Chlorophyta

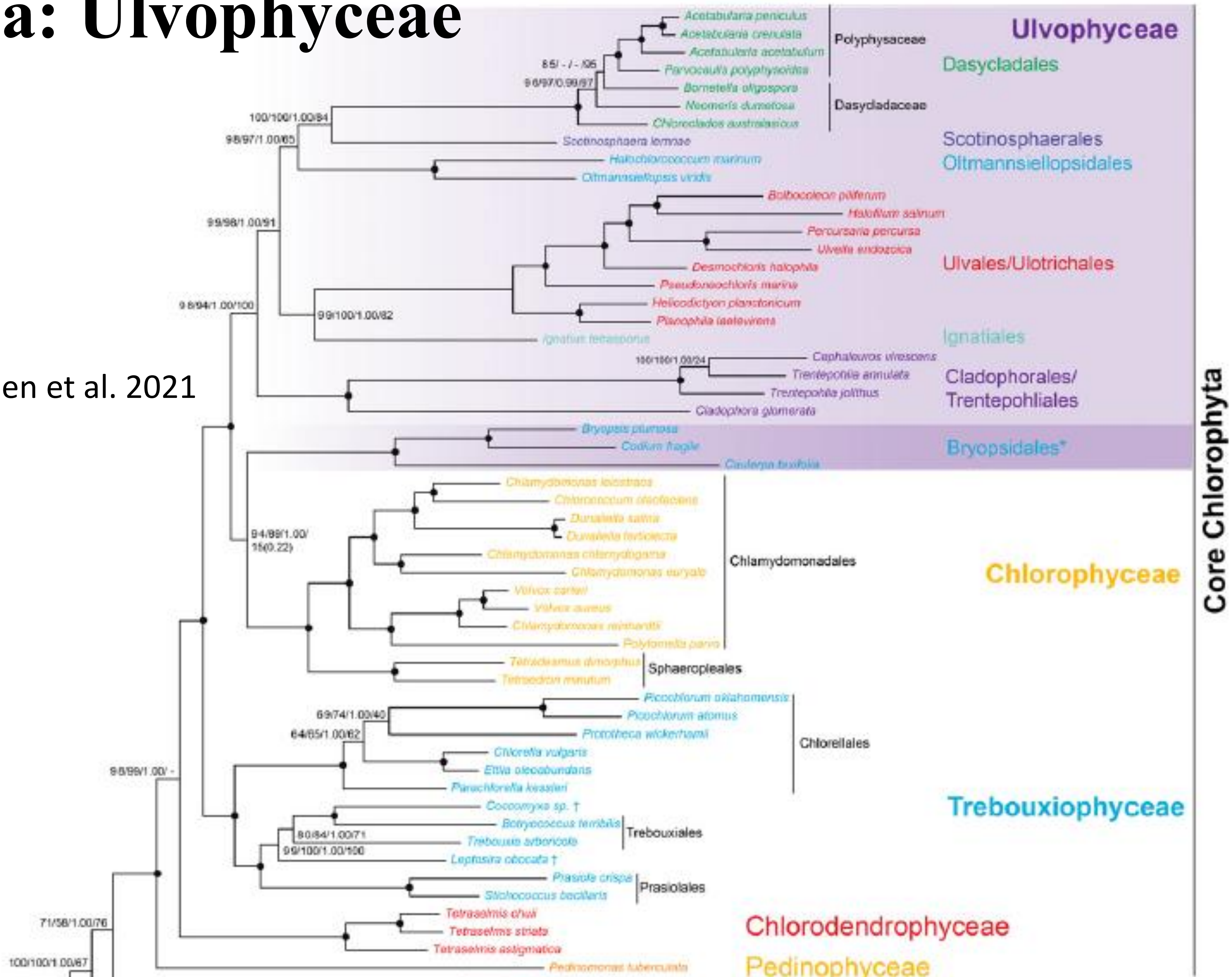
Ulvophyceae

Bryopsidales

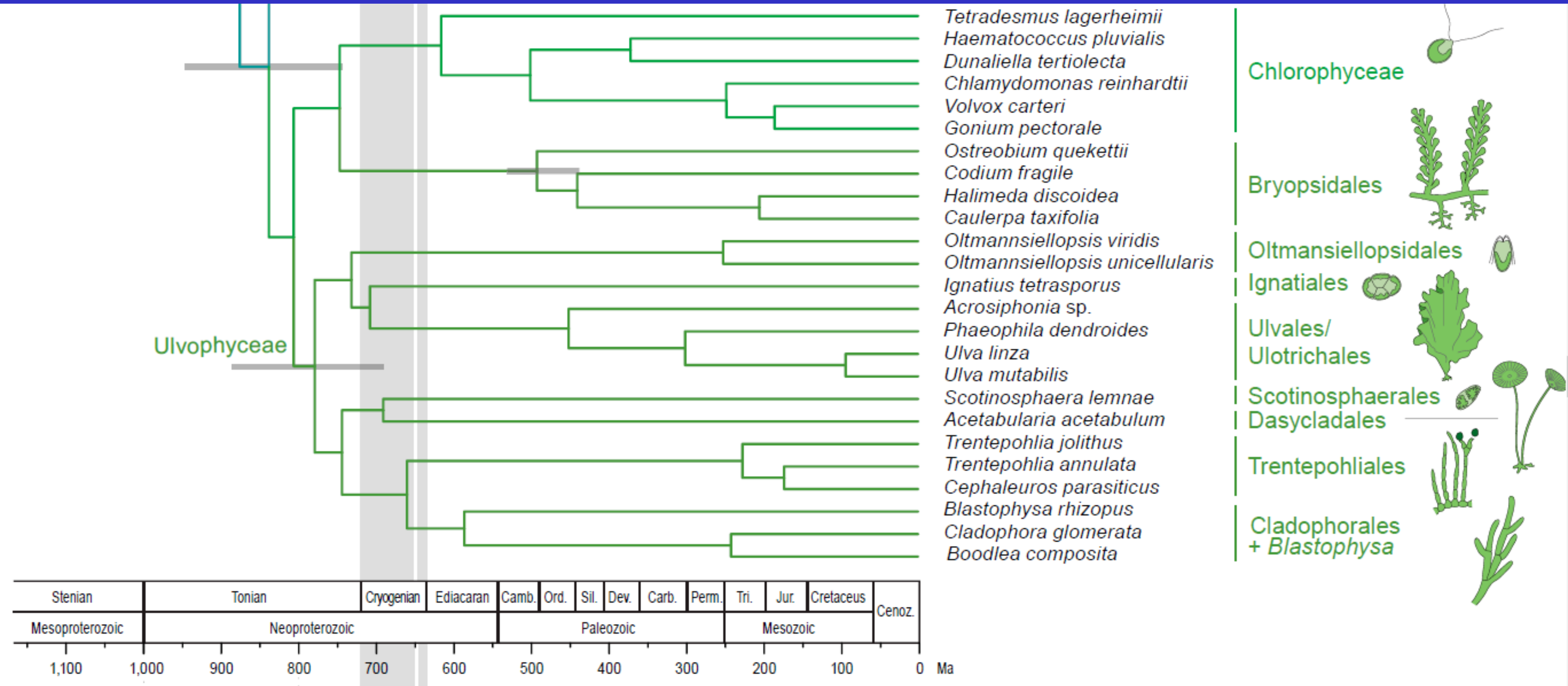
Dasycladales

Třída: Ulvophyceae

Gulbrandsen et al. 2021



Phylogenetic position of Bryopsidales and Dasycladales



Del Cortona et al. 2020

Bryopsidales

Základní charakteristika:

• stélka vždy sifonální (uniaxiální nebo multiaxiální druhy)

• strukturní polysacharidy BS – mannany, xylany, glukany (celulóza není v krystalické formě)

• zoidi 2 nebo 4 bičíky, CCW orientace bičíkových bazí, u některých stefanokontní zoospory

• mitóza uzavřená, perzistující telofázové vřeténko, jádro v telofázi – činkovitý tvar; centrioly mohou, ale nemusí být přítomny

• akcesorické pigmenty sifonein, sifonoxantin

• četné chloroplasty v nástěnné vrstvě cytoplasmy (homoplastidické x heteroplastidické druhy)

• proudění cytoplasmy v podélné ose stélky

• haplontní životní cyklus (haploidní gametofyt, mikroskopická zygota s obrovským diploidním jádrem), anizogamie

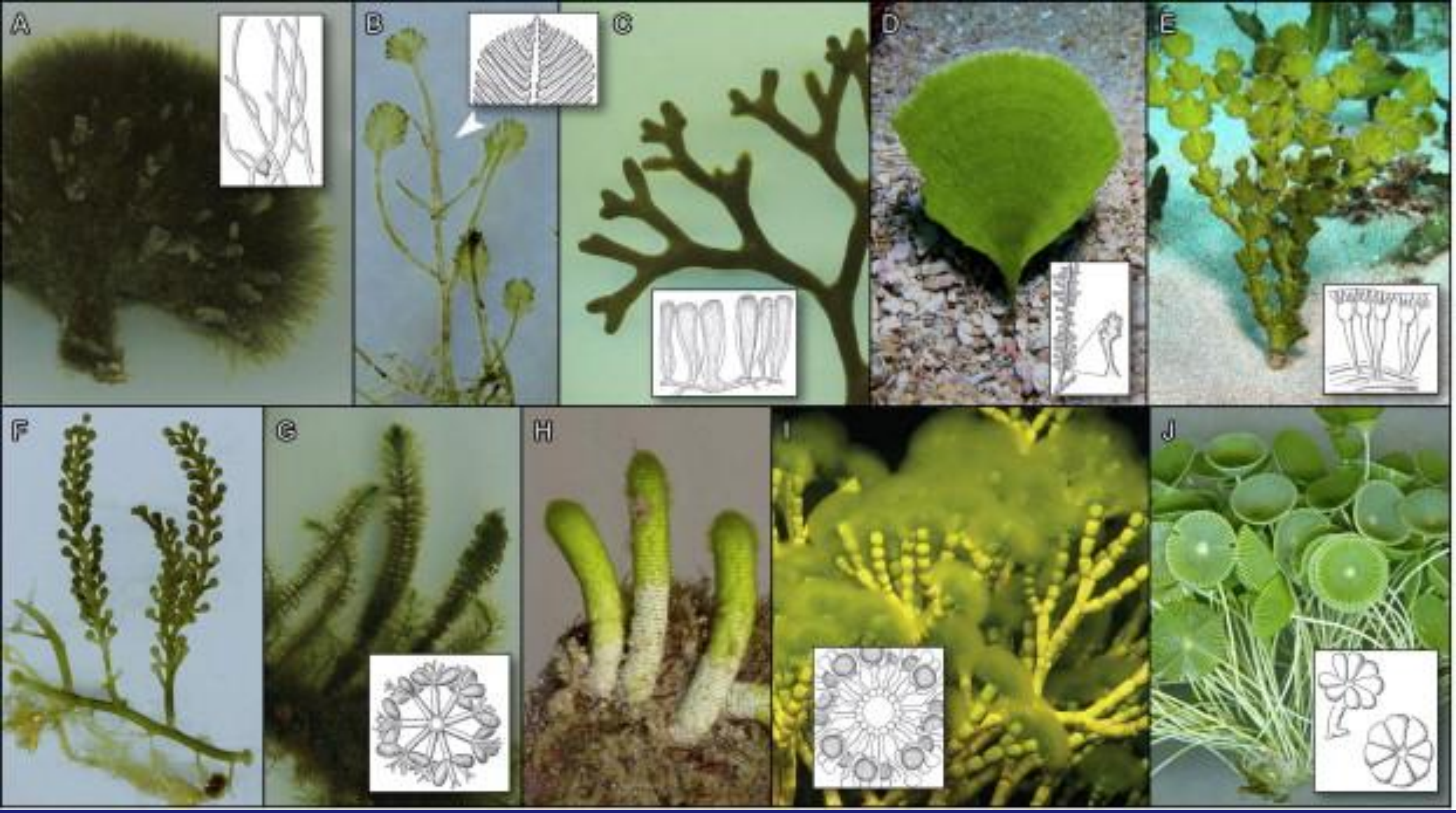


Fig. 1. Morphology and anatomy of the siphonous green algae comprising the orders Bryopsidales (A–F) and Dasycladales (G–J). (A) *Derbesia*, (B) *Bryopsis*, (C) *Codium*, (D) *Udotea*, (E) *Halimeda*, (F) *Caulerpa*, (G) *Batophora*, (H) *Neomeris*, (I) *Cymopolia*, (J) *Acetabularia*.

Verbruggen et al. 2009

Cremen et al. 2019

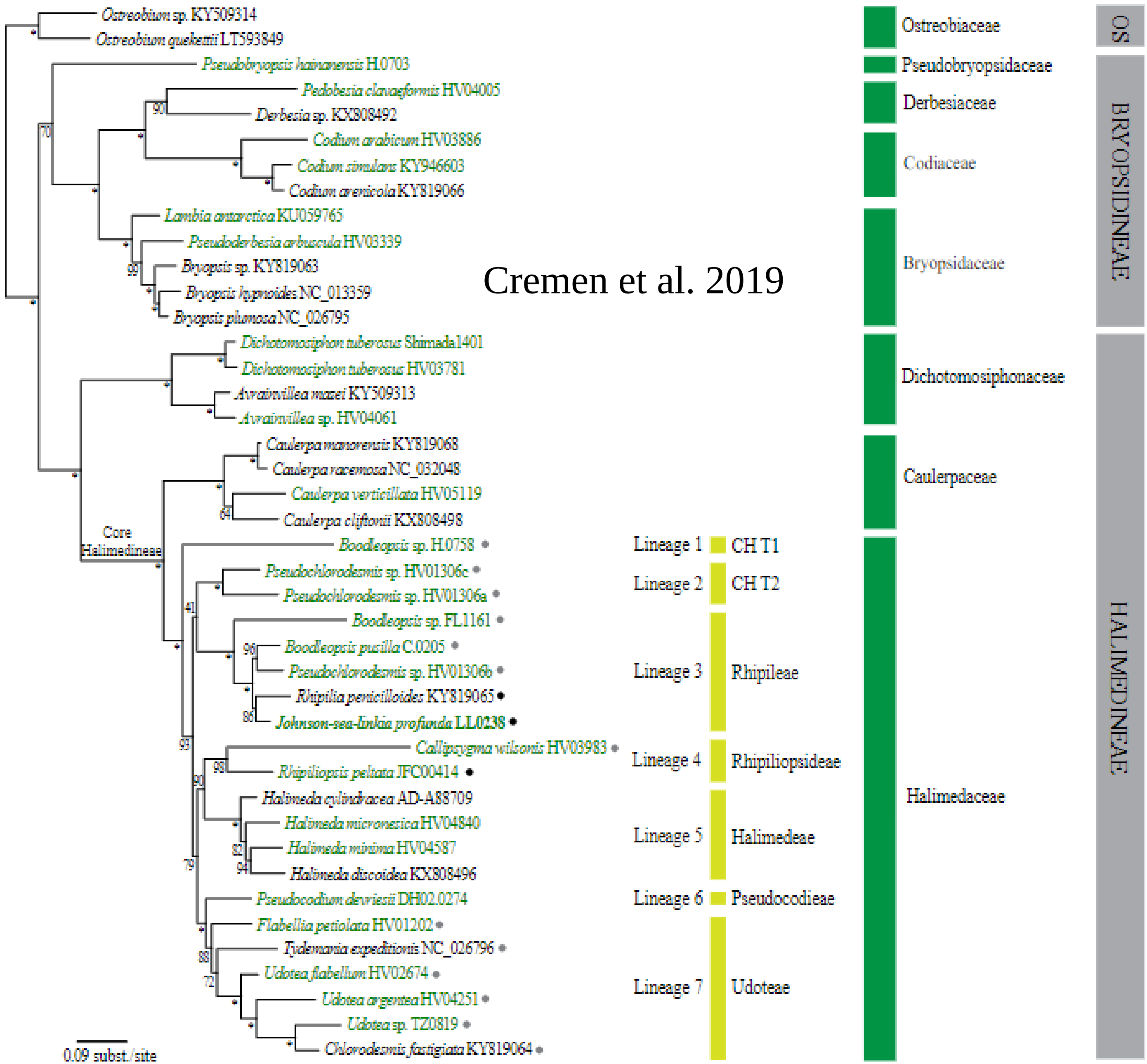
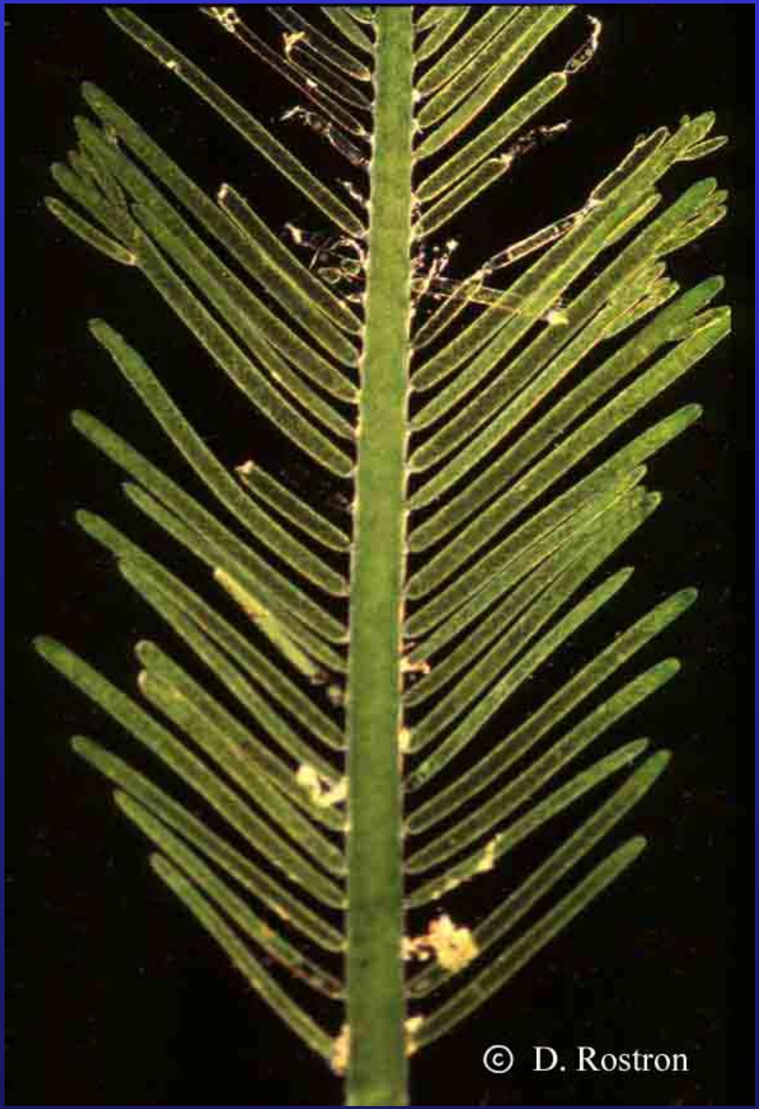


Fig. 1. Maximum likelihood phylogeny inferred from the concatenated amino acid (partitioned) alignment of 71 chloroplast protein coding genes from 42 bryopsidalean taxa using CPREV + Γ + F model and manually rooted along the branch between Ostreobineae (abbreviated OS) and the other suborders. Values at nodes indicate bootstrap support where (*) denotes maximum bootstrap support. The new proposed classification scheme is shown to the right of the tree and all newly sequenced taxa are in green text. Black and grey dots after the taxon name indicate their current placement in Rhipiliaceae and Udoteaceae, respectively.

