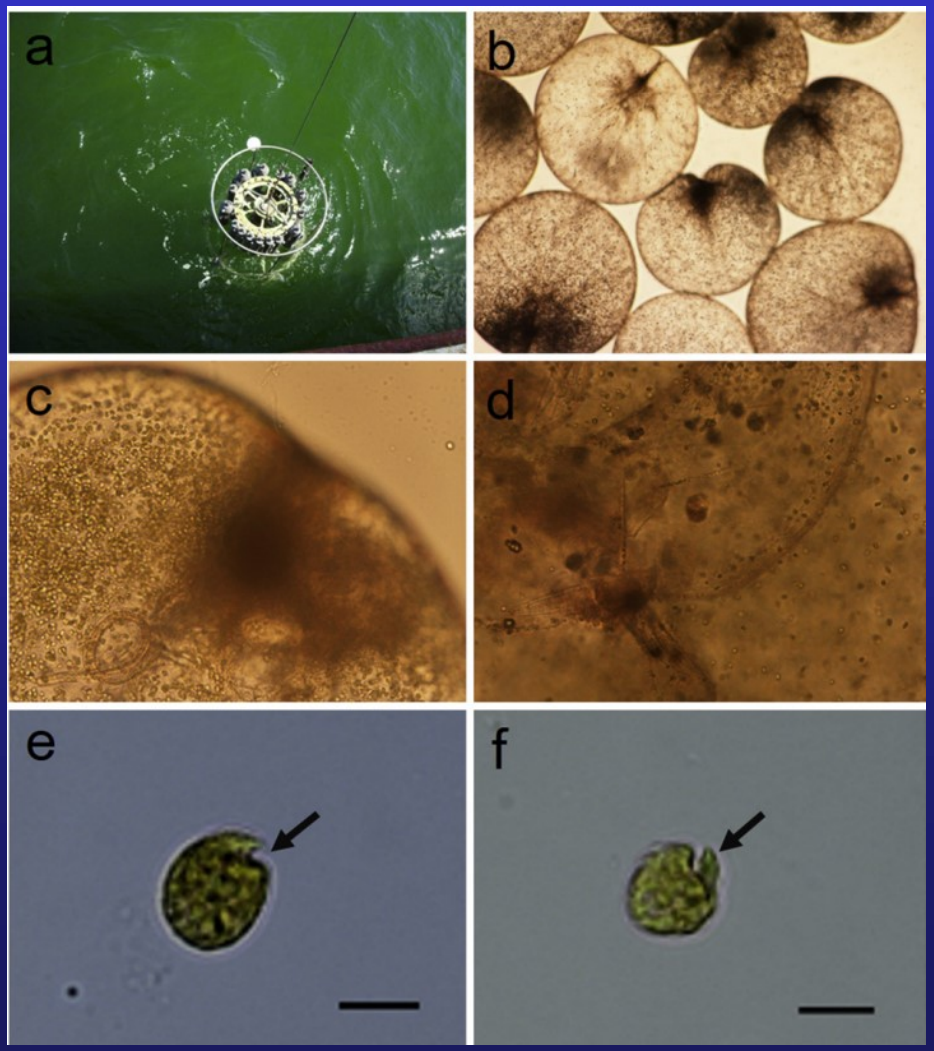
Yang et al. 2023

https://doi.org/10.1038/s41467-023-41137-5

Pedinophyceae

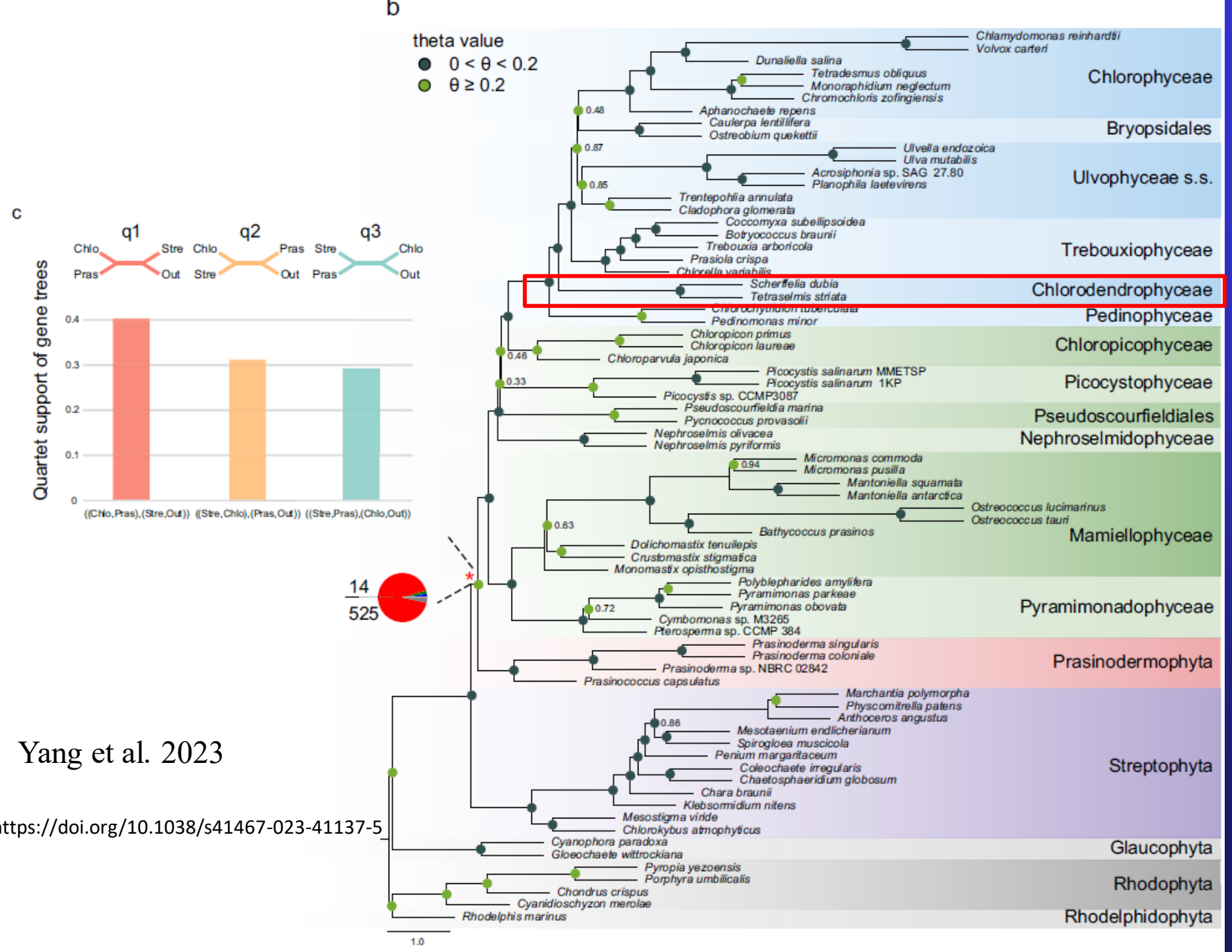
Marsupiomonadales – žijí v mořích ve slaných či brakických vodách a jsou součástí planktonu. Druhá linie – *Pedinomonadales* – se vyznačuje sladkovodními druhy, či druhy žijícími v půdě

2.5 - 10 µm



green Noctiluca contains a large number of endosymbiotic algal cells – blooms in the northern Arabian Sea

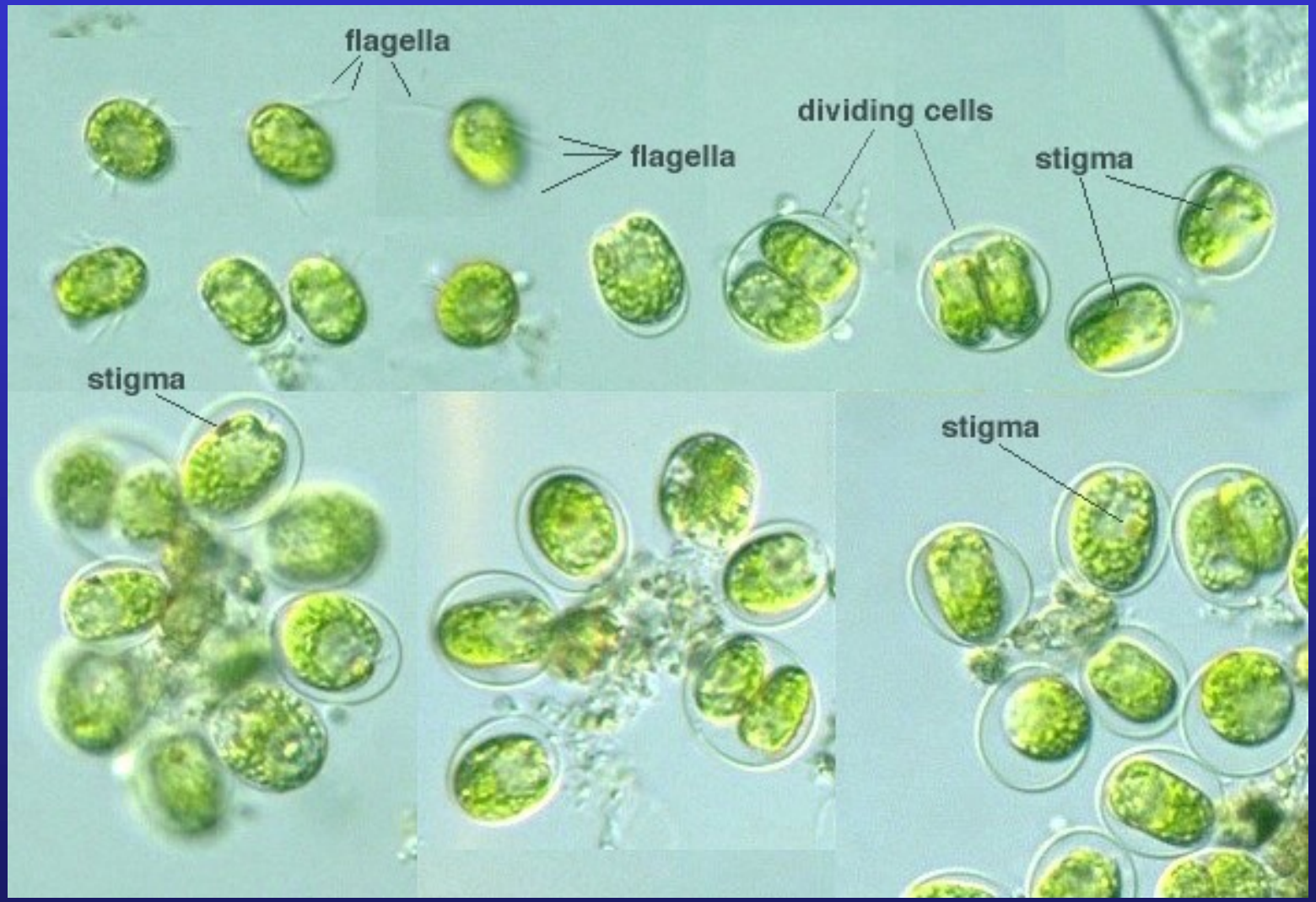
Pedinomonas noctilucae



Yang et al. 2023

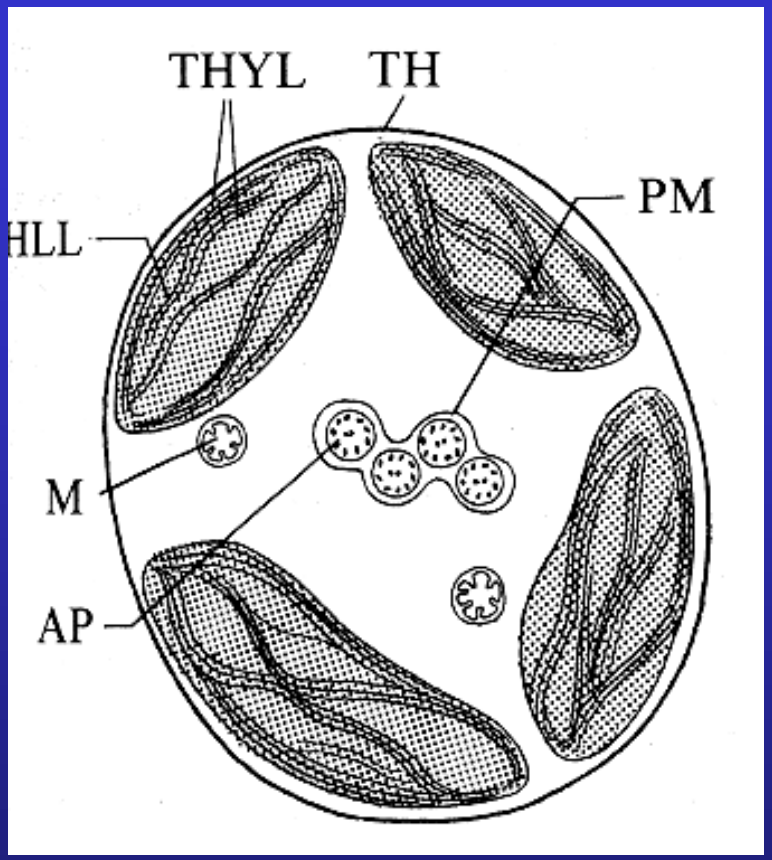
https://doi.org/10.1038/s41467-023-41137-5

Chlorodendrophyceae

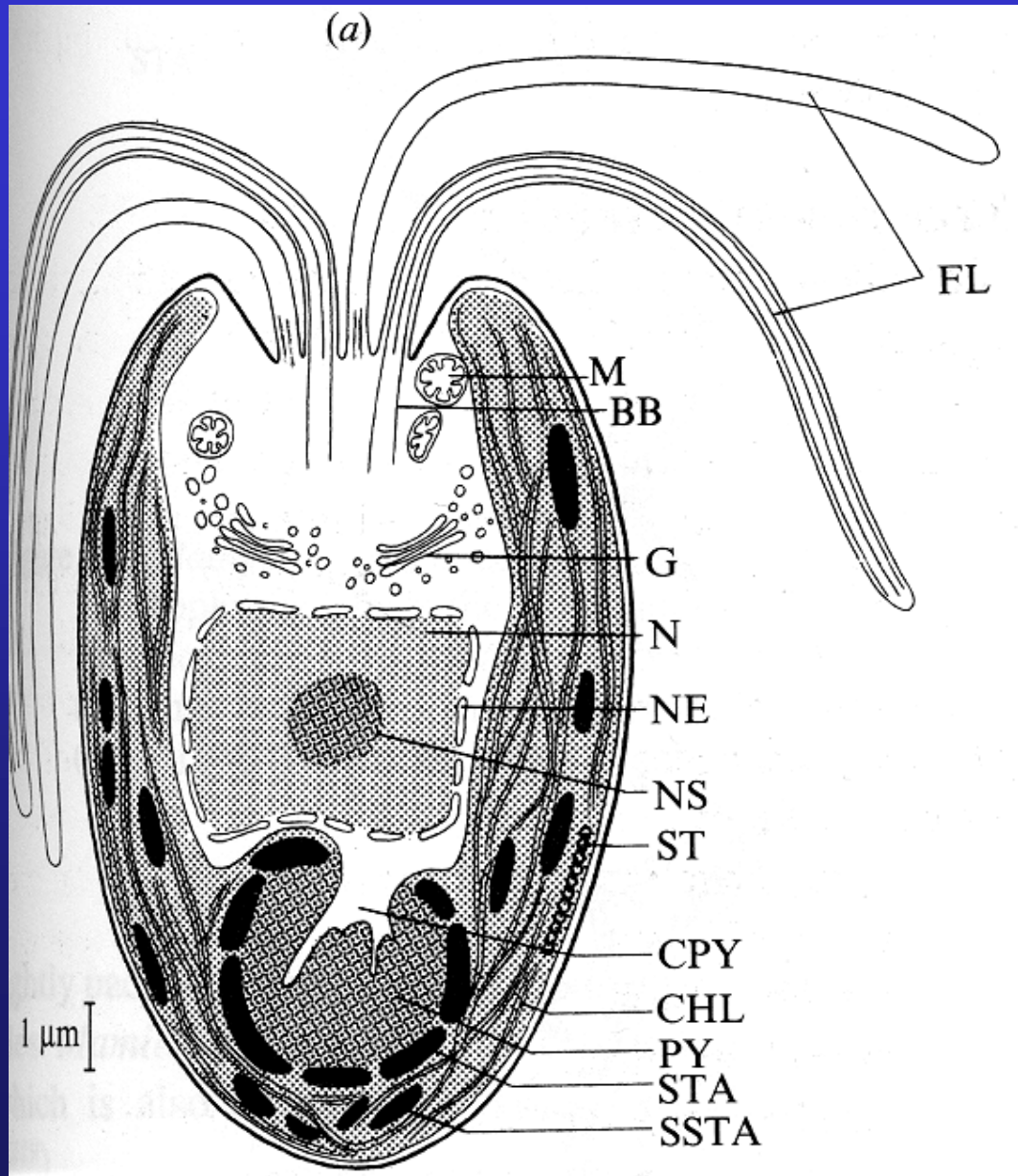


Tetraselmis

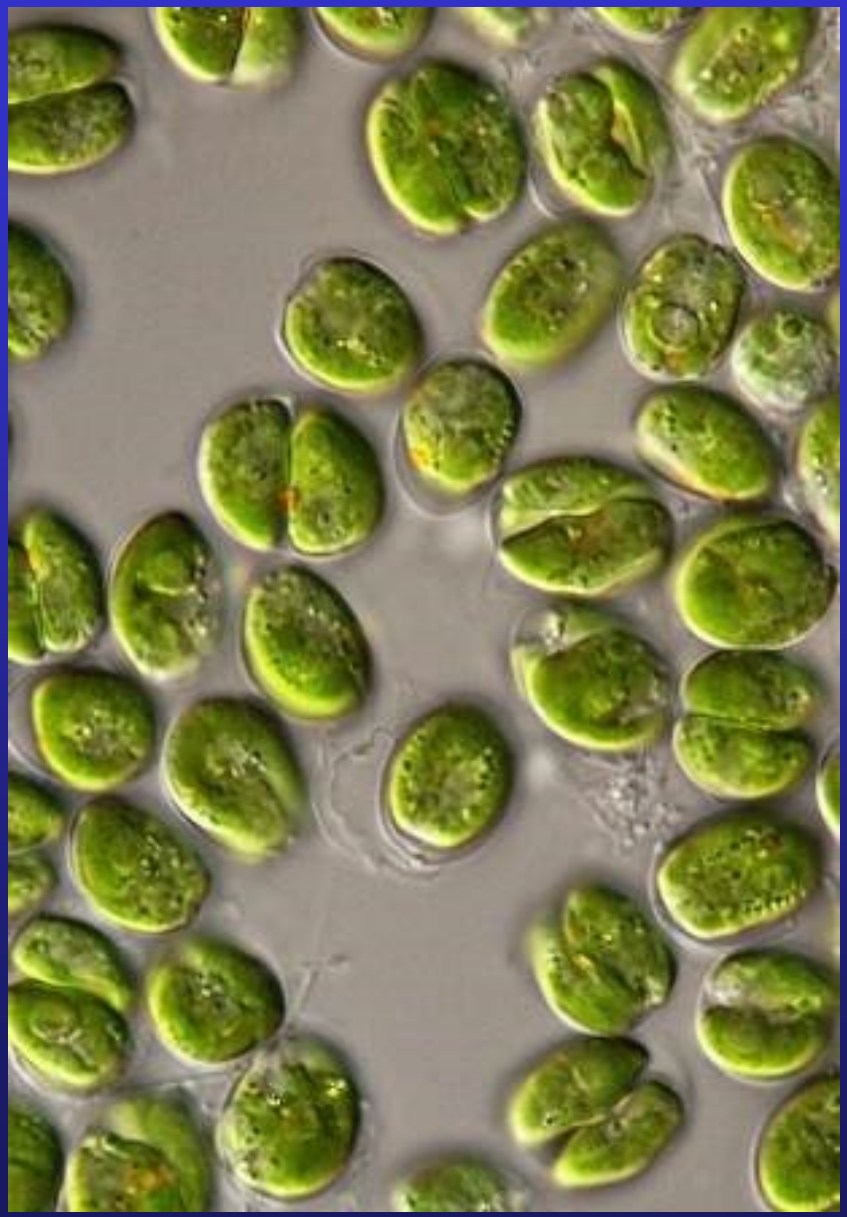
Chlorodendrophyceae



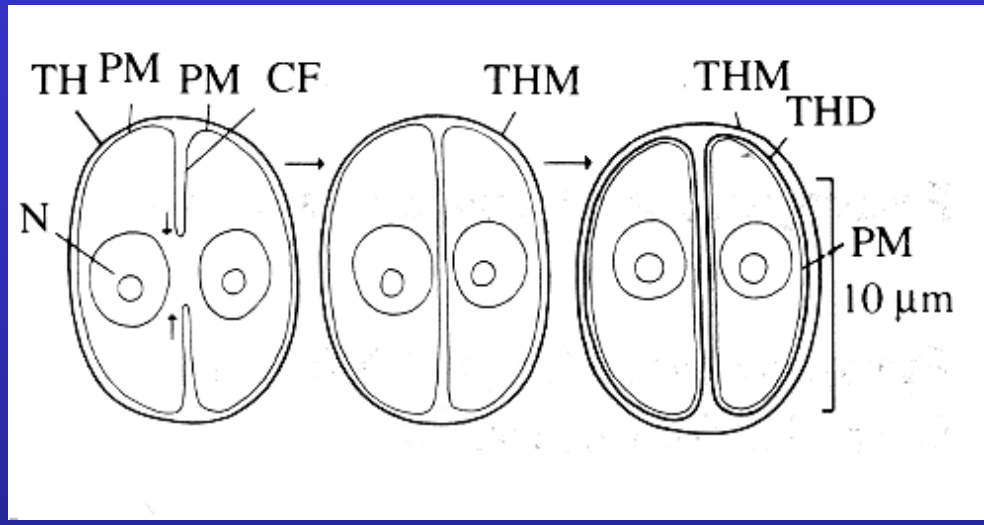
Tetraselmis suecica



Mitóza a cytokineze



- na povrchu kryté thékou

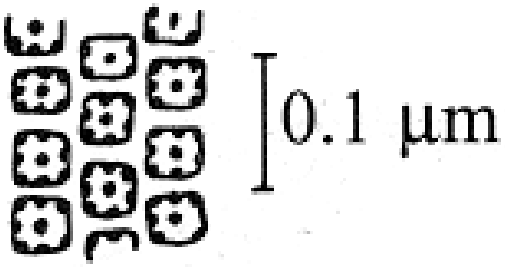


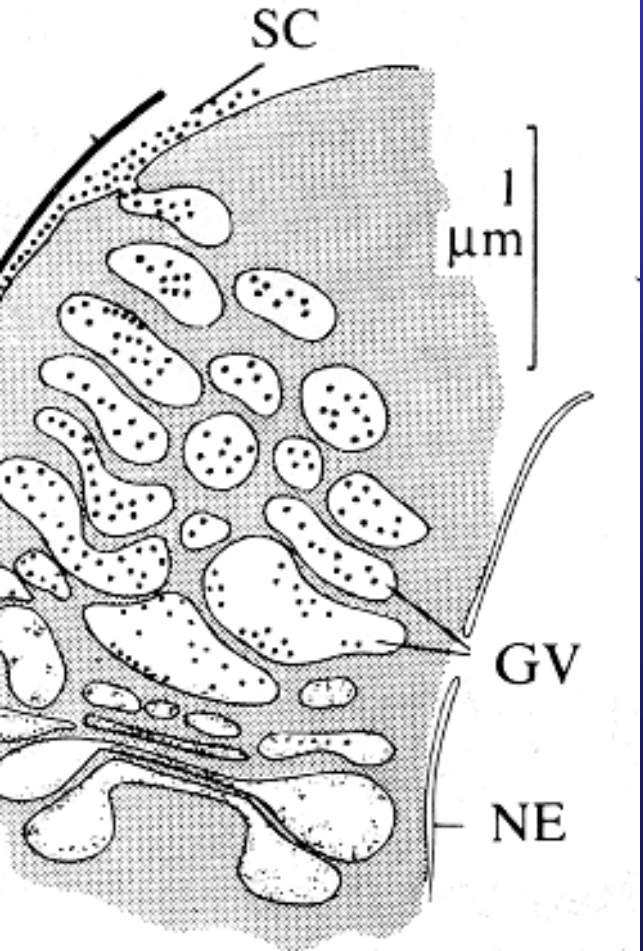
Tetraselmis suecica

shed flagella - division within the mother theca

Scales fuse to form organic theca

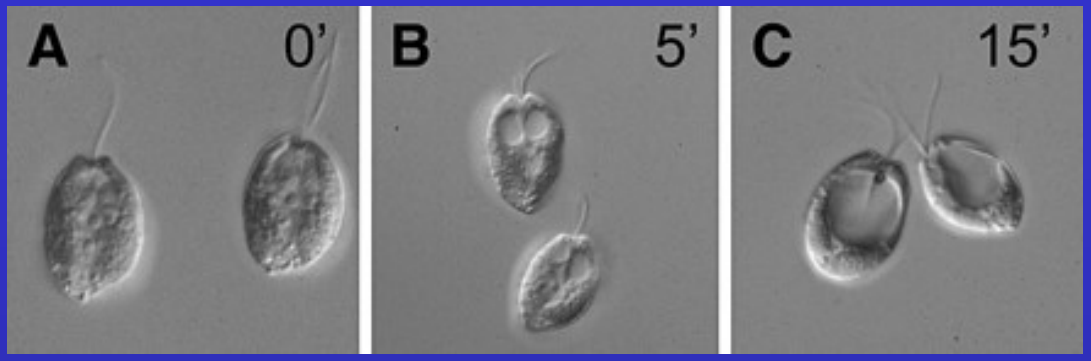
Chlorodendophyceae

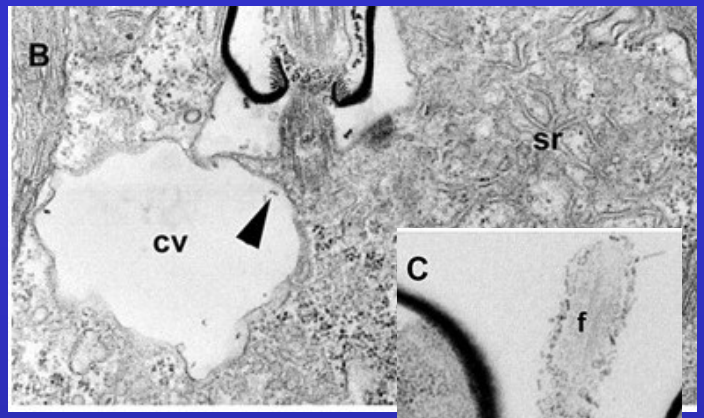


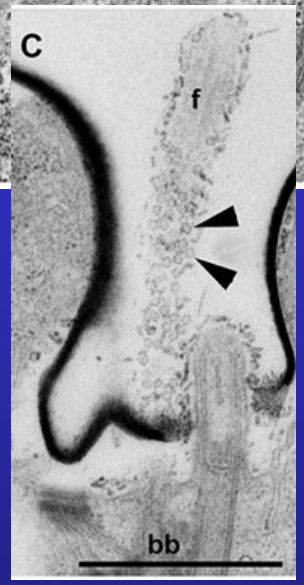


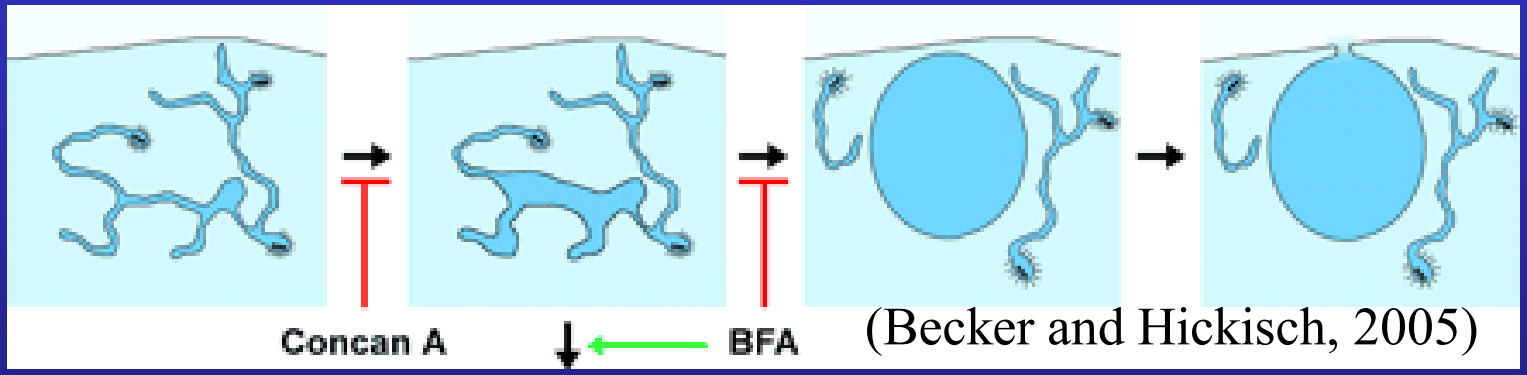
Tetraselmis

Contractile vacuoles







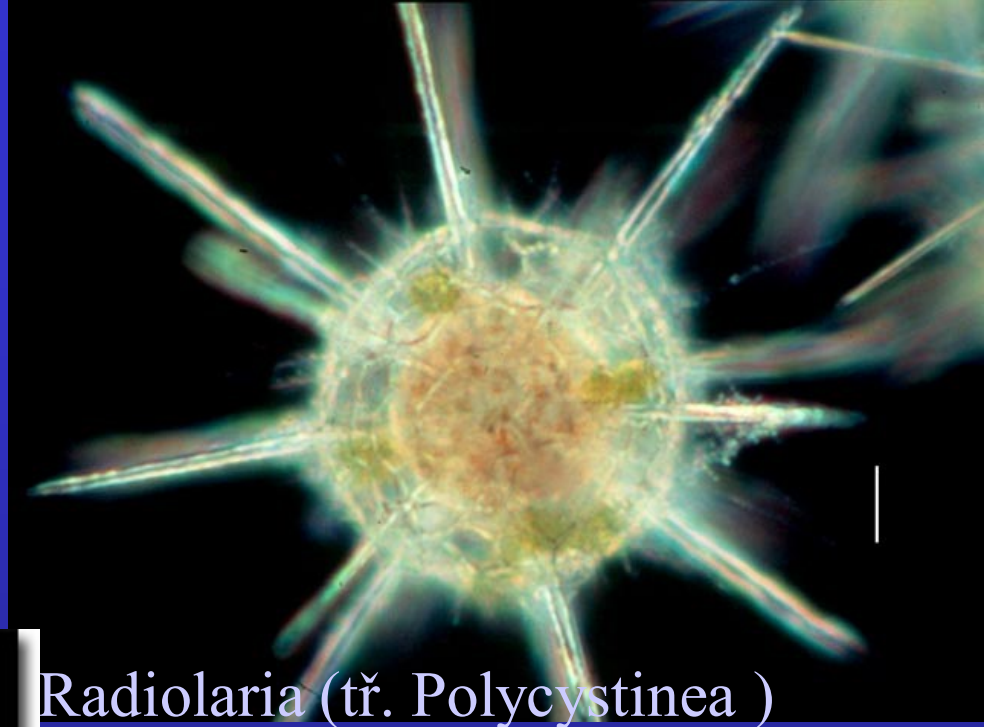


(Becker and Hickisch, 2005)

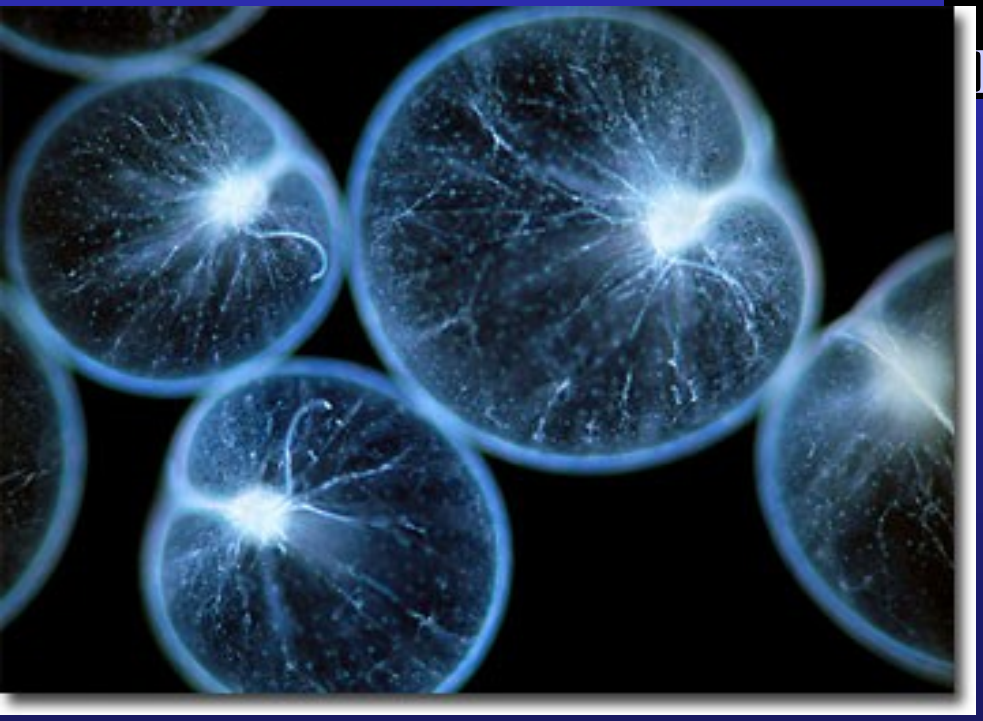
CV – Scherffelia - osmoregulačí organela – pravidelně odstraňuje vodu z buňky
Brefeldin – inhibuje sekreci a fci GA a fci kontraktilních vakuol (blokuje splynutí membrány CV s plasmatickou membránou). Po alpikaci Brefeldinu – vznikne obrovská centrální vakuola (představuje fázi diastoly) – proces reverzibilní, pokud dáme buňku do hypertonického média CV se zmenší. Experimentální model pro studium diastoly, jakési zpomalení celého procesu (jinak 20ms)

Ekology

symbionts of different heterotrophic organisms



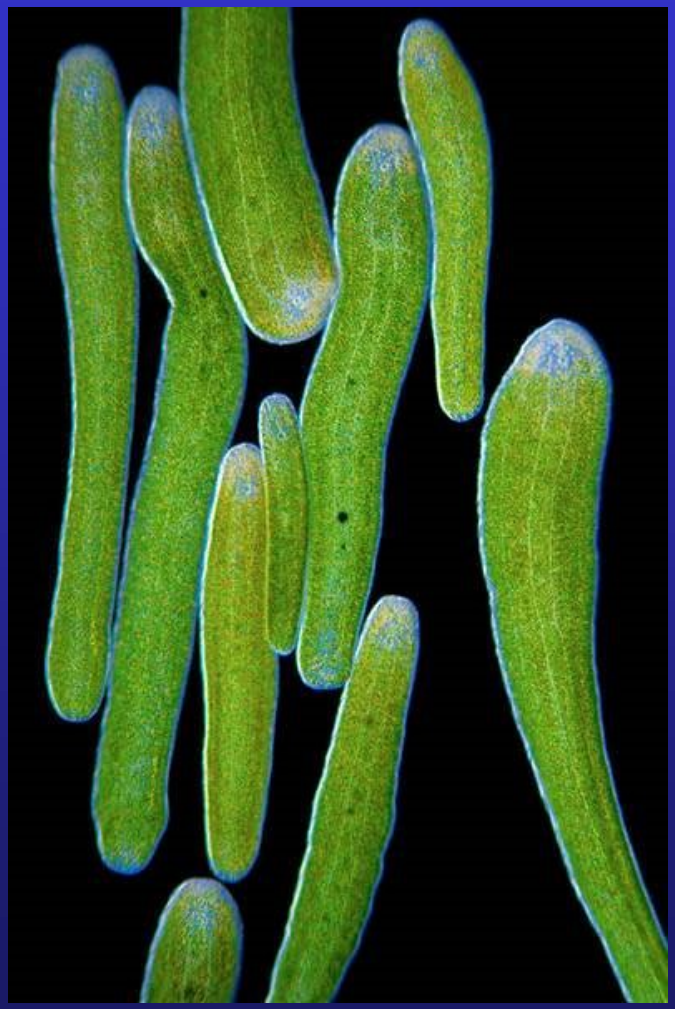
Radiolaria (tř. Polycystinea)



Noctiluca

Ekology

symbionts of different heterotrophic organisms



(Convoluta) Symsagittifera roscoffensis - flatworms Acoela– no mouth

Symsagittifera

Host
***(Convoluta)* provides:**

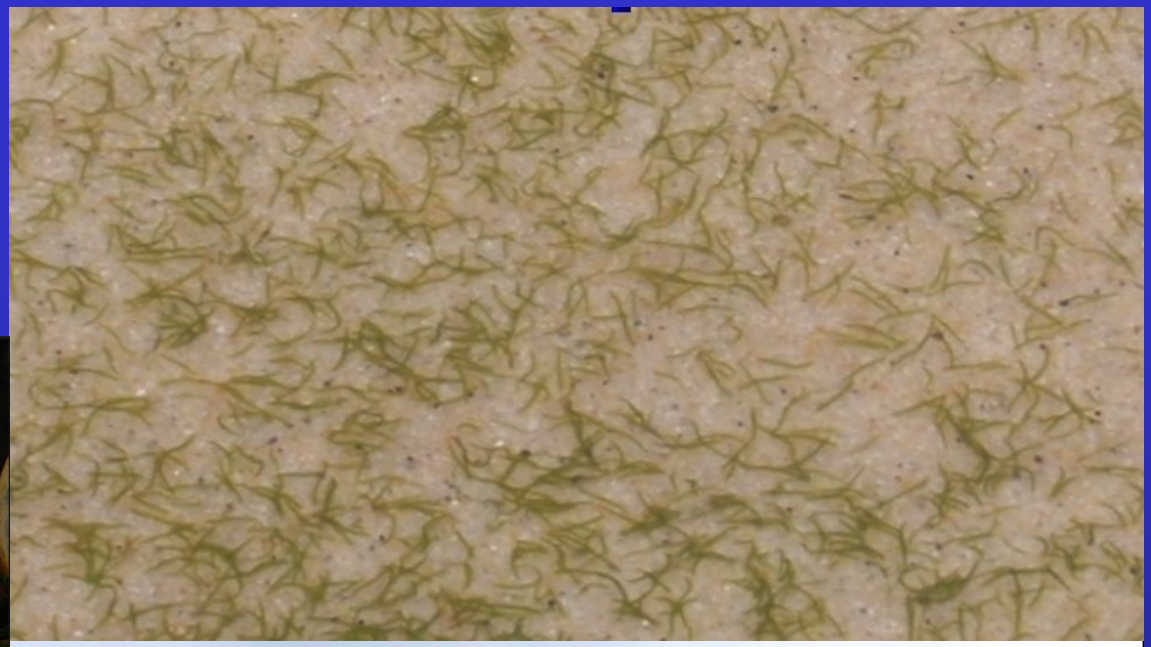
- shelter (against predation)
- constant milieu
- optimal photosynthetic conditions (light and CO_2)
- nutrition (N-compounds)