Siphonous (coenocytic) thallus

uniaxial

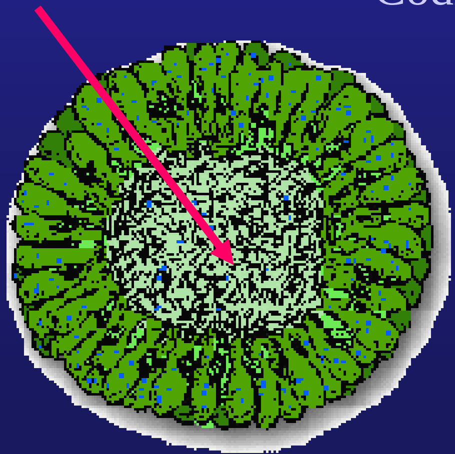
multiaxial organisation



Bryopsis

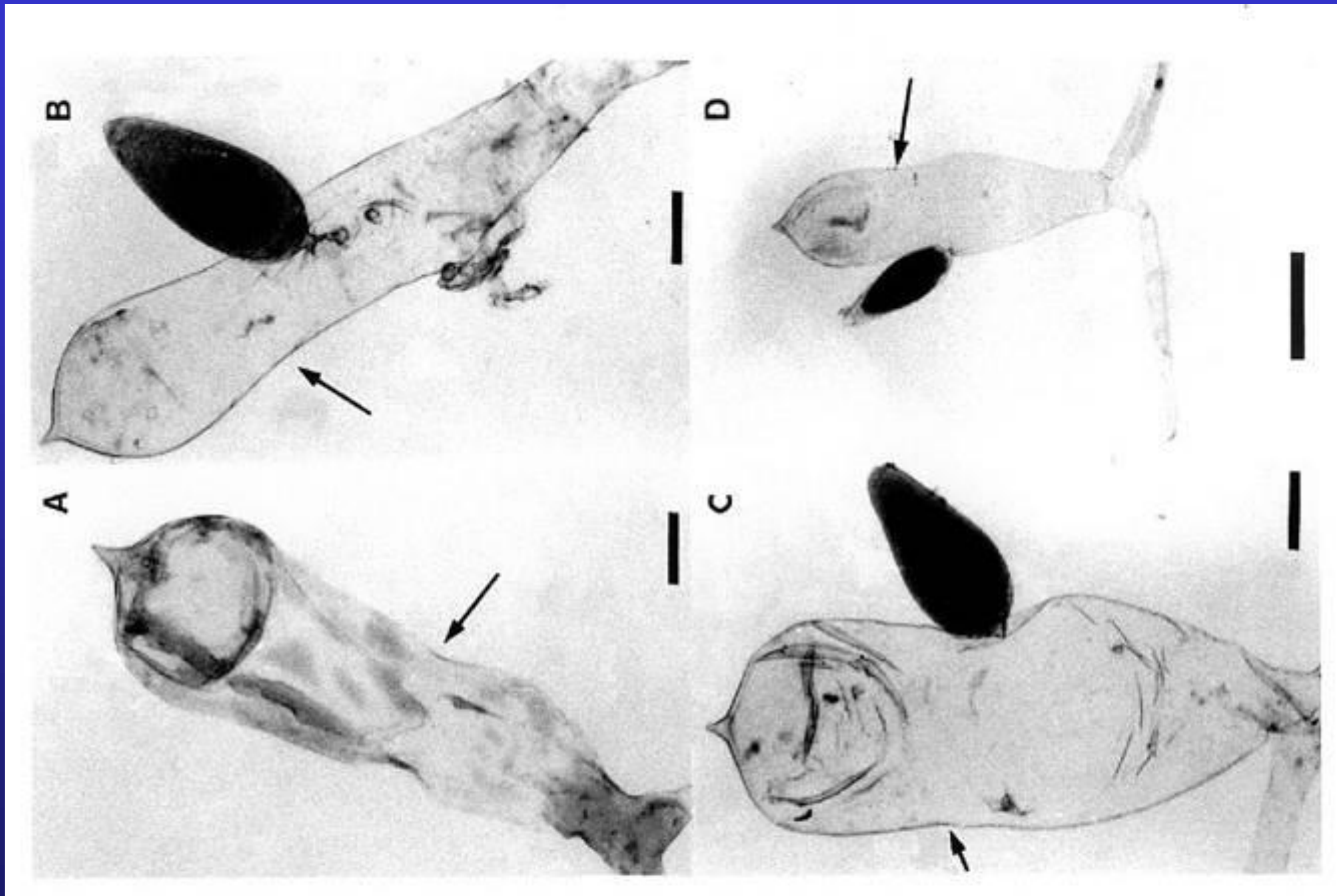
Codium

medulla



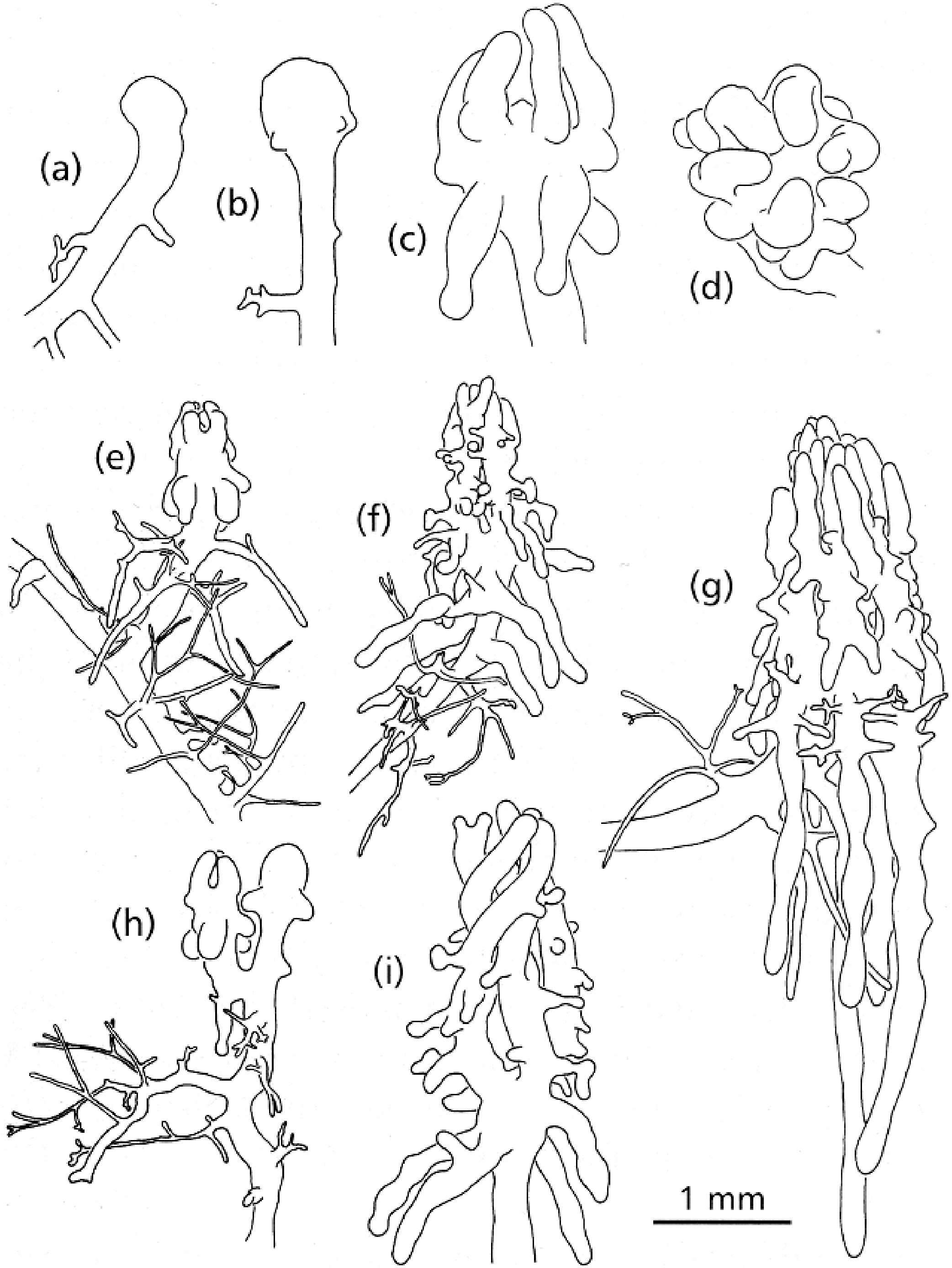
utriculus

Siphonous (coenocytic) thallus



Codium – utriculus bearing gametangium

Siphonous (coenocytic) thallus

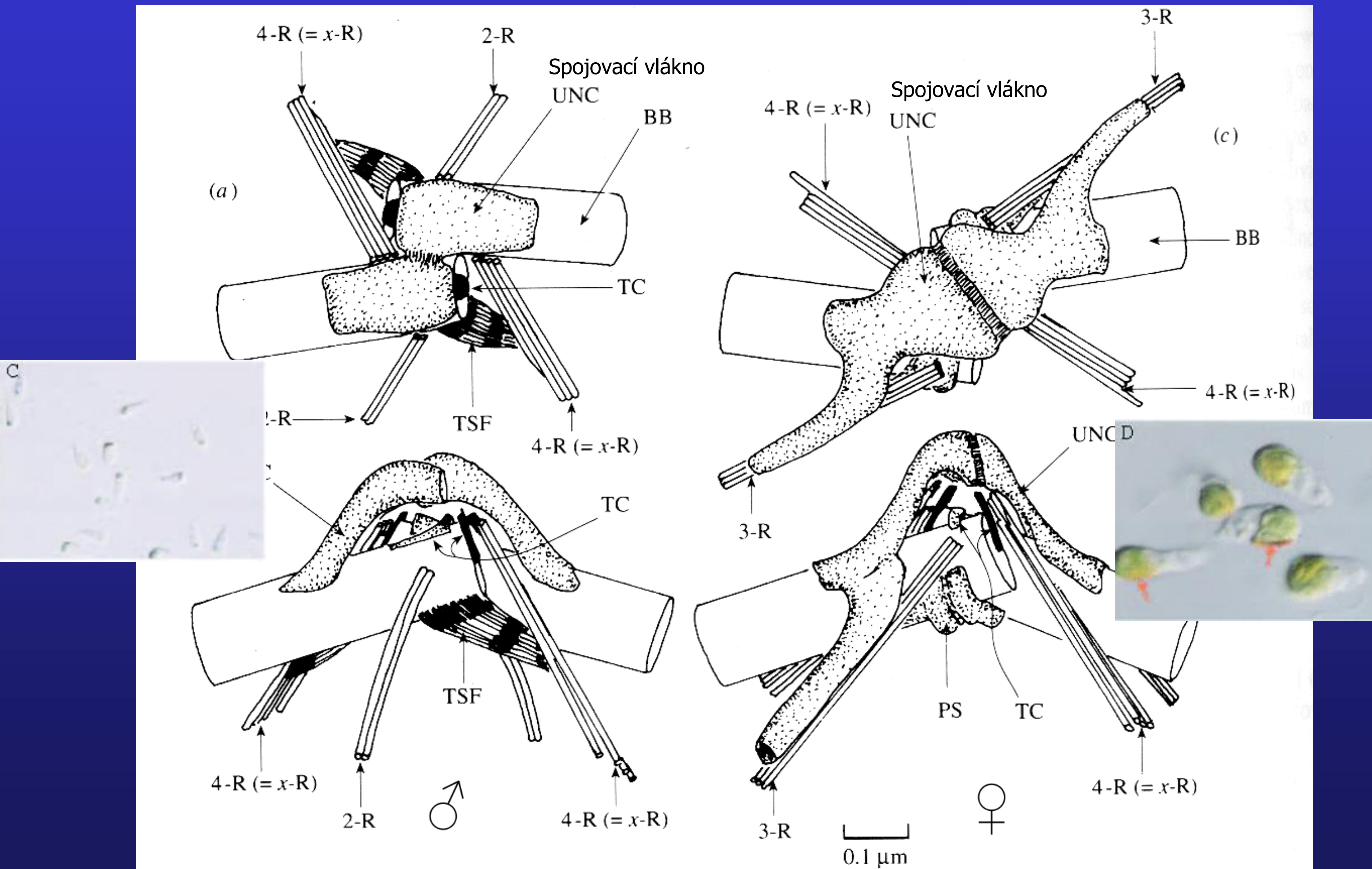


multiaxial thallus formation in *Penicillus*

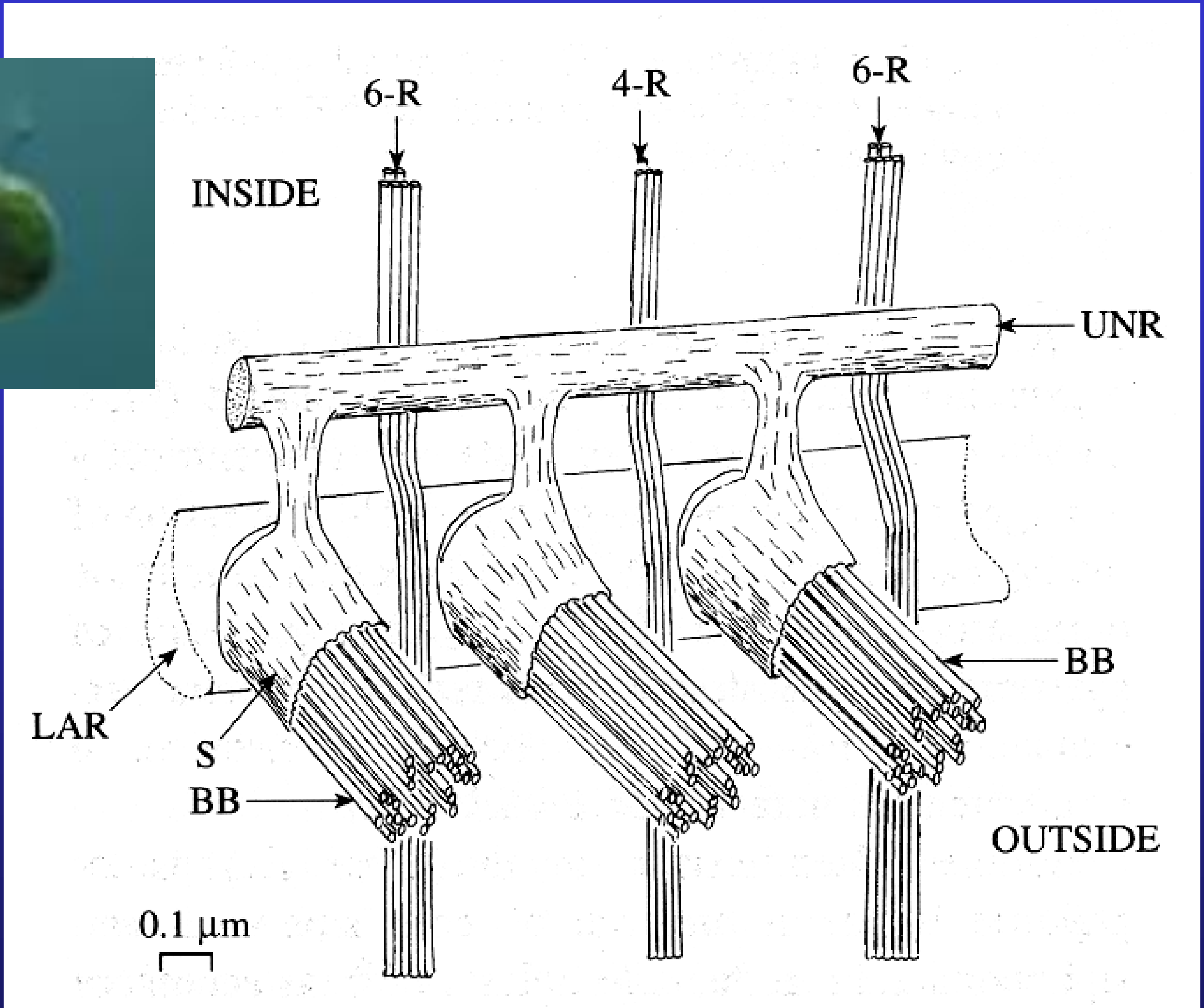
Pseudobryopsis

Flagellar apparatus

Ultrastruktura bičíkového aparátu se u ♂ a ♀gamet *Pseudobryopsis*



Flagellar apparatus of the stephanokont zoospore

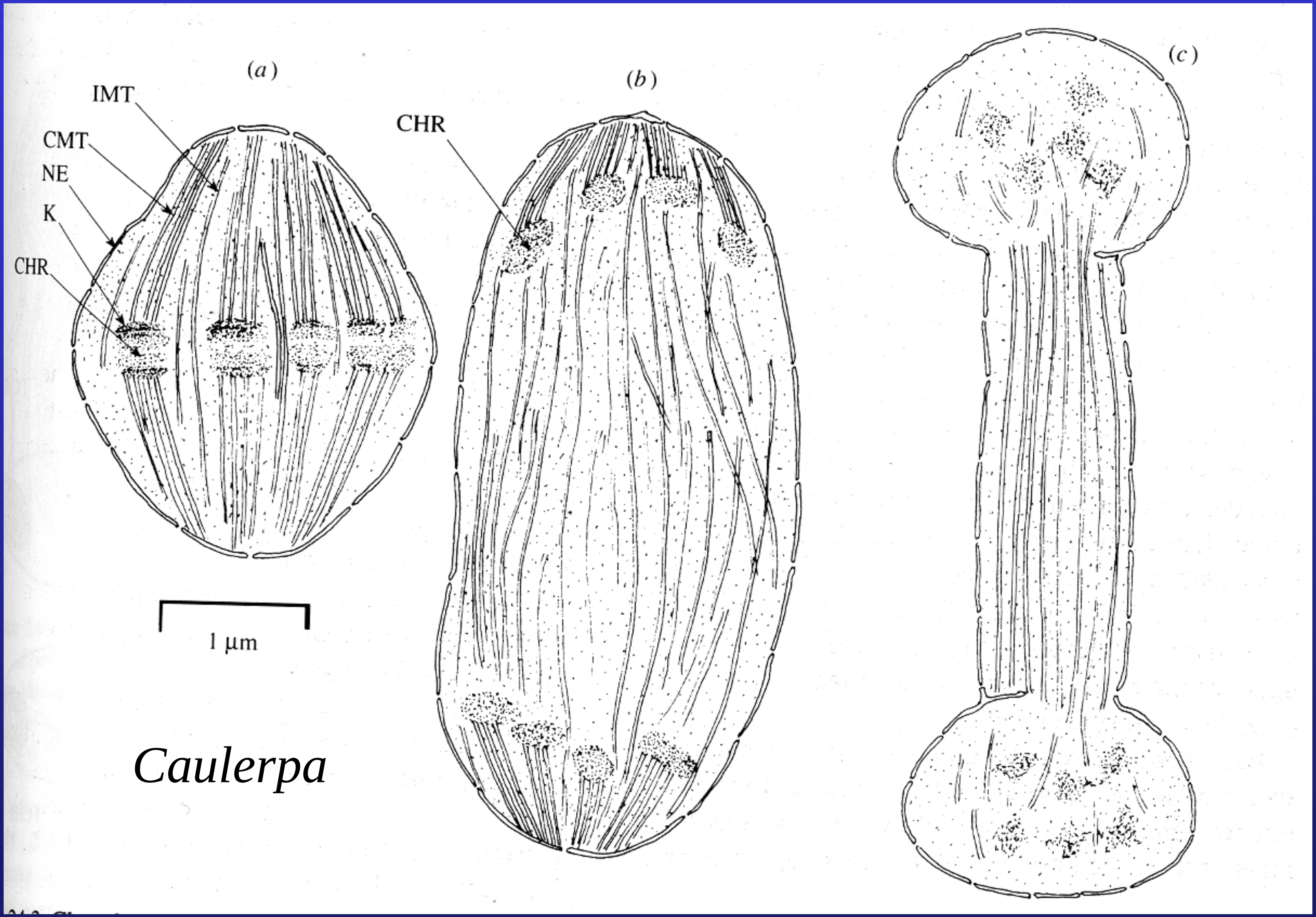


upper non-striated ring

lower amorphous ring

Pseudobryopsis – each stephanokont cell possesses 35 basal bodies

Mitosis

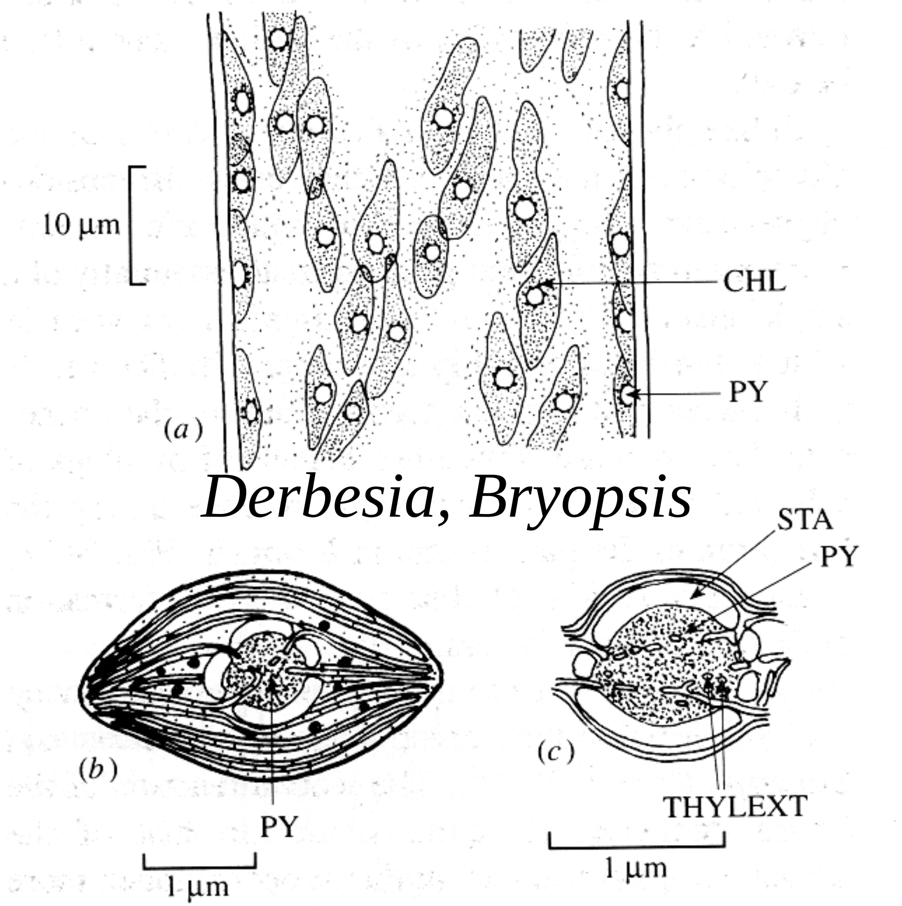


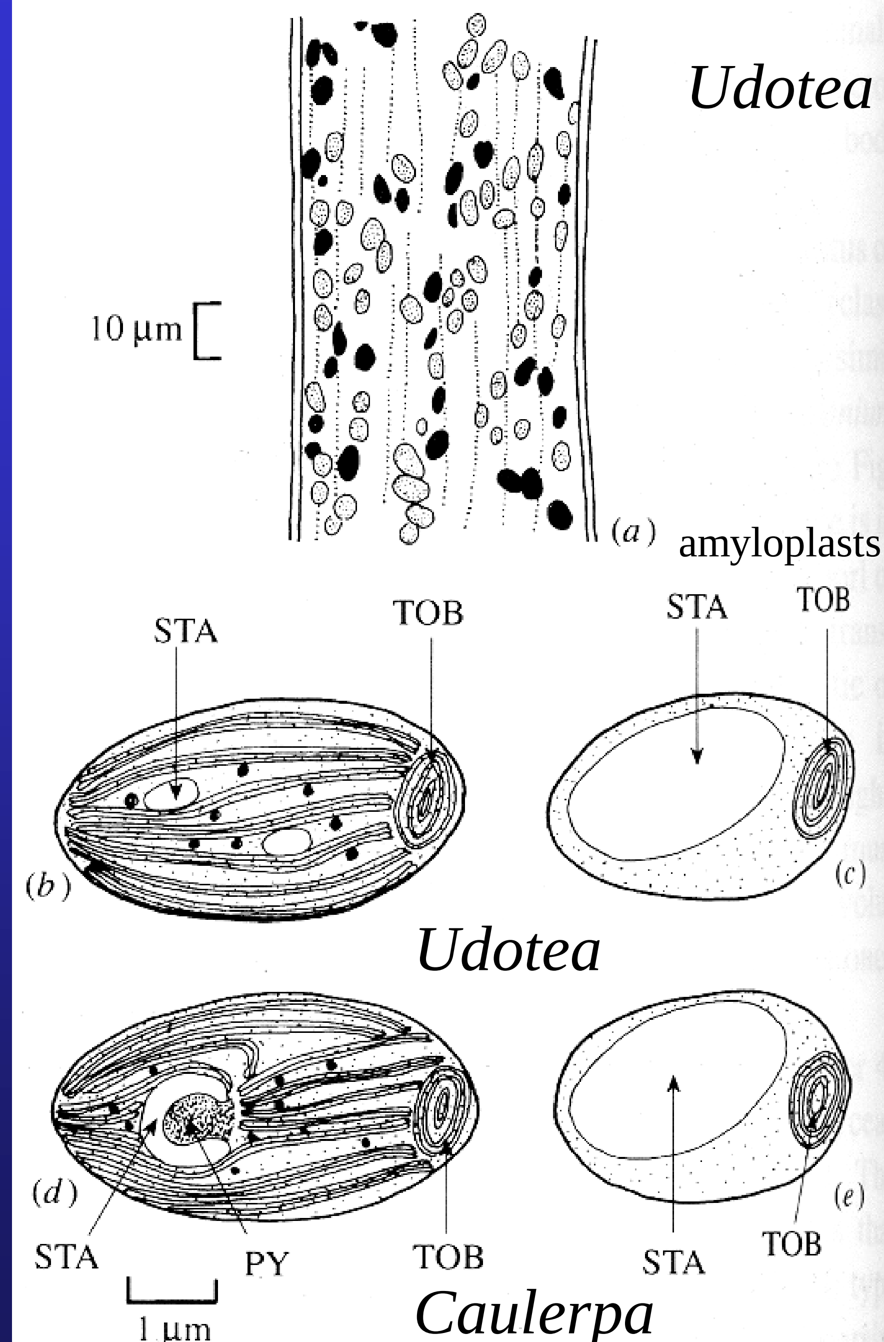
dumbbell-shaped giant nukleus in telophase

Chloroplasts

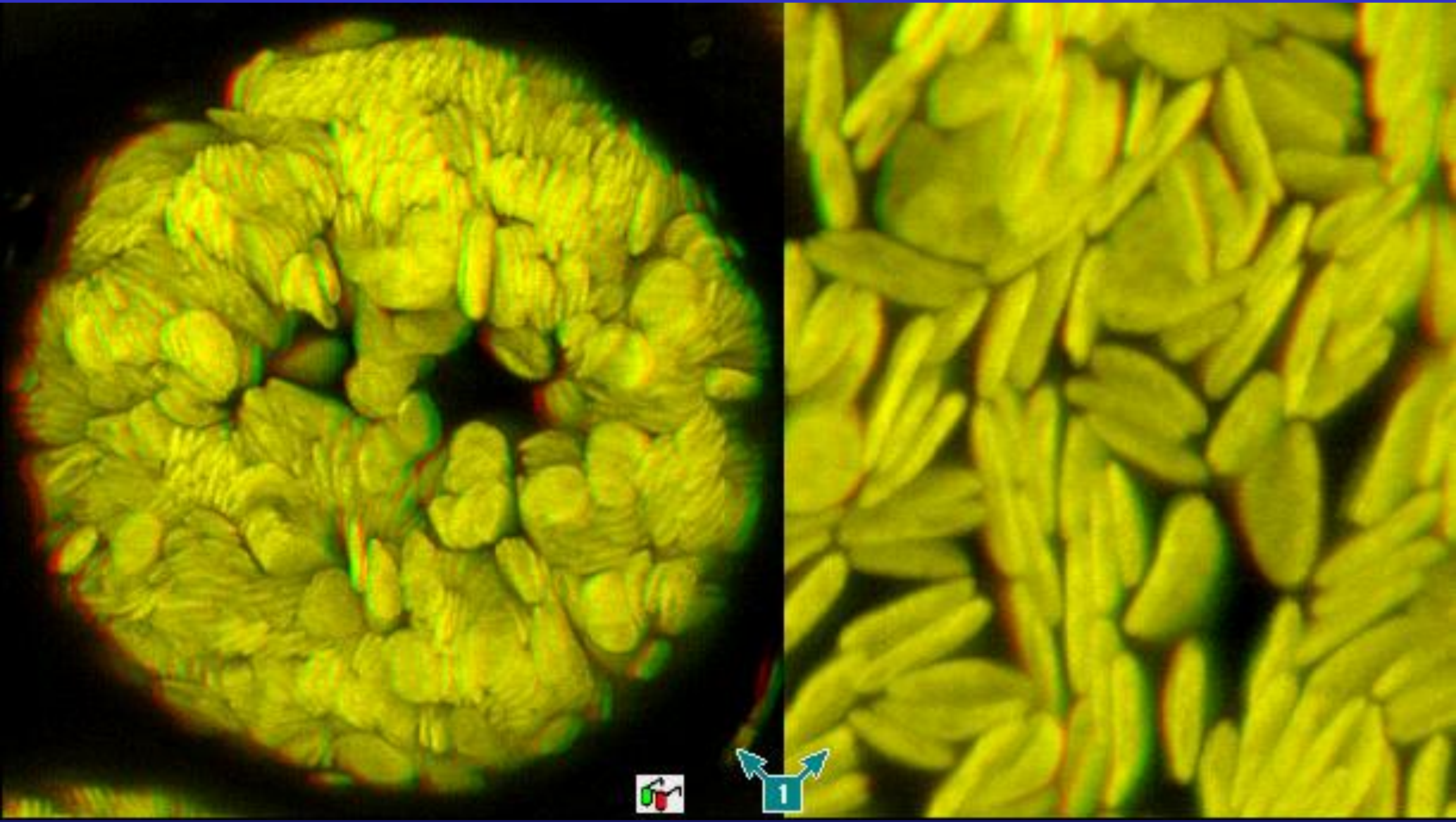
heteroplastidic species

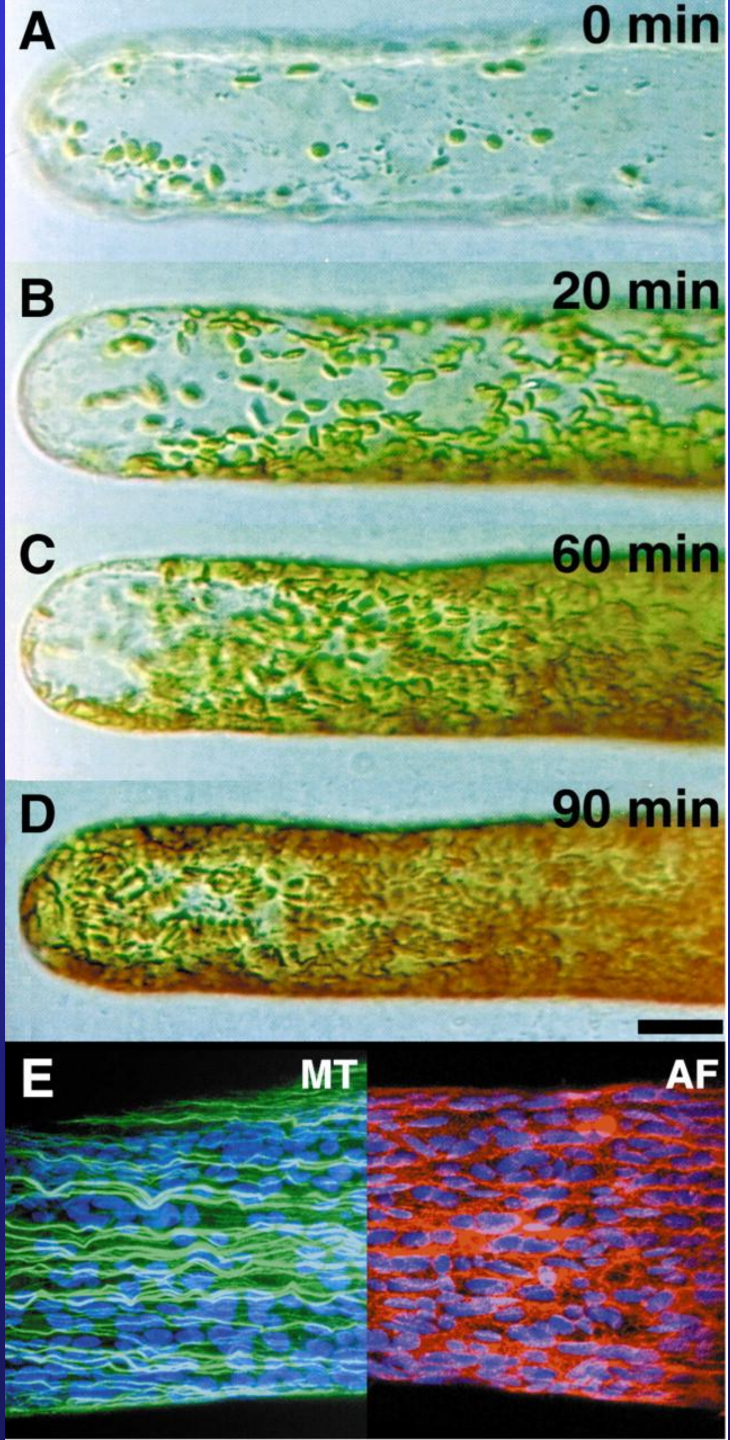
homoplastidic species





Chloroplasts of *Codium*
homoplastidic species, chloroplasts without pyrenoid





60 µm/sec

dim blue light

Accumulation of chloroplasts in the cell apex of the coenocytic green alga

Dichotomosiphon

MT – microtubules
AF – actin filaments

Calcification

Some multiaxial species precipitate calcium carbonate on the surface of siphons or in interutricular spaces (*Halimeda*) in the form of aragonite crystals

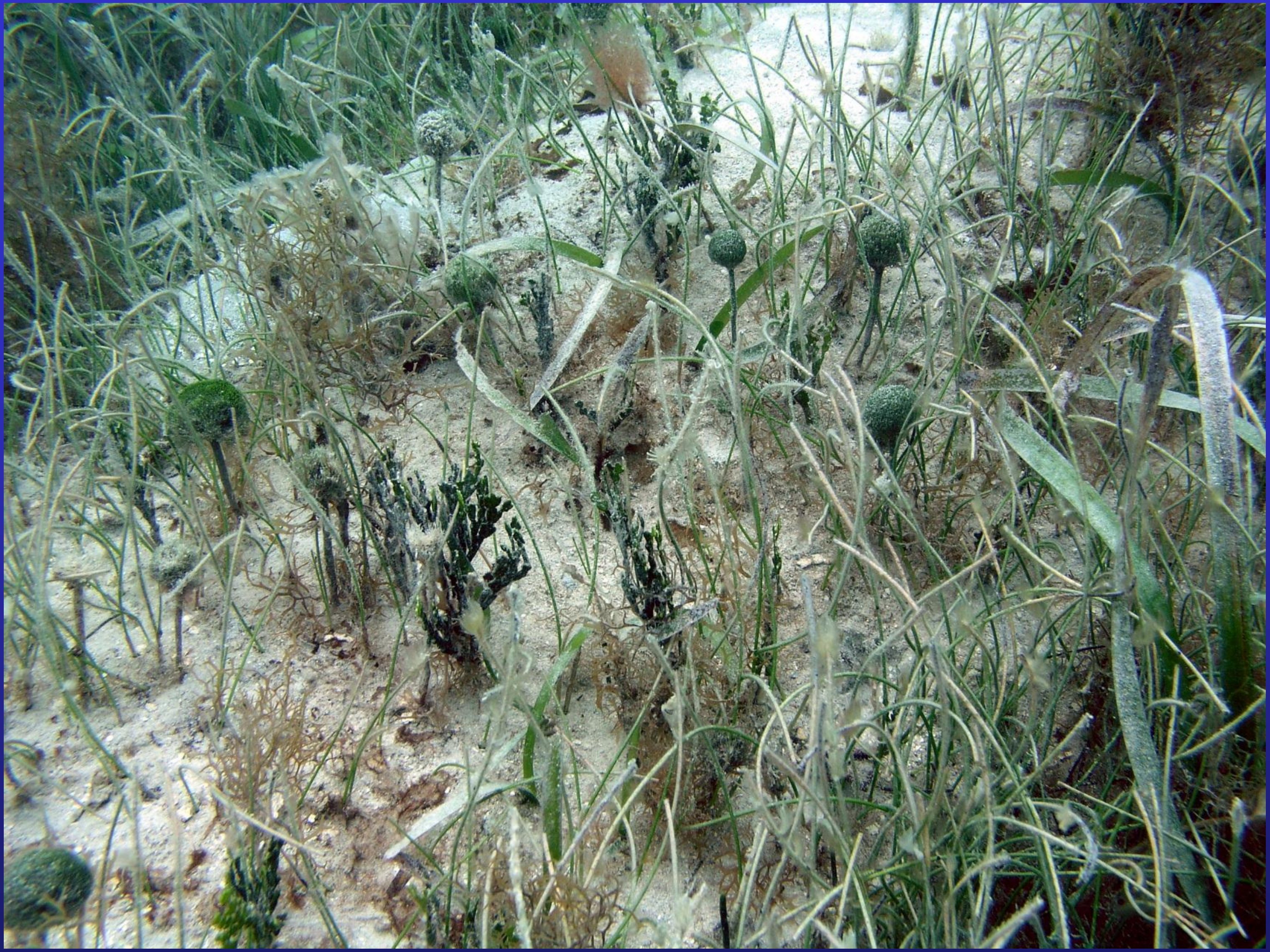
$$\mathbf{Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3 + H_2O + CO_2}$$

bicarbonate   calcium carbonate   carbon dioxide

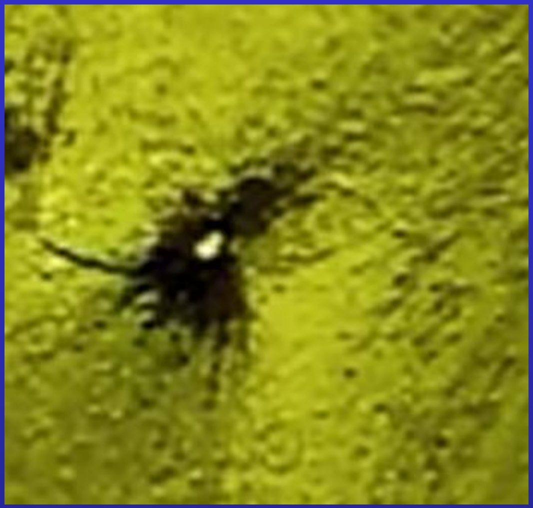
kalcifikace repeatedly

Adhesion to substrate

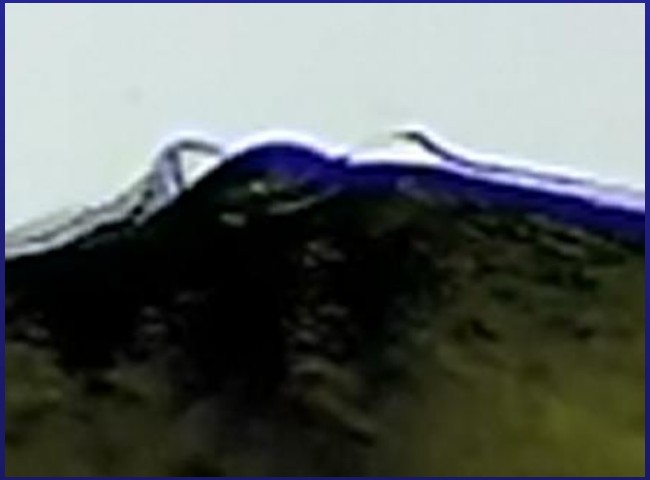
bulbouse base - bulbous mass of rhizoids adhering sand, anchor the adult plant in the sediment



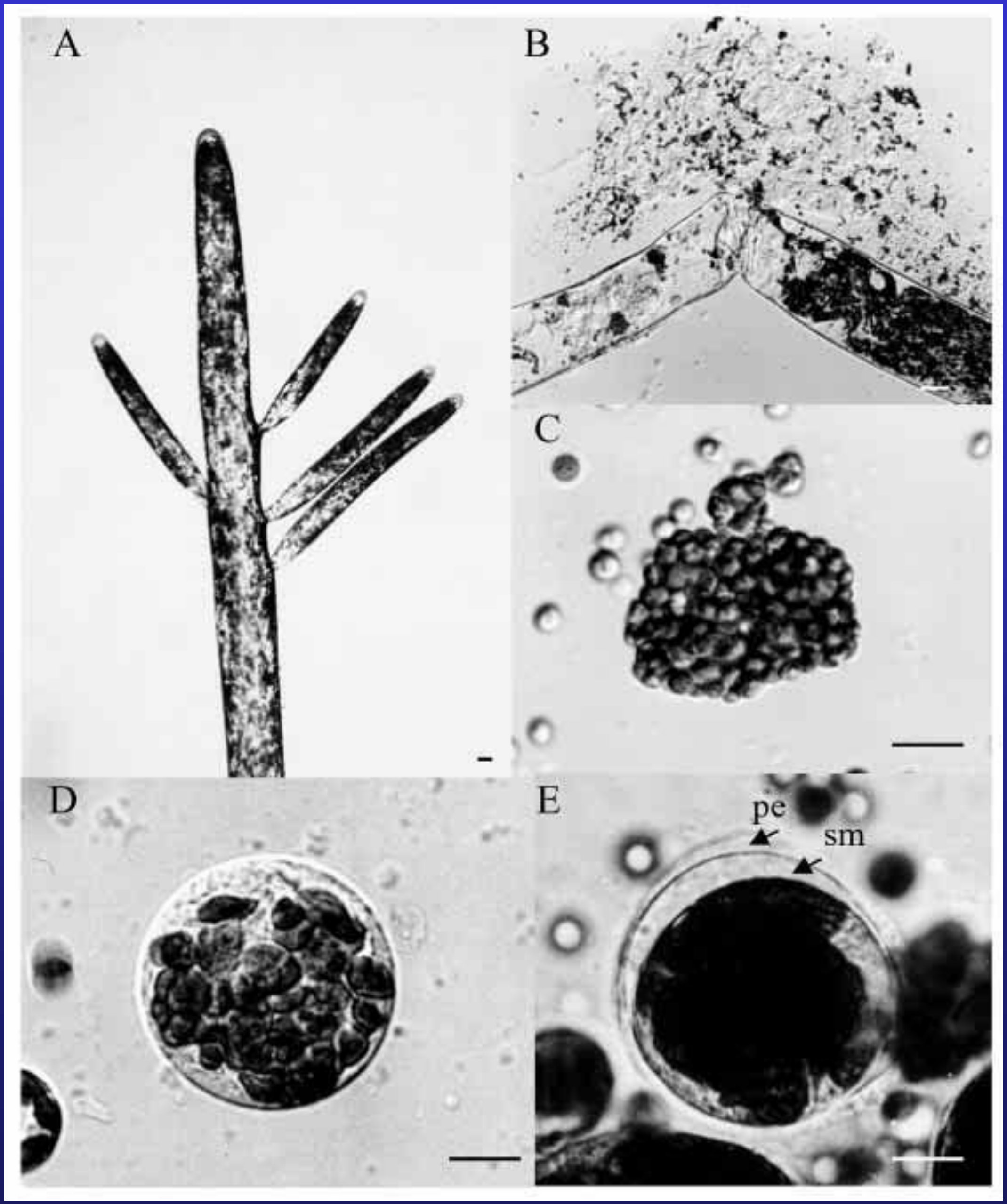
shallows seagrass meadows (*Penicillus*, *Halimeda*) predation - extensove perforation of CW, efficient repair mechanisms



Derbesia

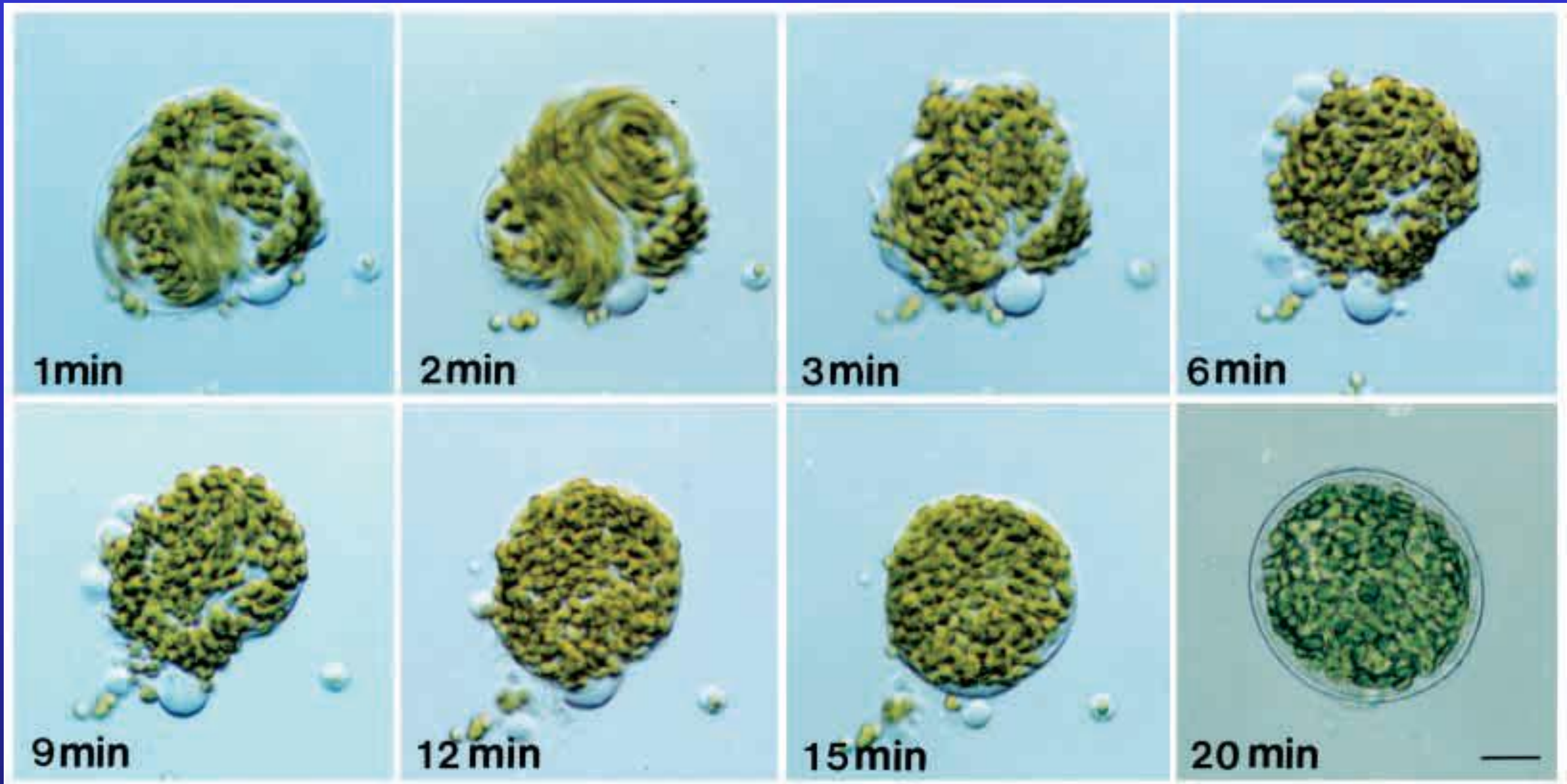


Sub-protoplast regeneration from disintegrated cells of *Bryopsis plumosa*



(A) Vegetative plant with distichous branches. (B) Protoplasm comes out from the wounded cell and spreads in seawater. (C) Aggregation of the extruded cell organelles in seawater. (D) Regenerated sub-protoplast with **a primary envelope** 20 minutes after wounding. (E) The secondary **lipid-based membrane** inside the primary envelope 12 hours after wounding

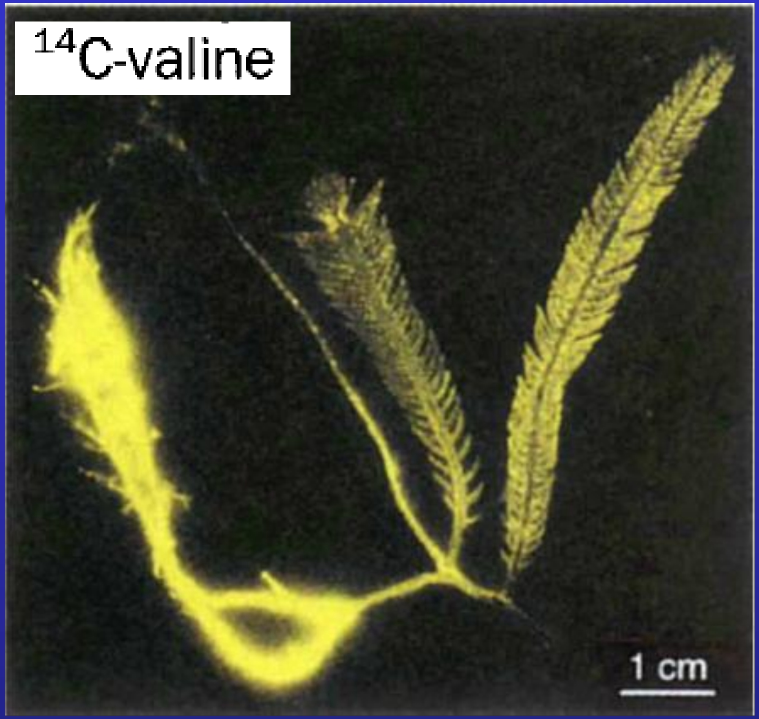
Kim et al. 2001



Time-lapse photography of early sub-protoplast regeneration. Bar, 10 mm.