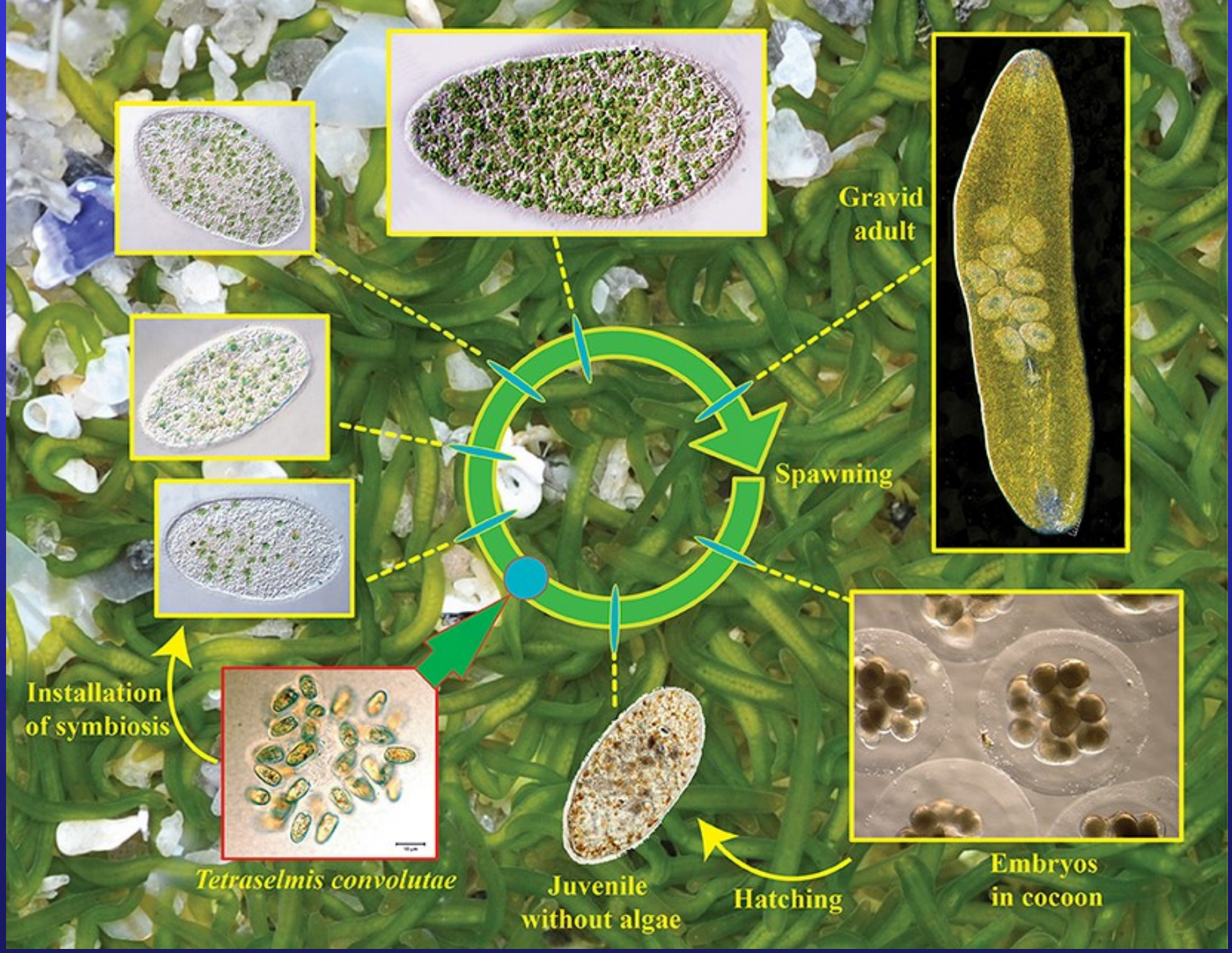
Symbiont
***(Tetraselmis)* provides:**

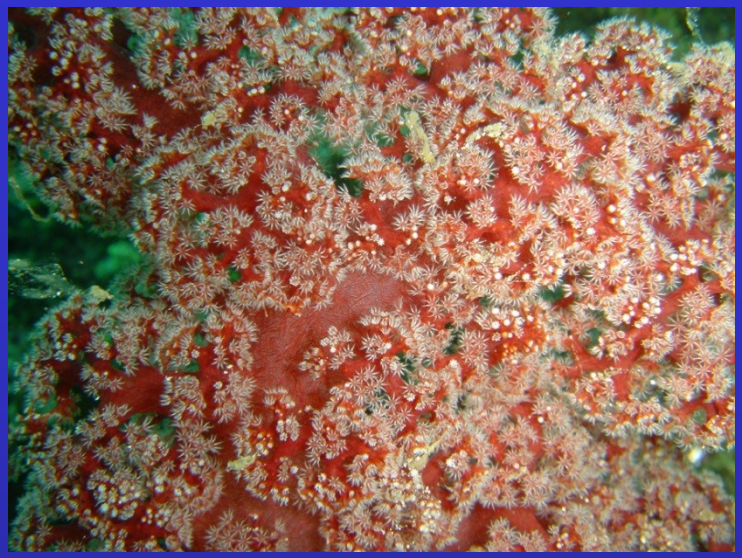
- sugars and O_2 as products of photosynthesis
- capability of adaptation under harsh environmental conditions

Akvitaine - France

Atlantic ocean shore




Gravid adult
Spawning
Installation of symbiosis
Tetraselmis convolutae
Juvenile without algae
Hatching
Embryos in cocoon

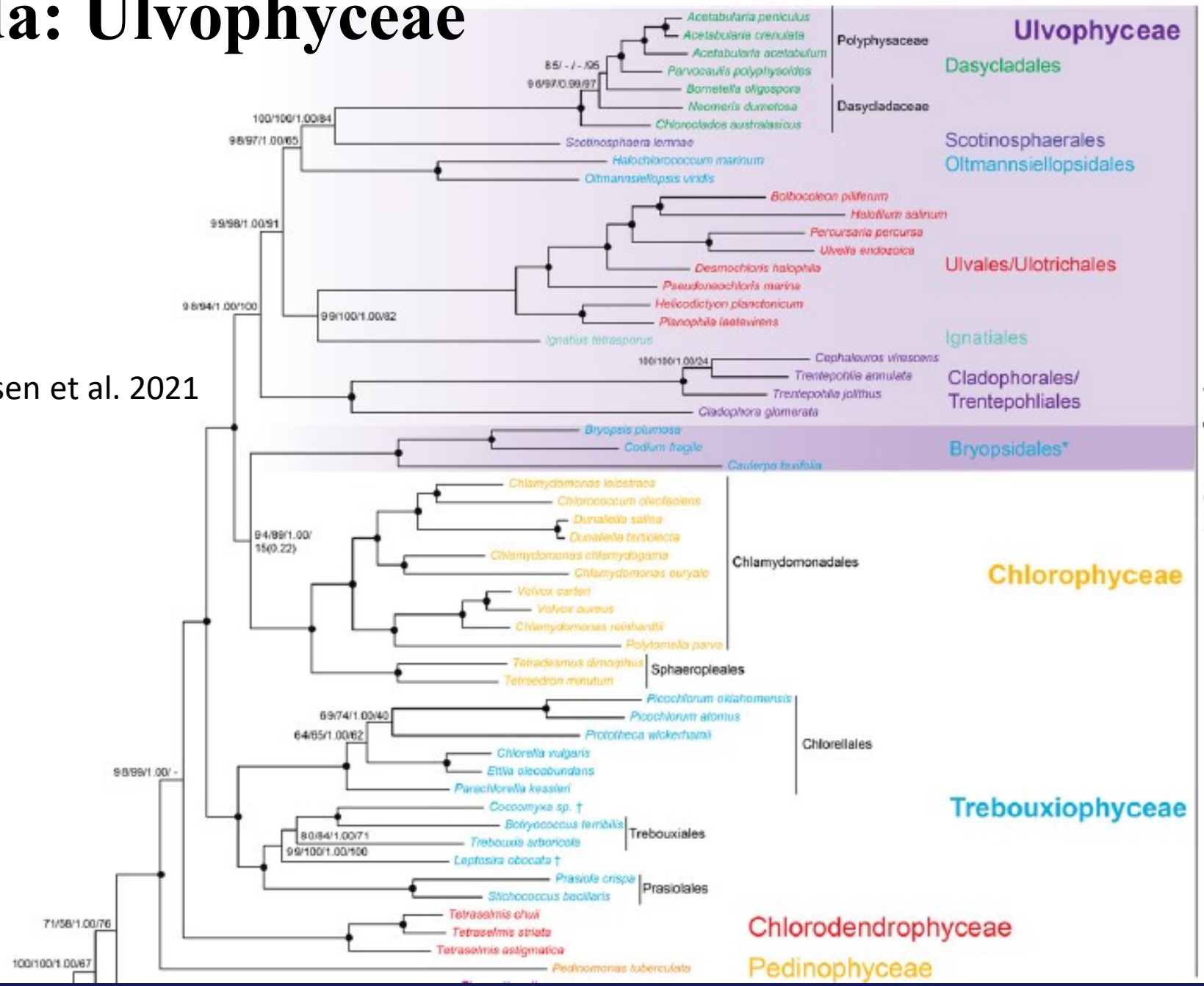


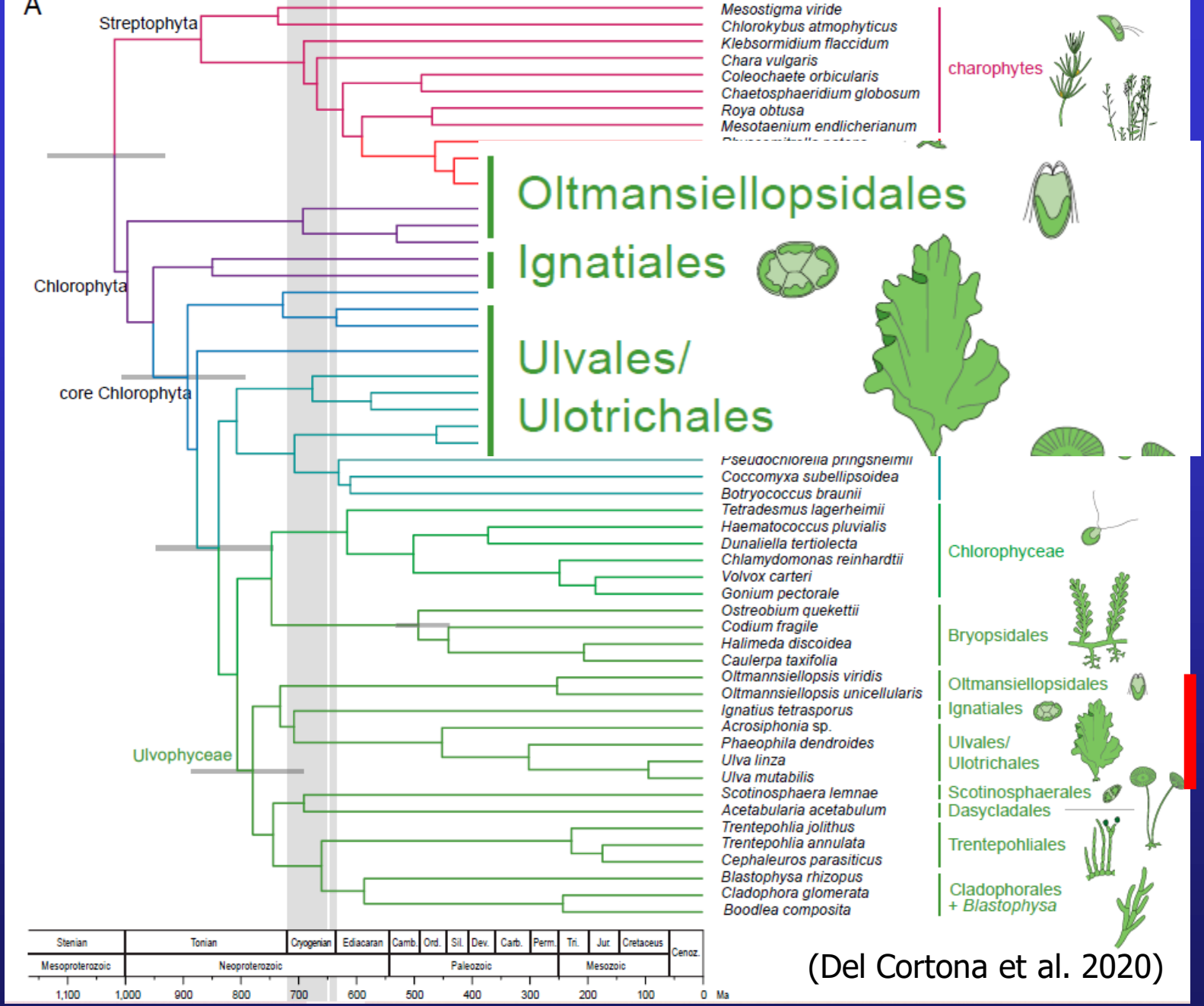
polyunsaturated fatty acids

Live Foods for **Feeding** Aquarium Fish, Inverts & **Corals**

Třída: Ulvophyceae

Gulbrandsen et al. 2021





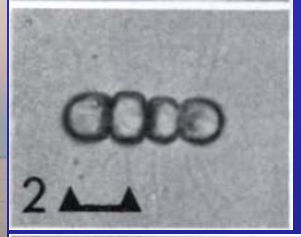
(Del Cortona et al. 2020)

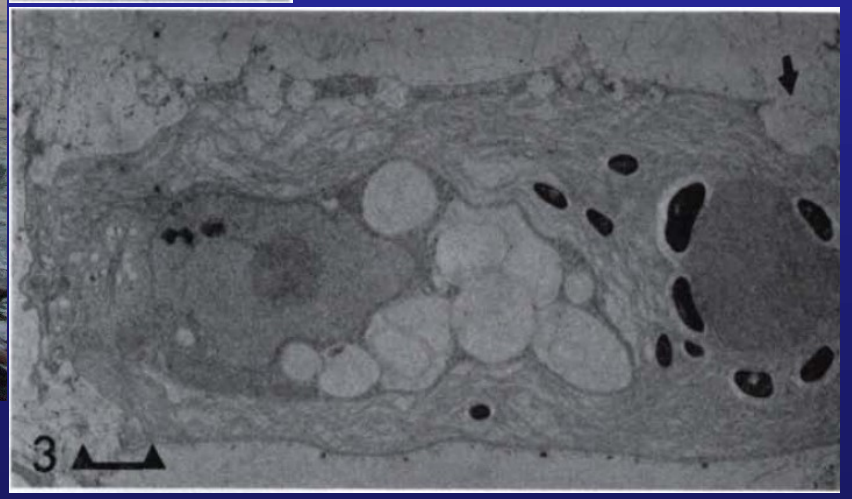
Time-calibrated phylogeny of the green algae. (A) The topology of the tree is based on the ML analysis inferred from a concatenated amino acid alignment of 539 nuclear genes

Oltmansiellopsidales

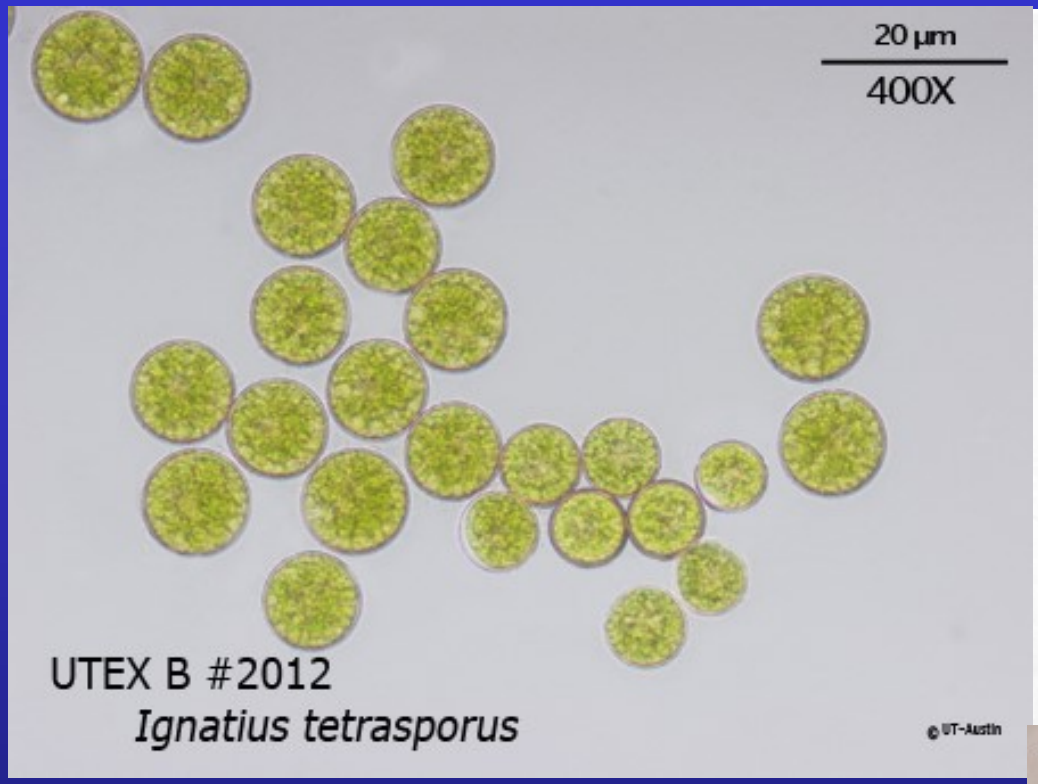
Oltmansiellopsis viridis -a quadriflagellate green alga is described from temperate coastal waters. It occurs primarily as four-celled colonies,

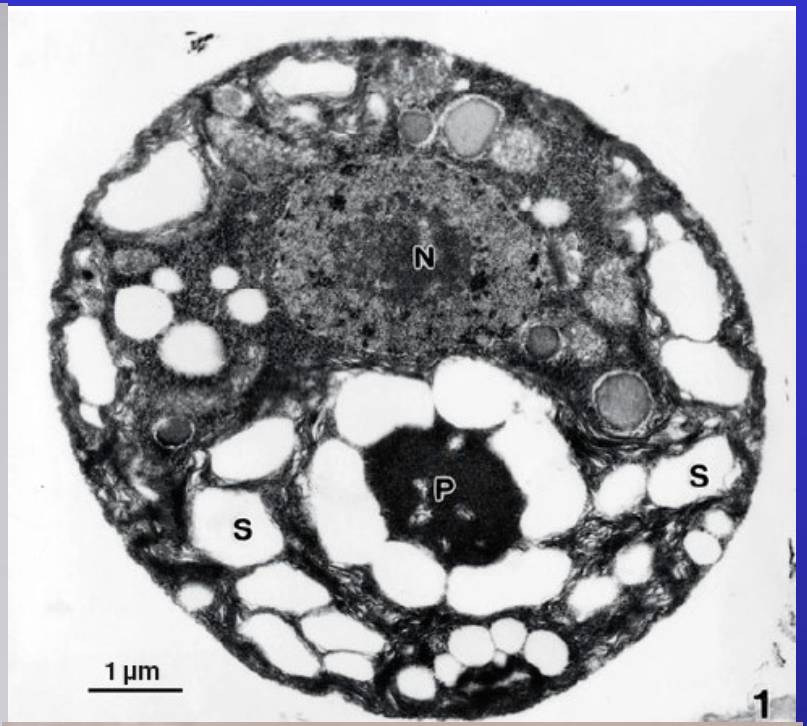
Narragansett Bay, Rhode Island, USA





Ignatiales

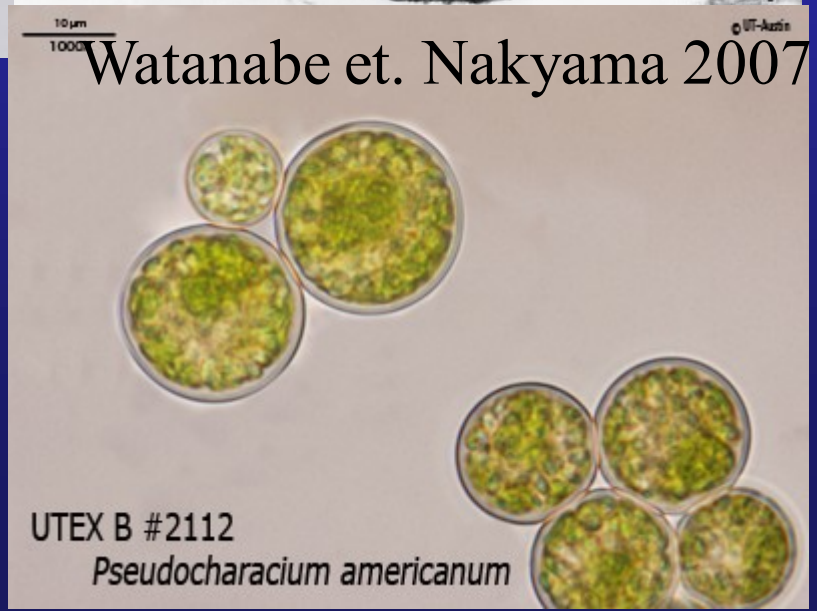




Watanabe et. Nakyama 2007

Coccoids from damp terrestrial habitats

A young vegetative cell included a single nucleus and a cup-shaped chloroplast that contained a pyrenoid and stroma starch grains

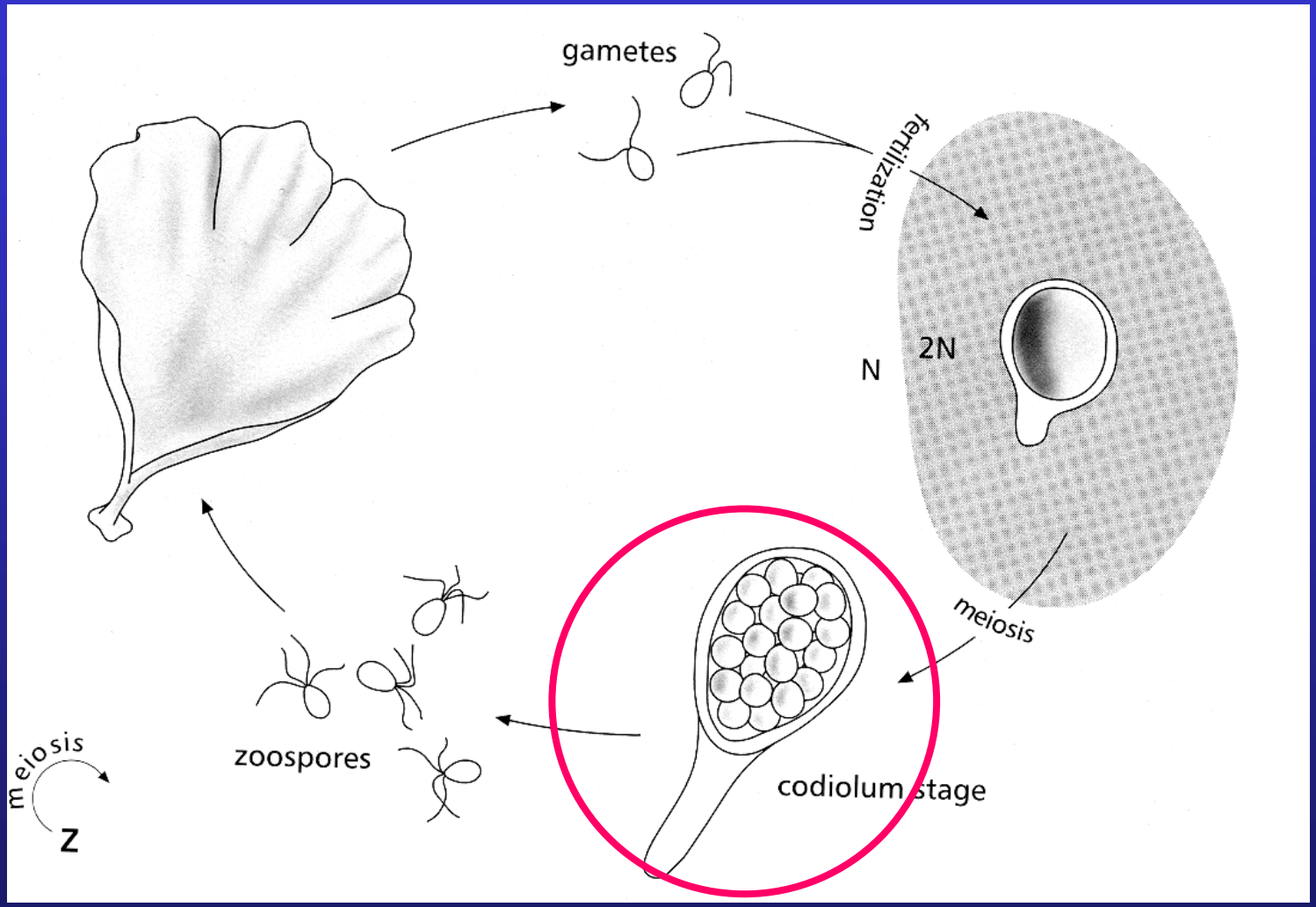


Ulvales/Ulotrichales

Základní charakteristika:

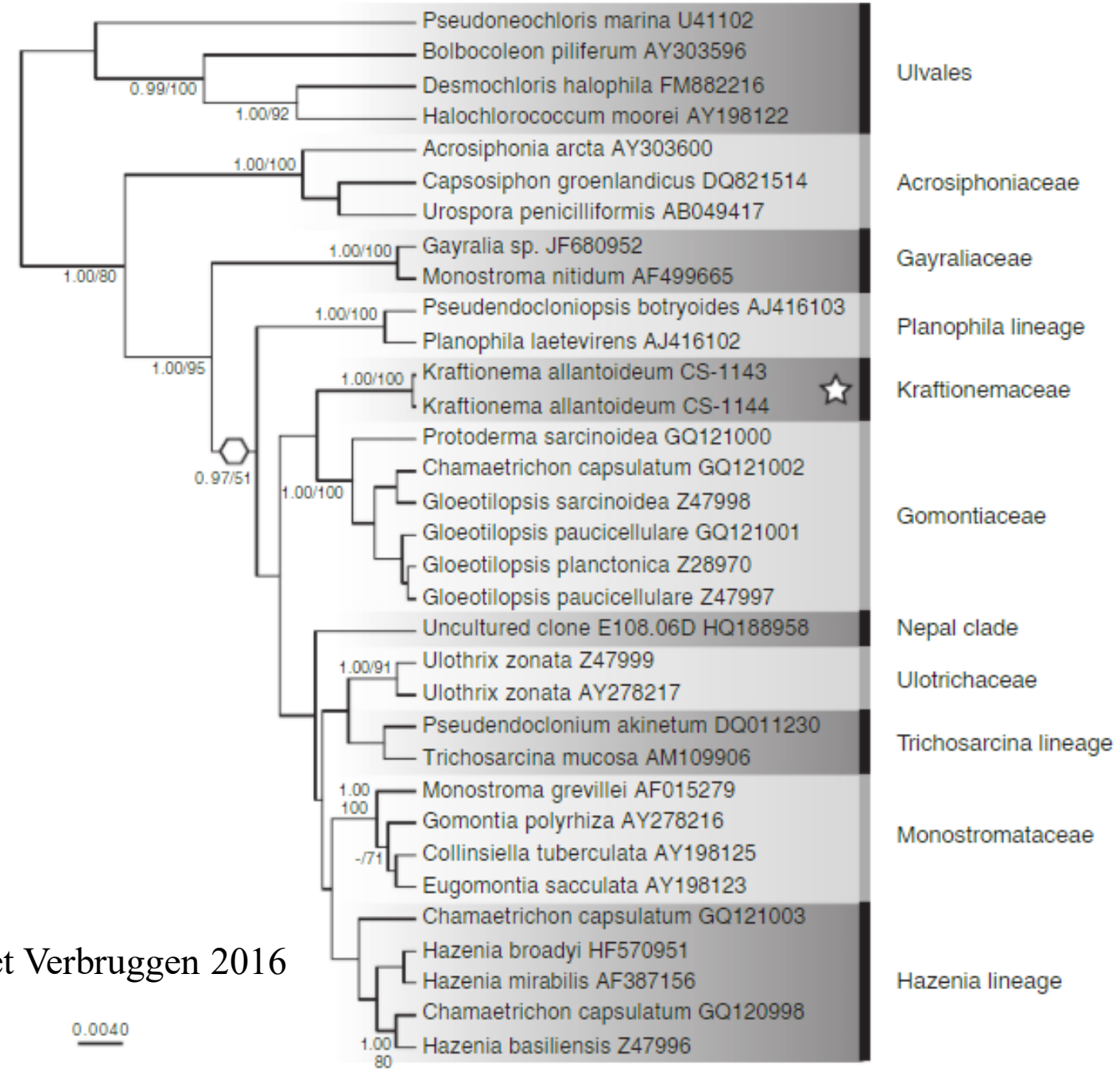
- stélka kokální, vláknitá, sifonální, pletivnou
- zoidi mají 2 nebo 4 bičíky (křížové uspořádání bičíkových kořenů, CCW orientace bazálních tělísek), někt. zástupci Ulotrichales – povrch zoidů pokryt rhomboidními šupinami
- mitóza uzavřená, perzistentní telofázové vřeténko (bez fykoplastu a fragmolastu)
- každá buňka obsahuje nástěnný chloroplast (páskovitý nebo hrncovitý), někdy perforovaný s jedním až několika pyrenoidy
- haplontní nebo diplo-haplontní životní cyklus, vznikají tlustostěnné hypnozygoty
- zástupci třídy téměř výhradně mořské organismy

Řád: Ulotrichales (Codiolales)



Monostroma

Phylogenetic tree of Ulotrichales inferred from 18S ribosomal RNA sequences



Wetherbee et Verbruggen 2016

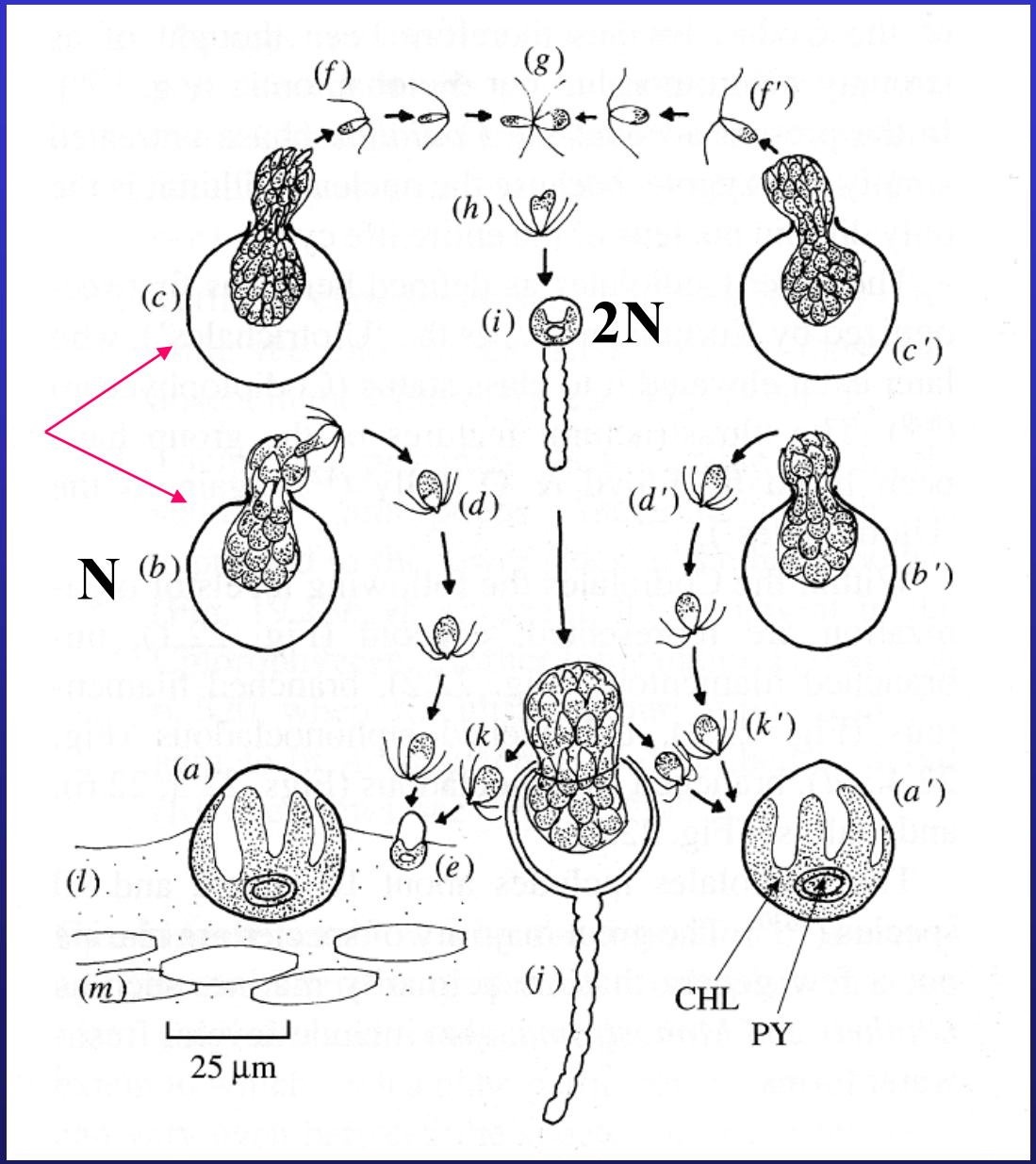
Chlorocystis

endophyte, haplontic life cycle, codiolus stage

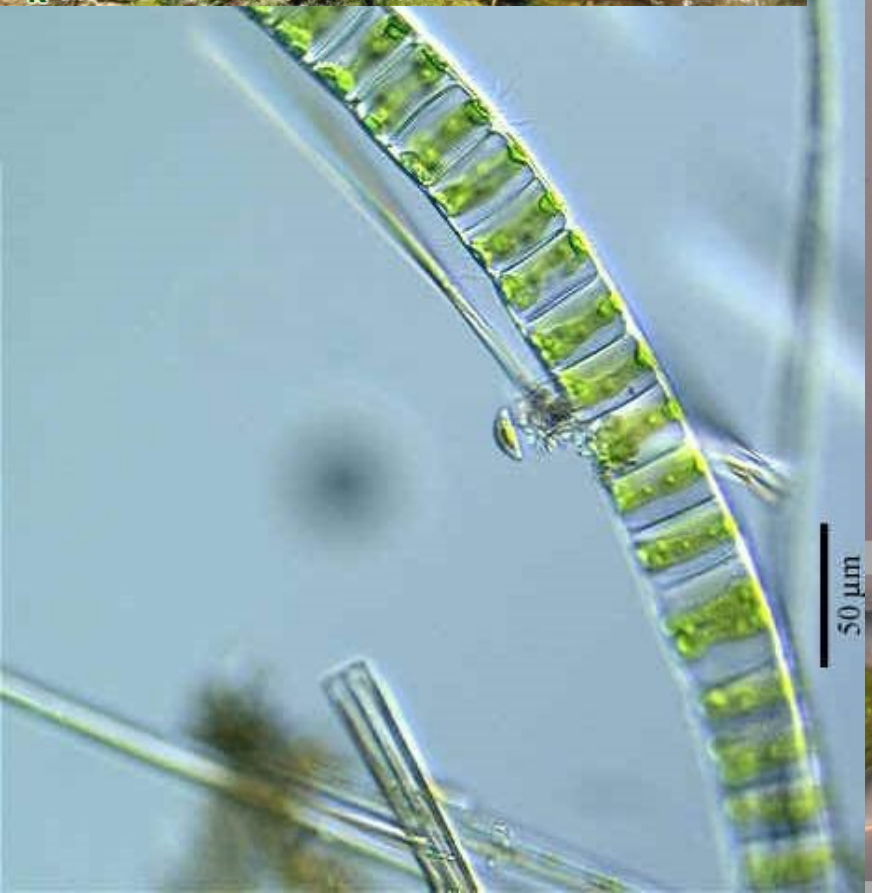
anizogamy

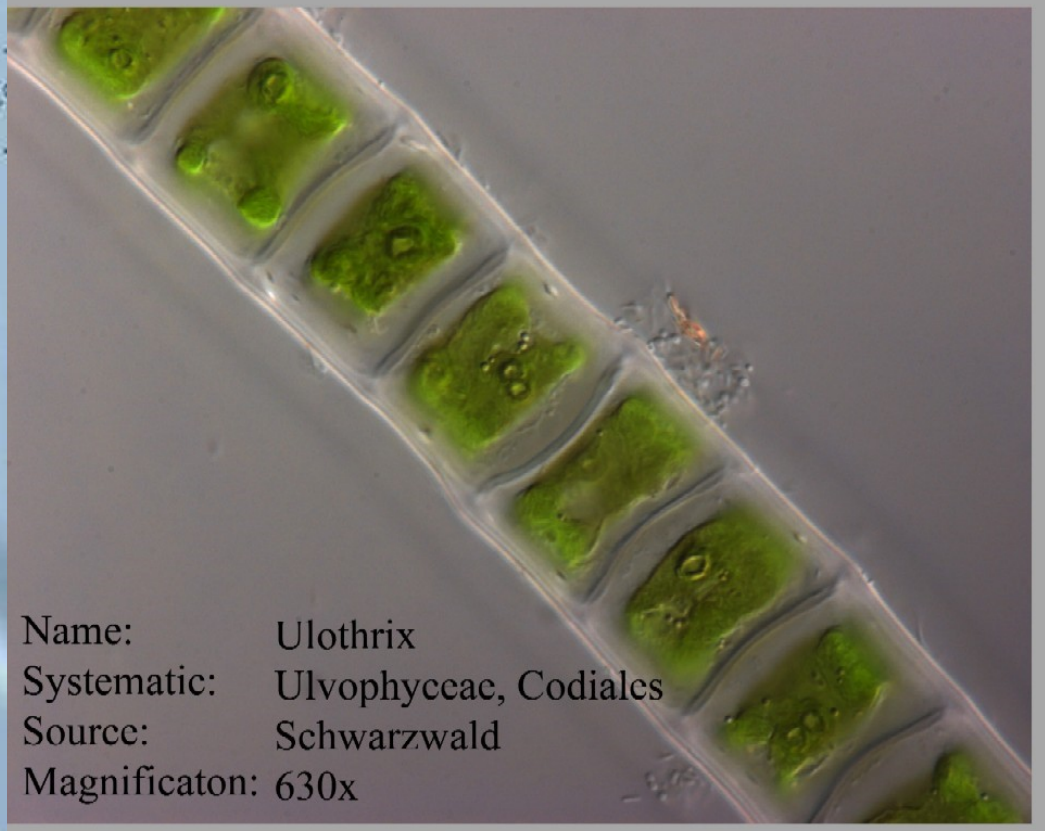
heterothalism

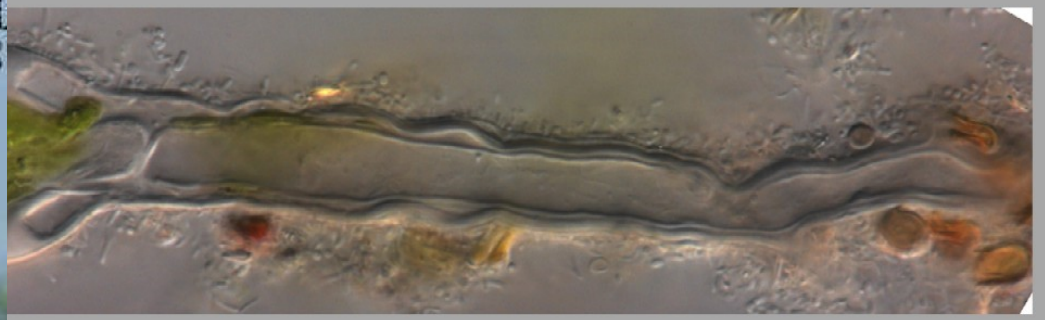
evolutionary parallelism (*Trebouxia*, *Chlorococcum*)