Kim et al. 2001

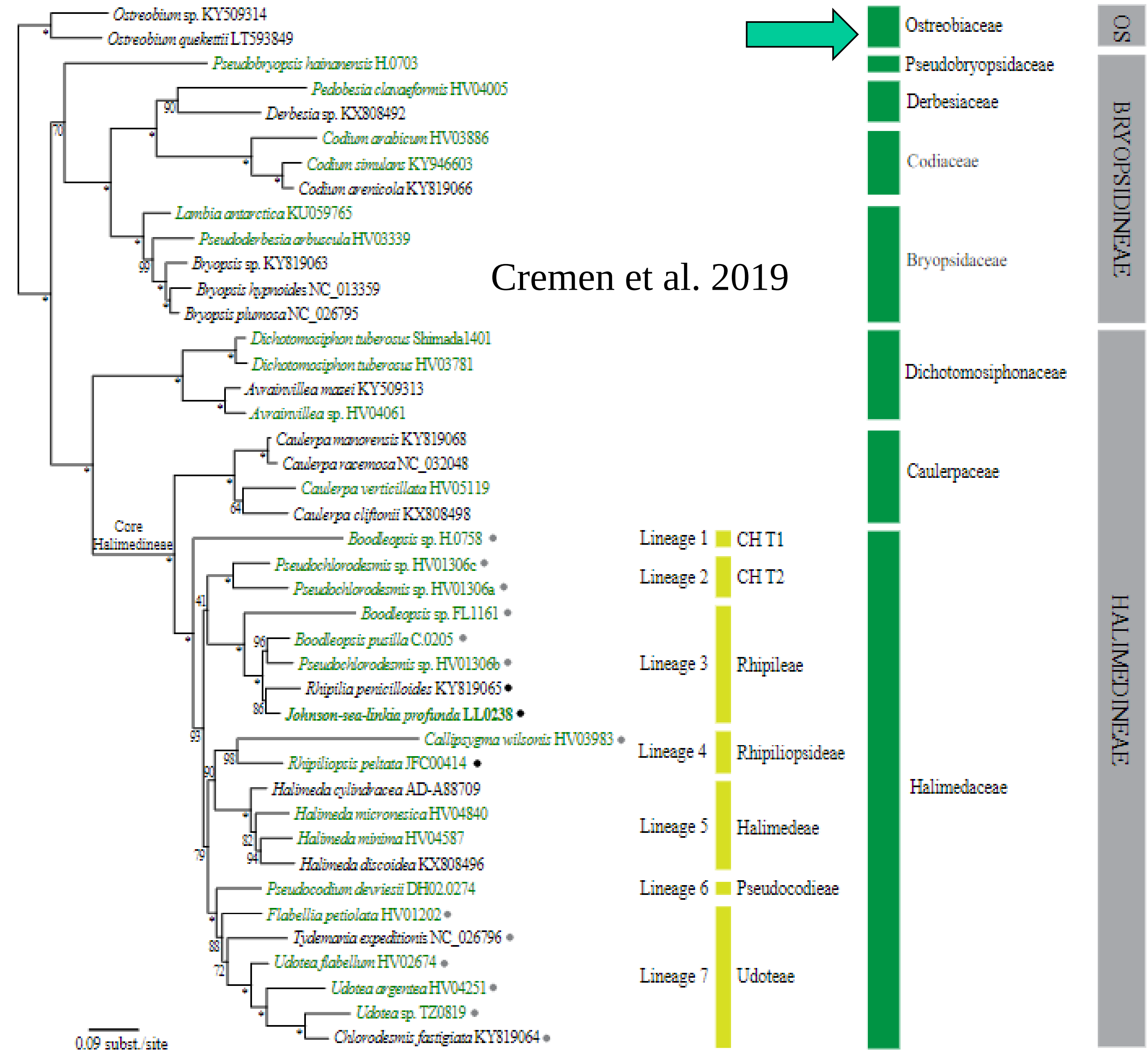
„Roots“ in mixotrophic algae *C. taxifolia*



Rhodopseudomonas – *nif* H gene

Chisholm et al. 1996 Nature

„root system“ containing endocellular bacteria – up take of inorganic phosphorus, C, organic N from substrata – translocation of nutrient to photoassimilatory organs (fronds)

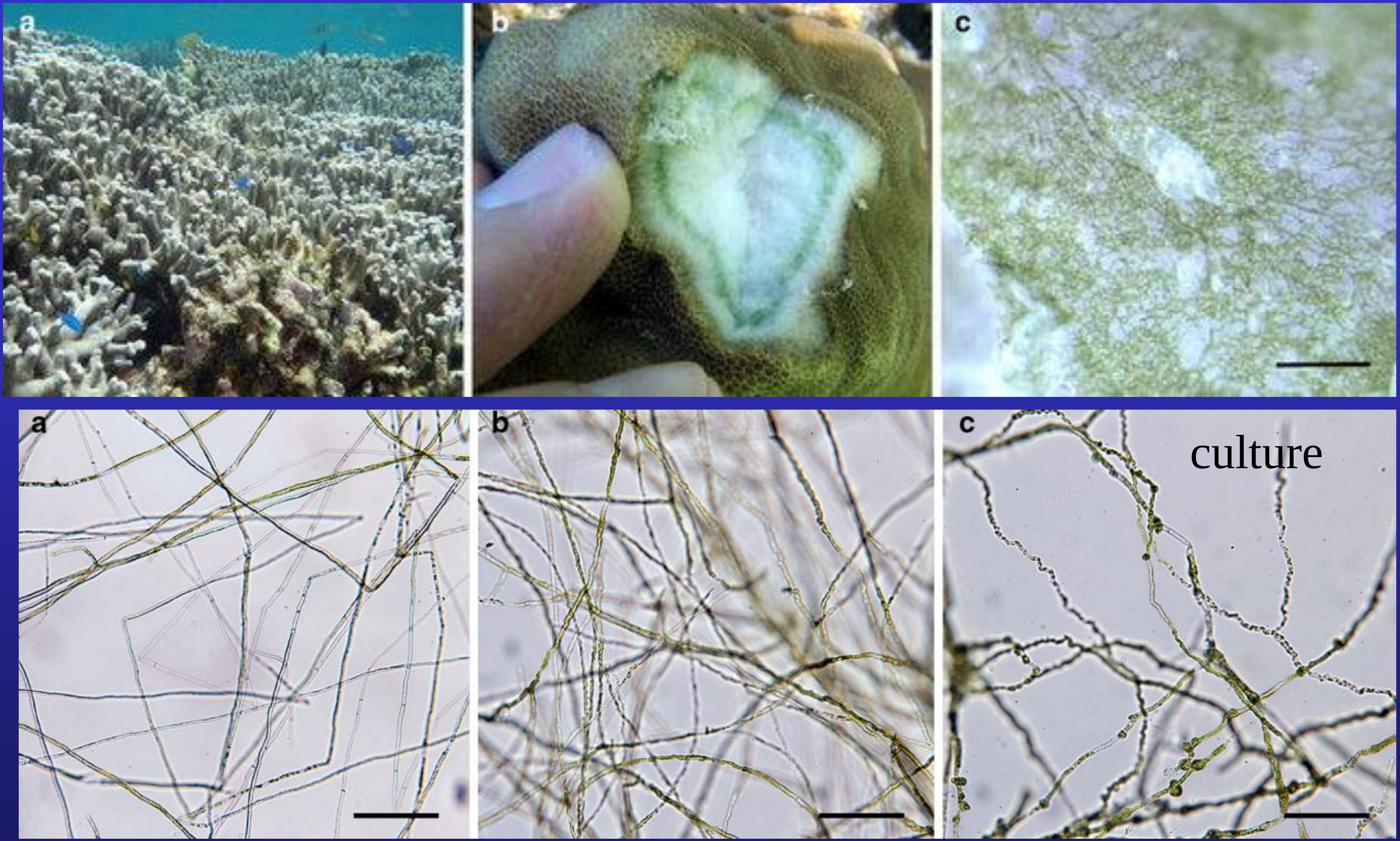


Cremen et al. 2019

Fig. 1. Maximum likelihood phylogeny inferred from the concatenated amino acid (partitioned) alignment of 71 chloroplast protein coding genes from 42 bryopsidalean taxa using CPREV + Γ + F model and manually rooted along the branch between Ostreobineae (abbreviated OS) and the other suborders. Values at nodes indicate bootstrap support where (*) denotes maximum bootstrap support. The new proposed classification scheme is shown to the right of the tree and all newly sequenced taxa are in green text. Black and grey dots after the taxon name indicate their current placement in Rhipiliaceae and Udoteaceae, respectively.

Ostreobium

Sauvage et al. 2016



live in low-light conditions on calcium carbonate substrata in tropical conditions, coral symbiont exchanges nitrogen and carbon

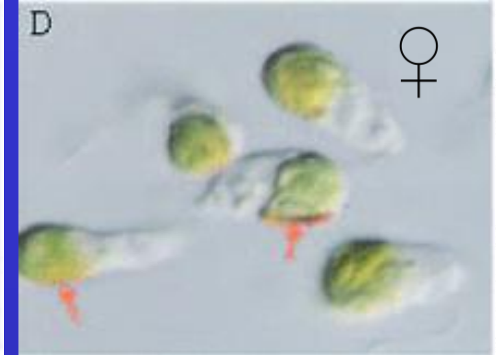
linage - Bryopsidineae

• homoplastidic thalli
• thylakoid organizing body absent from chloroplasts
• production of zoids is non-holocarpic (gametangia and sporangia are formed withis special zones of the thallus; whole thallus in not destroyed)
• many members (though not all) produce stephanokont zoids
• main cell wall polysaccharide is mannan, xylan, cellulose

Codium

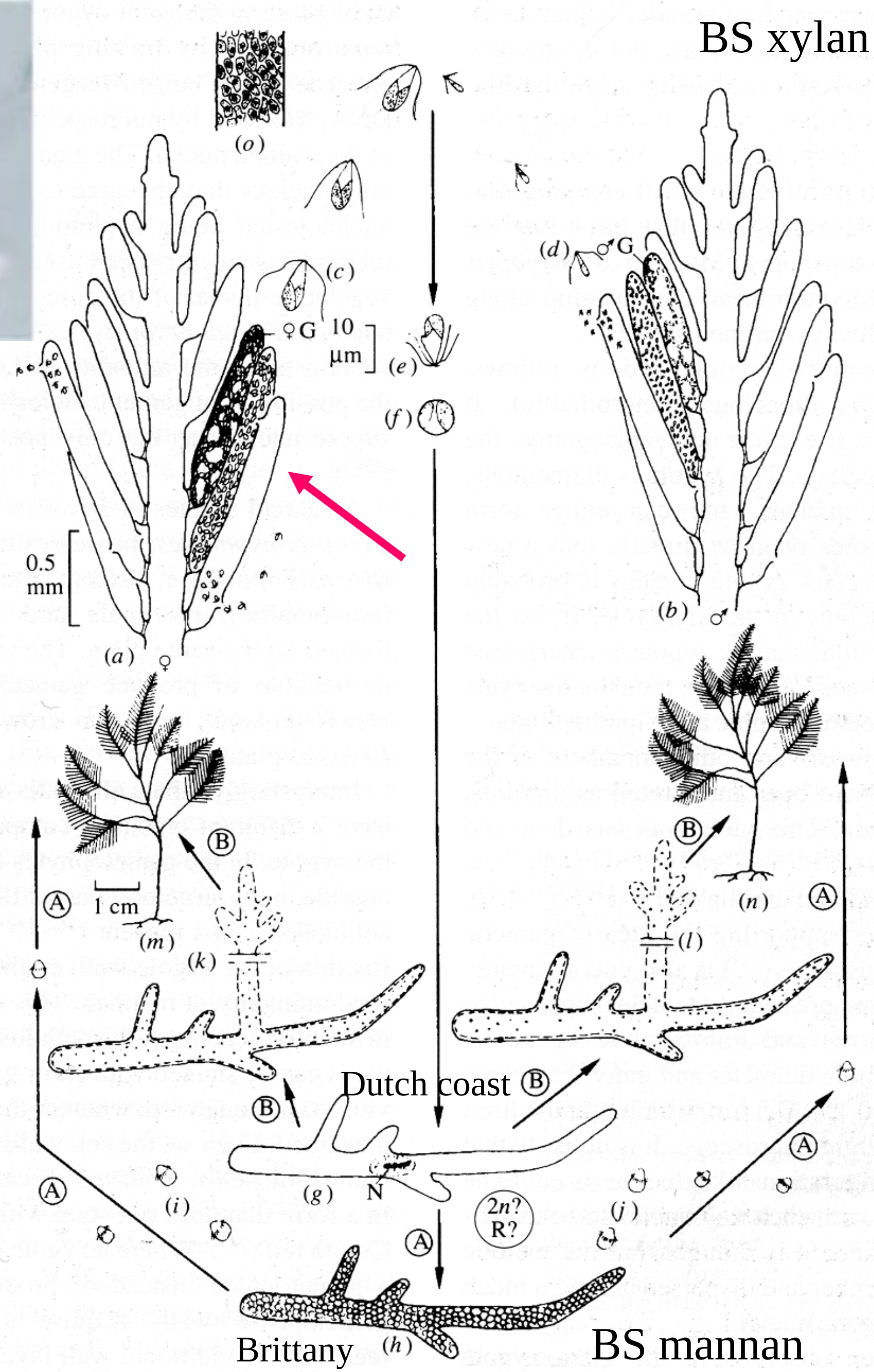
Bryopsis

Derbesia



Maternal inheritance of chloroplast DNA

Bryopsis plumosa (10-15 cm)



Light and electron micrographs of sporophytes of *Bryopsis plumosa*.

Minamikawa, et al.2005

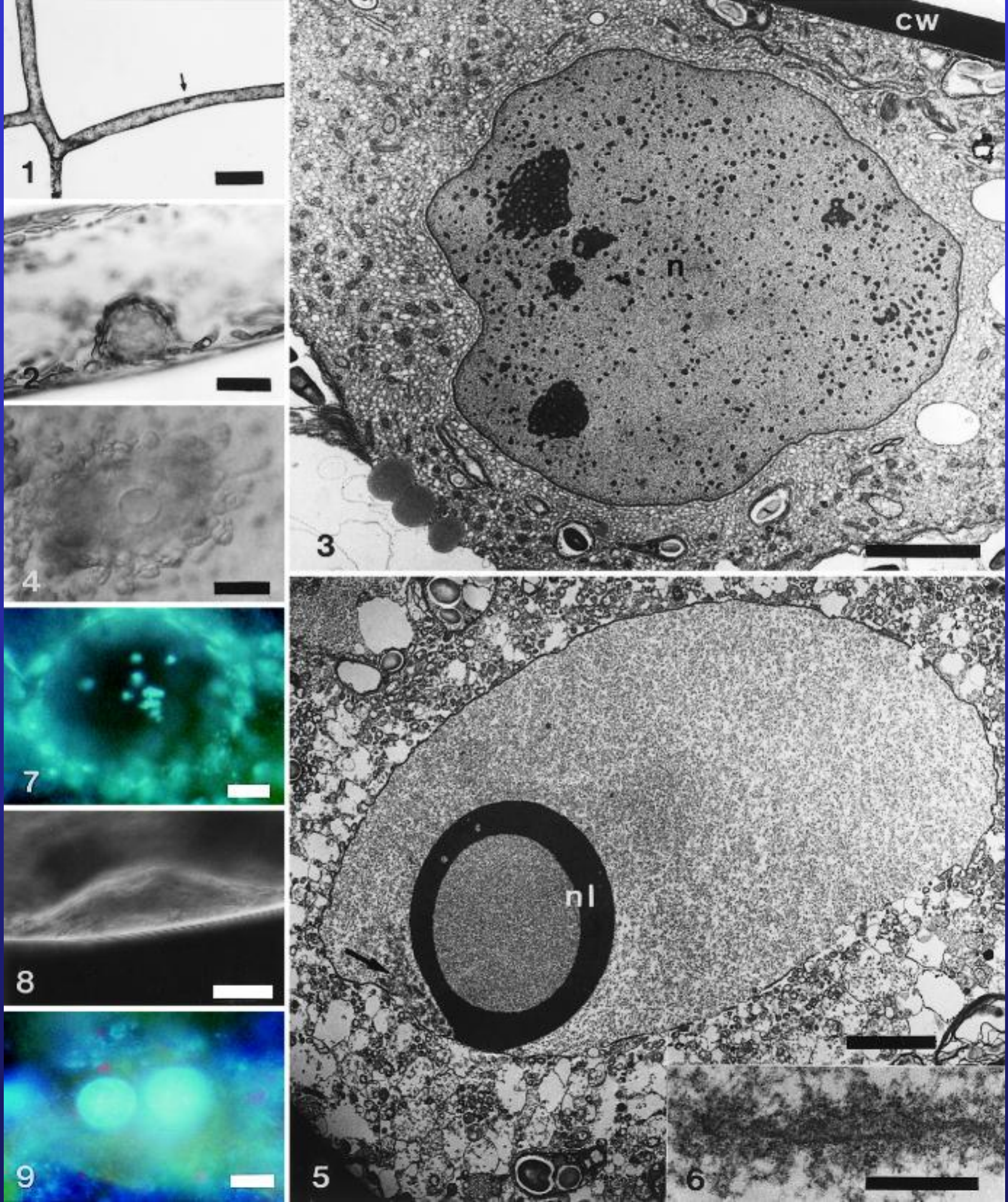
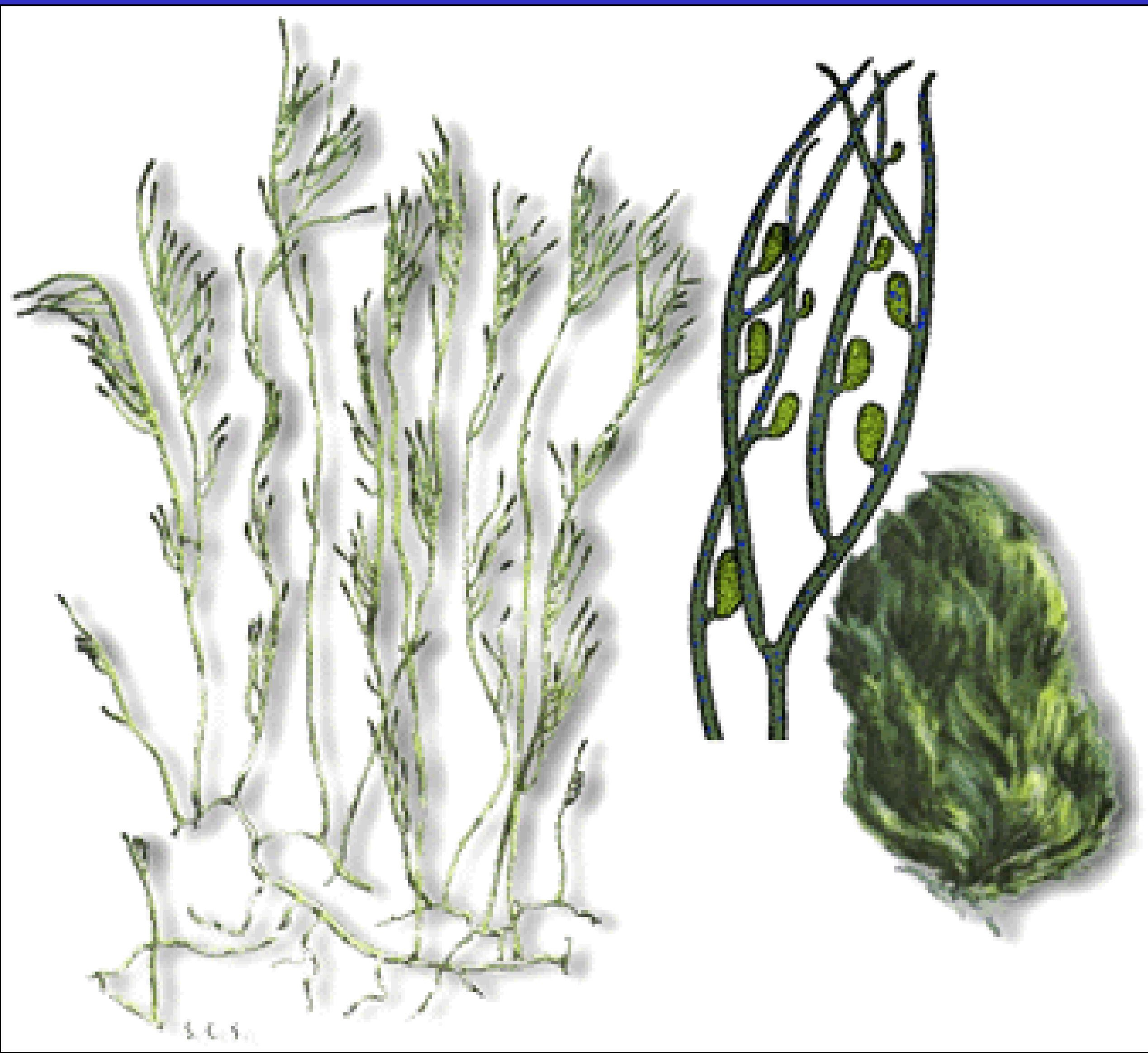


Fig. 1 . *1* a sporophyte, containing a giant nucleus (*arrow*). *2* Giant nucleus, about **25 um** in diameter. *3* Electron micrograph of a giant nucleus. *4* Giant nucleus containing a ring-shaped nucleolus. *5* Electron micrograph of *7* Giant nucleus containing chromosomes (Hoechst staining). *8* Dumbbell-shaped giant nucleus. *9* Two small nuclei.

uniaxiální rozvětvená stélka (1-10 cm). Chloroplasty bez pyrenoidů (kromě Derbesia tenuissima)

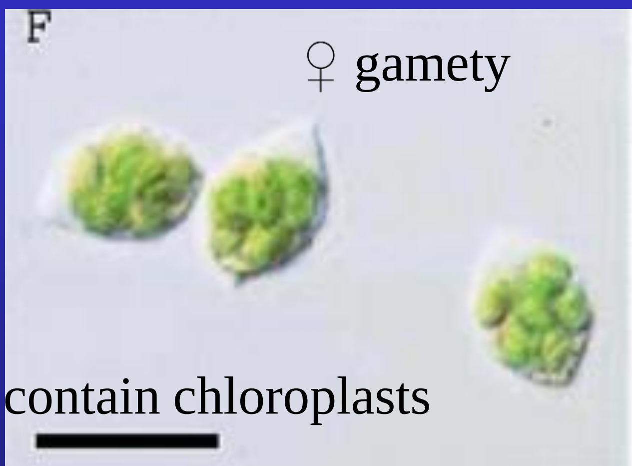
Derbesia

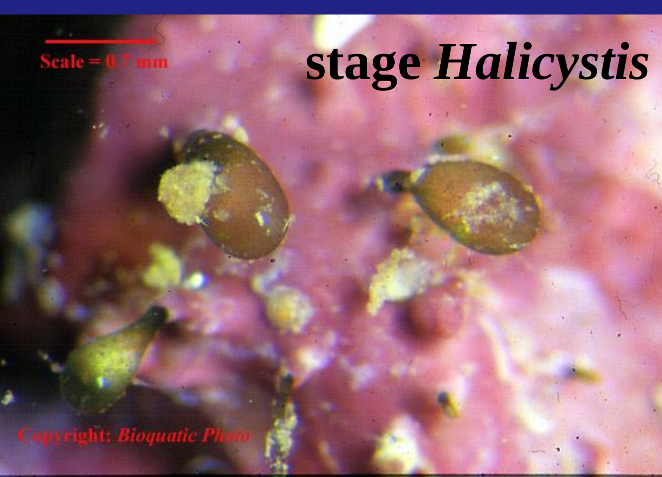
uniaxial thallus

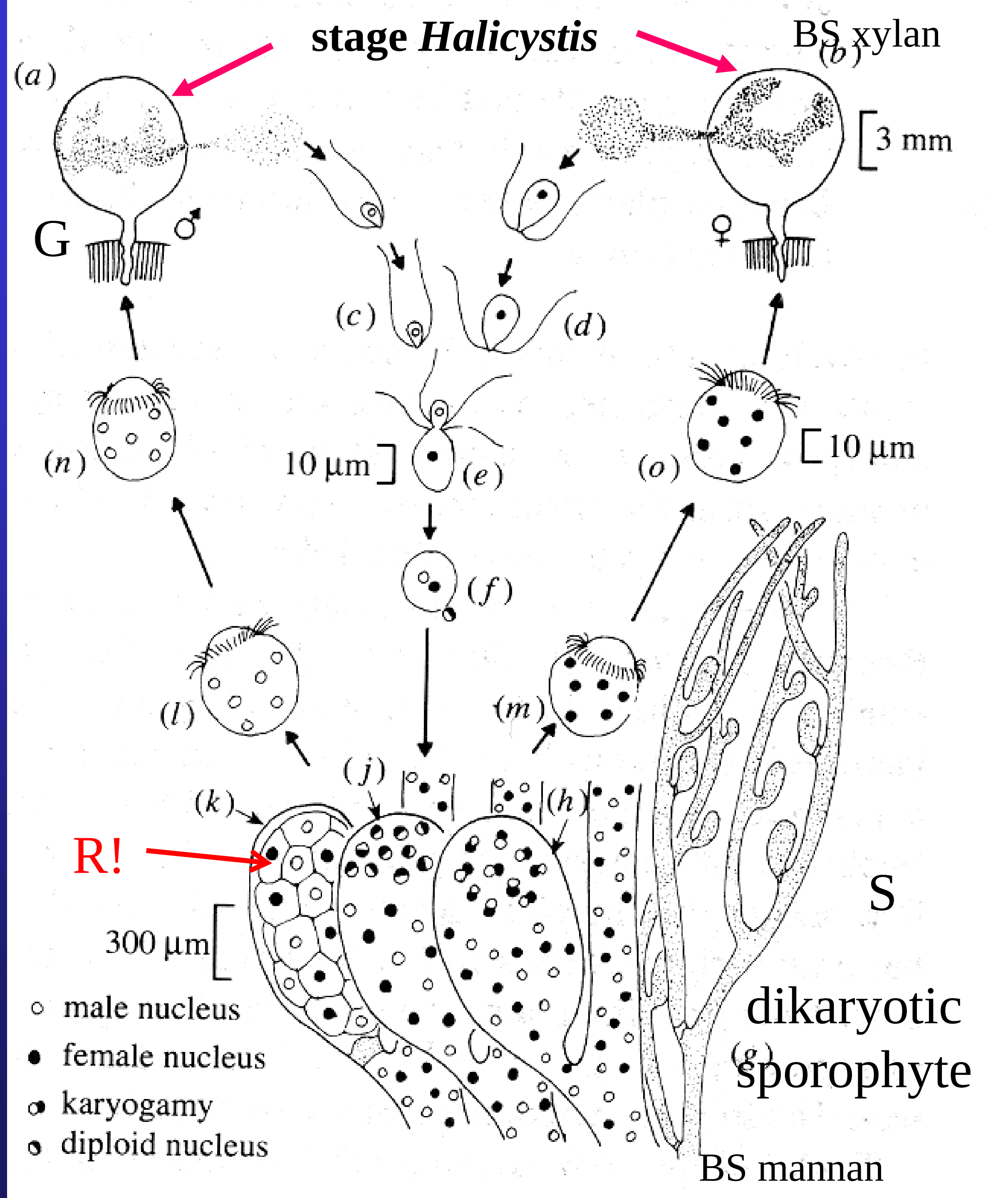


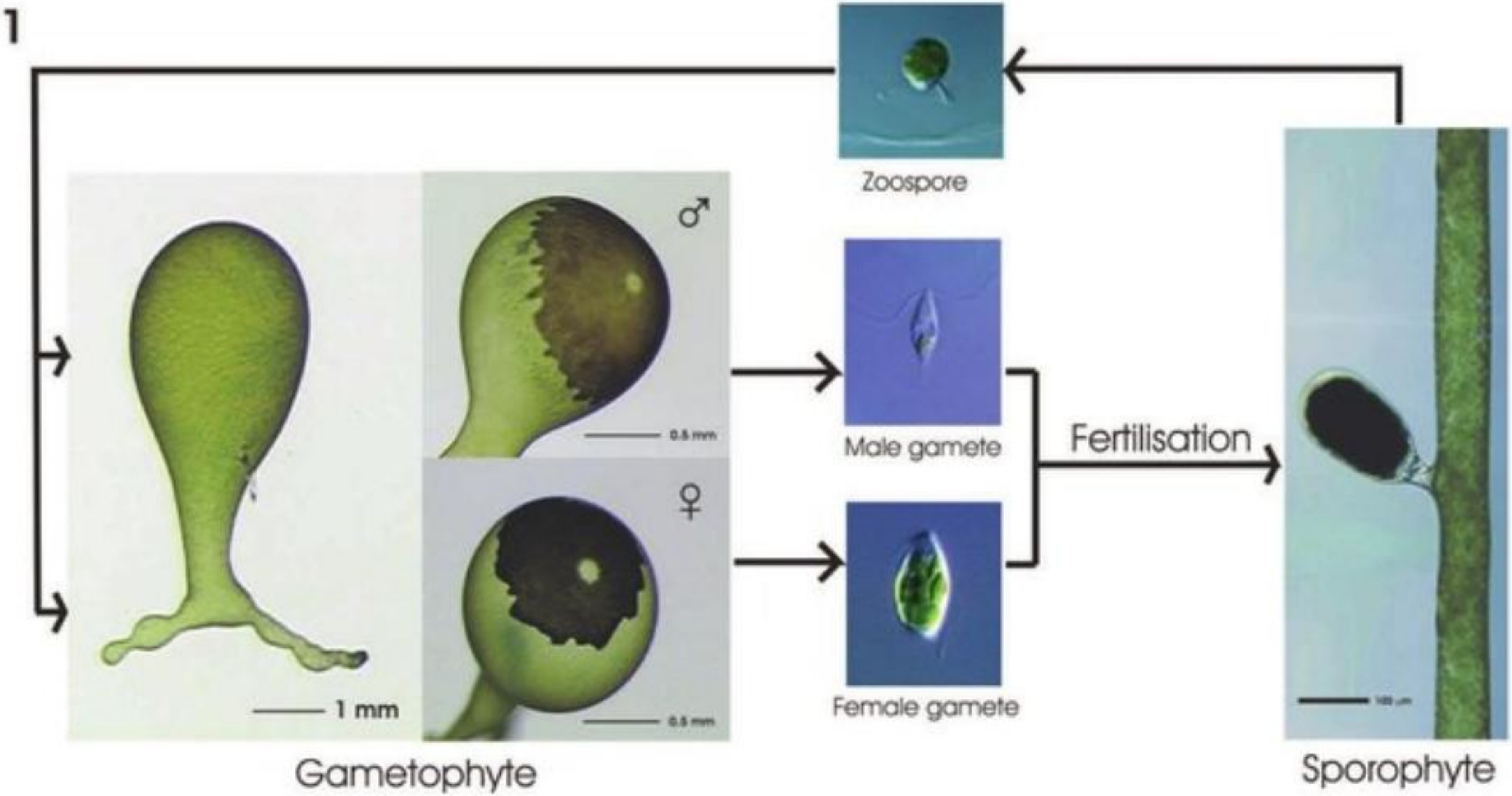
stage
***Halicystis*(=gametophyte)**


E
Derbesia


F
♀ gamety
contain chloroplasts


Scale = 0.7 mm
stage Halicystis
Copyright: Bioquatic Photo


stage Halicystis
BS xylan
(a)
(b)
3 mm
G
♂
♀
(c)
(d)
(n)
10 µm
(e)
(o)
10 µm
(f)
(l)
(m)
(j)
(k)
(h)
R!
300 µm
S
○ male nucleus
● female nucleus
karyogamy
diploid nucleus
dikaryotic sporophyte
(g)
BS mannan



1
Zoospore
♂
♀
Male gamete
Female gamete
Fertilisation
1 mm
0.5 mm
0.5 mm
Gametophyte
Sporophyte

videa

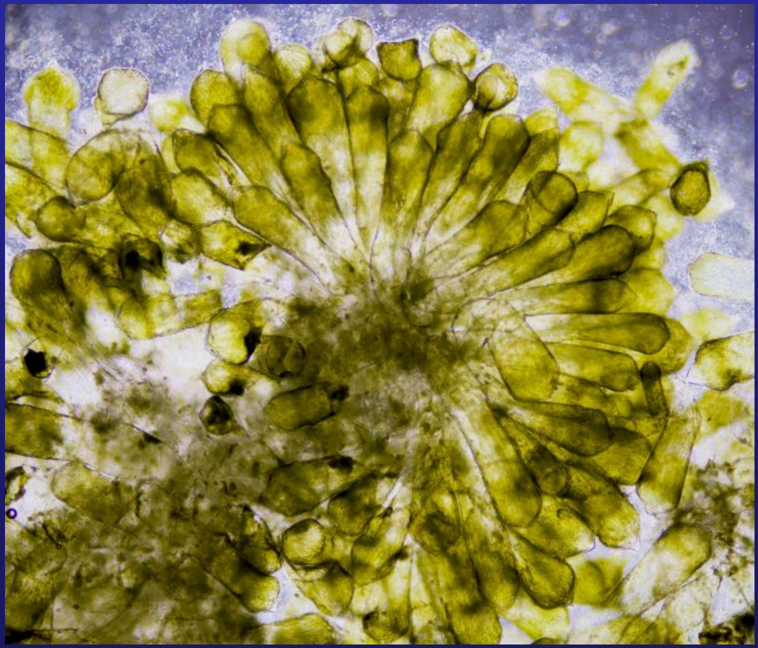
http://www.cytographics.com/

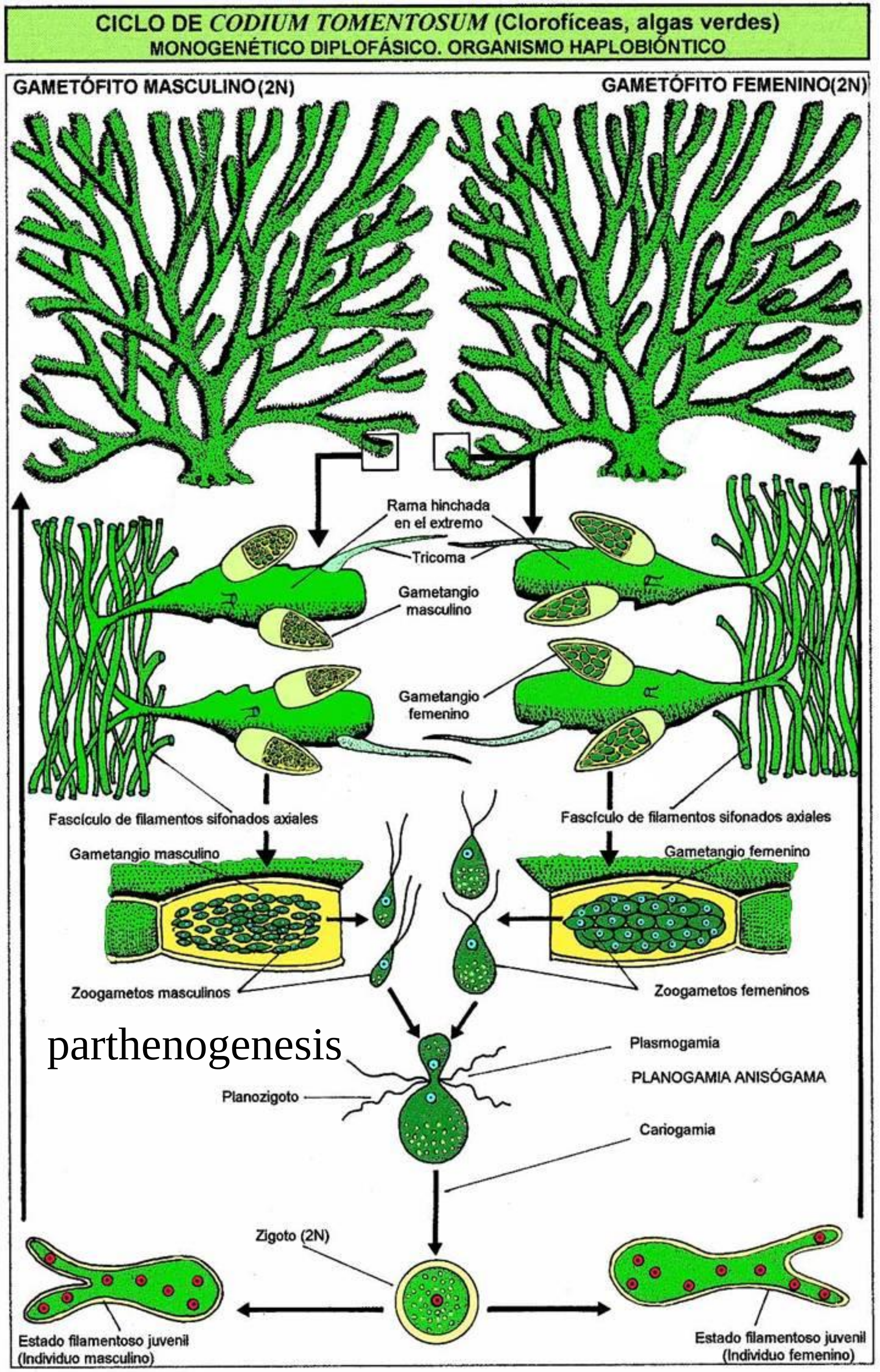
http://www.cytographics.com/clip_articles.html

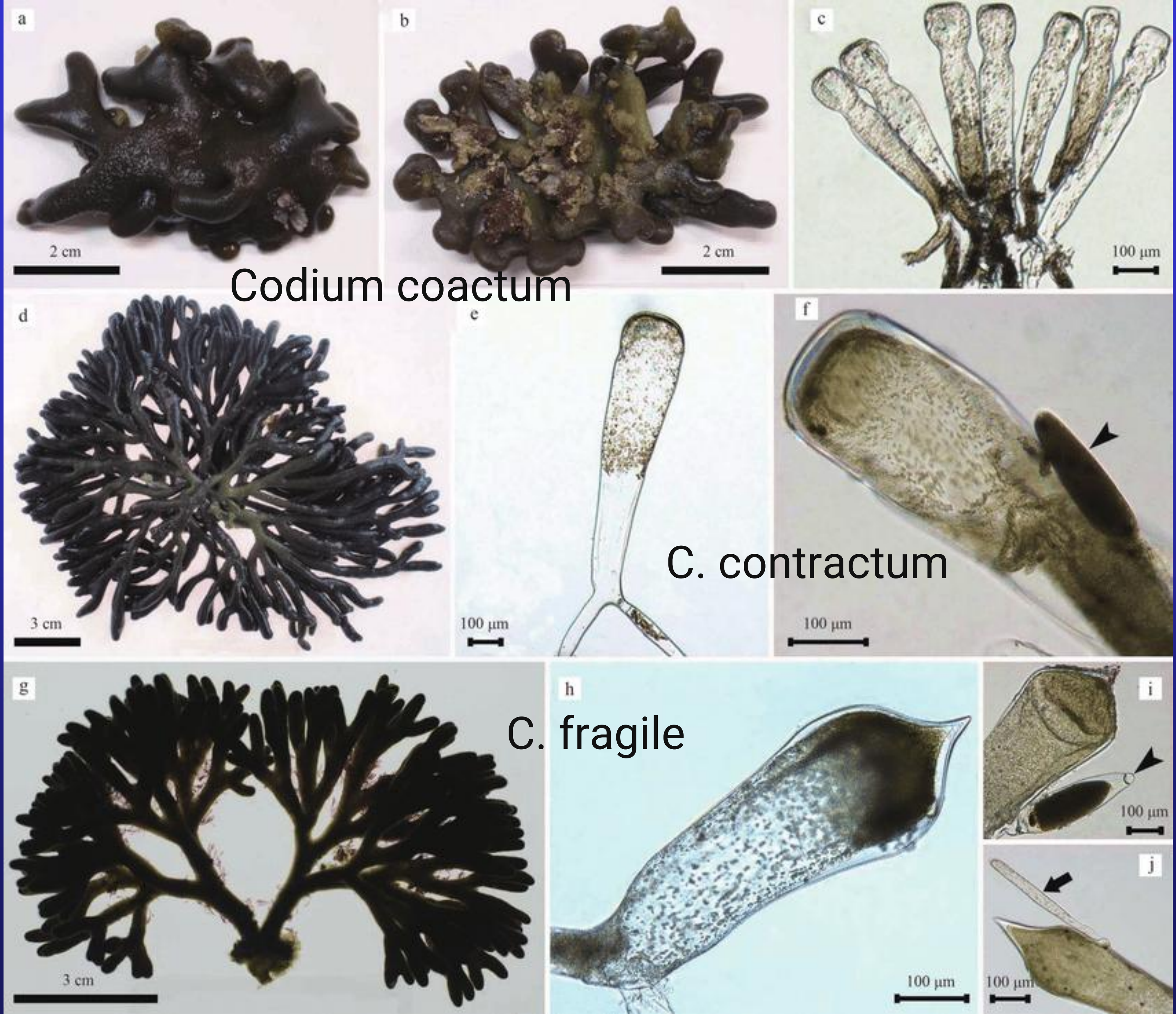
Codium

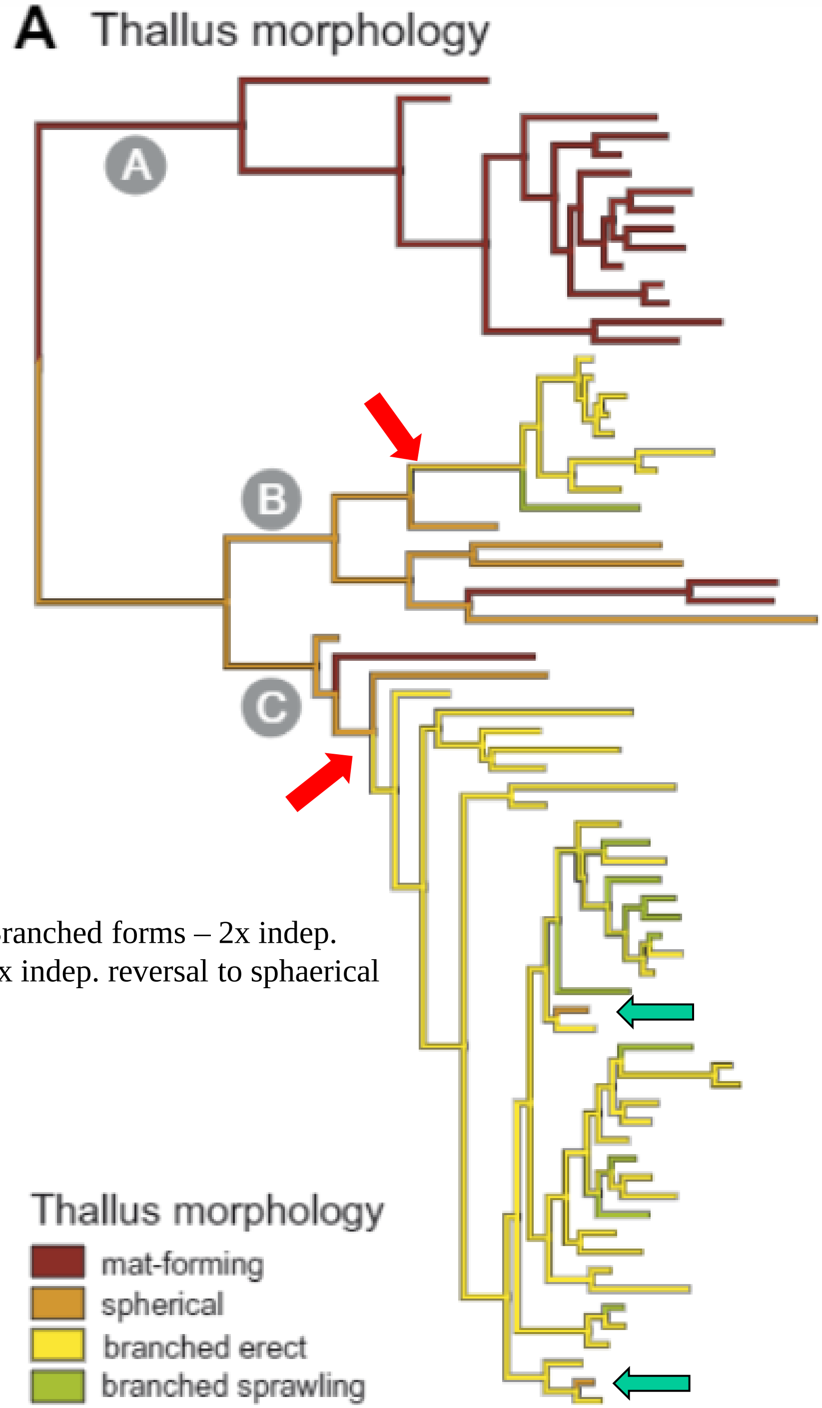
Codium fragile

multiaxial thallus, medulla, utriculi



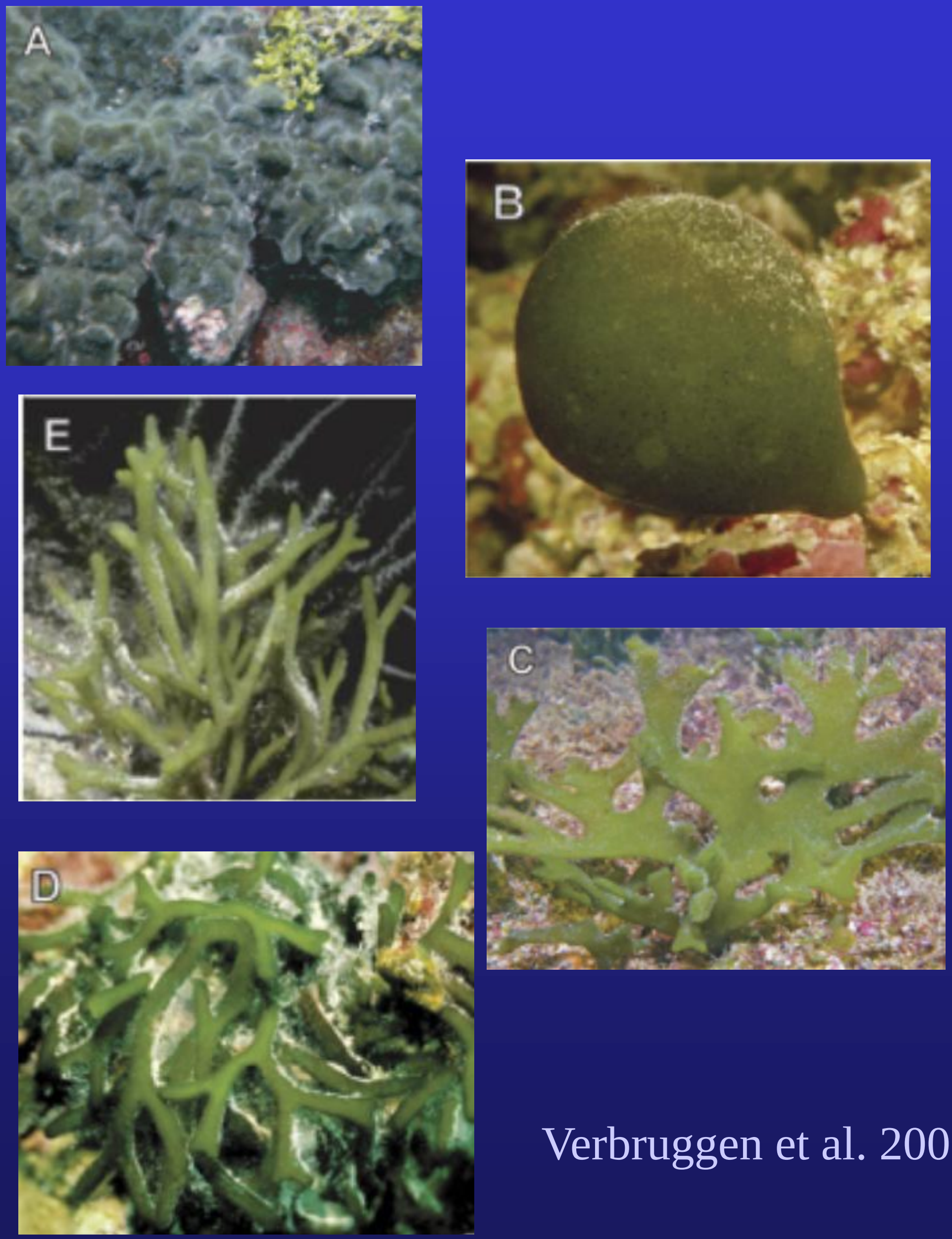



a
b
c
2 cm
2 cm
100 µm
Codium coactum
d
e
f
3 cm
100 µm
100 µm
C. contractum
g
h
i
j
C. fragile
100 µm
3 cm
100 µm
100 µm



Branched forms – 2x indep.
2x indep. reversal to sphaerical

Thallus morphology

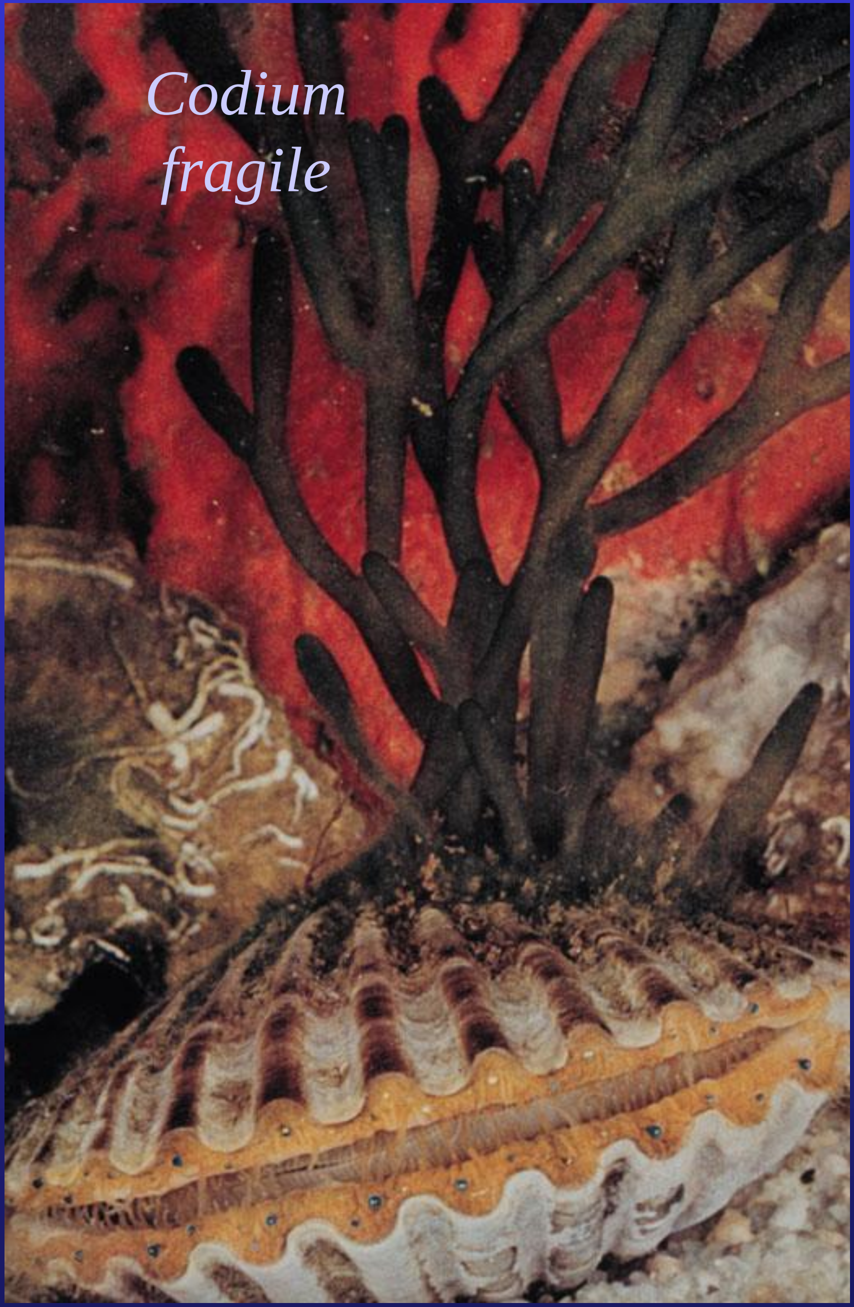


Verbruggen et al. 2007

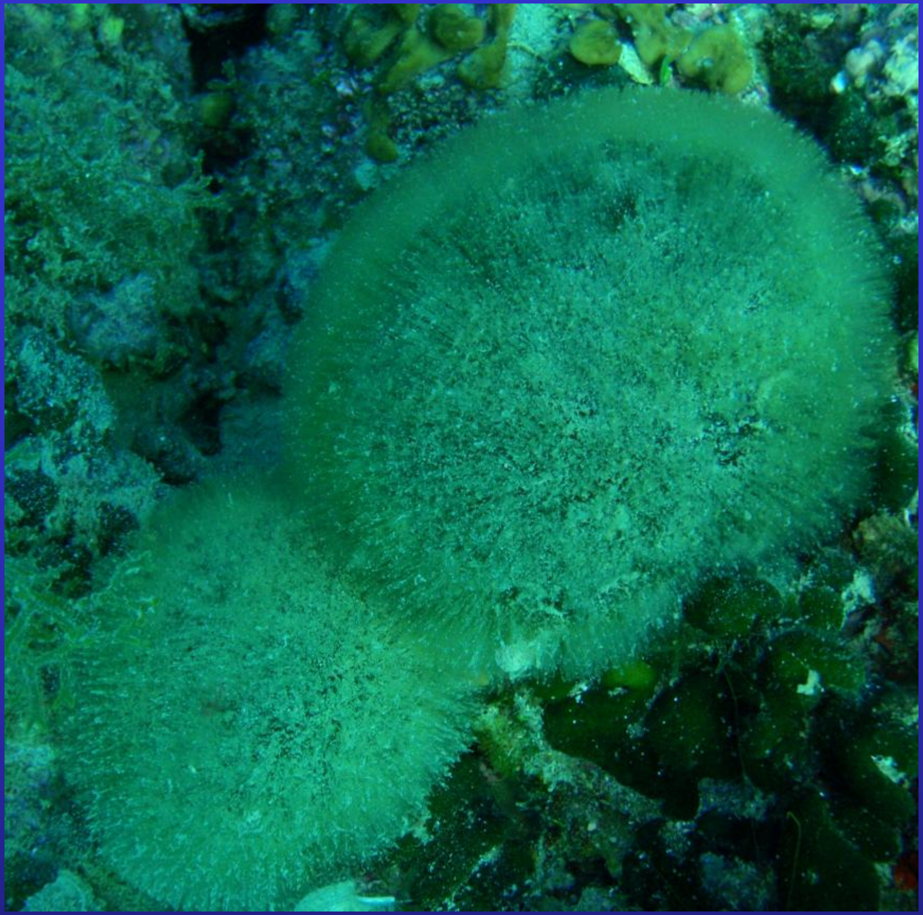
Codium

Codium sp.

Codium dimorphum



Scallop (Argopecten)



Codium – Piran/Punta; Mediterranean Sea

Codium

Codium bursa

C. fragile

Codium fragile spp. *tomentosoides* nepohlavně se rozmnožující invazní druh - parthenogeneze

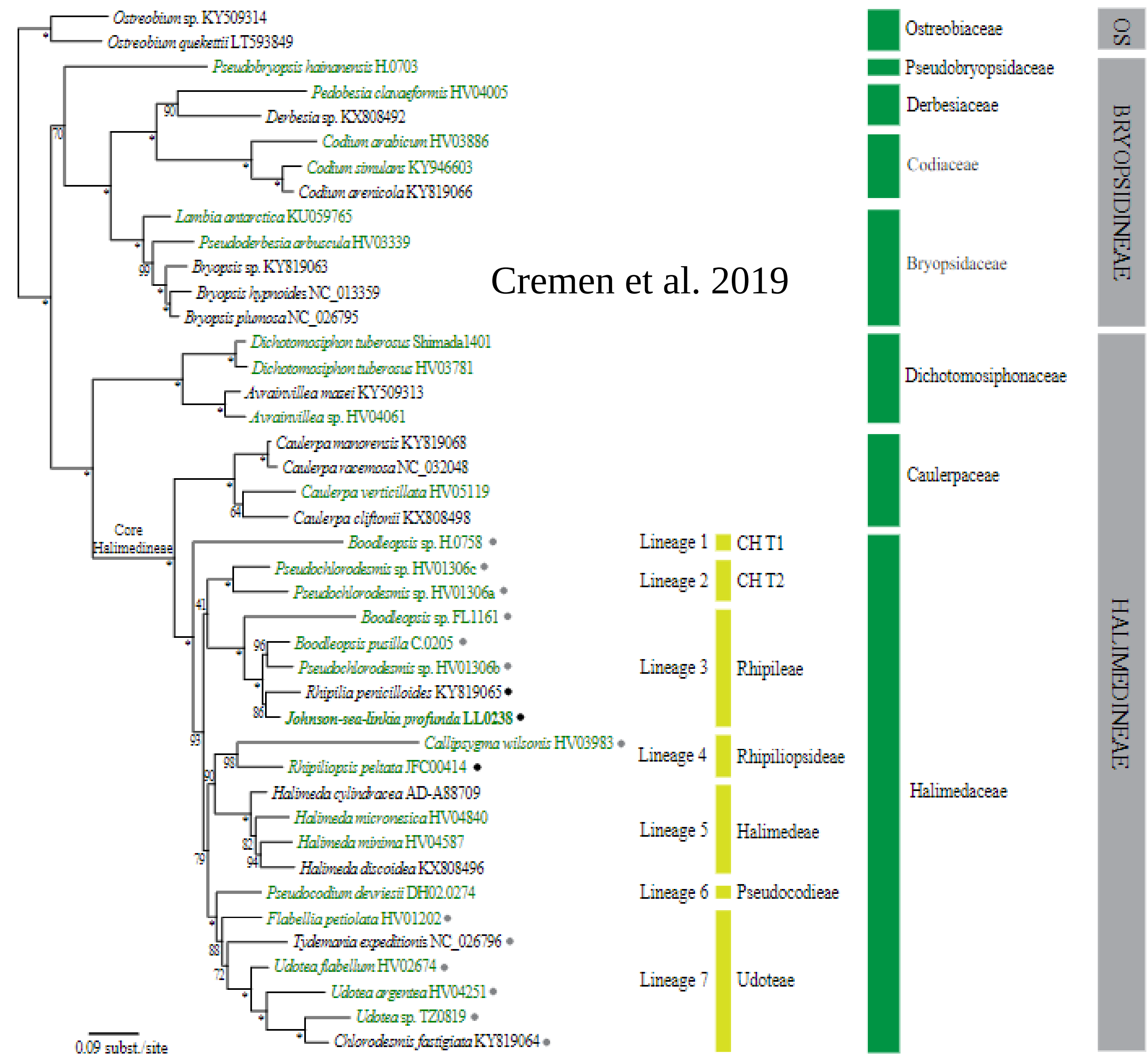
female gametes that germinate without fertilisation

Trowbridge (1998)

being unintentionally spread around the globe with cultured shellfish

linage Halimedinae

• heteroplastidic species (chloroplasts + amyloplasts)
• thylakoid organizing body in both the chloroplasts and amyloplasts
• production of zoids (gametes) holocarpic (whole thallus is entirely transformed to gametes, empty cell wall is left)
• stefanokont zoids are never produced
• main cell wall polysaccharide xylan (with little or no cellulose)
• mass simultanous release of ♂ and ♀gamets



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Simultanous release of ♂ and ♀gamets

Characteristic for *Caulerpa*, *Halimeda*, *Penicillus*, *Rhipocephalus* and *Udotea* (ca 17 species) Clifton, 1997

Penicillus. Note the contrast between a non-fertile thallus on the left and a fertile female on the right (dead thallus from earlier reproduction in the middle)

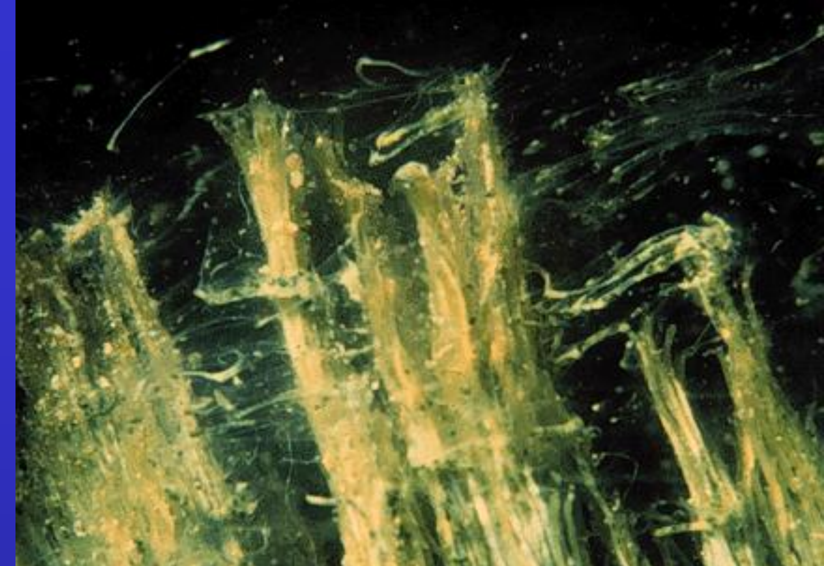
Udotea Panama reef

Simultanous release of ♂ and ♀gamets

sterilní *Udotea caribbaea*

plodná ♀ stélka *Udotea cyathiformes*. Bílé části stélky – migrace protoplasmy do gametangií

Udotea caribaea



♀thallus

♂thallus

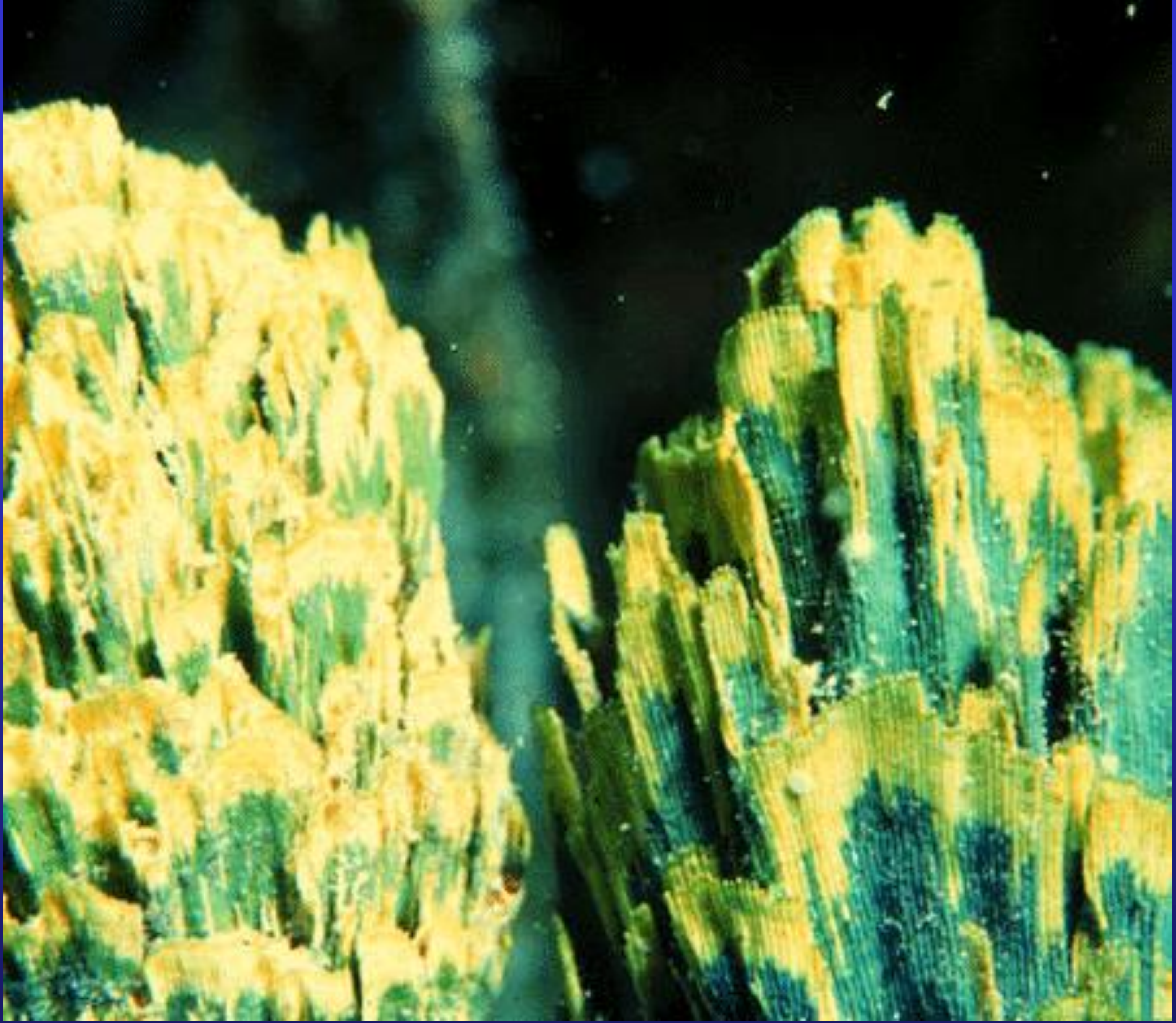
release of gametes →

Simultanous release of ♂ and ♀gamets

♀ **gametangia**

♂ rostlina vypouští gamety

Penicillus



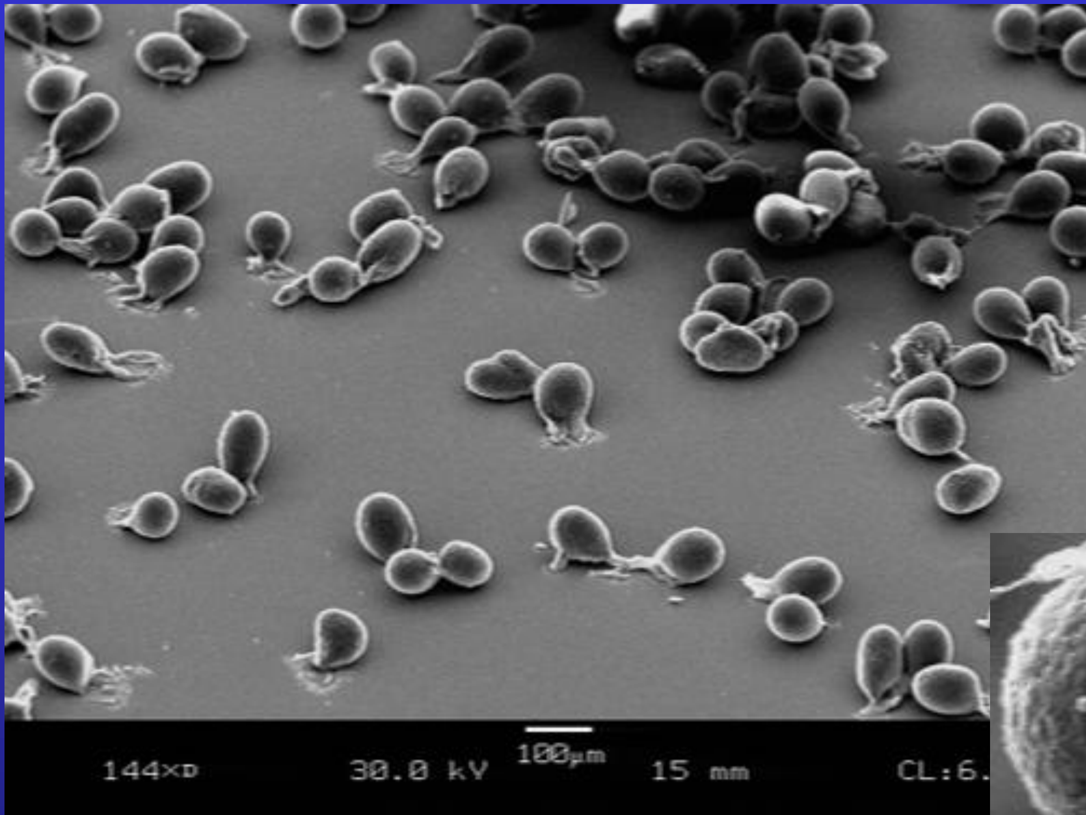
Rhipocephalus phoenix ♂ thallus (left), ♀(right)