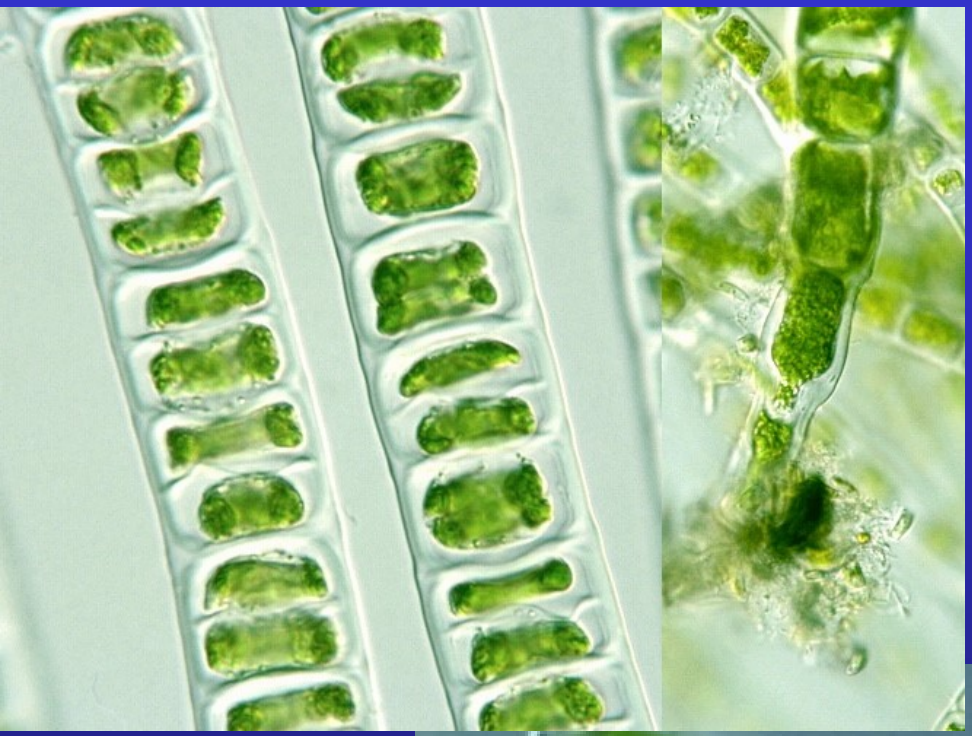
Ulothrix

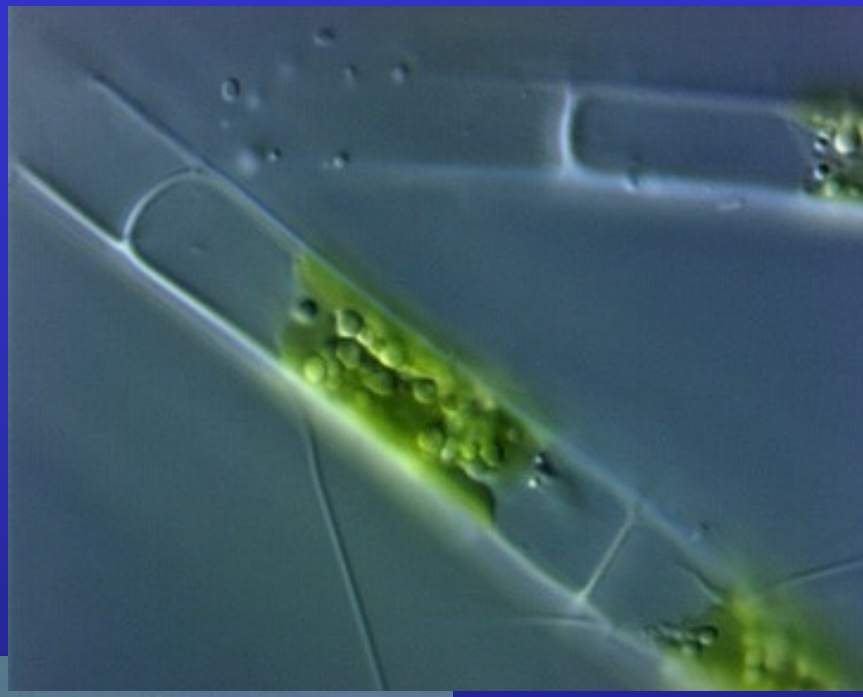

50 µm


Name: Ulothrix
Systematic: Ulvophyceae, Codiales
Source: Schwarzwald
Magnificaton: 630x



Ulothrix



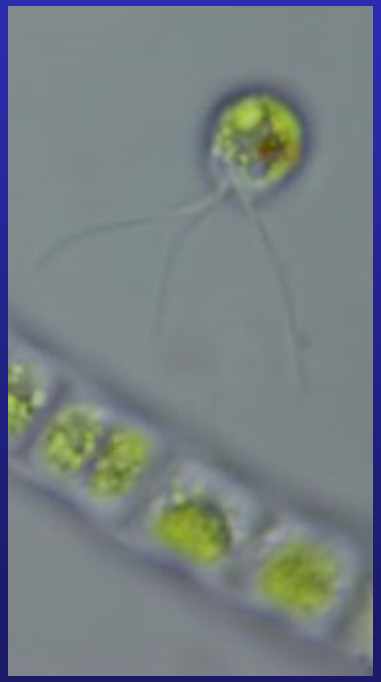


Ulothrix

haplontic cycle

izogamy

heterothalism



Ulothrix Life Cycle

zygote

zygote settles

gametes pair and unite, forming a zygote

2n

fertilization

meiosis

n

sexual

gametes escape from parent cell

zoospores escape

zoospores escape from parent cell

asexual

zoospore settles

new filament arises through mitosis

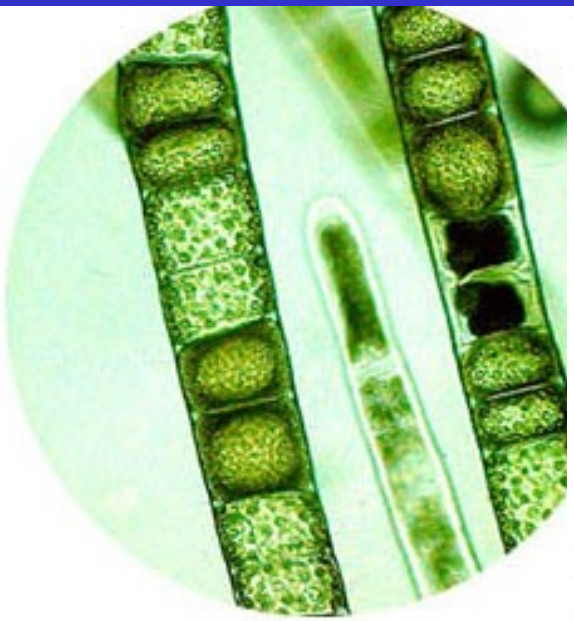
zoospore settles; new filament arises through mitosis

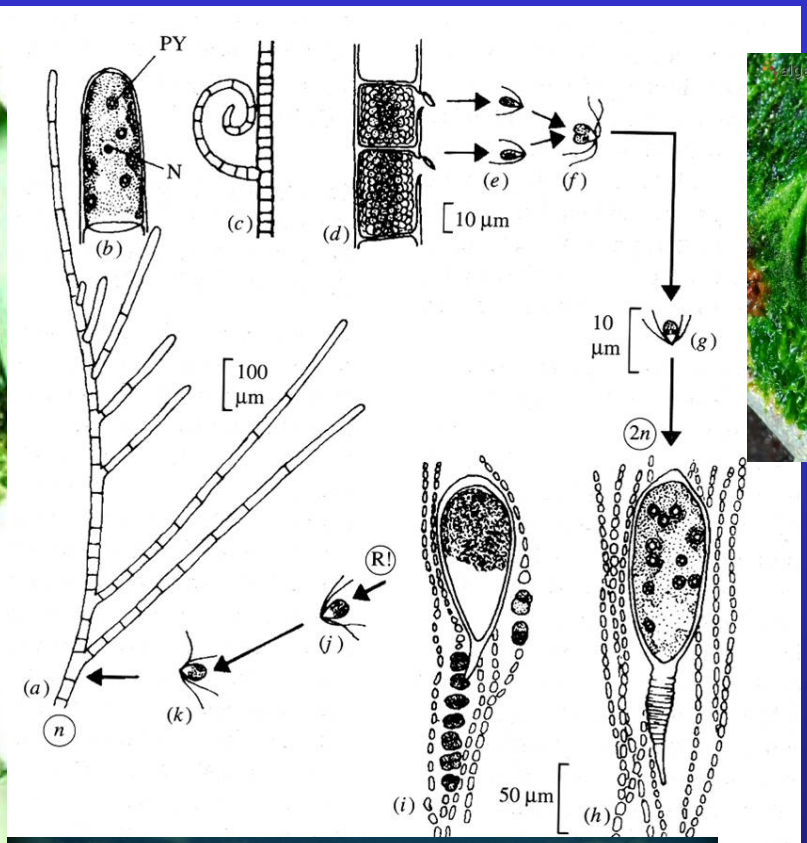
holdfast

Ulothrix zonata

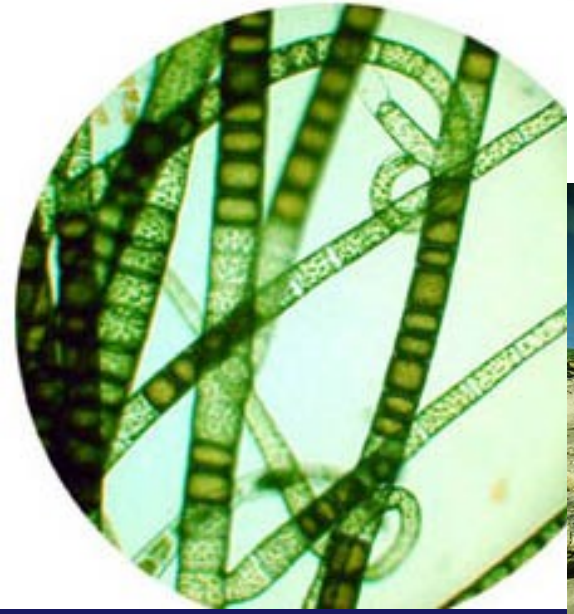
Spongomorpha

izogamy;
apical growth





uninuclear cells

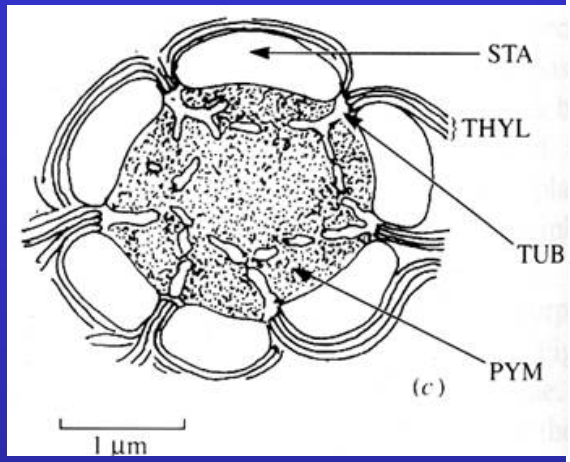


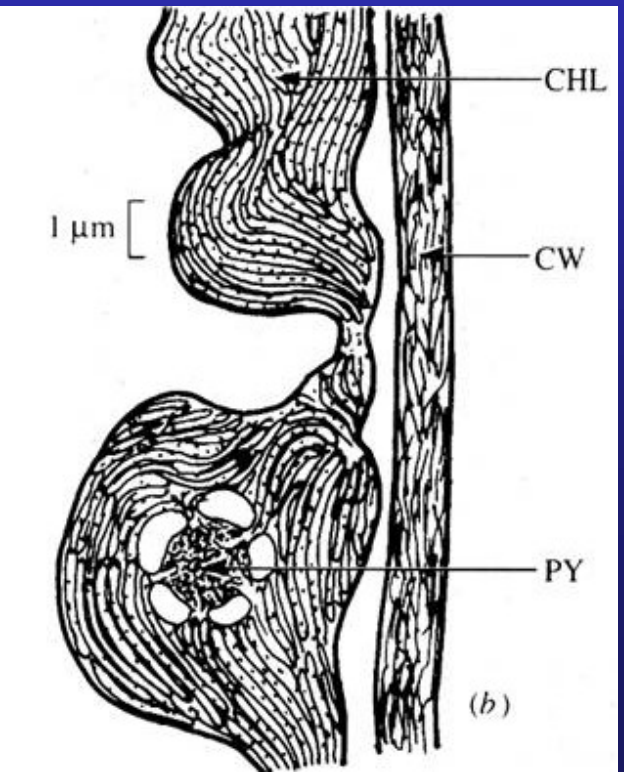
codiolus stage resembles *Petrocelis* (red alga)

eulitoral of North Altantic

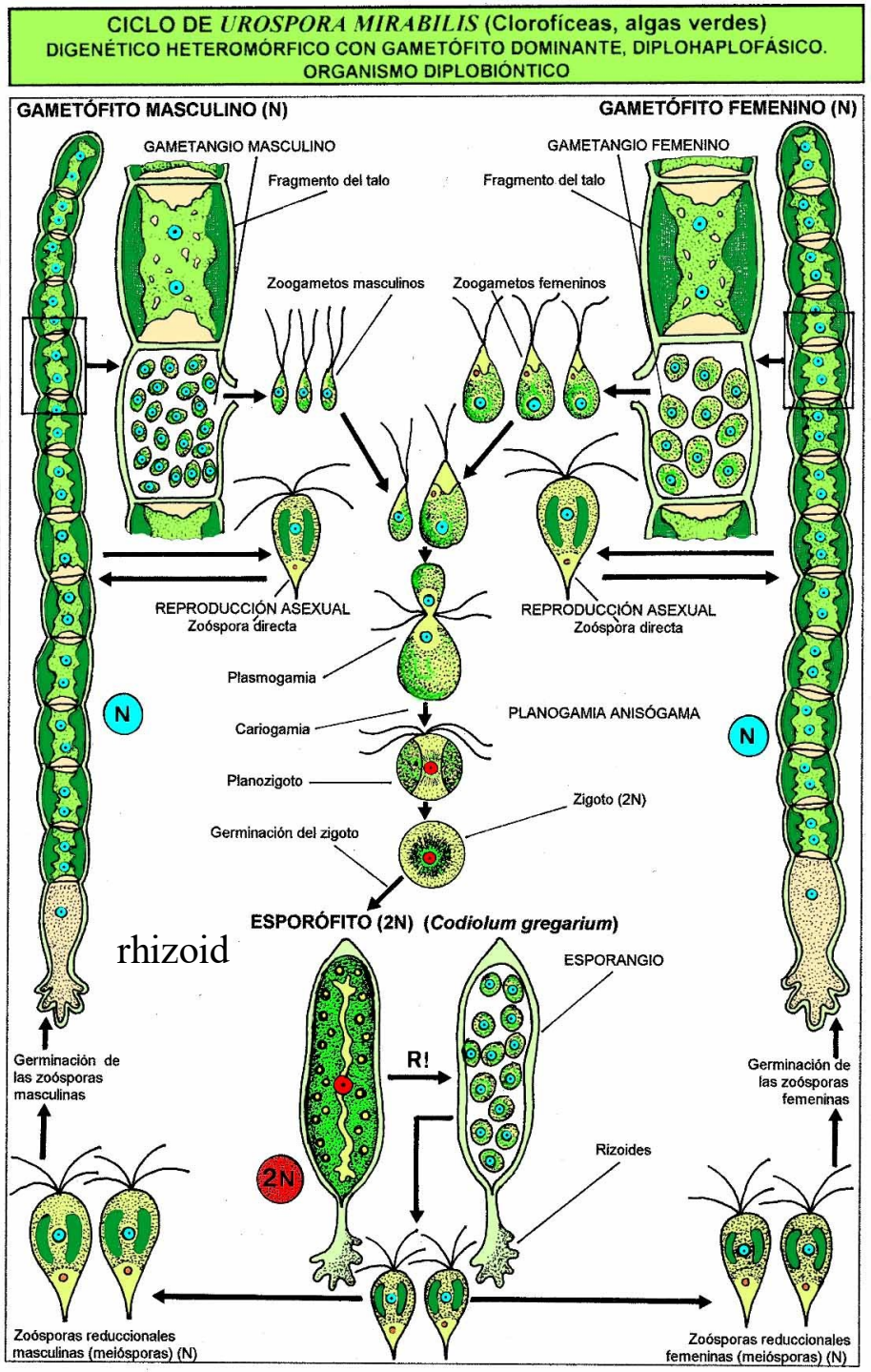
Urospora

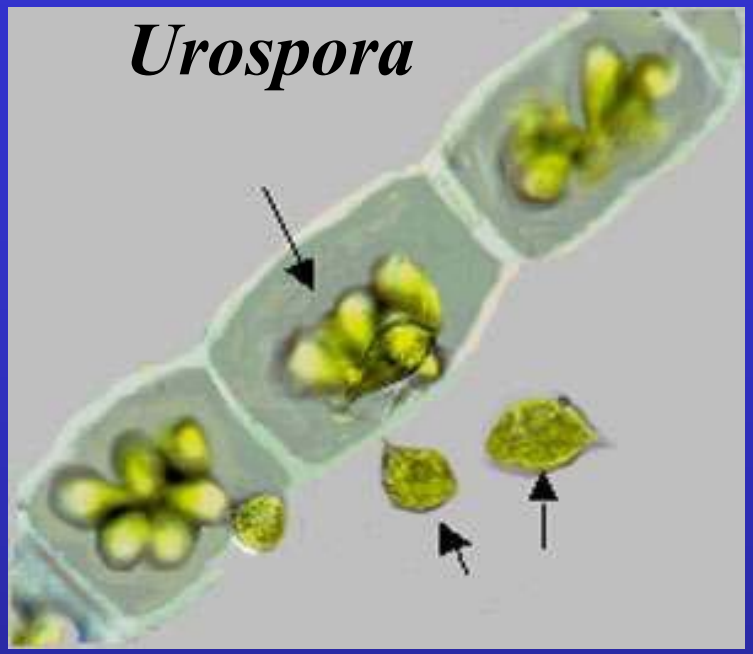
anizogamy
heterothalism





multinucleate
cells

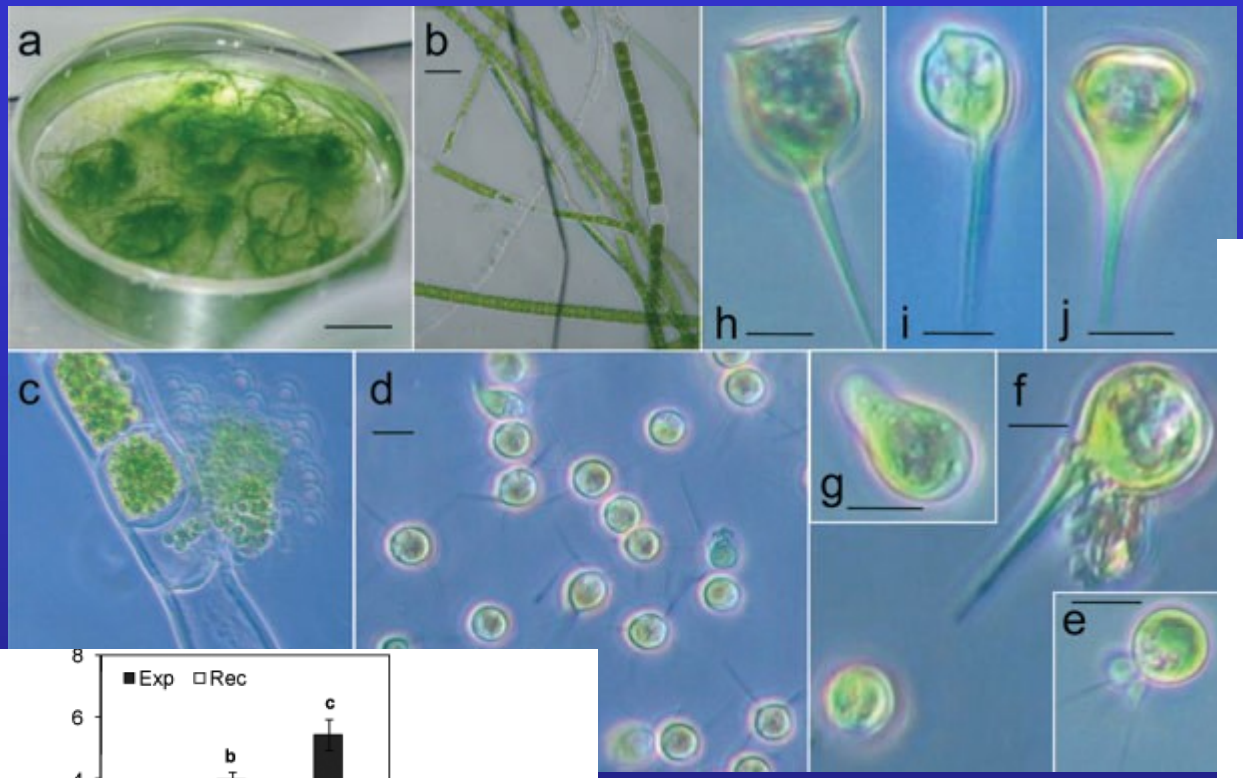




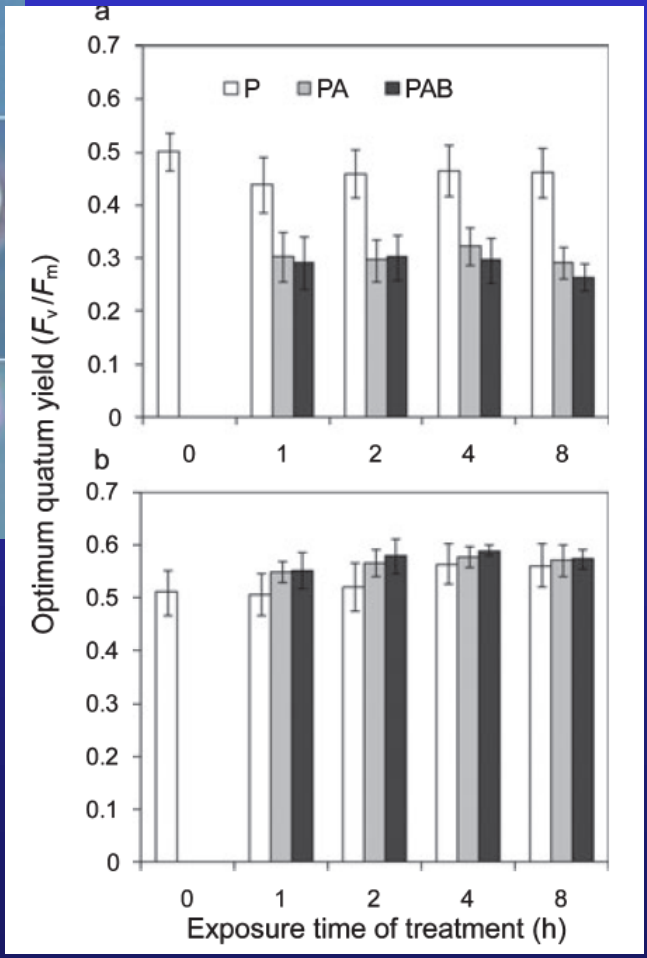
4-flagellate zoospores

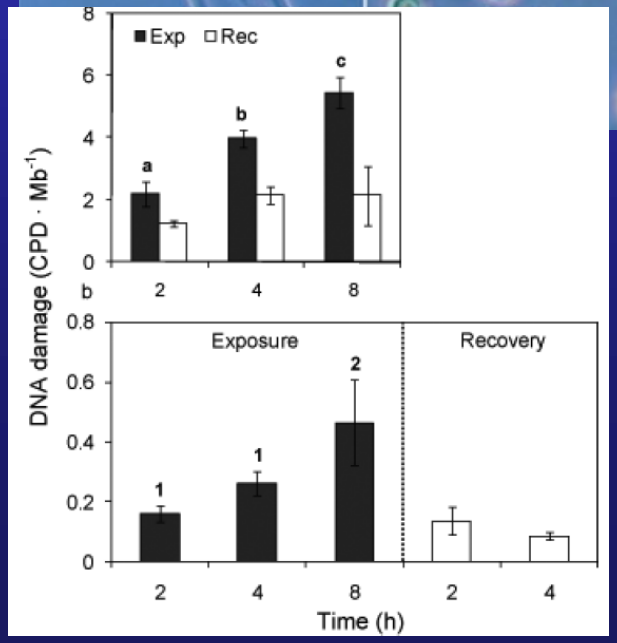
Arctic and Antarctic sea

Sensitivity of Antarctic Urospora to UV (UVA, UVB) radiation



Gametophytic filaments and propagules (zoospores and gametes)