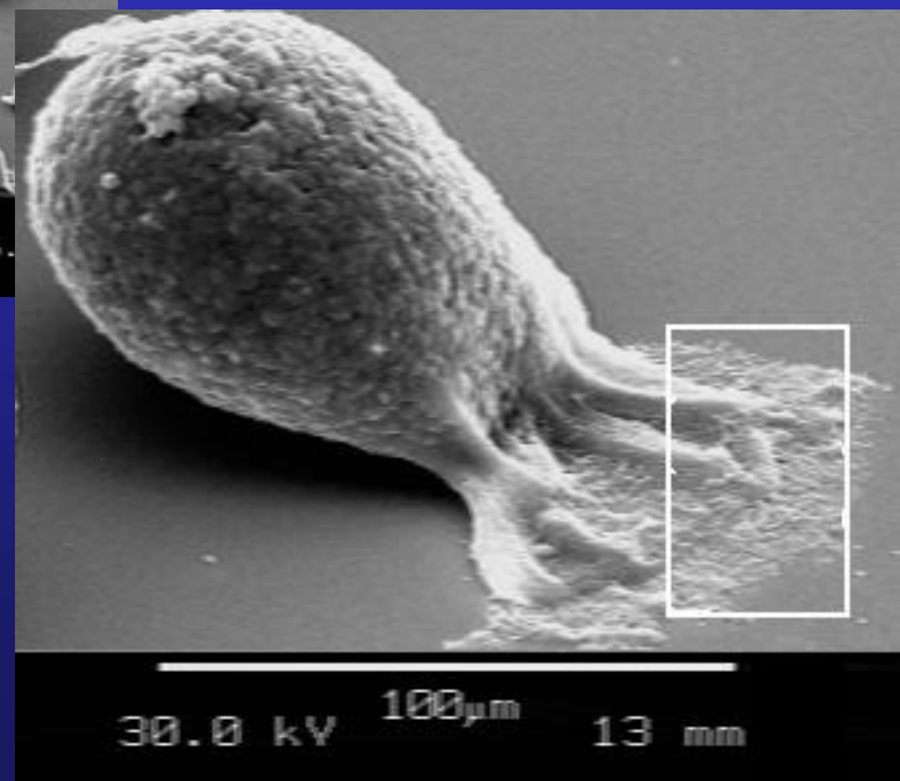
Examples of fertility—evident by the presence of gametangia and color change; Clifton 2013

♂

♀

nonfertile thalli

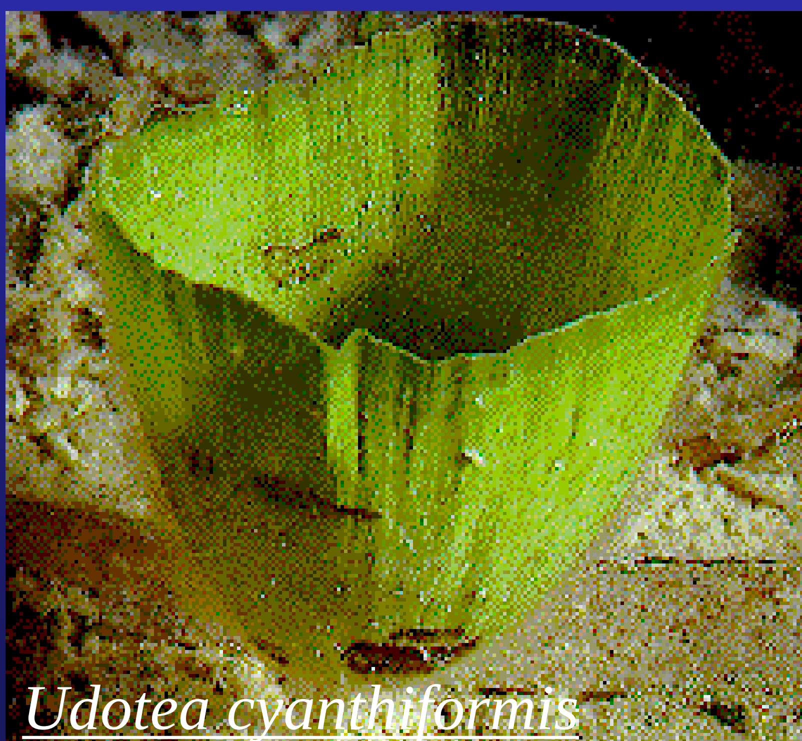


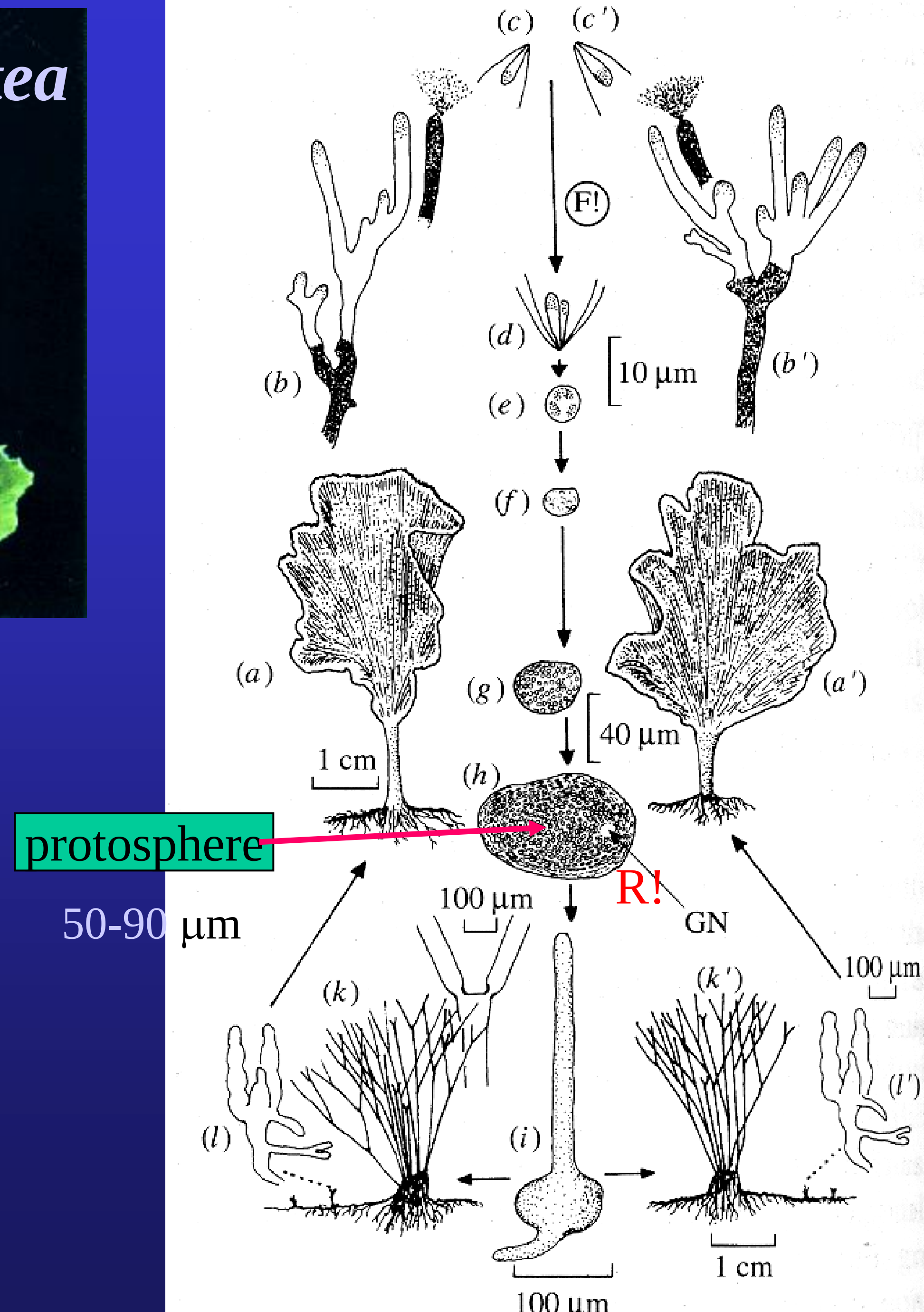


♀ gamety *Rhipocepalus phoenix*

-pinecone alga

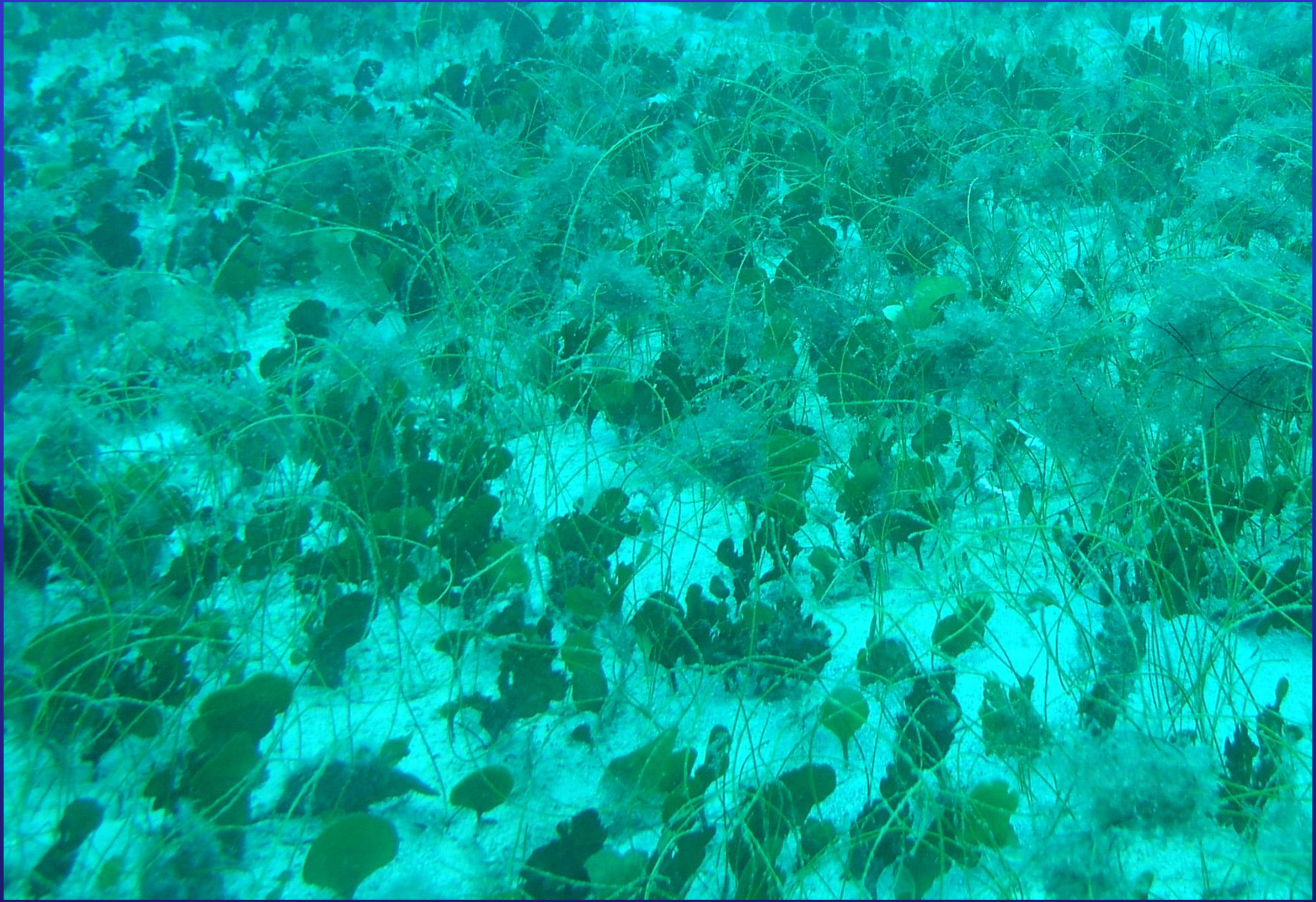

Udotea


Udotea cyanthiformis


(c)
(c')
F!
(b)
(b')
(d)
10 µm
(e)
(f)
(a)
(a')
(g)
40 µm
1 cm
(h)
protosphere
R!
GN
50-90 µm
100 µm
(k)
(k')
100 µm
(l)
(l')
(i)
1 cm
100 µm

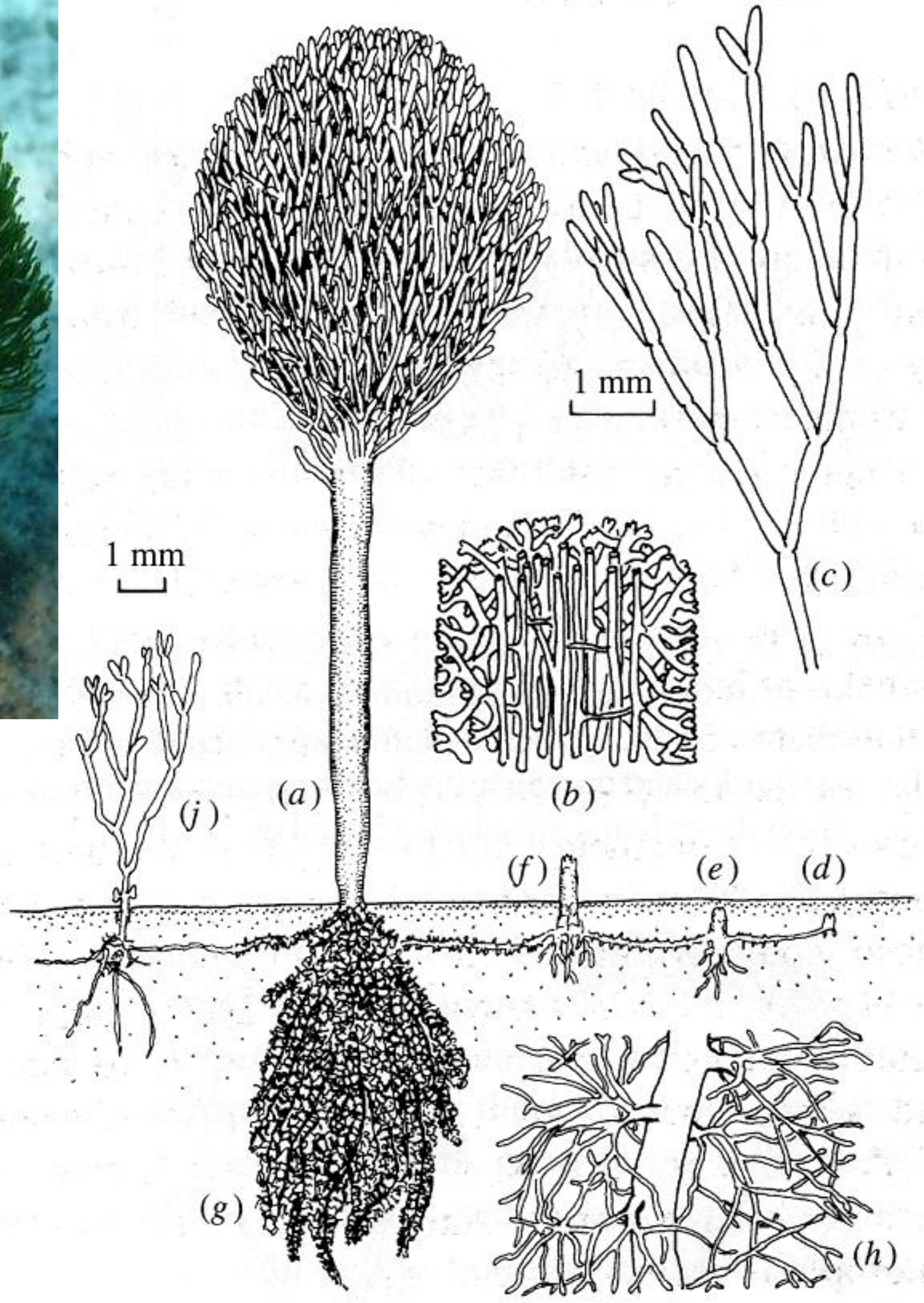
Flabellia petiolata = Udotea petiolata

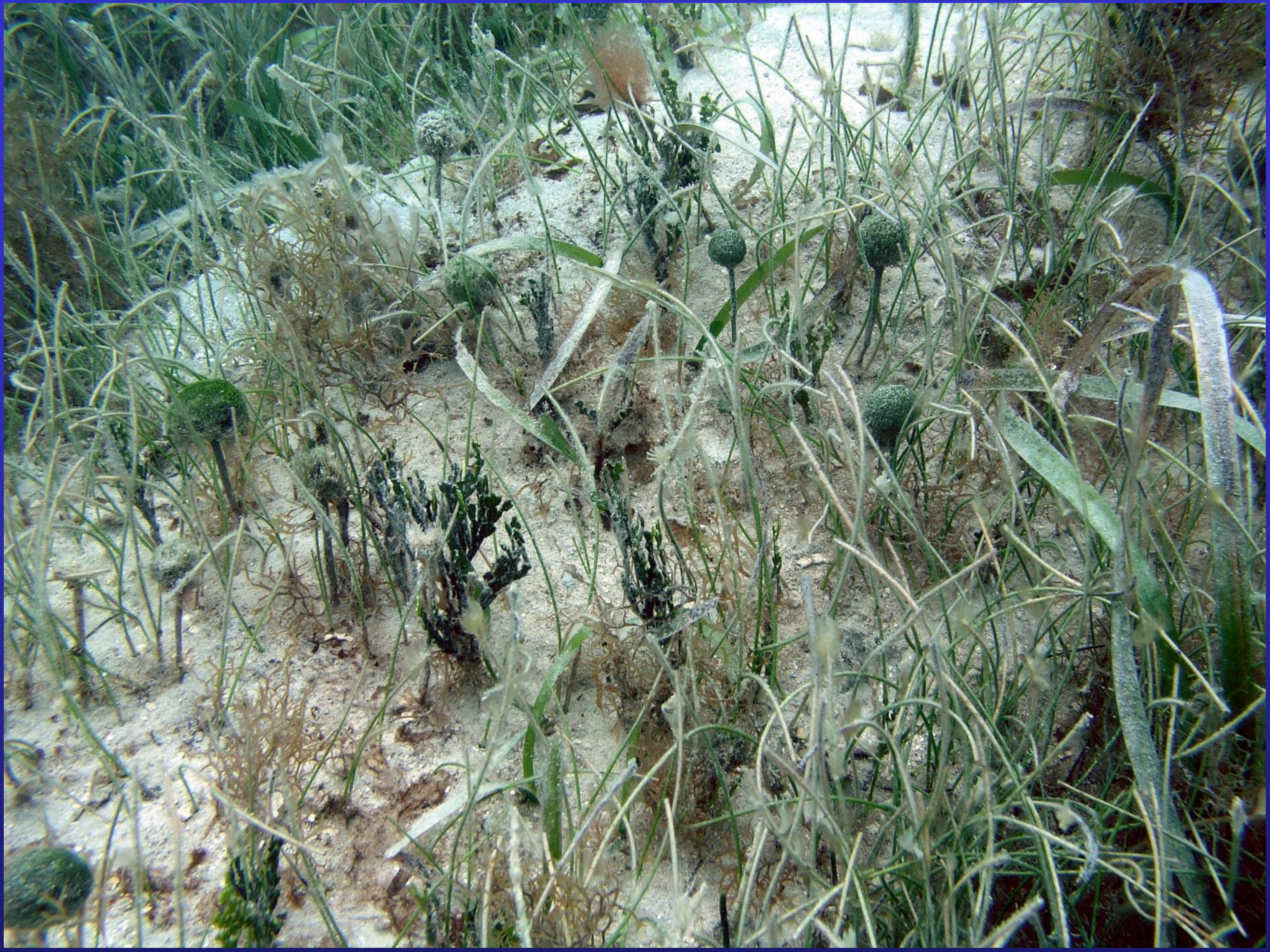
– Piran/Strunjan - Mediterranean Sea



Genus: Udotea and Syringodium (sea grass)
Location: Puerto Rico

Neptune's Shaving Brush





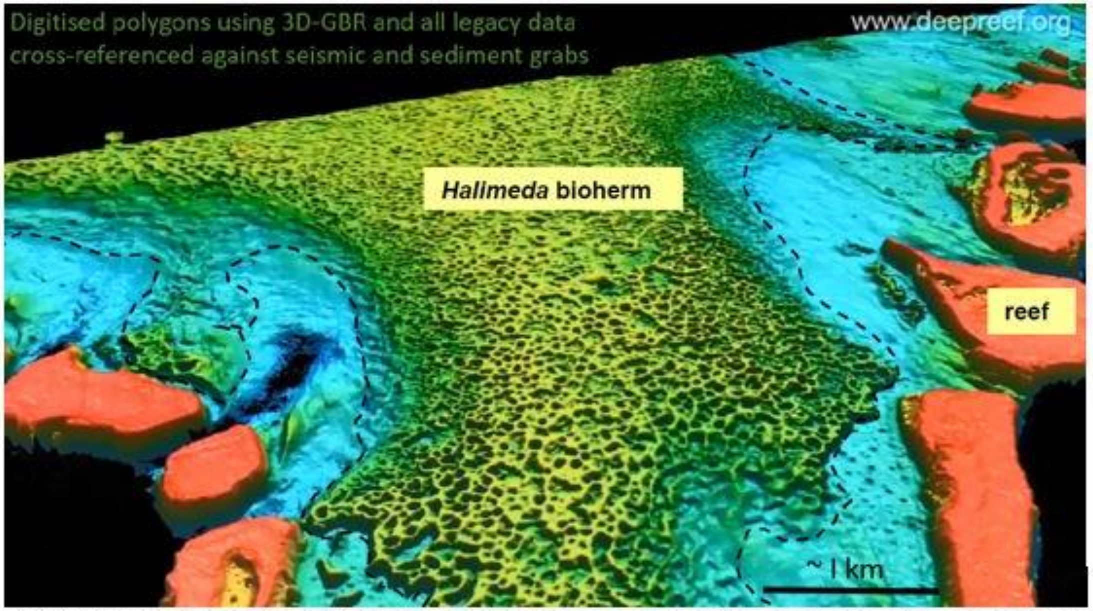
shallow seagrass meadows (*Penicillus, Halimeda*)

Halimeda

Halimeda tuna

Halimeda cuneata

Why is *Halimeda* important?



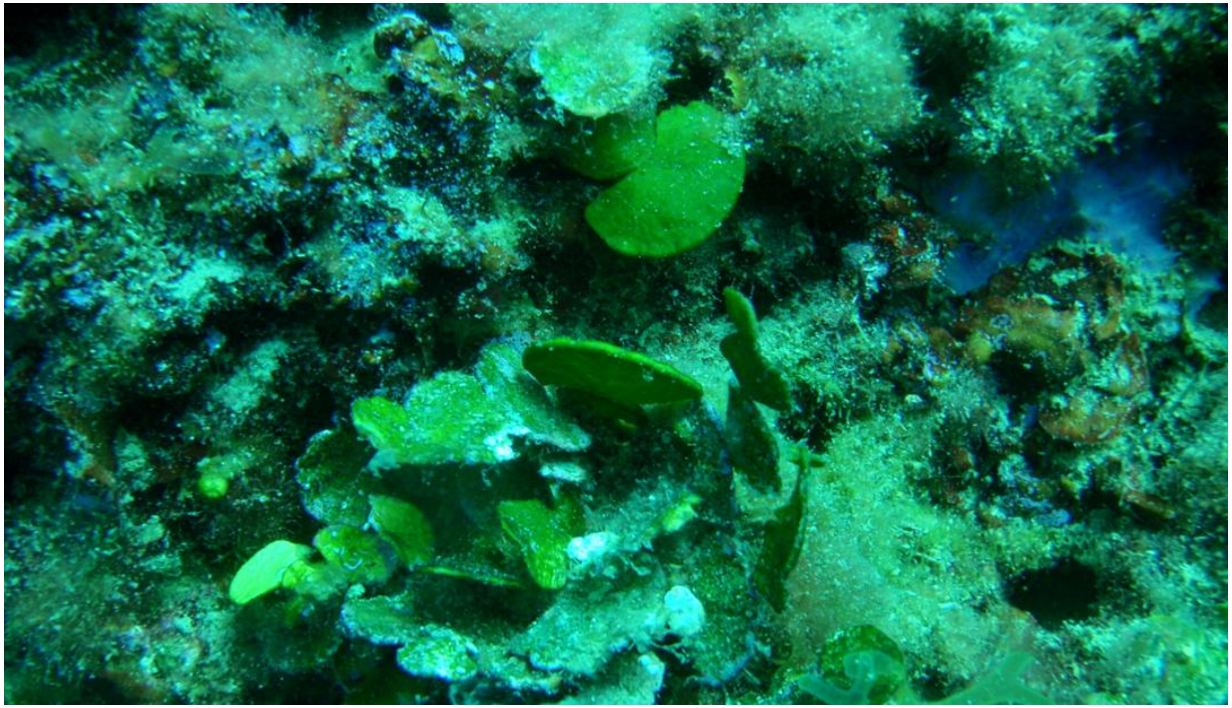
3D image showing the distribution and morphology of a Halimeda bioherm in the nothern (Source: www.deepreef.org GBR & sea floor image showing the alcareous green algae Halimeda (Source: Emma Kennedy).

Halimeda bioherms: inter-reef carbonate sediments along the north GBR shelf

- produce 3 kg $CaCO_3$ m^{-2} $year^{-1}$ compared to 3–4 kg for the reefs
- long-term storage of atmospheric carbon in tropical coral reef environments (CO_2 sink)

CaCO3 deposited in the modern sediments made by the members of the genus Halimeda was conservatively estimated to at least 575 Gt of mass carbon, i.e. the amount comparable to the present day carbon in the global terrestrial vegetation

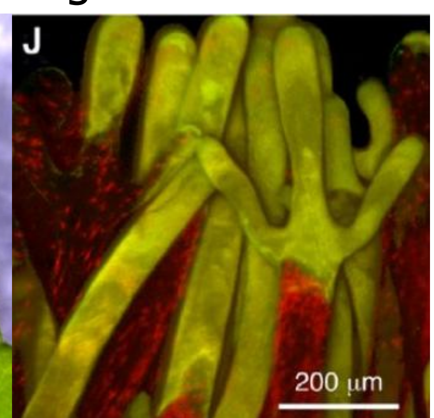
Halimeda tuna Adriatic Sea

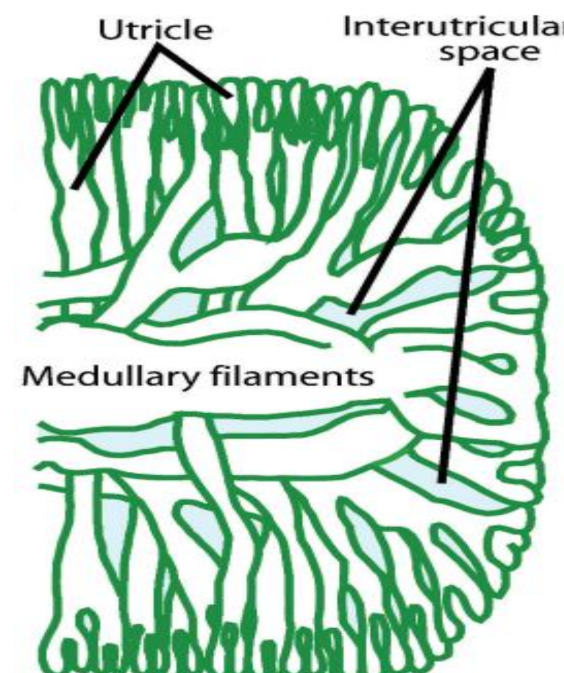


H. tuna + *Mesophyllum alternans* approx. 465 g of $CaCO_3$ m^{-2} $year^{-1}$

Halimeda attached to the hard substratre

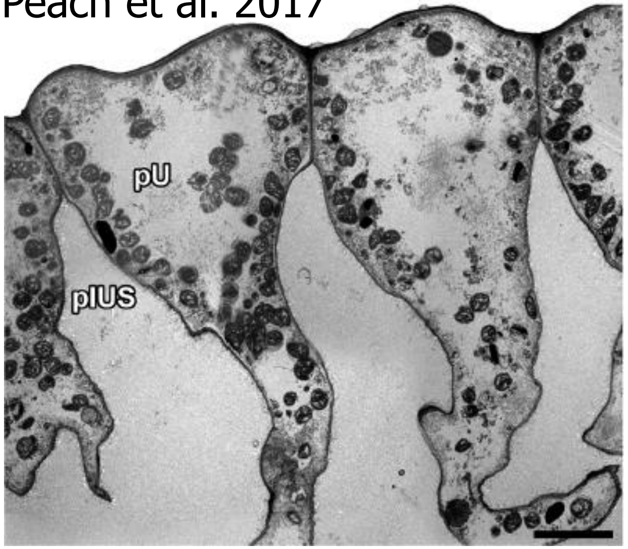
The whole thallus consists of a single cell





Calcification

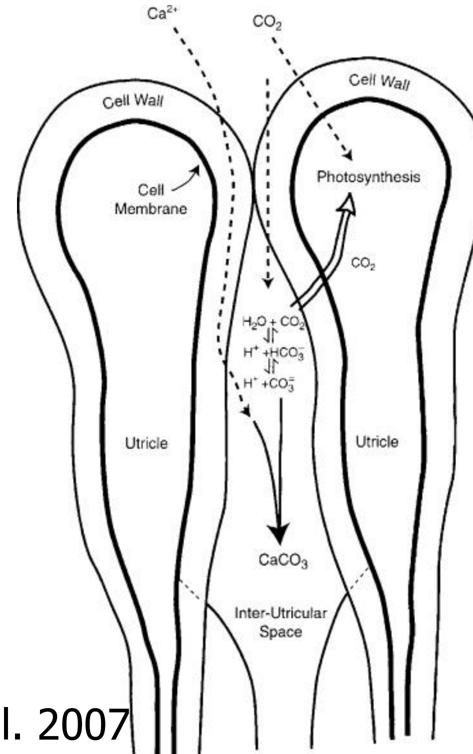
Peach et al. 2017



inter-utricular space

gradual increase of $CaCO_3$ content

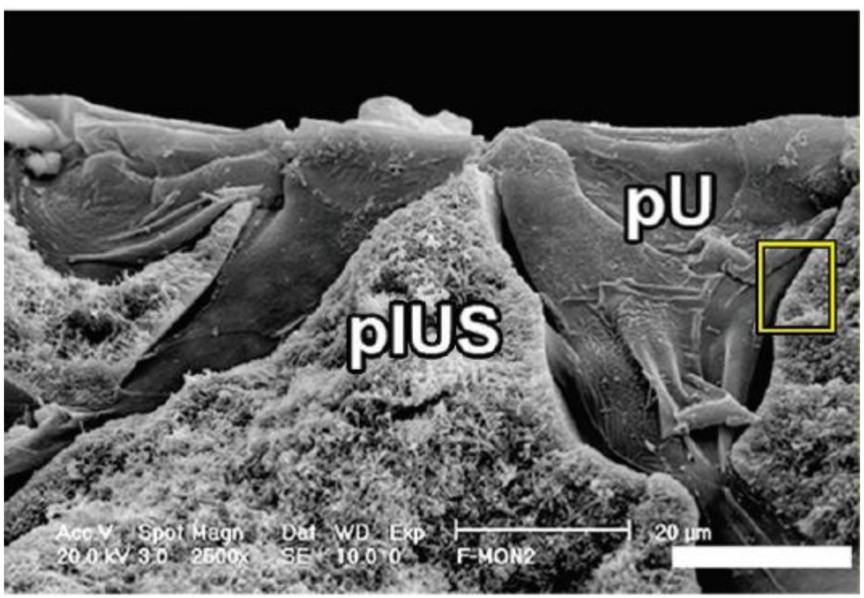
photosynthesis → alkalinisation of the inter-utricular space → trigger for calcification

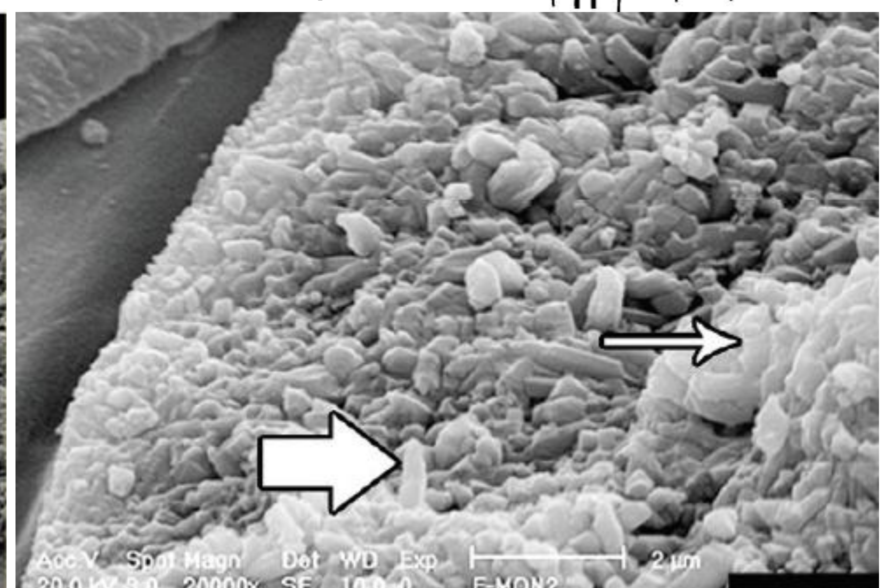


$$Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3 + H_2O + CO_2$$

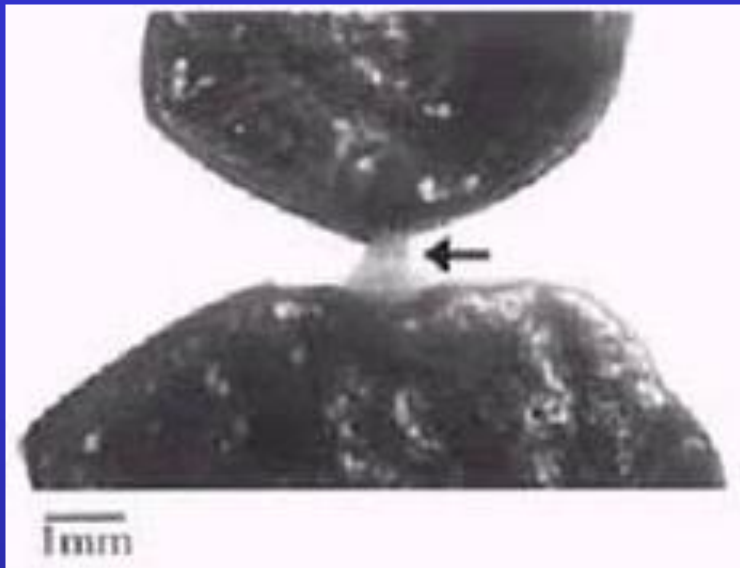
bicarbonate   calcium carbonate

Adey et al. 2007





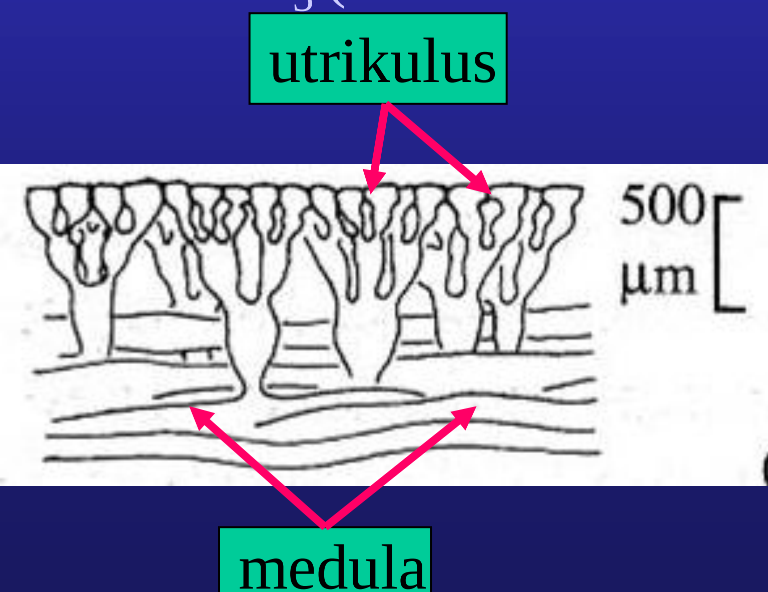
Aragonite microcrystals

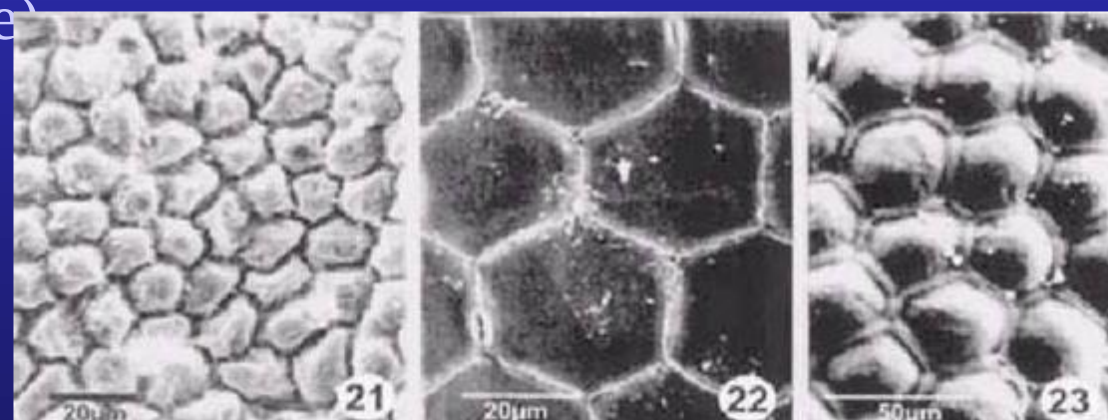


detailed view in SEM

H. cuneata – nodulus není inkrustován

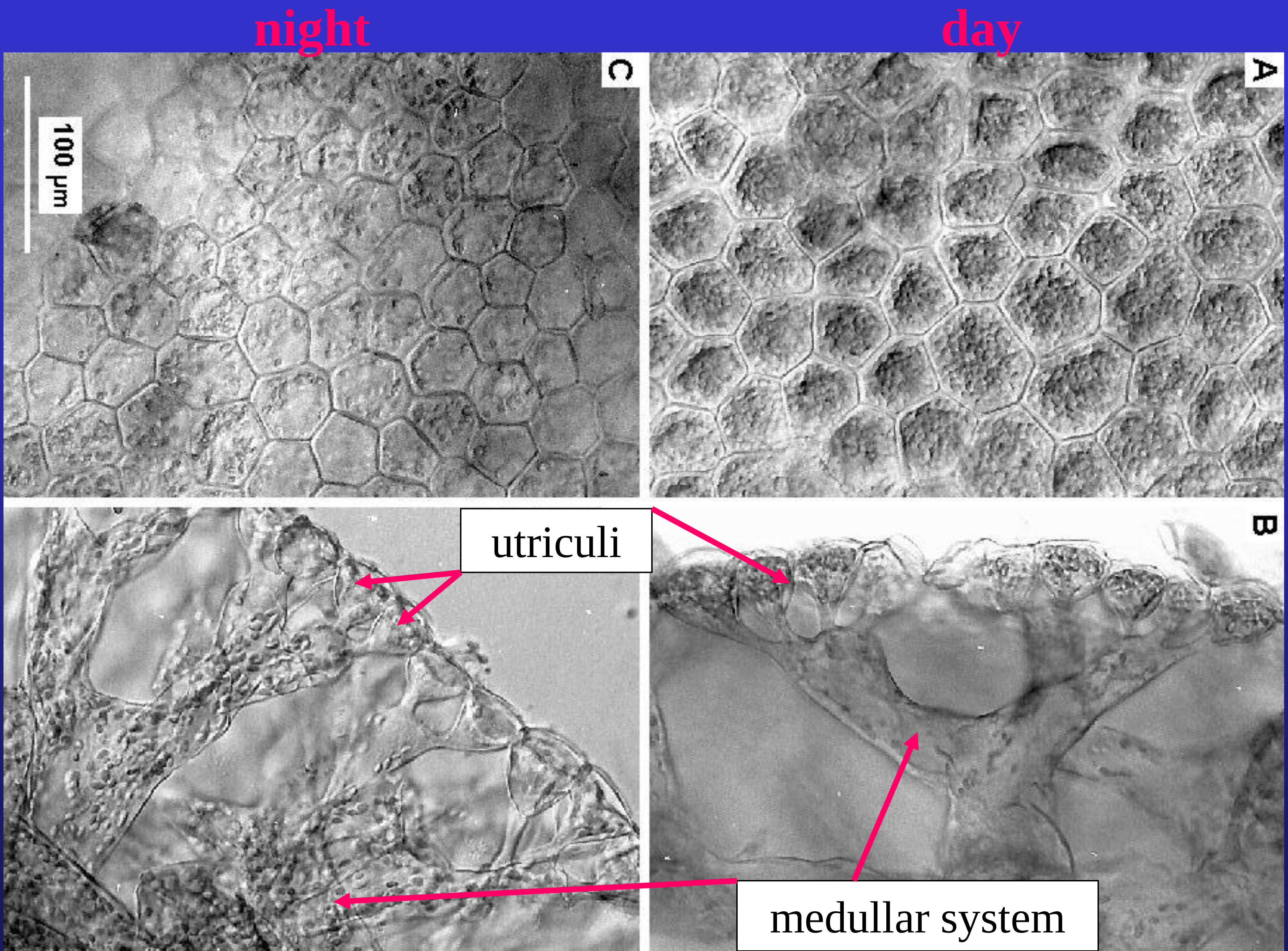
$CaCO_3$ (calcium carbonate)





segment surface in different *Halimeda* species SEM

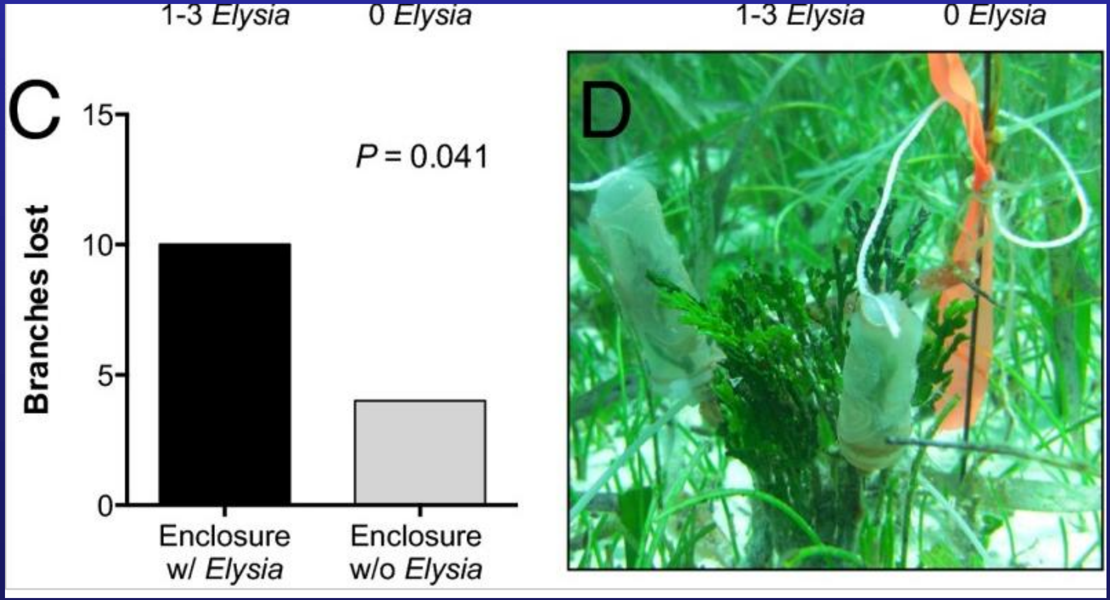
Distribution of chloroplasts in *Halimeda* during the day and night



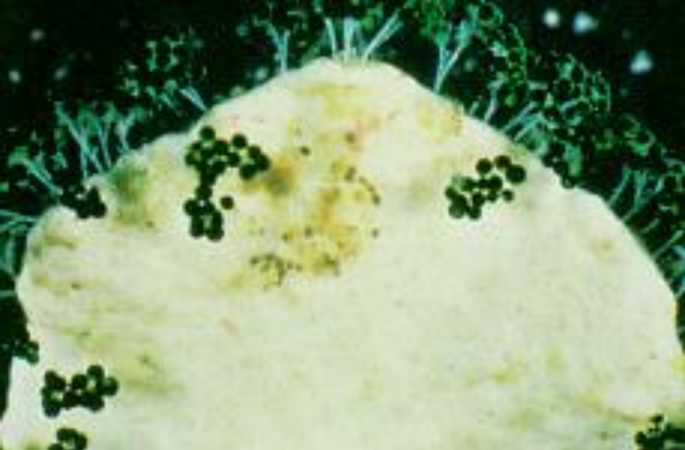
Elysia pusilla

Elysia pusilla feeds on the calcified green alga *Halimeda incrassata* and incorporates functioning chloroplasts into its body, thus it is known as a solar-powered sea slug. It is found in shallow water in tropical regions of the Indo-Pacific wherever its host species grows.

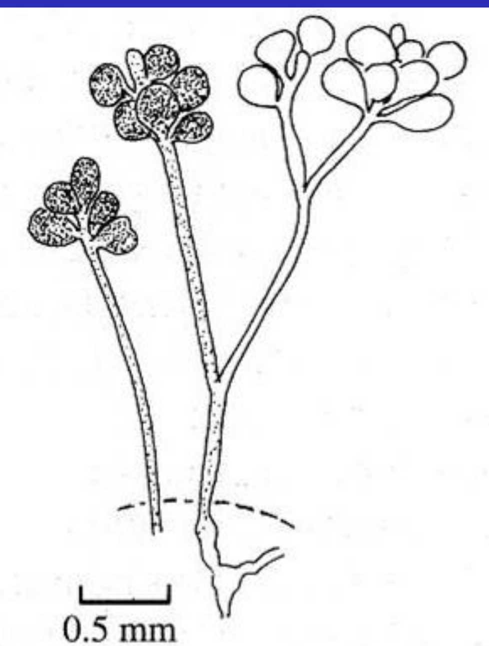
Halimeda responds by dropping branches occupied by Elysia, apparently to prevent fungal infection associated with Elysia feeding

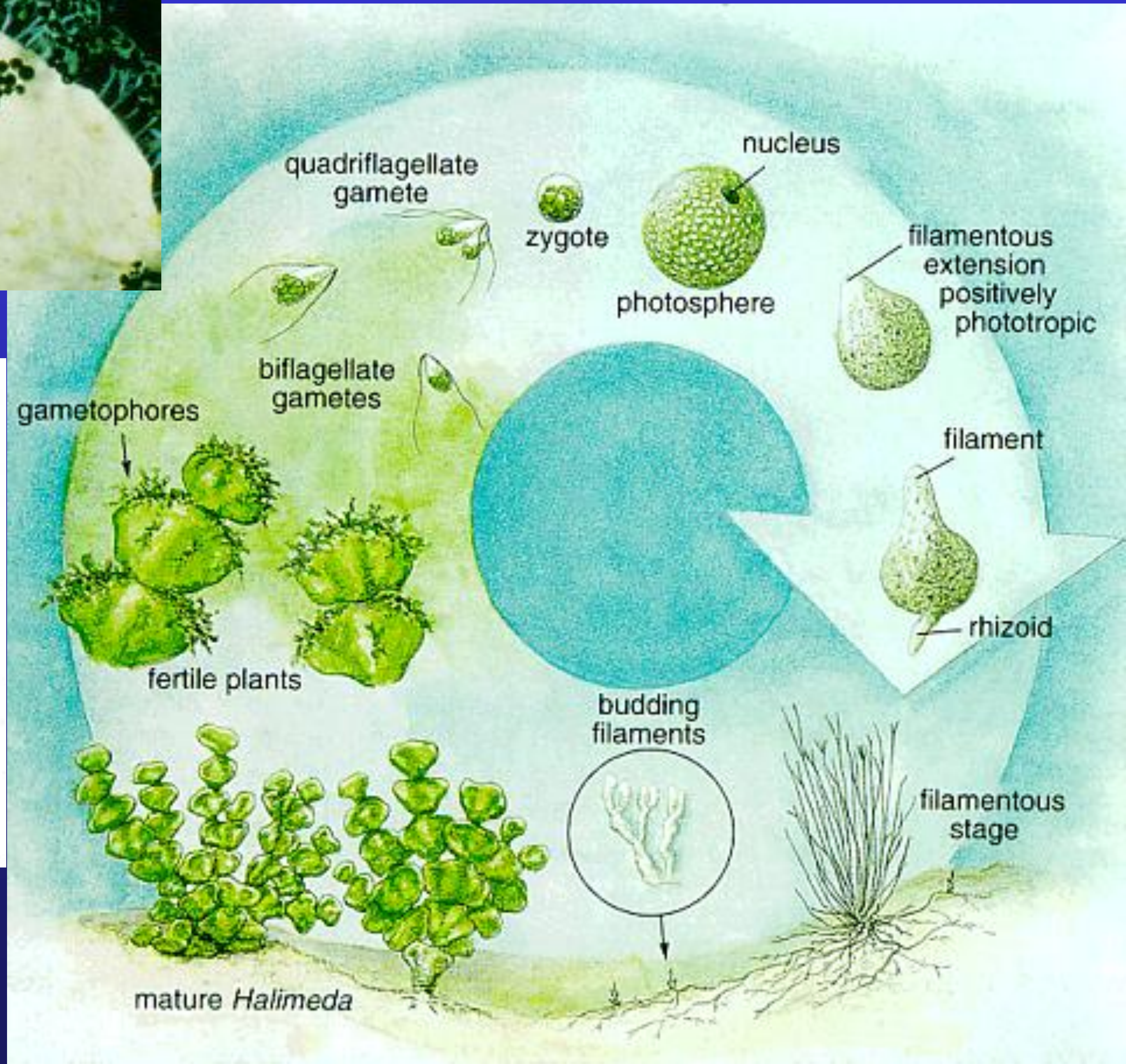


Rasher et al. 2015

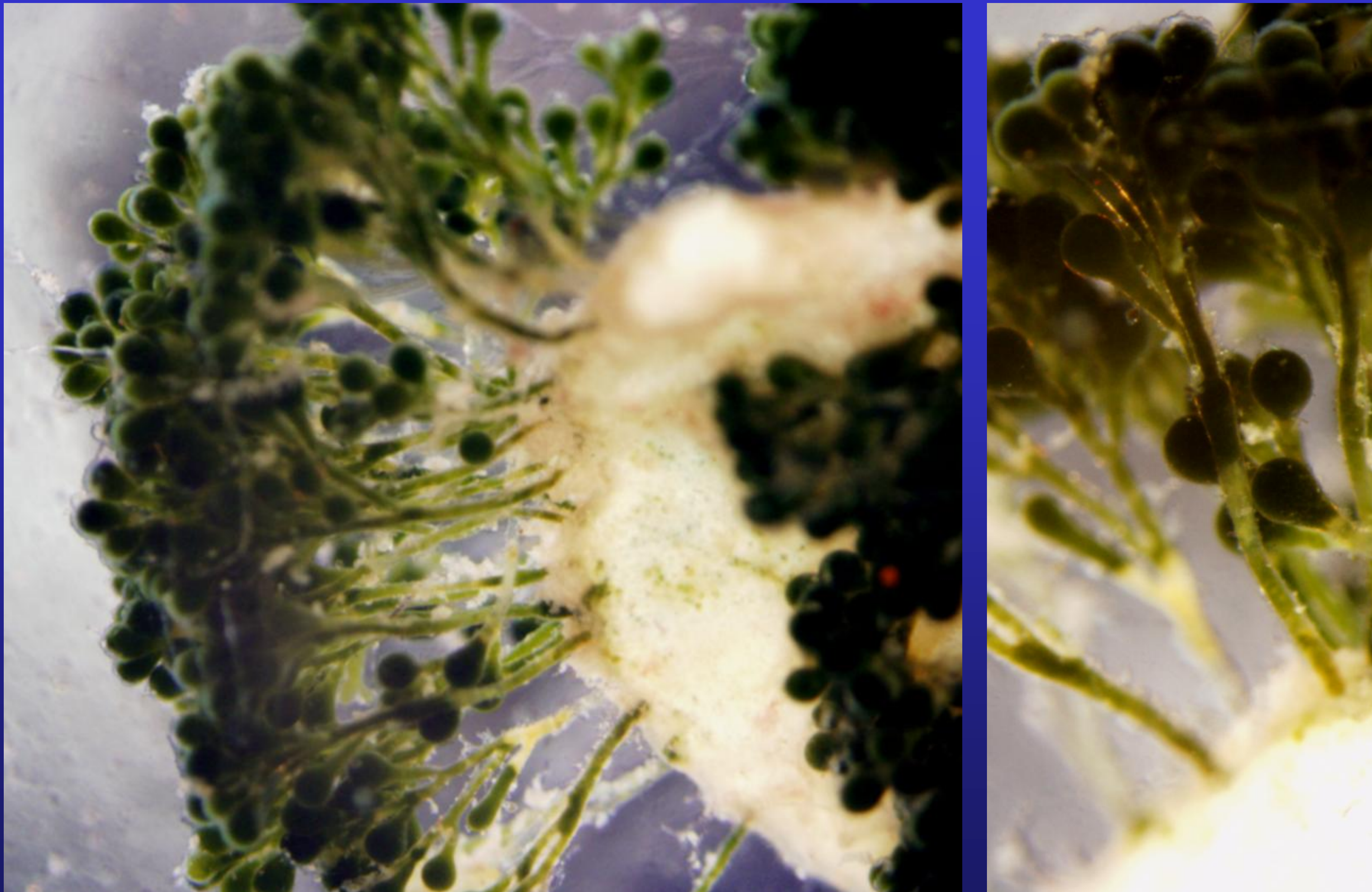


gametangia



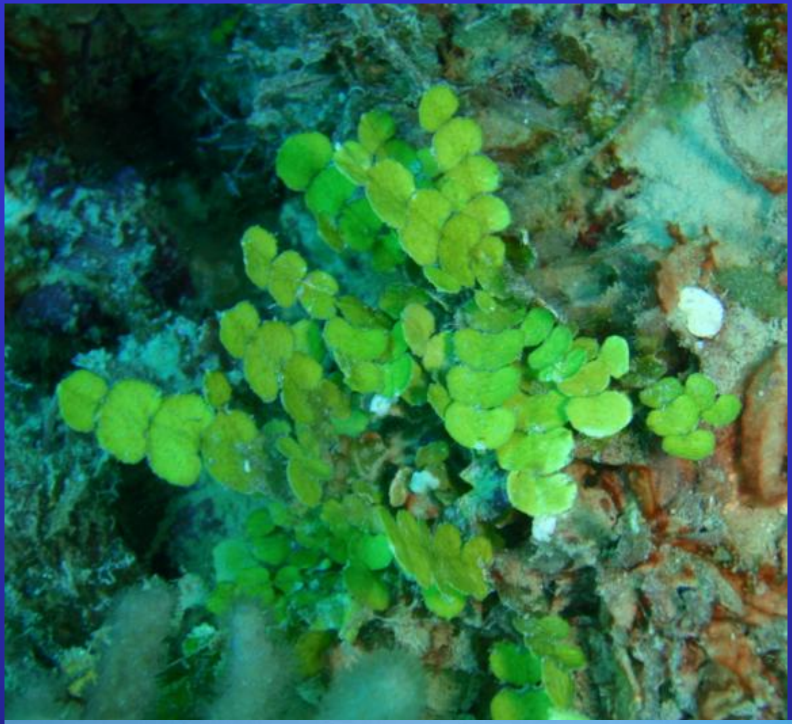


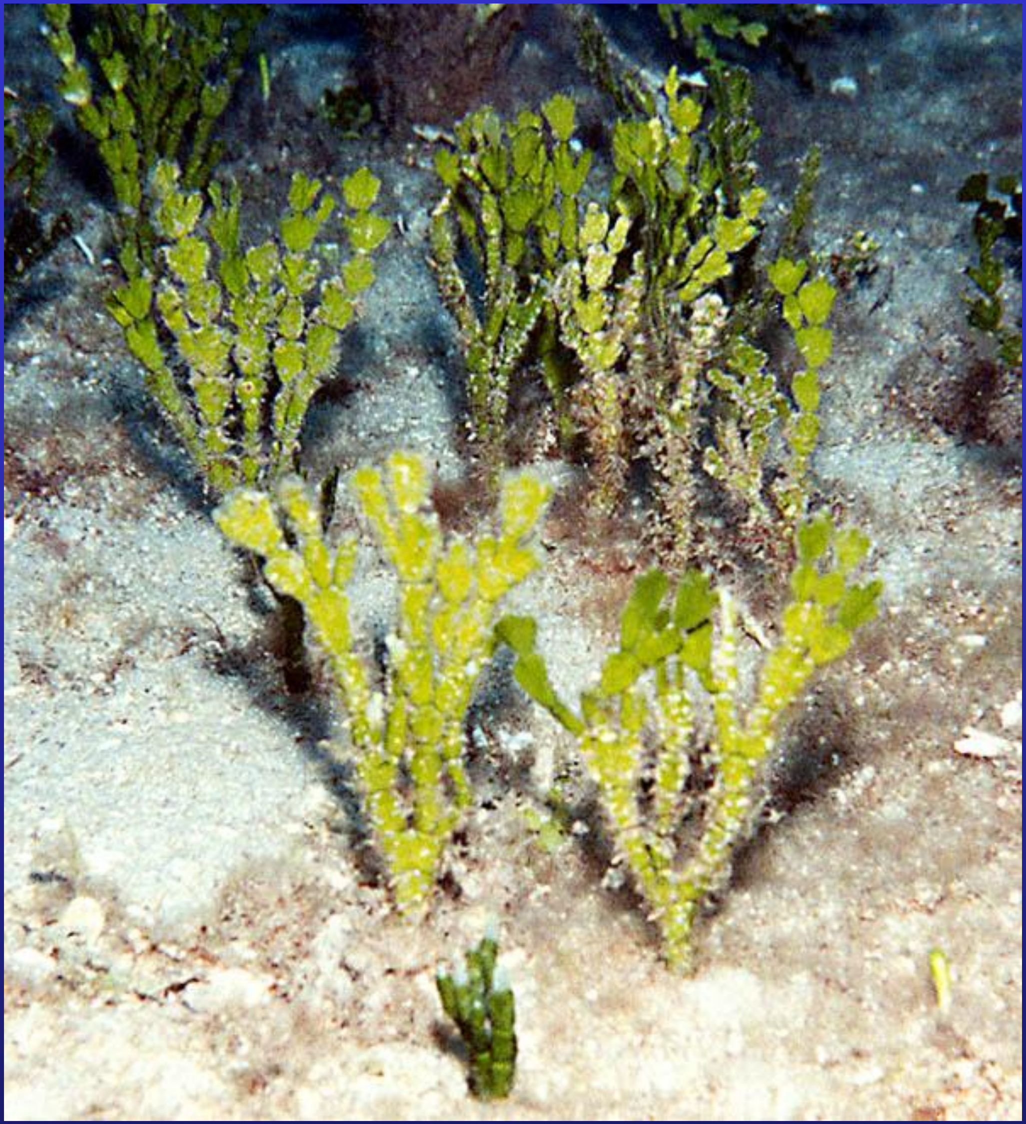
Halimeda



gametangia *Halimeda tuna* – Mediterranean Sea

Halimeda – Great Barier Reef





Halimdea incrassata

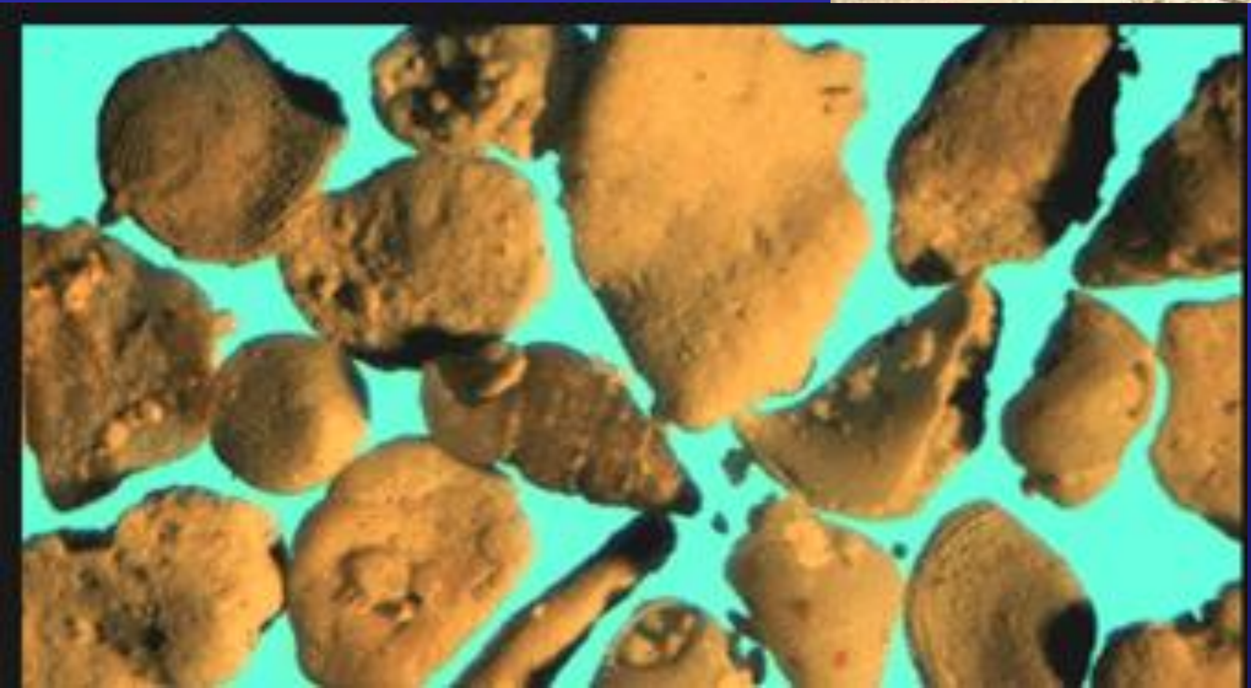
Halimeda - mimikry

Solenostomus halimeda - ryba, dokáže měnit barvu a napodobit i prázdné=bílé segmenty

krab *Huenia heraldica* uses living fronds of *Halimeda* algae as a hat

Halimeda

tropical beach in Belize (Caribbean Sea)



The flattened grains are fragments from jointed calcareous plates of the green alga **Halimeda** (probably **H. opuntia**). This interesting green alga grows among the submarine turtlegrass beds and the luxuriant coral reefs of this region.

Fig. 1. Illustration of morphological variation in the species *Halimeda cuneata* (A–N), *H. discoidea* (O–Q) and *H. tuna* (R, S). (A, B) *H. cuneata* 1. (C, D) *H. cuneata* 2. (E, F) *H. cuneata* 3. (G, H) *H. cuneata* 4. (I, J) *H. cuneata* f. *digitata*. (K, L) *H. cuneata* f. *undulata*. (M, N) *H. cuneata* 7. (O) *H. discoidea* 1. (P) *H. discoidea* 2. (Q) *H. discoidea* 3. (R) *H. tuna* 1. (S) *H. tuna* 2.