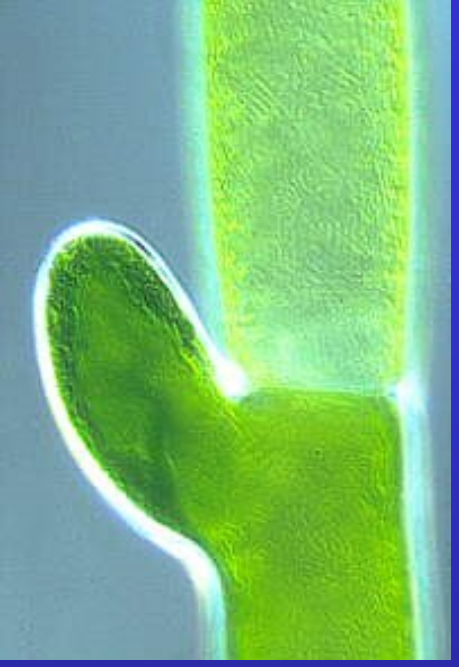




propagules slightly more sensitive, fast recovery

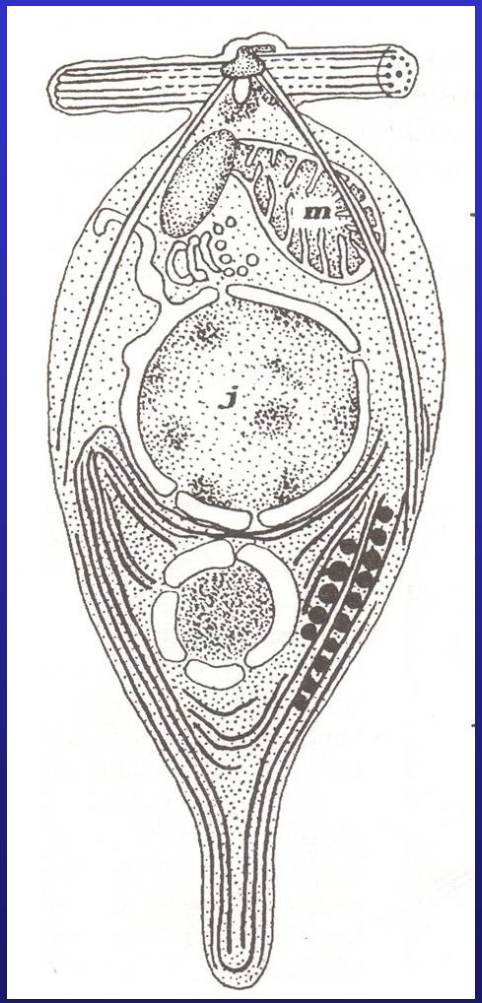
filaments with thick sell walls

Roleda et al. 2009



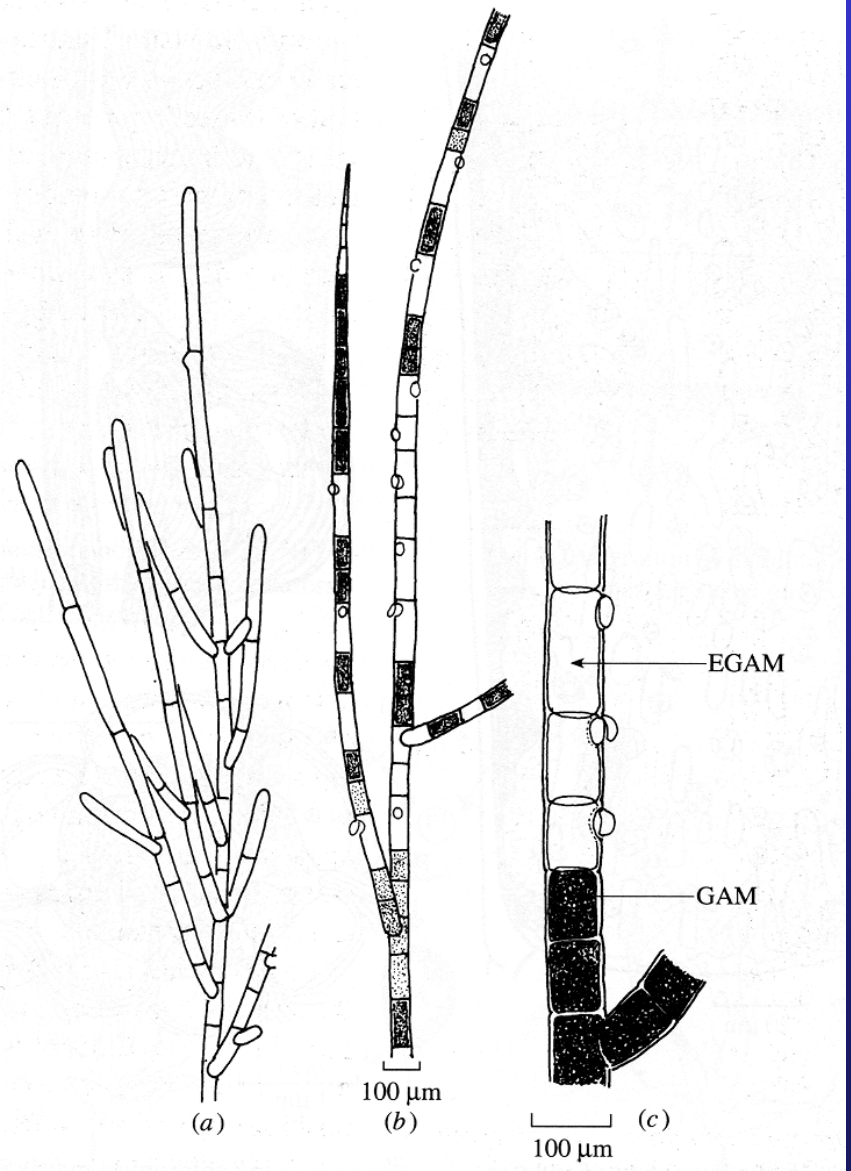
Acrosiphonia

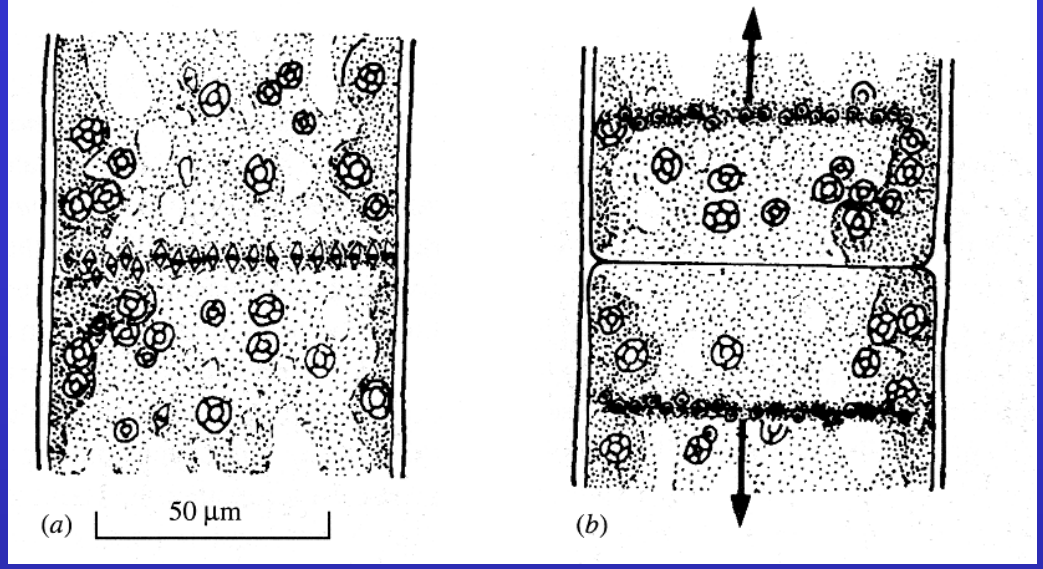
2-flagellate gamete



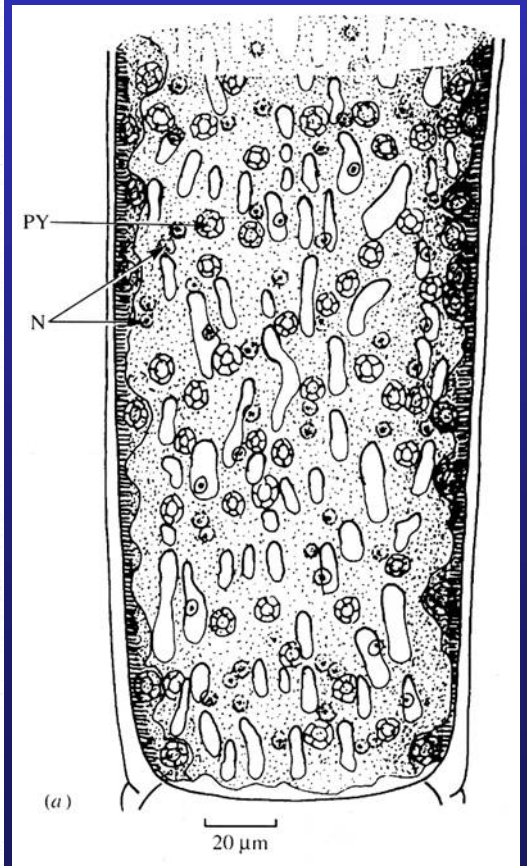
rozvětvené vlákno, b. mnohojaderné. Epilyticky v temperátních a polárních oblastech

Acrosiphonia



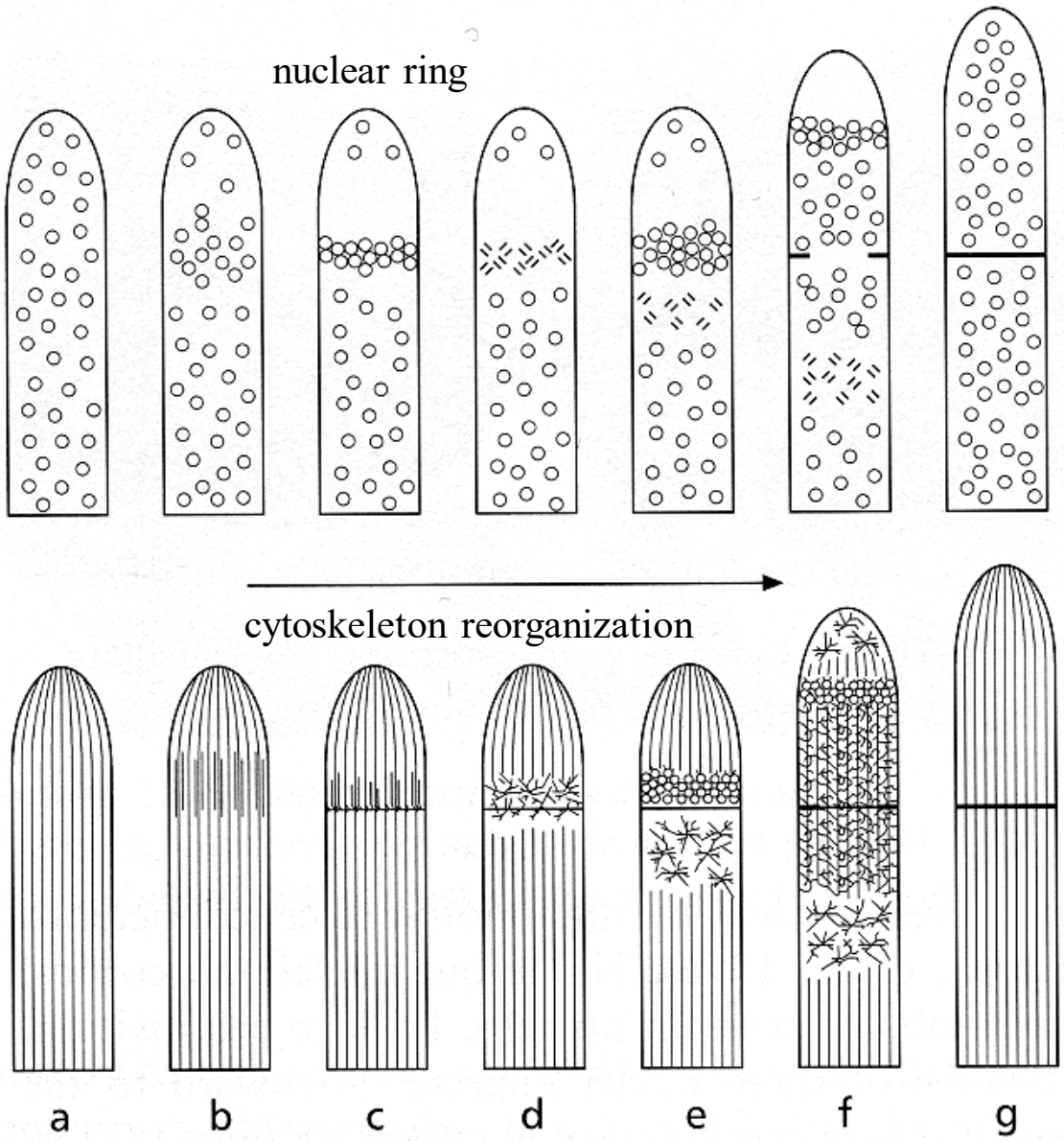


synchronous mitosis



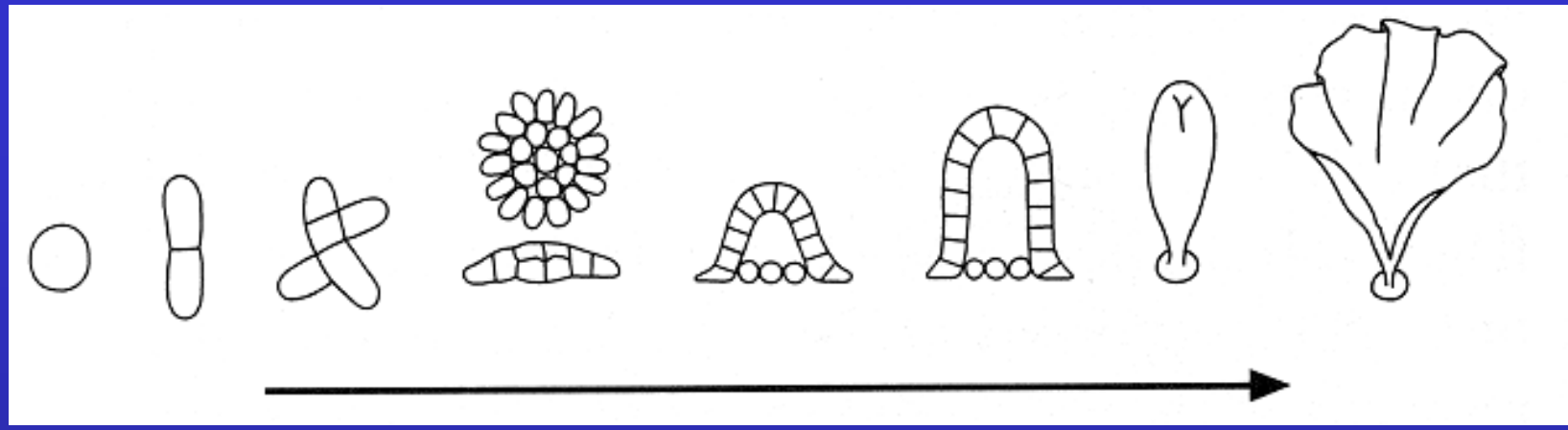
perforated chloroplast

Acrosiphonia



behaviour of nuclei and microtubuli during mitosis

Monostroma



thallus formation from the short filaments

monostromatic thallus

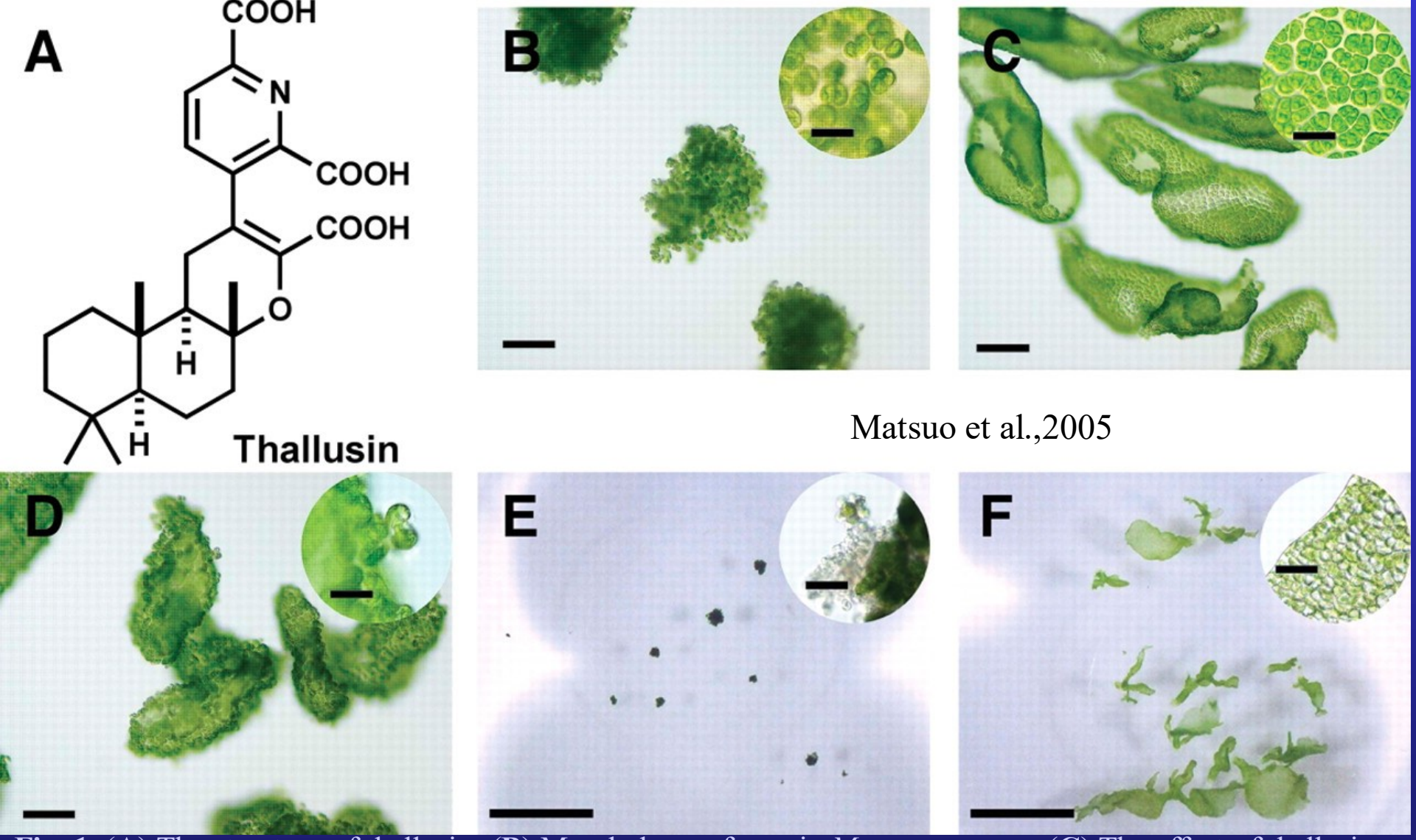
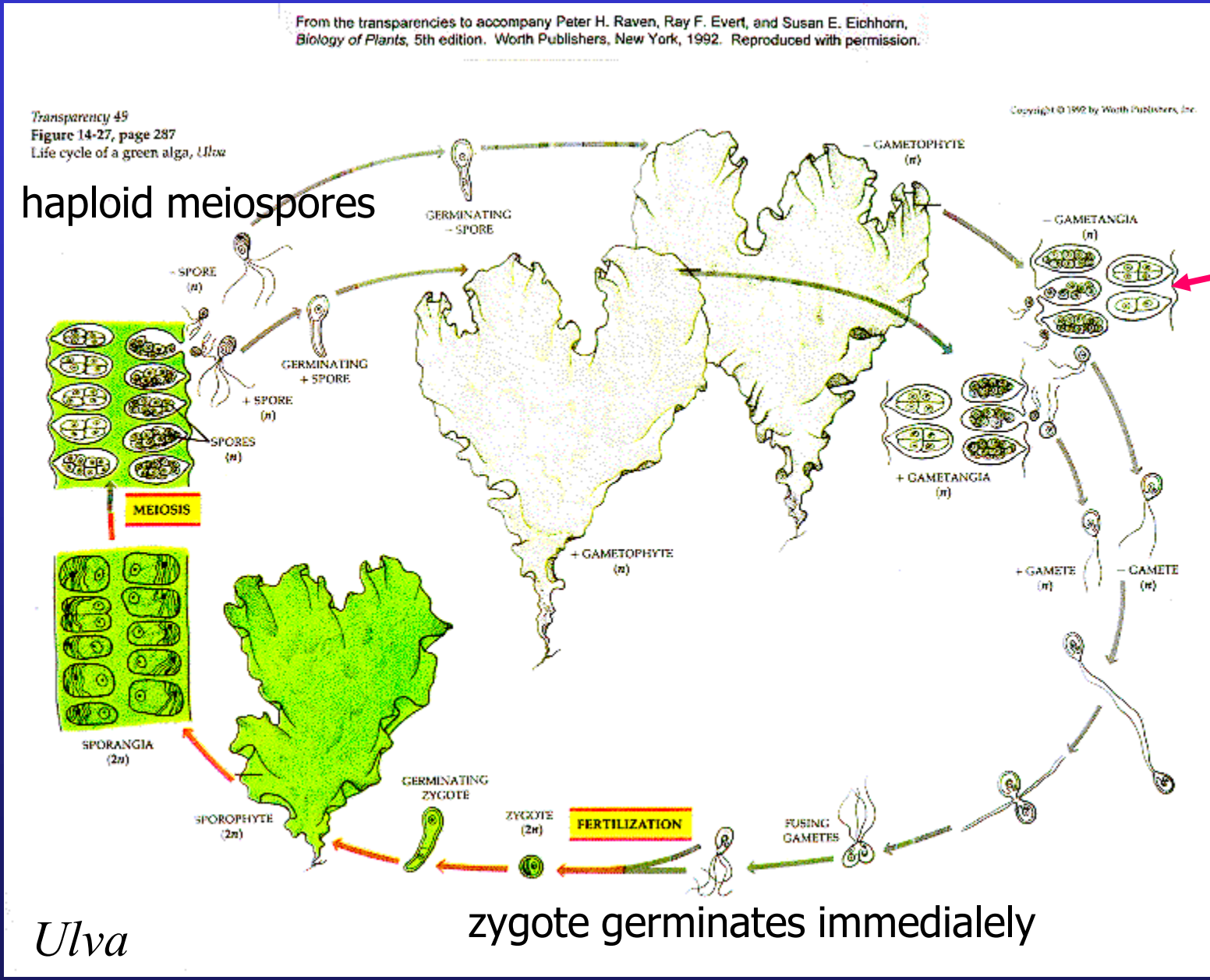


Fig. 1. (**A**) The structure of thallusin. (**B**) Morphology of axenic *M. oxyspermum*. (**C**) The effect of thallusin on *M. oxyspermum* (an initial concentration of 1 ng ml–1). (**D**) Dedifferentiation given a lack of thallusin (an initial concentration of 1 pg ml–1). Inset: Protruding cells from disintegrating thalli. (**E**) Small callus-like morphology of *U. pertusa,* after 2 months of cultivation under aseptic conditions. Inset: Colorless protrusions from the lateral cell walls. (**F**) The effect of thallusin (1 ng ml–1) on *U. pertusa*. Inset: A foliaceous distromatic blade.

Řád: Ulvales


From the transparencies to accompany Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn, Biology of Plants, 5th edition. Worth Publishers, New York, 1992. Reproduced with permission.
Transparency 49
Figure 14-27, page 287
Life cycle of a green alga, Ulva
haploid meiospores
– GAMETOPHYTE (n)
GERMINATING – SPORE
– GAMETANGIA (n)
– SPORE (n)
GERMINATING + SPORE
+ SPORE (n)
SPORES (n)
+ GAMETANGIA (n)
MEIOSIS
+ GAMETOPHYTE (n)
+ GAMETE (n)
– GAMETE (n)
SPORANGIA (2n)
GERMINATING ZYGOTE
SPOROPHYTE (2n)
ZYGOTE (2n)
FERTILIZATION
FUSING GAMETES
Ulva
zygote germinates immedialely

Ulvaria

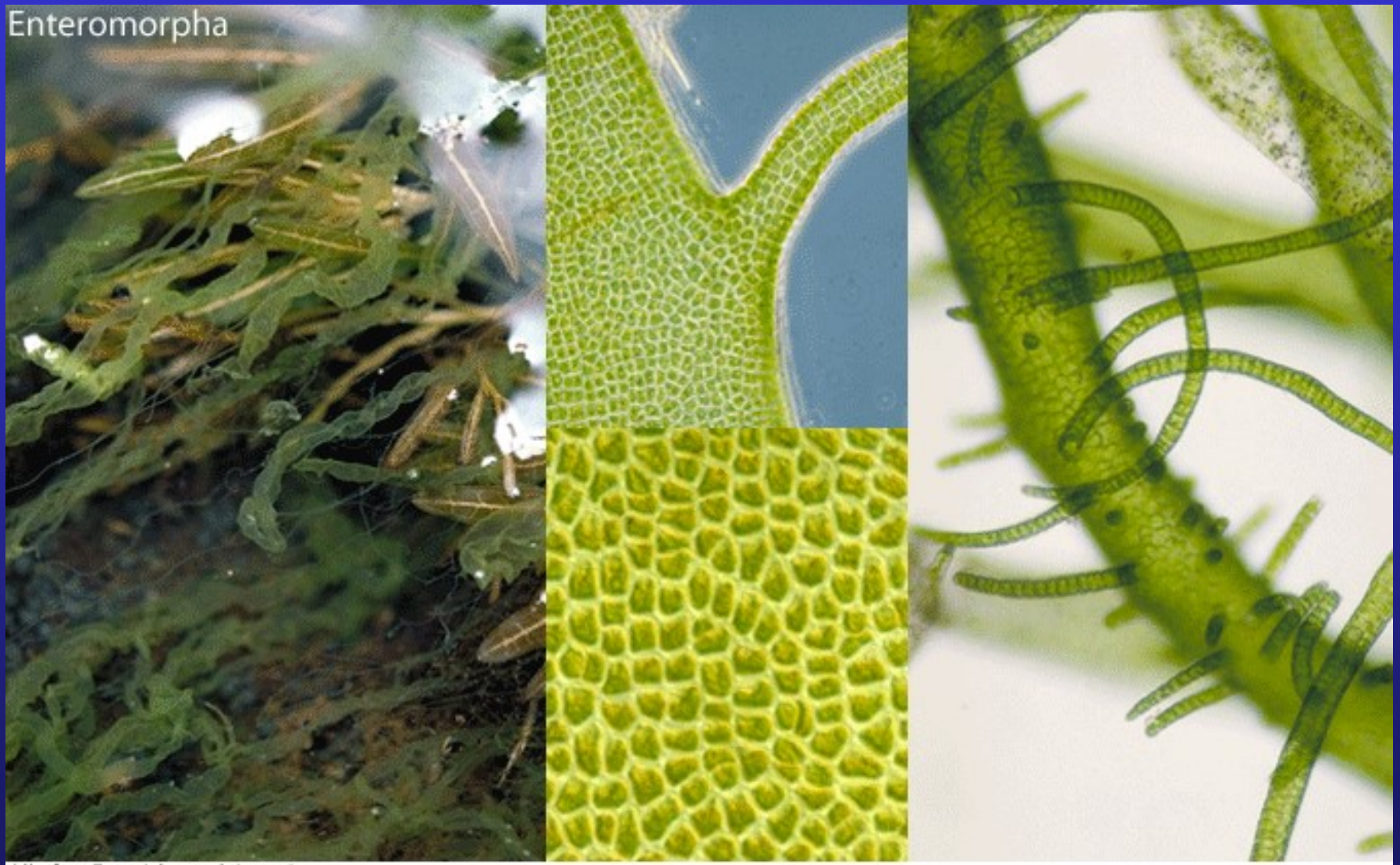
monostromatic thallus (single layer of cells)

temperate regions of the Northern hemisphere

North Atlantic, North Pacific

Enteromorpha=Ulva

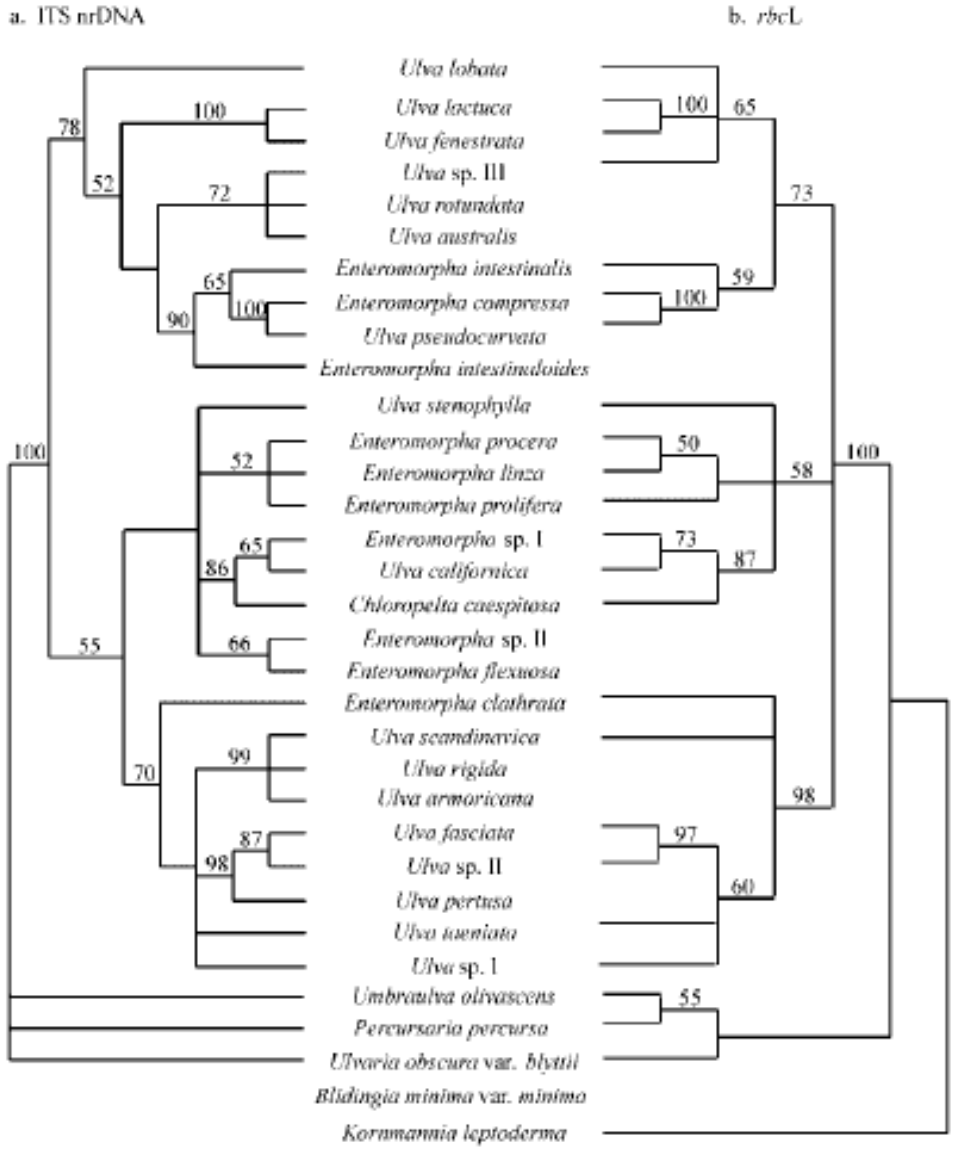
Hayden et al. 2003 synonimize both genera



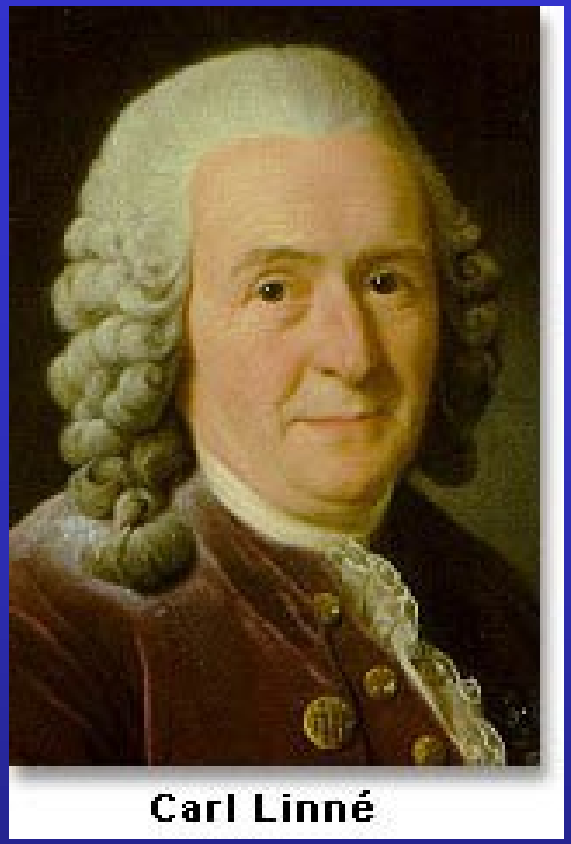
All after Entwisle et al. (1997)

Table 3. Characters used to delimit species of *Ulva* and *Enteromorpha* based on Koeman and van den Hoek (1981) and Bliding (1963, 1968). Characters noted with (E) and (U) are used only in *Enteromorpha* and *Ulva*, respectively.

Character
Gross morphology, including colour and texture of mature plant
Structure of plant base
Arrangement and shape of cells in surface view
Structure of branch tips (E)
Number of pyrenoids per cell
Shape of chloroplast in surface view
Cell size at base, middle and apex of thallus
Height-to-width ratio of cells in cross section (U)
Thallus thickness (U)
Morphology of young germling
Mode of reproduction
Ecology



Hayden et al. 2003. Linnaeus was right all along: *Ulva* and *Enteromorpha* are not distinct genera. *European Journal of Phycology*. 38: 277-294.



Carl Linné

(1719-1772)

only 5 algal genera discerned
(Tremella, Fucus, Ulva,
Conferva, Corallina + Volvox
(=animal like plant)

CAROLI A LINNÉ
EQUIT. AURAT. DE STELLA POLARI,
ACAD. PARIS. MEMBR. &C.

SYSTEMA NATURÆ

PER

REGNA TRIA NATURÆ,

SECUNDUM

CLASSES, ORDINES,
GENERA, SPECIES,

(1767)

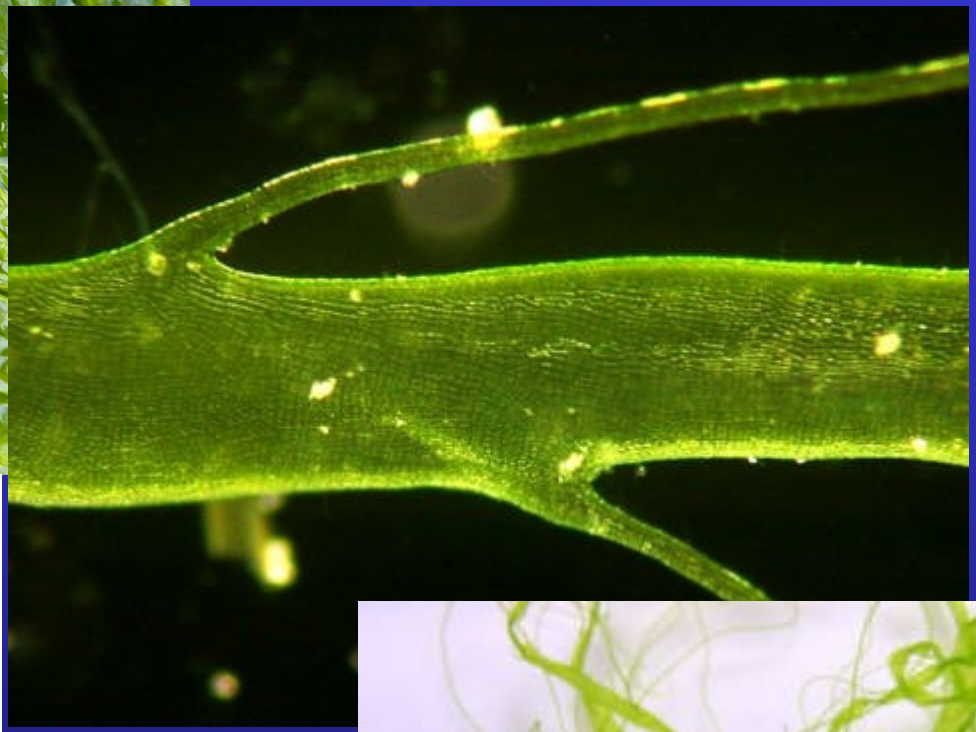
1204. TREMELLA. *Fructificationes* vix manifestæ, 1625. in corpore gelatinoso.