Verbruggen et al. 2005

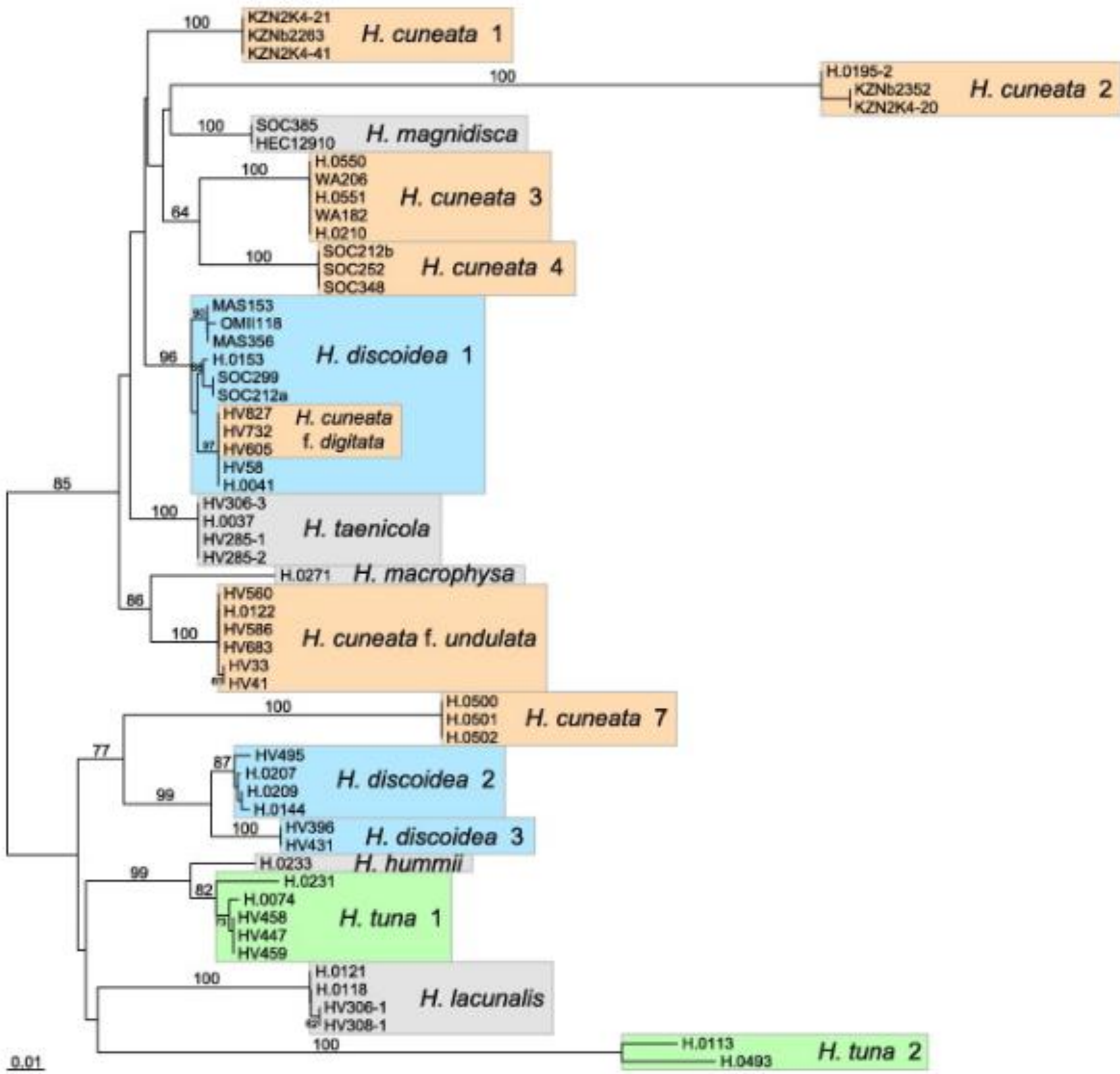
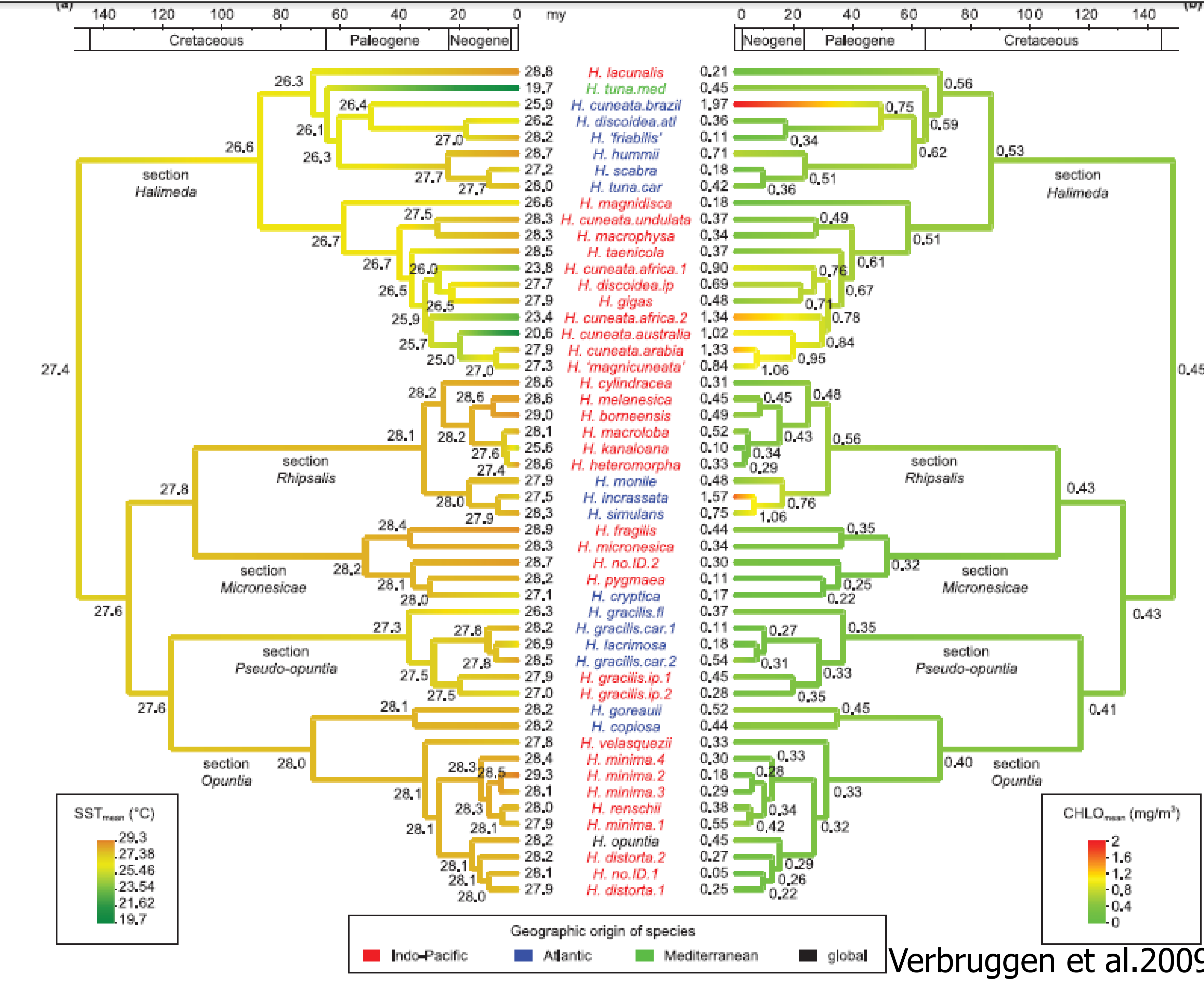


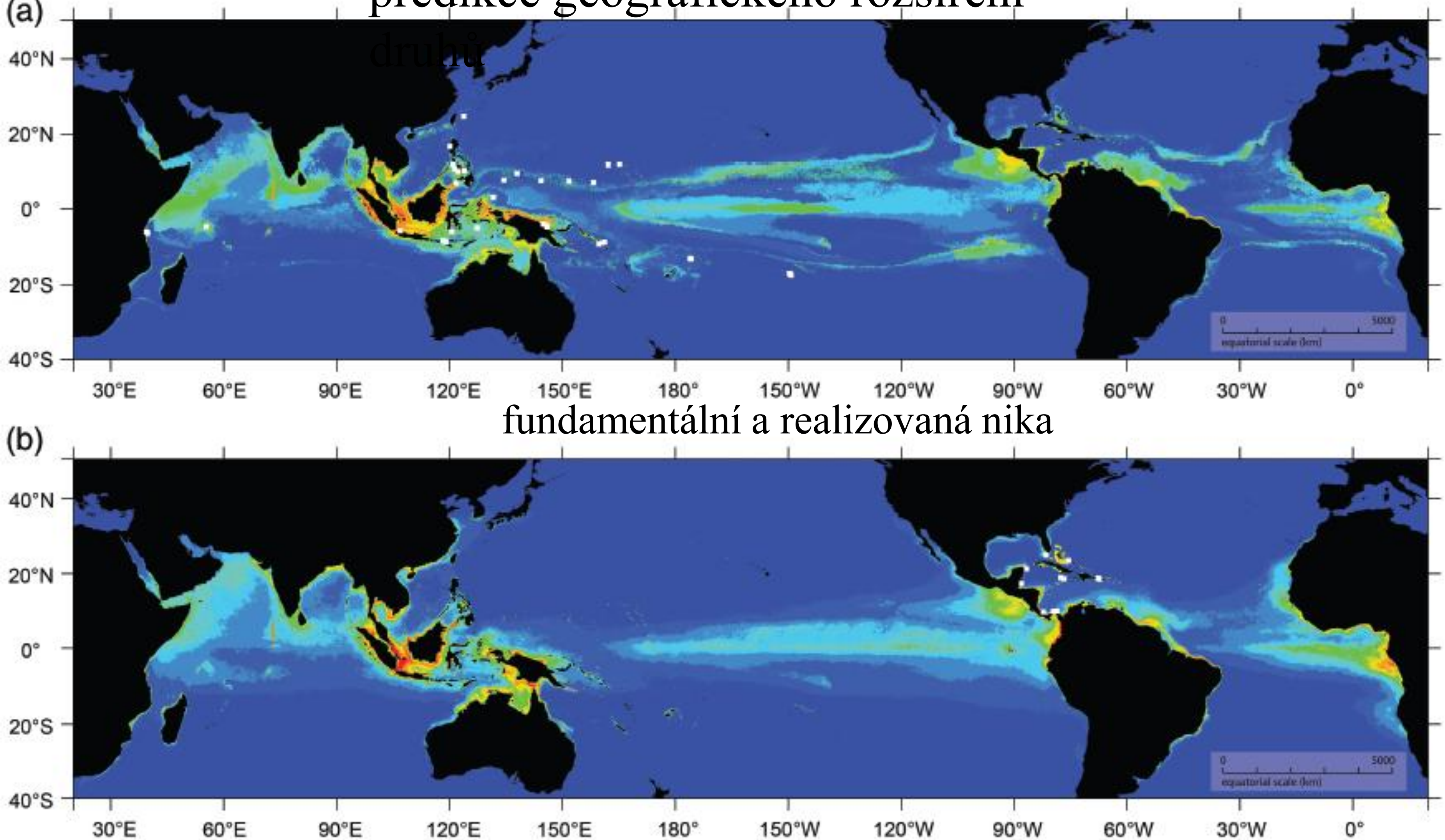
Fig. 3. Neighbor joining phylogram inferred from *rps*19–*rps*3 sequences of 60 *Halimeda* specimens (score = 1.13797). The outgroup was removed from the tree. Bootstrap proportions exceeding 50% are indicated at branches.



Verbruggen et al.2009

predikce geografického rozšíření druhů

fundamentální a realizovaná nika

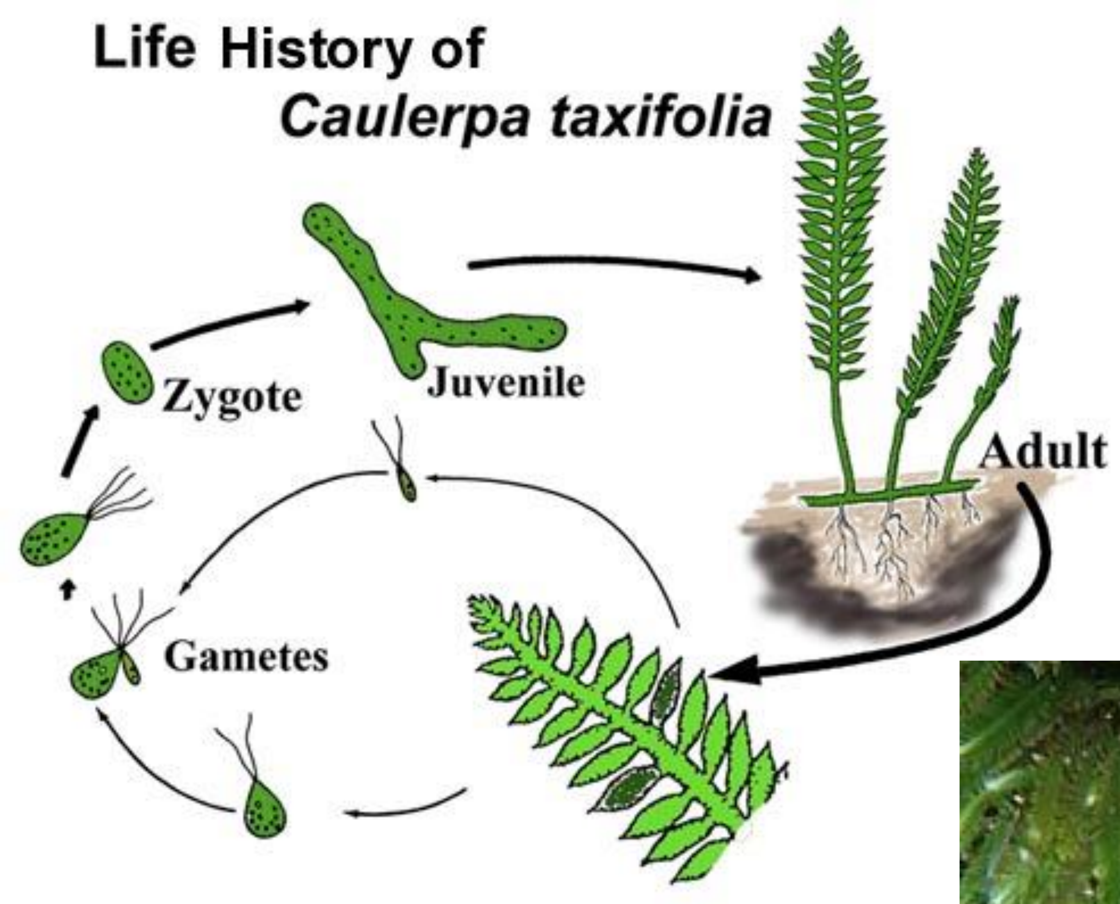


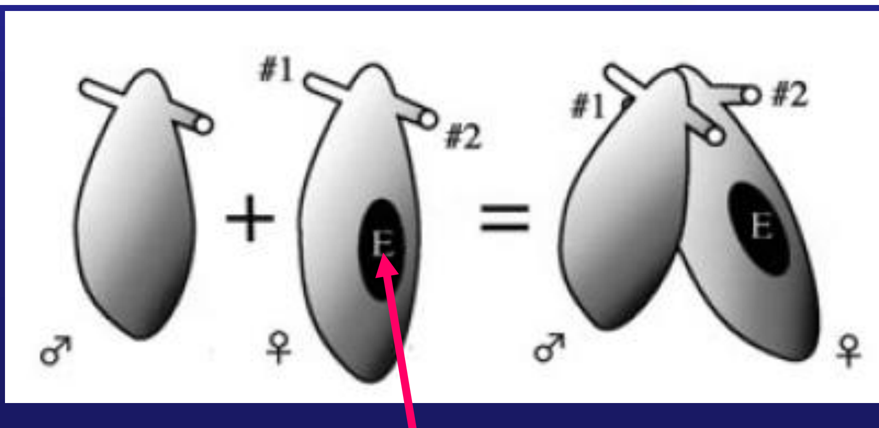
(a) Niche model of the exclusively Indo-Pacific species *Halimeda borneensis* indicating habitat suitability in some Atlantic regions. (b) Niche model of the exclusively Atlantic species *Halimeda simulans* predicting habitat suitability in several Indo-Pacific regions.

Caulerpa

uniaxial thallus

heteroplastidic





stigma

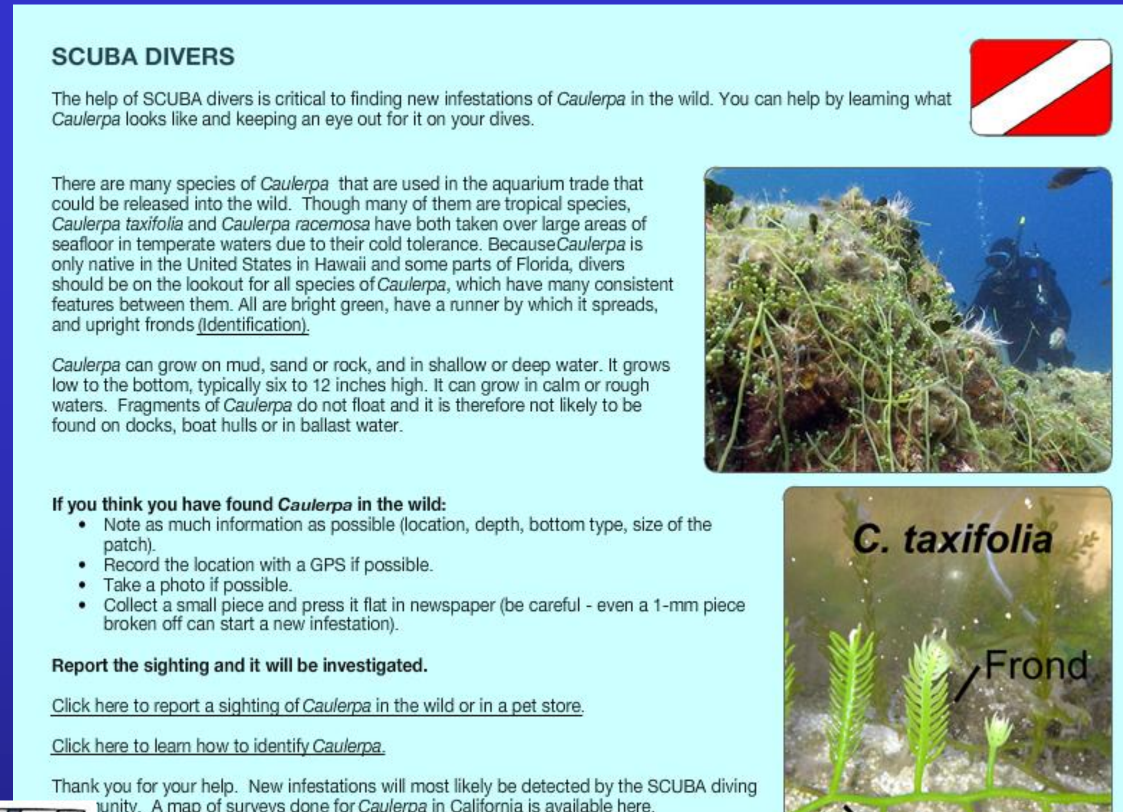
Caulerpa taxifolia – „killer alga“ invasive species, succesfull along Mediterranean Sea shores and California

C. taxifolia ve Středozemním moři

https://www.youtube.com/watch?v=H0snJY3GHuU

https://www.youtube.com/watch?v=h-odcuD9BvA

https://www.youtube.com/watch?v=AajEW07qCGw



SCUBA DIVERS

The help of SCUBA divers is critical to finding new infestations of *Caulerpa* in the wild. You can help by learning what *Caulerpa* looks like and keeping an eye out for it on your dives.

There are many species of *Caulerpa* that are used in the aquarium trade that could be released into the wild. Though many of them are tropical species, *Caulerpa taxifolia* and *Caulerpa racemosa* have both taken over large areas of seafloor in temperate waters due to their cold tolerance. Because *Caulerpa* is only native in the United States in Hawaii and some parts of Florida, divers should be on the lookout for all species of *Caulerpa*, which have many consistent features between them. All are bright green, have a runner by which it spreads, and upright fronds (Identification).

Caulerpa can grow on mud, sand or rock, and in shallow or deep water. It grows low to the bottom, typically six to 12 inches high. It can grow in calm or rough waters. Fragments of *Caulerpa* do not float and it is therefore not likely to be found on docks, boat hulls or in ballast water.

If you think you have found *Caulerpa* in the wild:

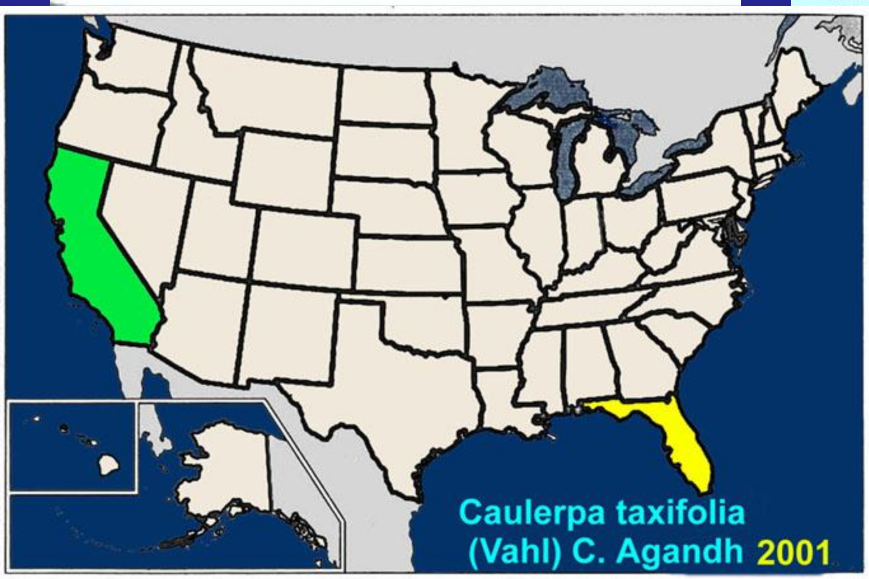
- Note as much information as possible (location, depth, bottom type, size of the patch).
- Record the location with a GPS if possible.
- Take a photo if possible.
- Collect a small piece and press it flat in newspaper (be careful - even a 1-mm piece broken off can start a new infestation).

Report the sighting and it will be investigated.

Click here to report a sighting of *Caulerpa* in the wild or in a pet store.

Click here to learn how to identify *Caulerpa*.

Thank you for your help. New infestations will most likely be detected by the SCUBA diving unity. A map of surveys done for *Caulerpa* in California is available here.



jediný výrazný nepřítel *Elysia subornata* – sap sucking slag - hermaphrodite

Caulerpa predators are being recruited to attack the invader. *Oxynoe* (left) has a partial shell to protect its reproductive organs and digestive glands, while *Elysia* (right) is shell-free. With each feeding on only 5 centimeters of frond per day, Meinesz estimates that efficient control would require more than 1,000 slugs per square meter of *Caulerpa*.

Chemical: Colonies of *C. taxifolia* that were discovered in Southern California were eradicated by covering and sealing them with PVC tarpaulins and injecting liquid chlorine underneath. Subsequent treatments at another location used solid chlorine formulations (Anderson & Keppner, 2001). Costs of the Southern Californian eradication were $US2.33 million from 2000-01 for control and monitoring (Carlton, 2001), with an ongoing annual surveillance cost of $US1.2 million until 2004 (Anderson, 2004).
Application of coarse sea salt at a concentration of ~50kg/m^2 has been used with moderate success in Australia, eradicating *C. taxifolia* from an area almost 5200 m^2 in one case, although in another case an area of 3000 m^2 showed a reduction in algal density but eradication was not achieved. The use of this method in the cooler months, when *C. taxifolia* naturally dies back, was recommended. Salting has so far only been succesfully used on soft sediments in water <6m in depth (Glasby *et. Al*, 2004).

Physical: Simply covering *C. taxifolia* colonies with black PVC plastic was found to be reasonably successful in Croatia. A total area of 512 m^2 was treated, with either no or sporadic regrowth occurring after treatment (McEnnulty *et. Al*, 2001).
Manual removal by scuba divers was successful in eradicating a small patch of *C. taxifolia*, around 3.4 m^2, in the French Mediterranean. The use of a suction pump to remove all fragments has also met with moderate success in other areas. Clearance rates for manual removal are from <1 m^2 to ~3 m^2 per diver per hour (McEnnulty *et.al*, 2001).

Biol Invasions (2015) 17:2717–2728
DOI 10.1007/s10530-015-0908-1

CrossMark

ORIGINAL PAPER

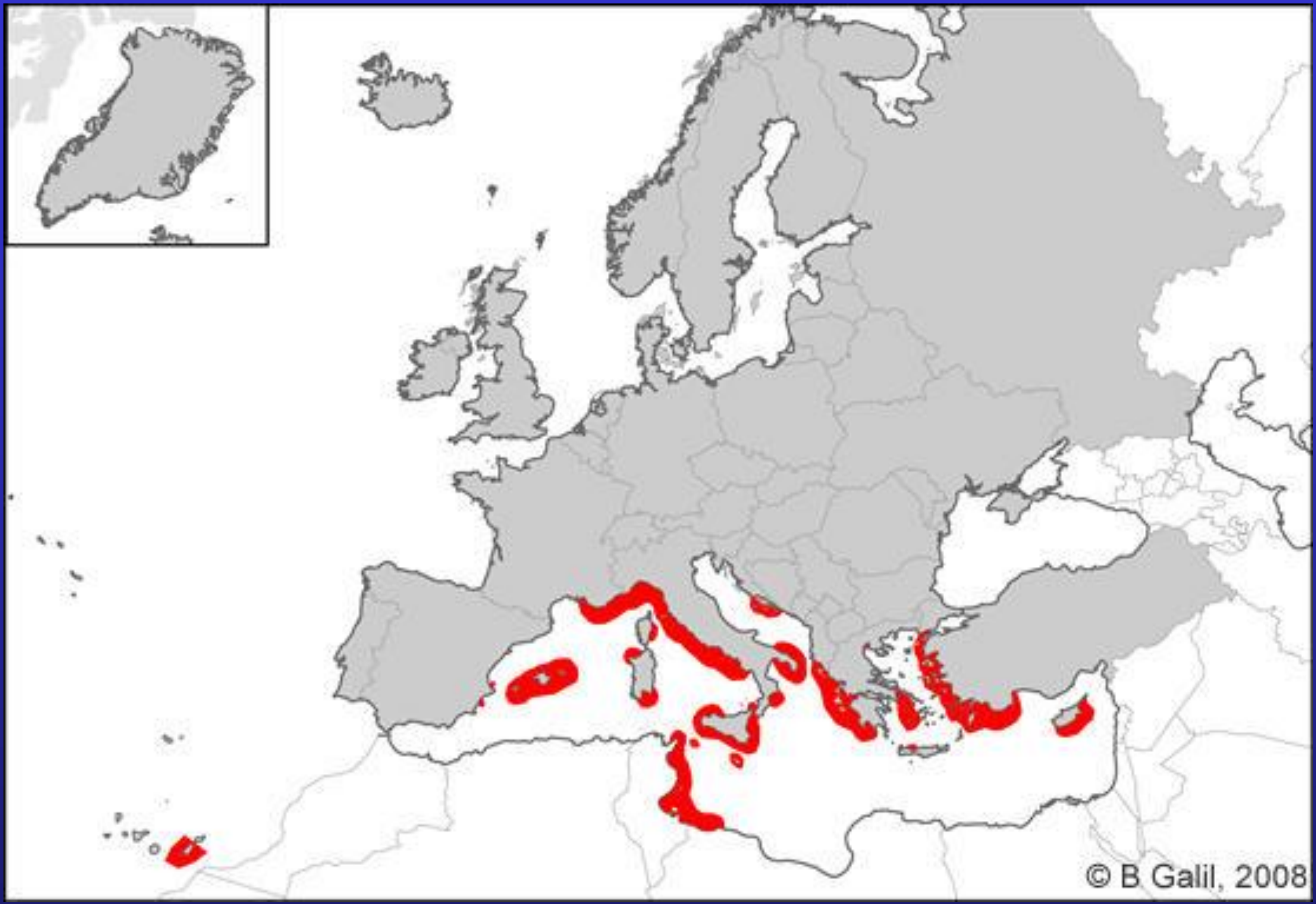
A tale of two invaders: divergent spreading kinetics of the alien green algae *Caulerpa taxifolia* and *Caulerpa cylindracea*

Monica Montefalcone · Carla Morri ·
Valeriano Parravicini ·
Carlo Nike Bianchi

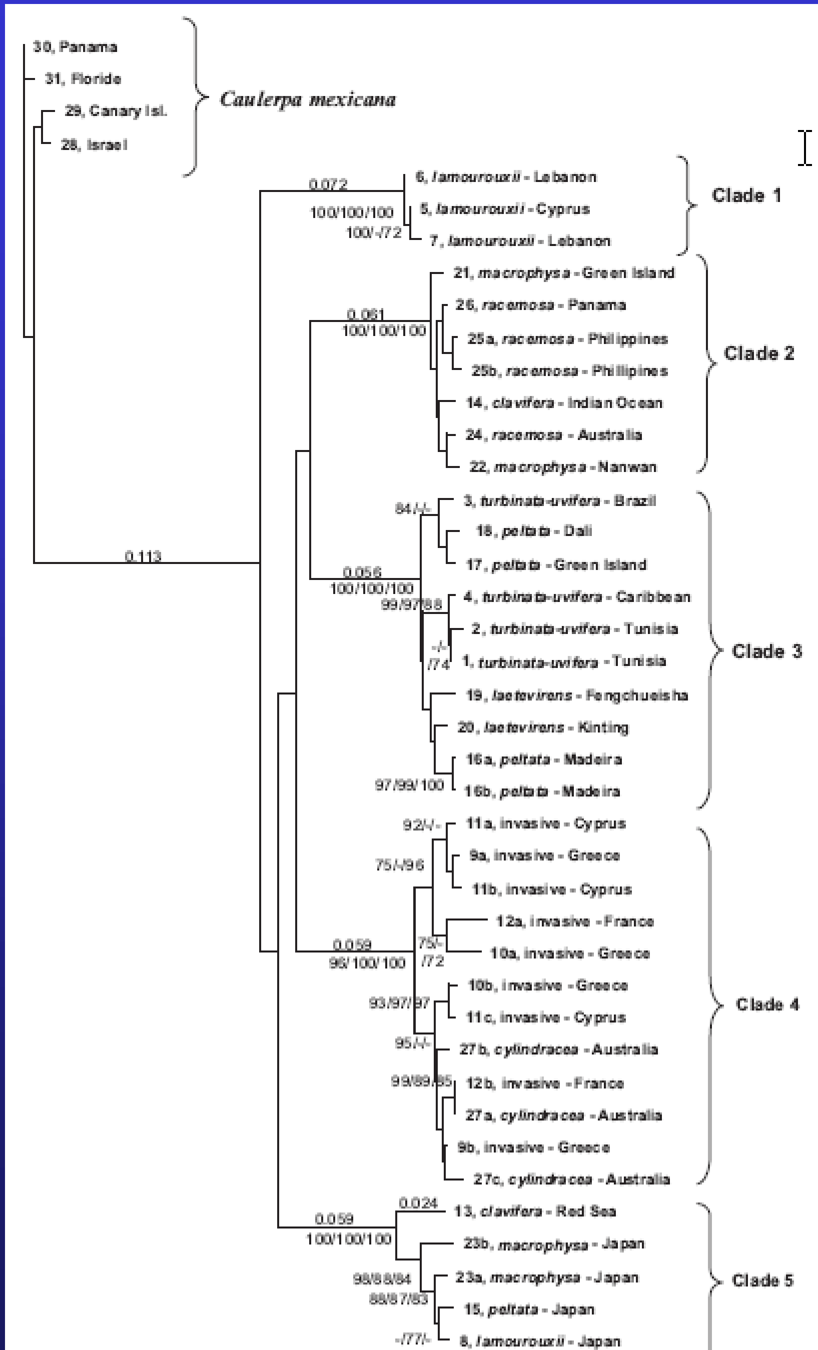
impressive expansion
phase from 1984 to 2000 but then,
its dispersal
rate showed lower than that
predicted and the species
did not persist in areas formerly
colonized

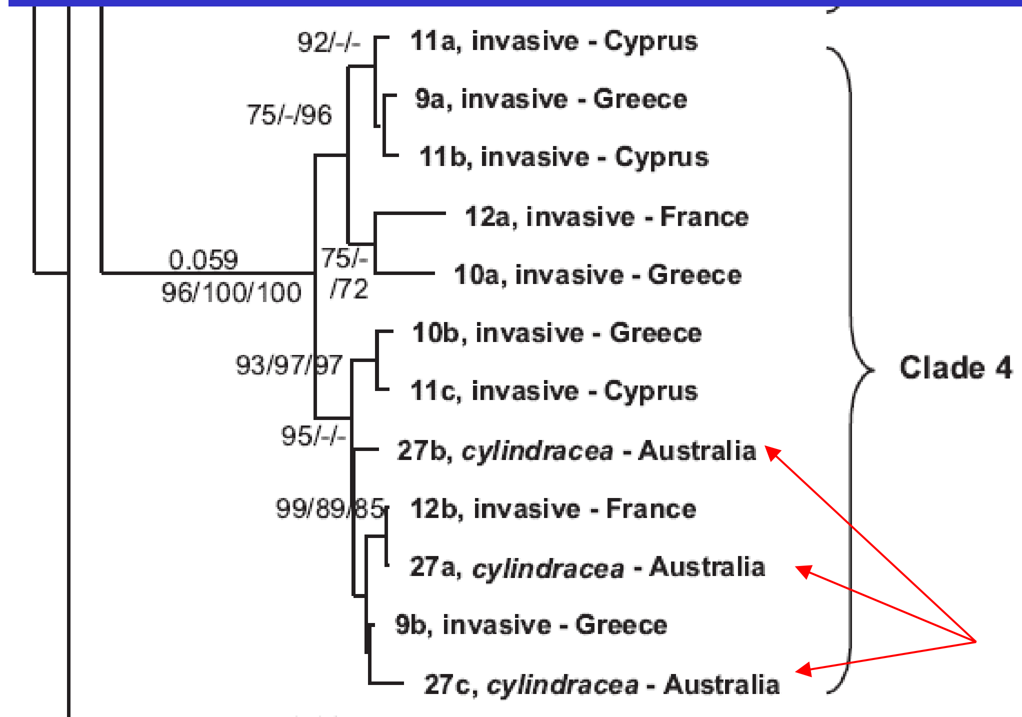
Invasion of *Caulerpa cylindracea*

first found in Libia
1990



invazní druh - do r. 2002 11 států, všechny velké ostrovy, daleko rychlejší invaze než u *C. taxifolia*