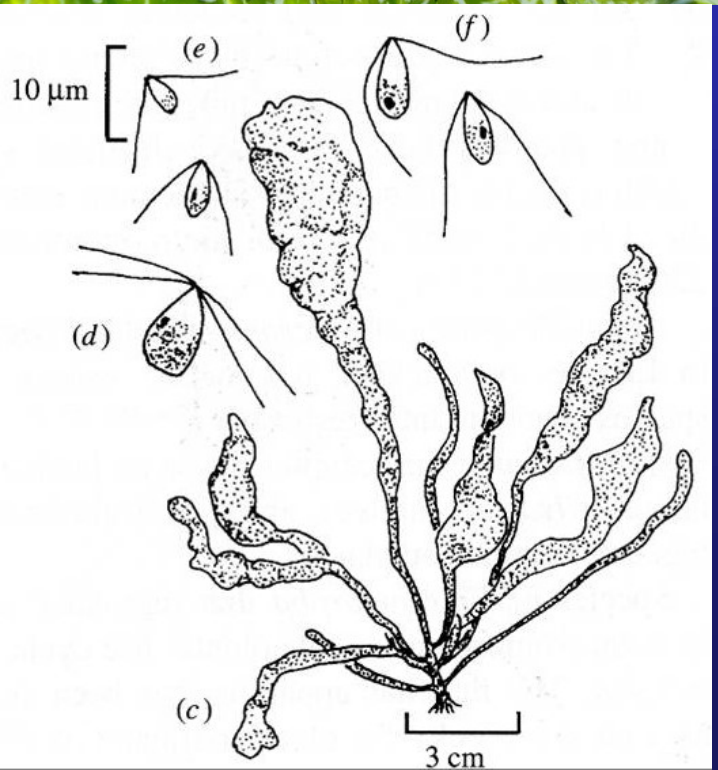
juniperin. 1. T. sessilis membranacea auriformis fulva.
Nostoc. 2. T. plicata undulata.
lichenoi-des. 4. T. erecta plana: margine crispo lacinulato. *Dill. musc. t.* 19. *f.* 32, 34, 35.
verrucosa. 5. T. tuberculosa solida rugosa. *Dill. musc. t.* 10. *f.* 16.
difformis. 8. T. subrotunda sinuata difformis gelatinosa.
hemisph. 6. T. hemisphærica sparsa.
purpurea. 7. T. subglobosa sessilis solitaria glabra.
adnata. 9. T. rotunda imbricata livida.

1205. FUCUS. MASC. *Vesiculæ* villis intertextæ. 1626. FEM. *Vesiculæ* adspersæ granis immersis apice prominulis. *Sem.* solitaria.

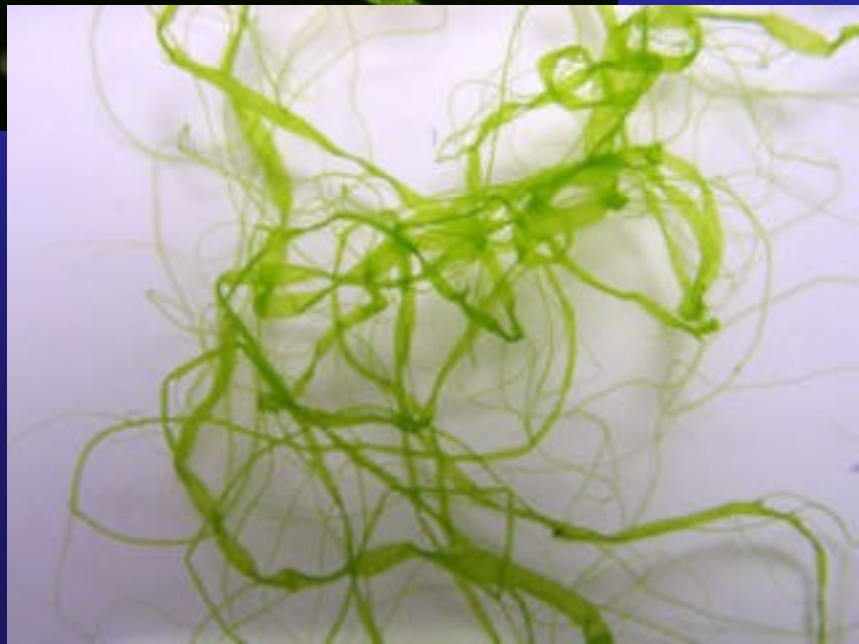
ovarius. 36. F. caule filiformi ramoso, fol. confertis ovatis fornicatis. *Habitat in O. Asiatico.* Folia *conferta in racemum, retrorsum fornicata, membranacea, purpurascentia, parva. Fructificationes non vidi.*

Enteromorpha=Ulva

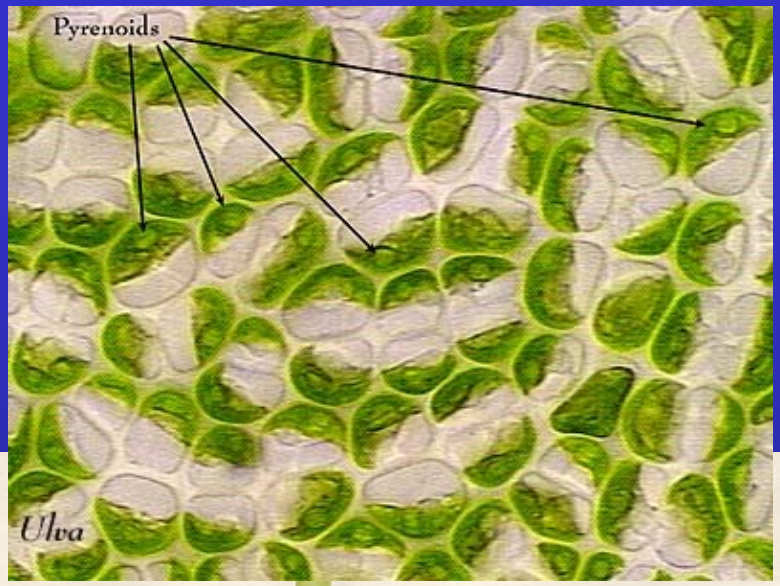




release of gametes influenced by lunar cycle



Ulva



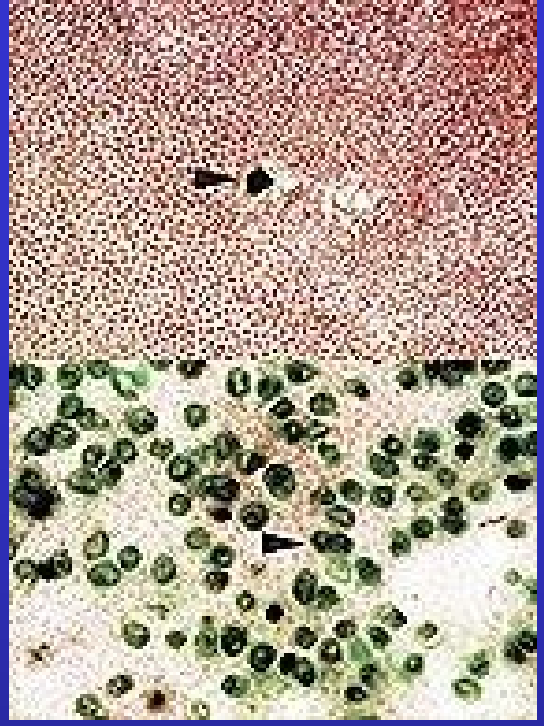
(Qingdao on 18.7.2011)
South China

Going Green: Beach Carpet

2013

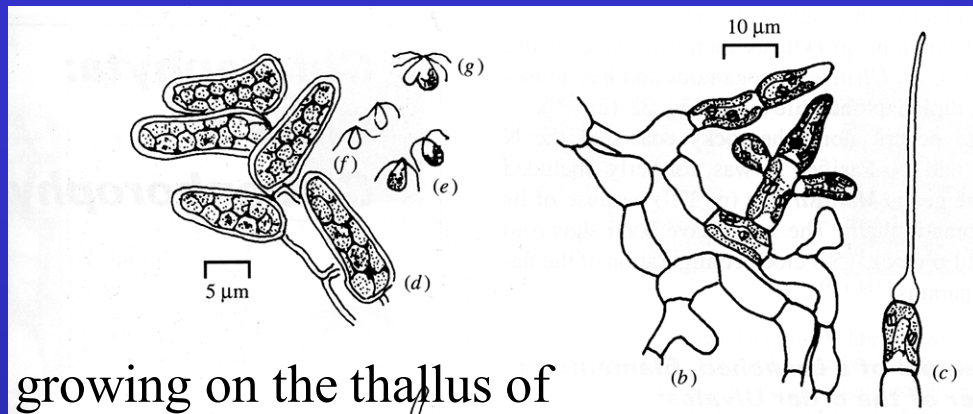
1. 7. 2008 - Sailing course for the Olympic Summer Games. Qingdao, China

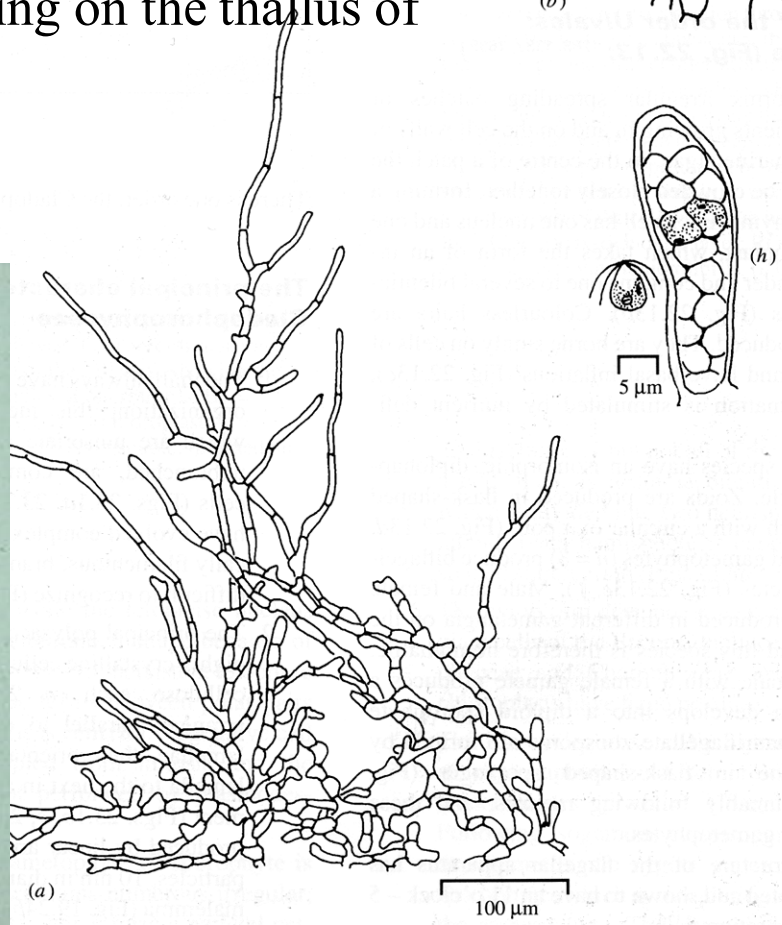
Acrochaete - parasite



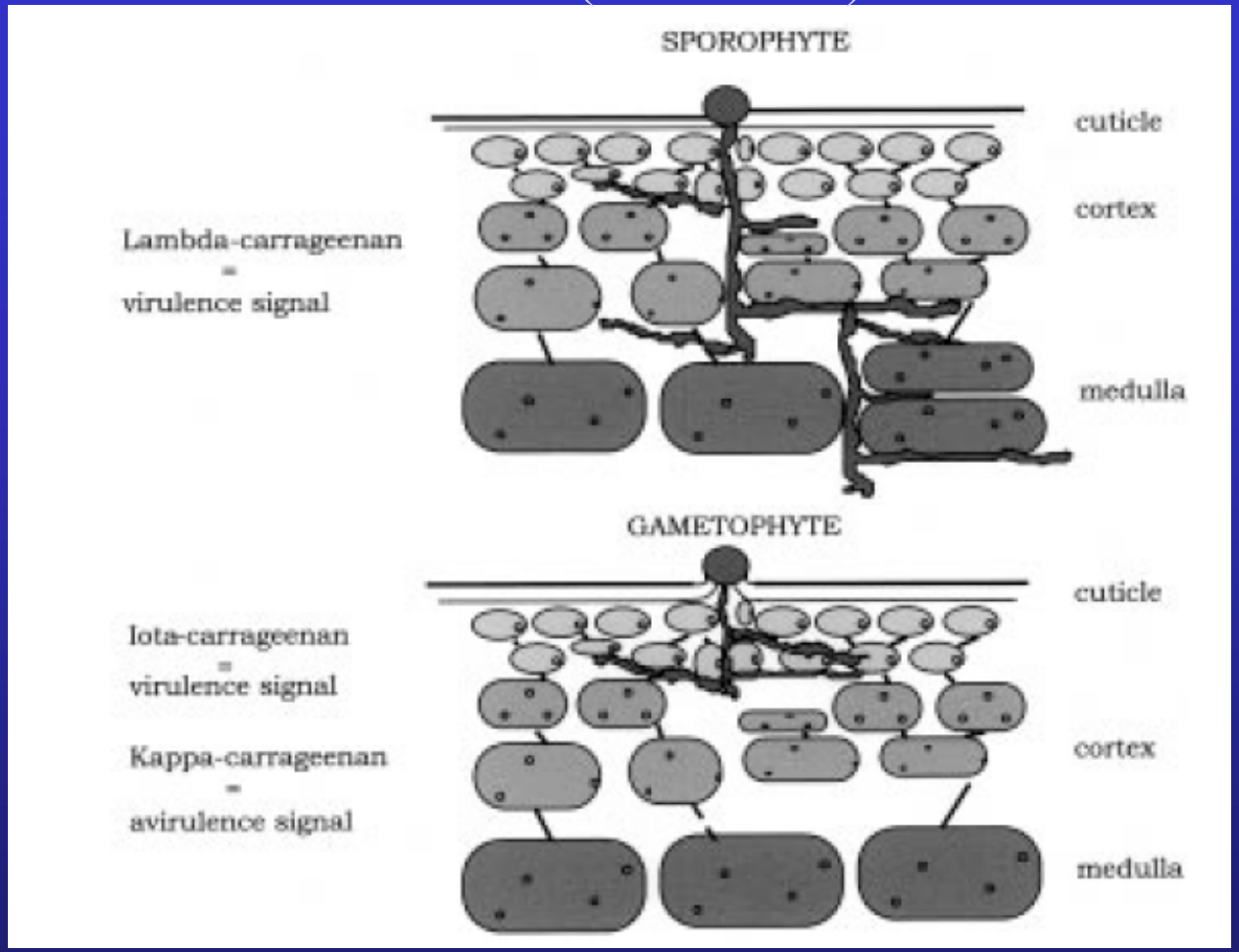
Acrochaete
Chondrus

growing on the thallus of





The virulence of *Acrochaete* mediated by CW composition of the host (*Chondrus*)



susceptible to infection

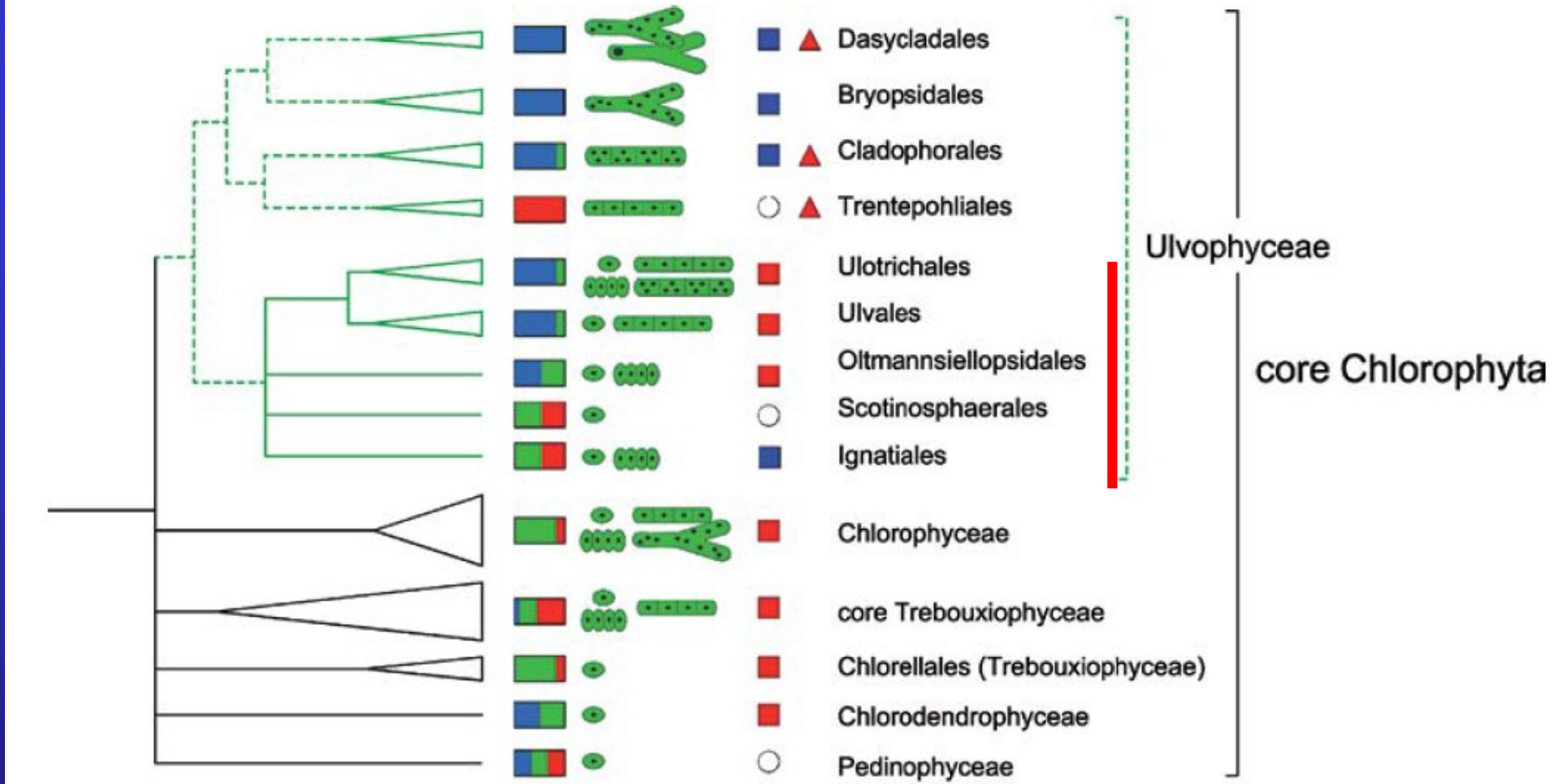
resistant

In this pathosystem,the host gametophytes are resistant to the pathogen, whereas the sporophytic generation is susceptible to infection. The virulence of the green algal pathogen is mediated by the recognition of carrageenan oligosaccharides released from its red algal host: kappa-carrageenan oligosaccharides inhibit *A. operculata* virulence while lambda-carrageenan oligosaccharides enhance its pathogenicity. Bouarab et al. 2004

Induced defence of red algae against pathogens

We investigate the alga/pathogen interaction in the system of the red alga Chondrus crispus (left on top) and the green algal pathogen Acrochaete operculata (below left), which is able to grow within the tissue of the red algal host. This process, called endophytism, can be inhibited during certain developmental phases of C. crispus. During the resistant, gametophytic, phase of the life cycle, C. crispus can recognise the attacker and kill it by an immediate release of hydrogen peroxide. We found that carrageenans from the red alga induce the release of asparagine from the green algal parasite. The free amino acid itself acts as a substrate for an amino acid oxidase of the host that releases micromolar amounts of hydrogen peroxide, sufficient to contain the attacker. The aim of a related collaborative project (European Union EPIFIGHT) is to understand the biological

carragenans induce the release of asparagine (Asn) from Acrochaete
Free Asn – substrate for amino acid oxidase of Chondrus – releas of H_2O_2 – enough to contain/kill the attacker



Habitat

aero-terrestrial

freshwater

marine

Translational apparatus

EFL

EF-1α

unknown

alternative nuclear genetic code

Cyto-morphological organisation

Type 1a: flagellate or non-flagellate unicells, cells uninucleate

Type 1b: flagellate or non-flagellate colonies, cells uninucleate

Type 2: multicellular filaments or blades composed of uninucleate cells.

Type 3: siphonocladous organisation: multicellular thalli, multinucleate cells

Type 4: siphonous organisation: thallus a single tubular cell, multinucleate

Type 4b: siphonous organisation: thallus a single tubular cell, single macronucleus

Del Cortona et Leliaert, 2018