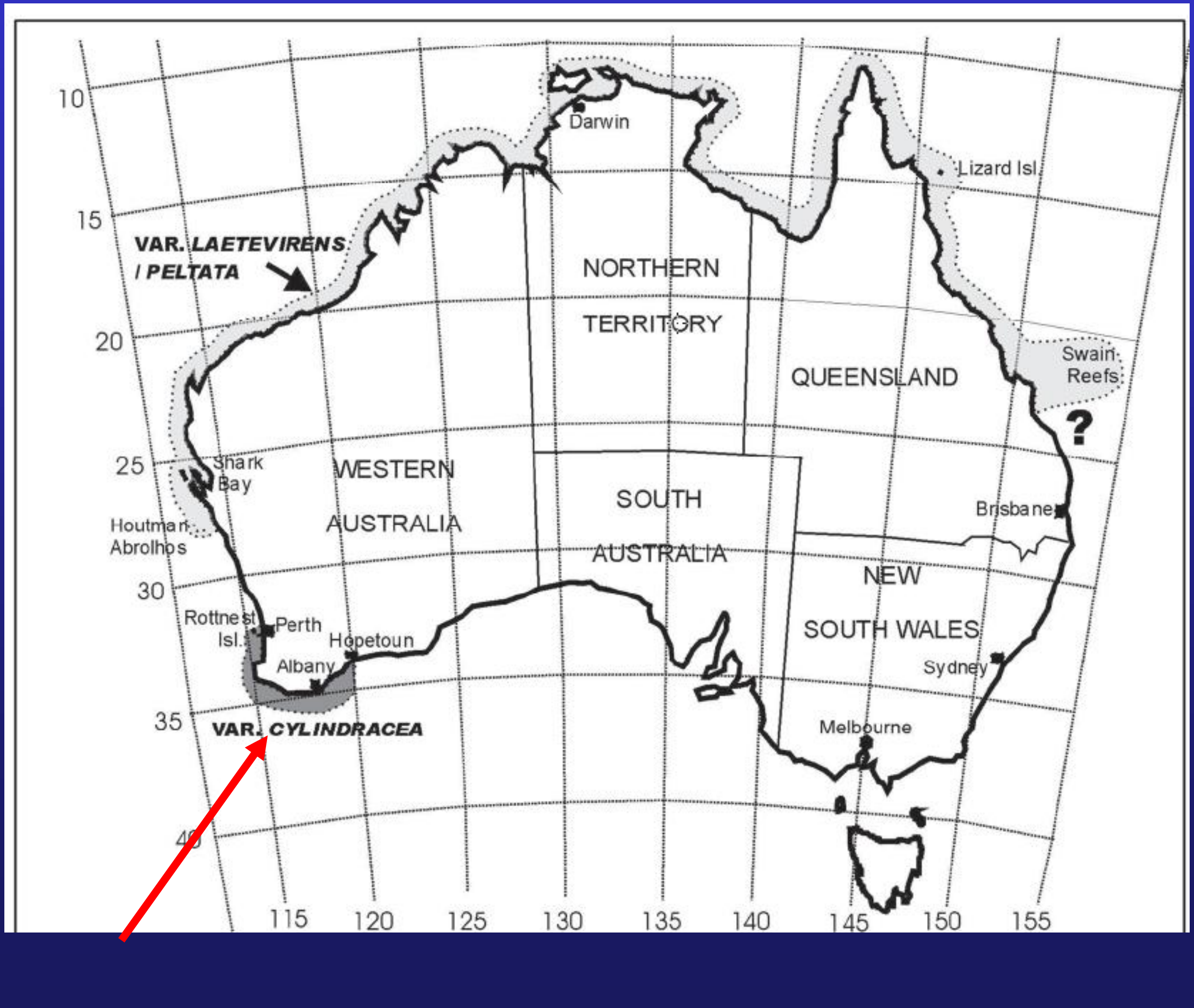




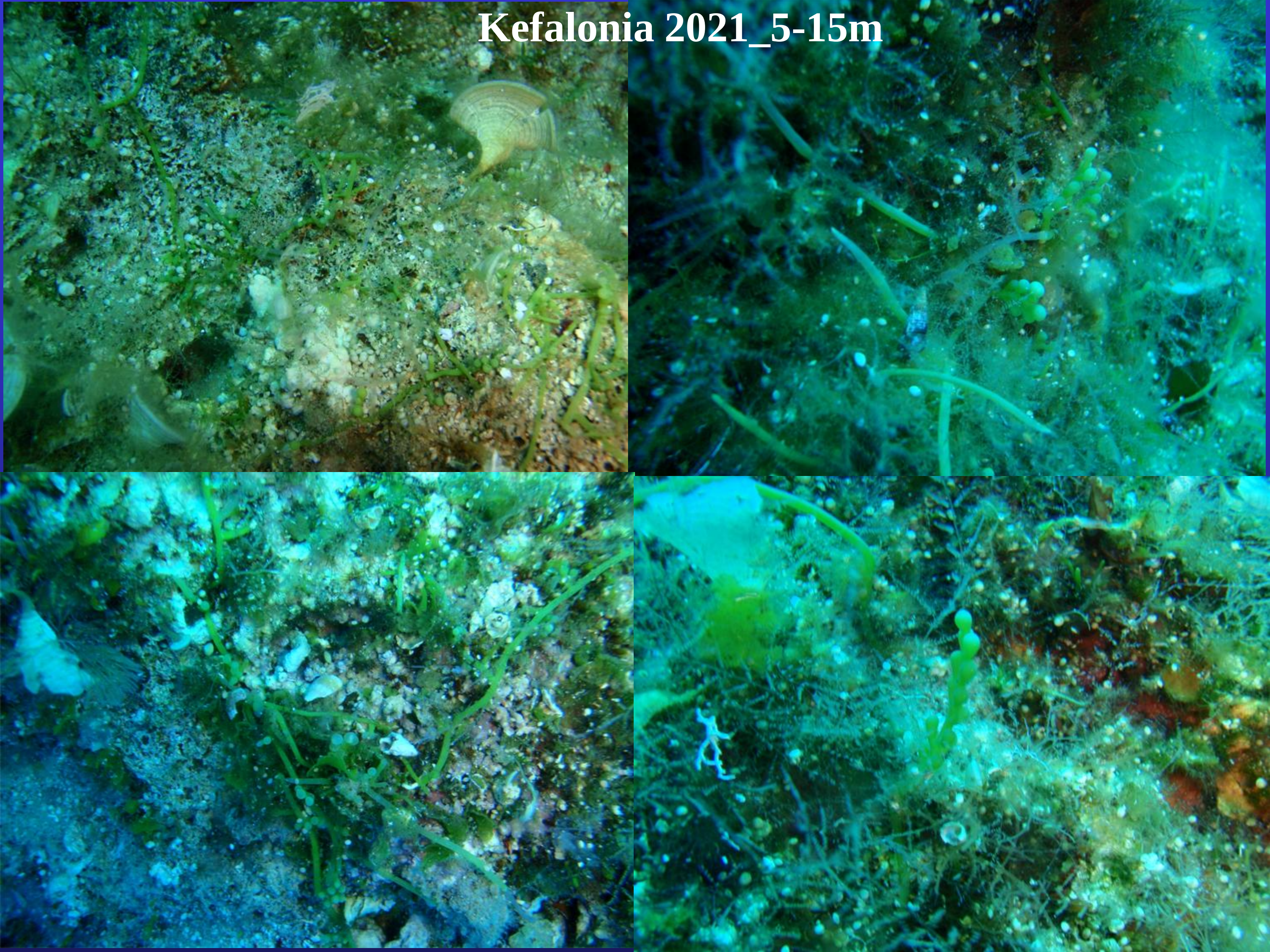
Neighbour-joining treeof ITS1, 5.8S and ITS2 sequences from a range of Caulerpa racemosa isolates, with C. mexicana as theoutgroup. NJ/MP/ML

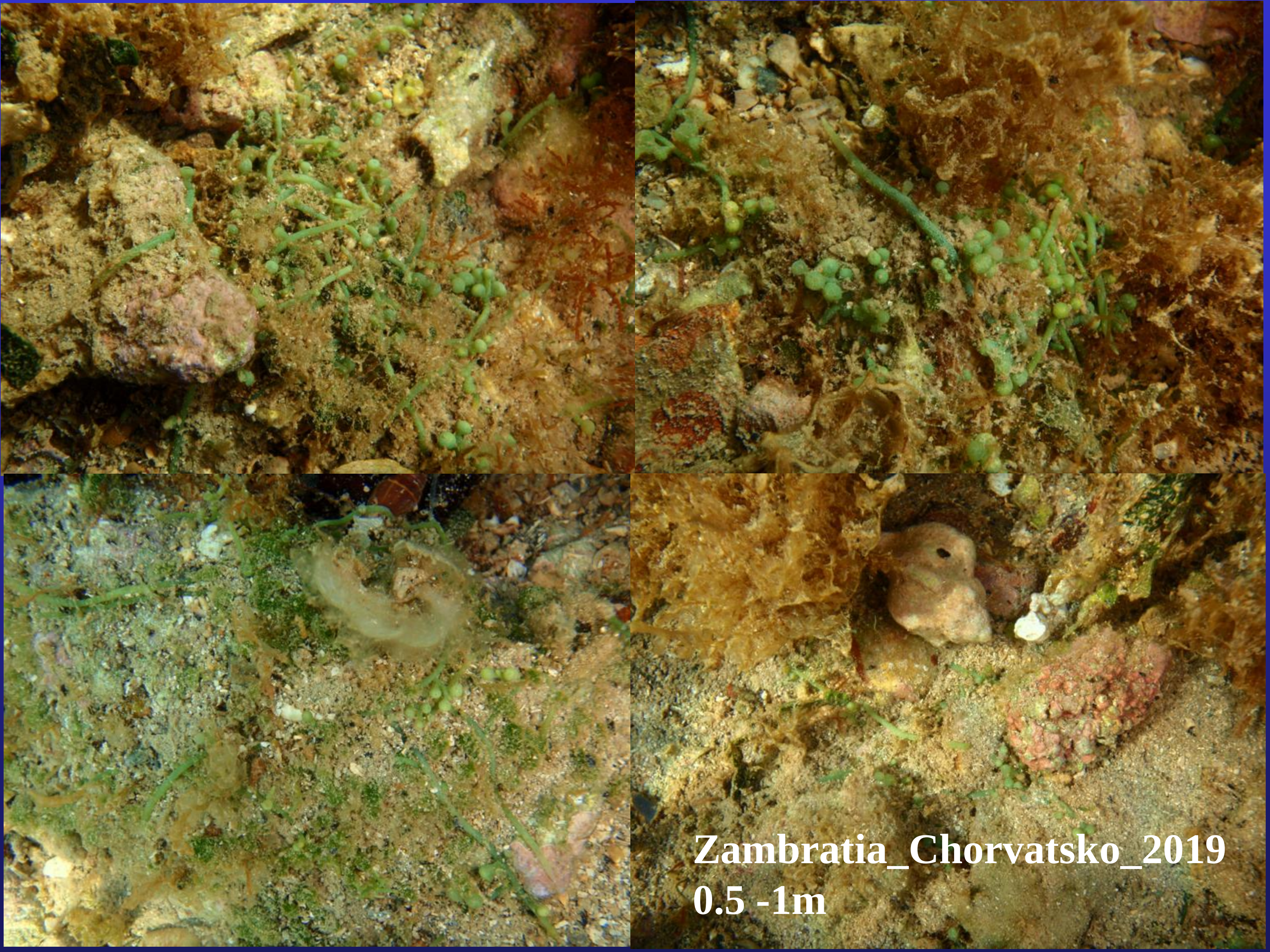
Verlaque et al. 2003

invaze je výsledkem recentní introdukce, identifikovali „invazní varietu“ - totožná s *Caulerpa cylindracea* -endemit jihozápadní Austrálie



Kefalonia 2021_5-15m




Zambratia_Chorvatsko_2019
0.5 -1m

Caulerpa lentilifera

pěstována na Filipínách, v Japonsku – písčito-bahnitá dna mělkých chráněných zátok, antibakteriální a antifungální účinky (fukoidany) proti vysokému tlaku a revmatismu

Lato

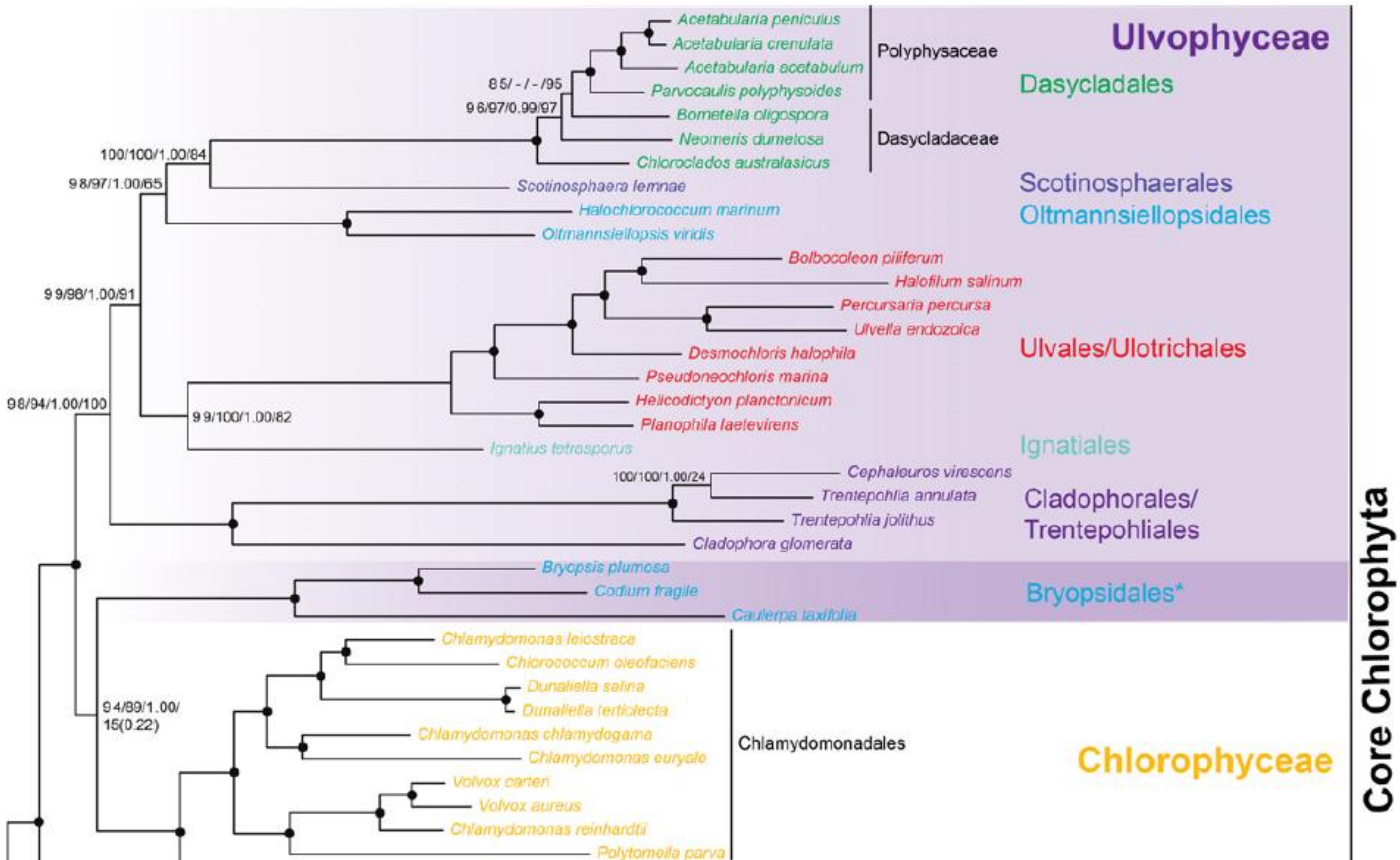
Umi-budō served Okinawan style

Lato, the strange sea salad Coron, Philippines

Coron, Filipíny - kmen Tagbanua se živí pěstováním a prodejem *C. lentilifera*

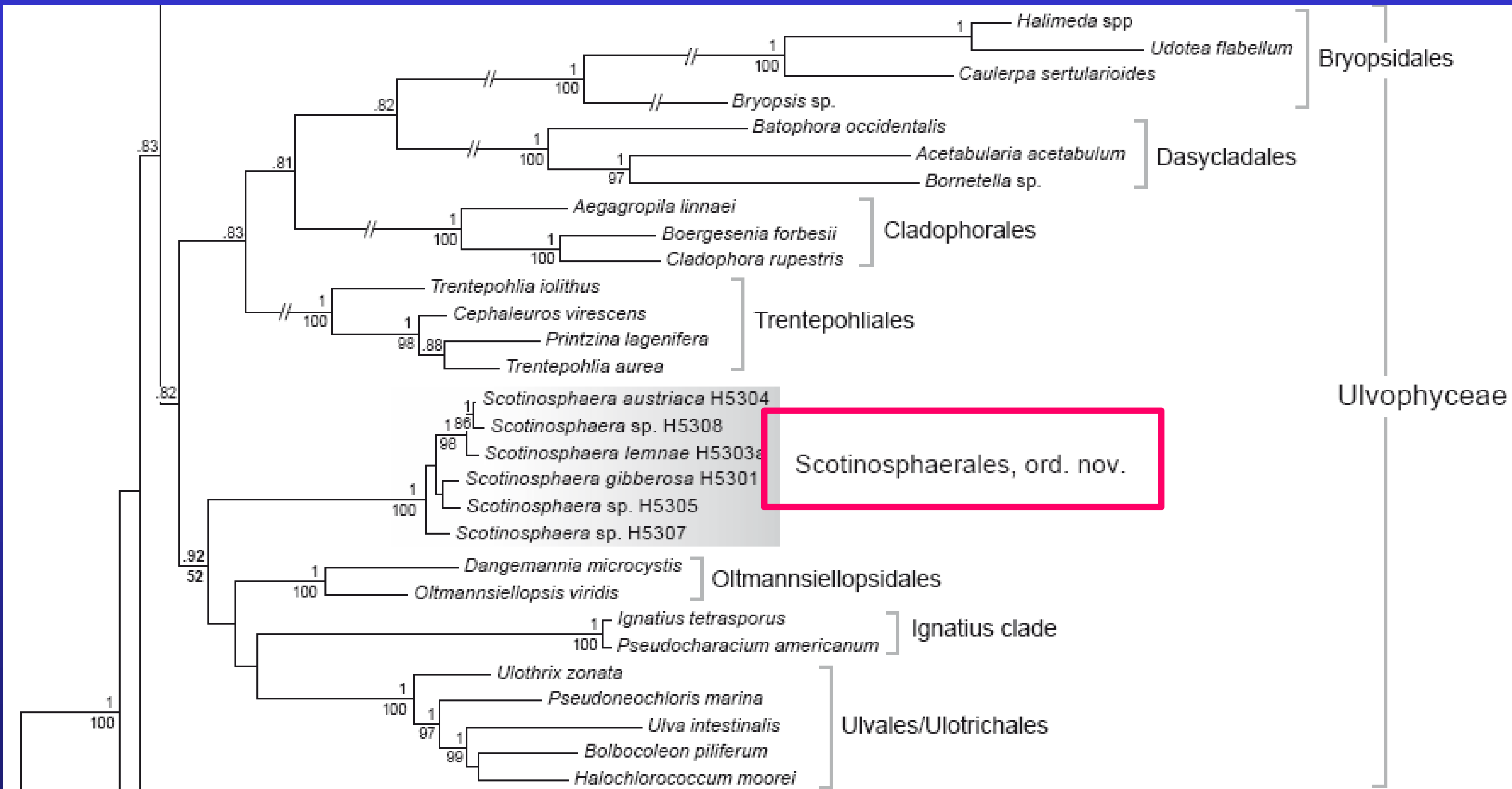
http://www.lemanger.fr/en/index.php/lato-the-strange-sea-salad/?lang=en

The big baskets will travel to Manila by cargo. There, their commercial value will increase dramaticaly. In Coron, the buyers get the lato from the Tagbanua for 8 pesos a kilo. In Puerto Princesa, the capital of the province of Palawan, the prices are already as high as 100 pesos a kilo. In Manila, it’s even more.



Gulbrandsen et al. 2021

Scotinosphaerales – sister l. to Dasycladales

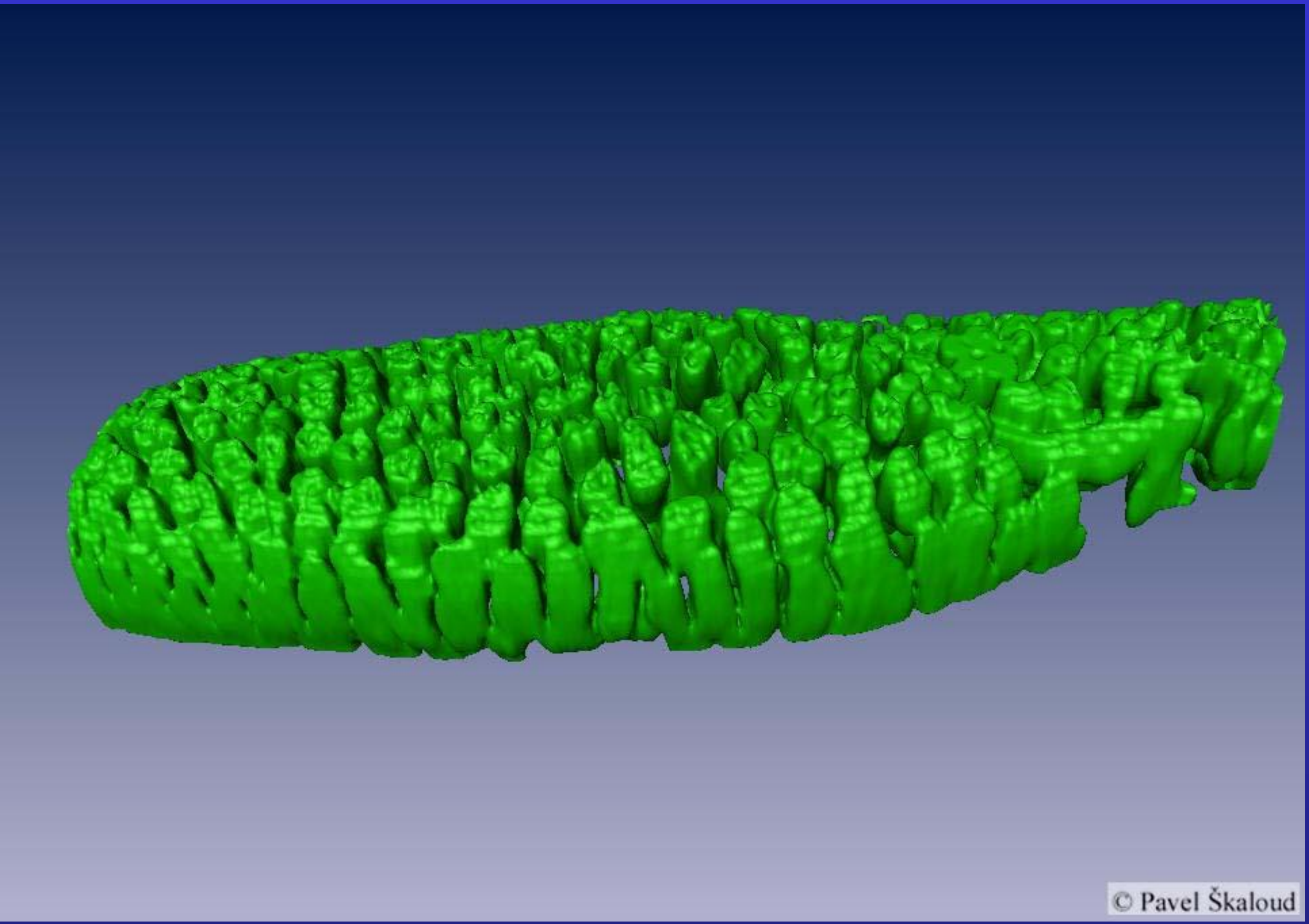


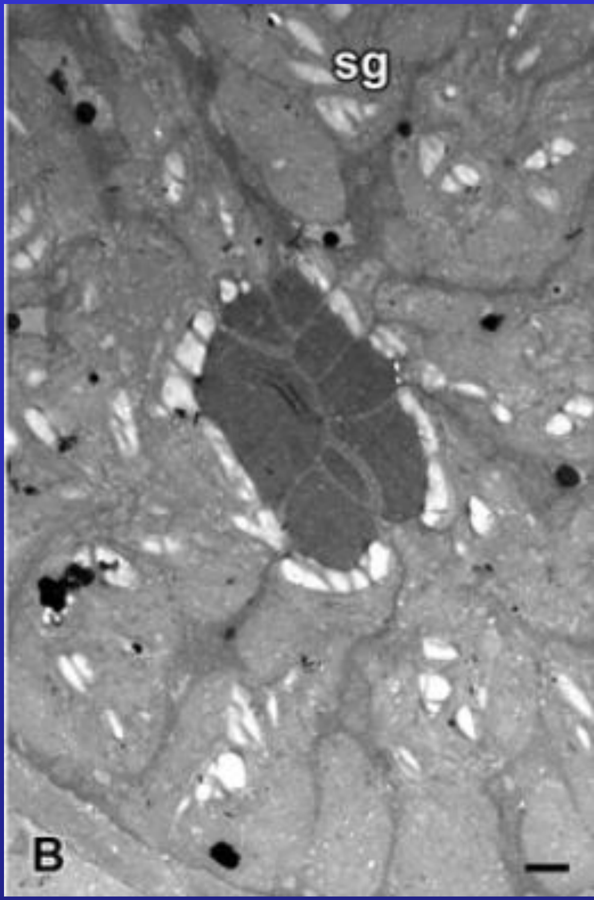
Phylogeny of the Chlorophyta obtained by Bayesian inference of the concatenated SSU-rbcL alignment.

Škaloud et al. 2013

Scotinosphaerales

Scotinosphaera - freshwater, soil

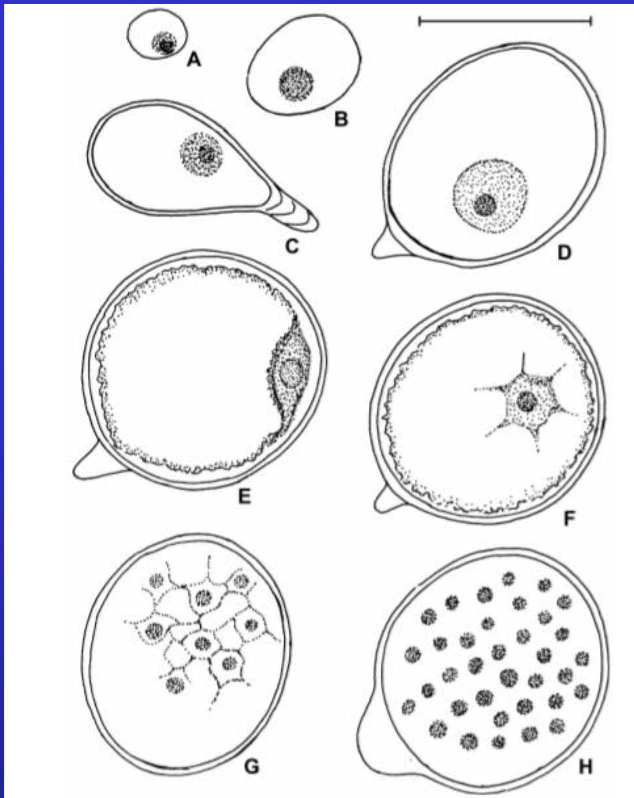


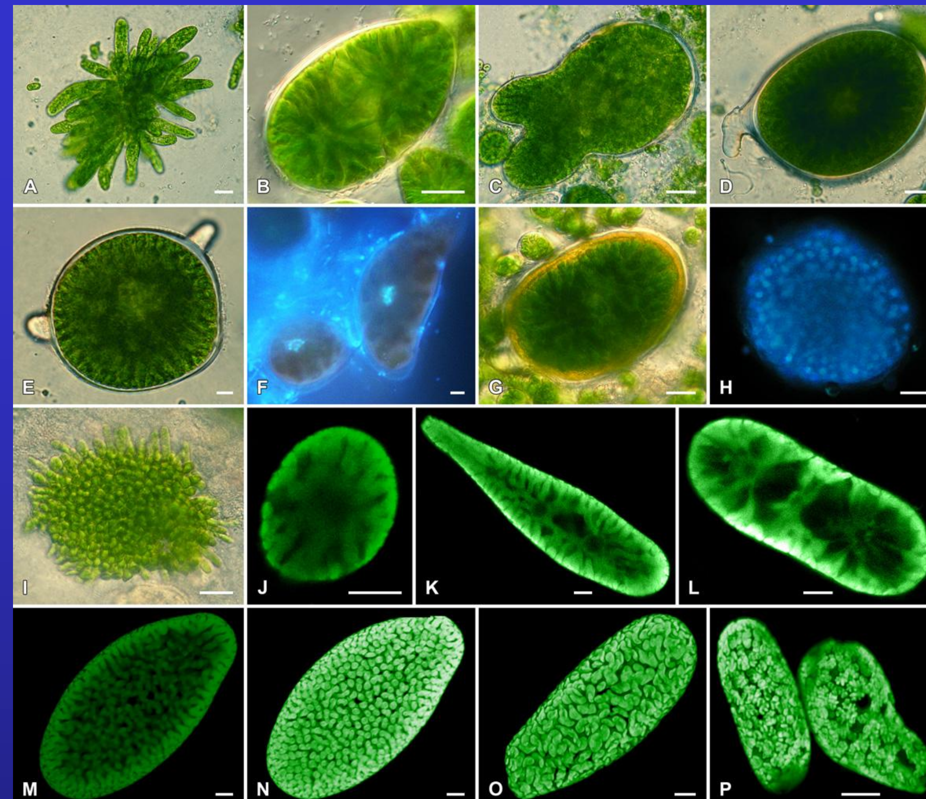


Scotinosphaera-plastid rekonstruction pyrenoid

large cells bearing local cell wall thickenings, pyrenoid matrix dissected by numerous anastomosing cytoplasmatic channels,

Simultaneous cytokinesis.





sporogenesis comprising the accumulation of secondary carotenoids in the cell periphery. Only asexual reproduction has been observed, which takes place by numerous biflagellate zoospores, arising from almost simultaneous cytokines

Škaloud et al. 2013, J. phycol

Dasycladales

Základní charakteristika:

• stélka vždy sifonální, většina zástupců inkrustována $CaCO_3$

• strukturní polysacharidy BS – β-1,4 mannany (celulóza dominantní složkou gametangiálních cyst)

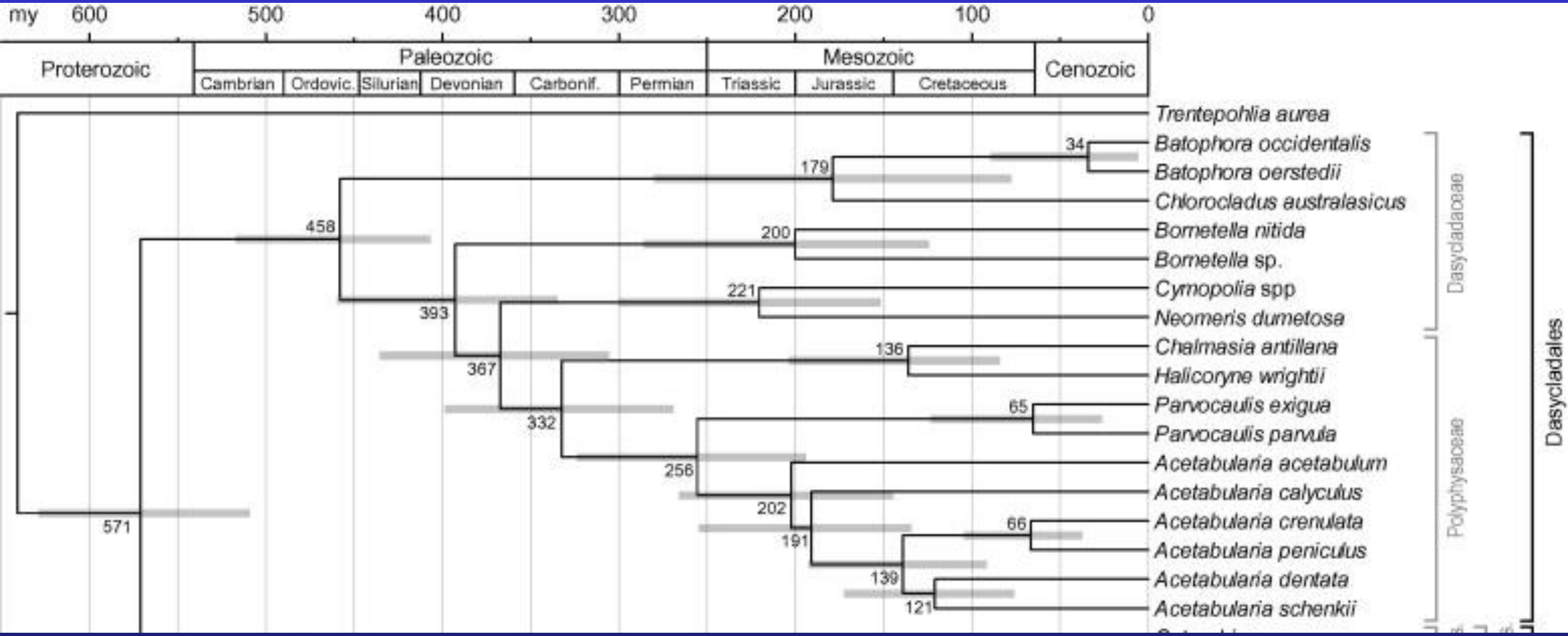
• gamety 2 bičíky, CCW orientace bičíkových bazí,

• mitóza uzavřená, perzistující telofázové vřeténko, jádro v telofázi – činkovitý tvar; mitóza acentrická

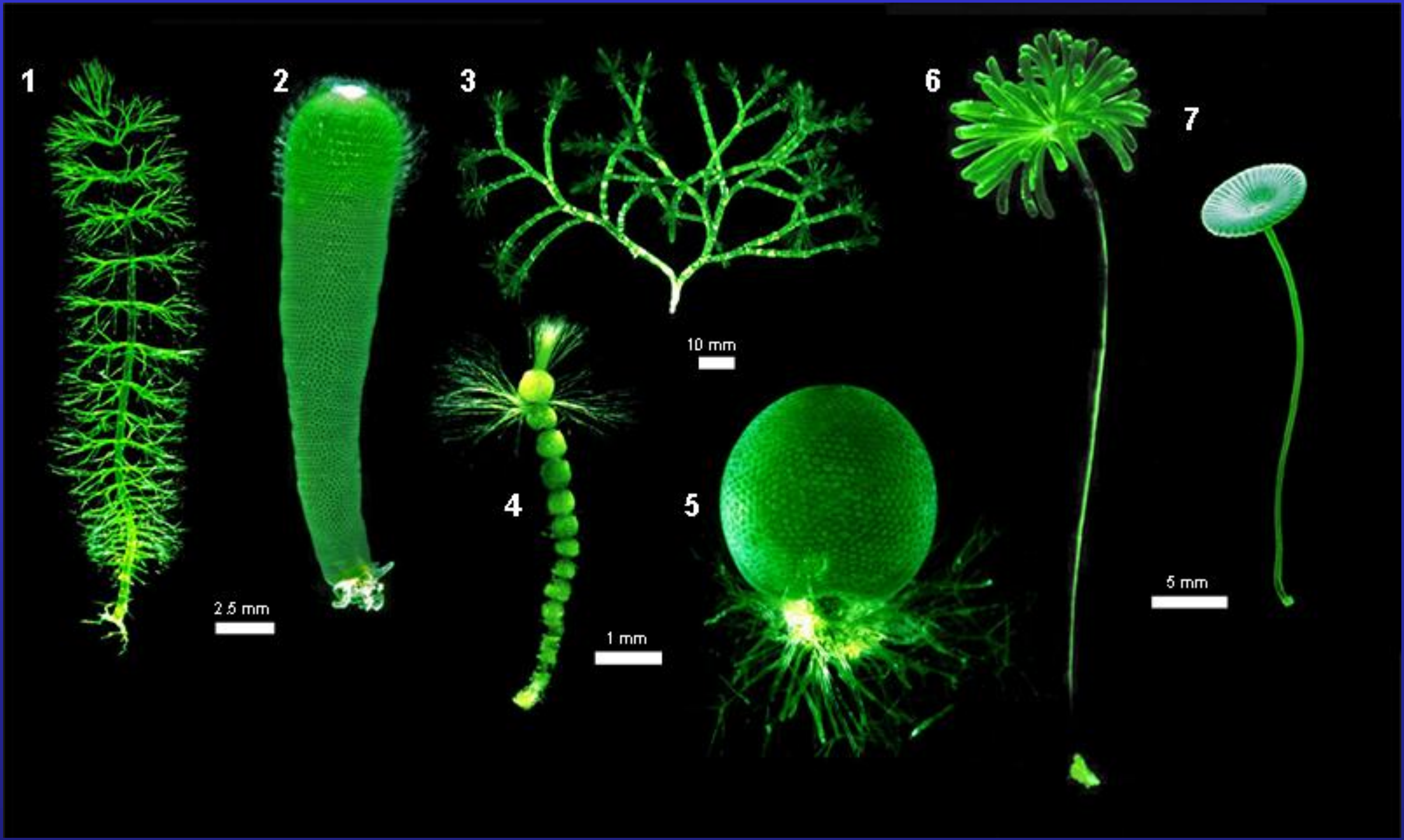
• četné chloroplasty v nástěnné vrstvě cytoplasmy, bez pyrenoidu, obsahují zrna fruktanu, zásobní polysacharidy i v cytoplasmě

• proudění cytoplasmy v podélné ose stélky, proudem cytoplasmy unášena jádra a chloroplasty

• haplontní životní cyklus (haploidní gametofyt, mikroskopická zygota s obrovským diploidním jádrem), izogamie



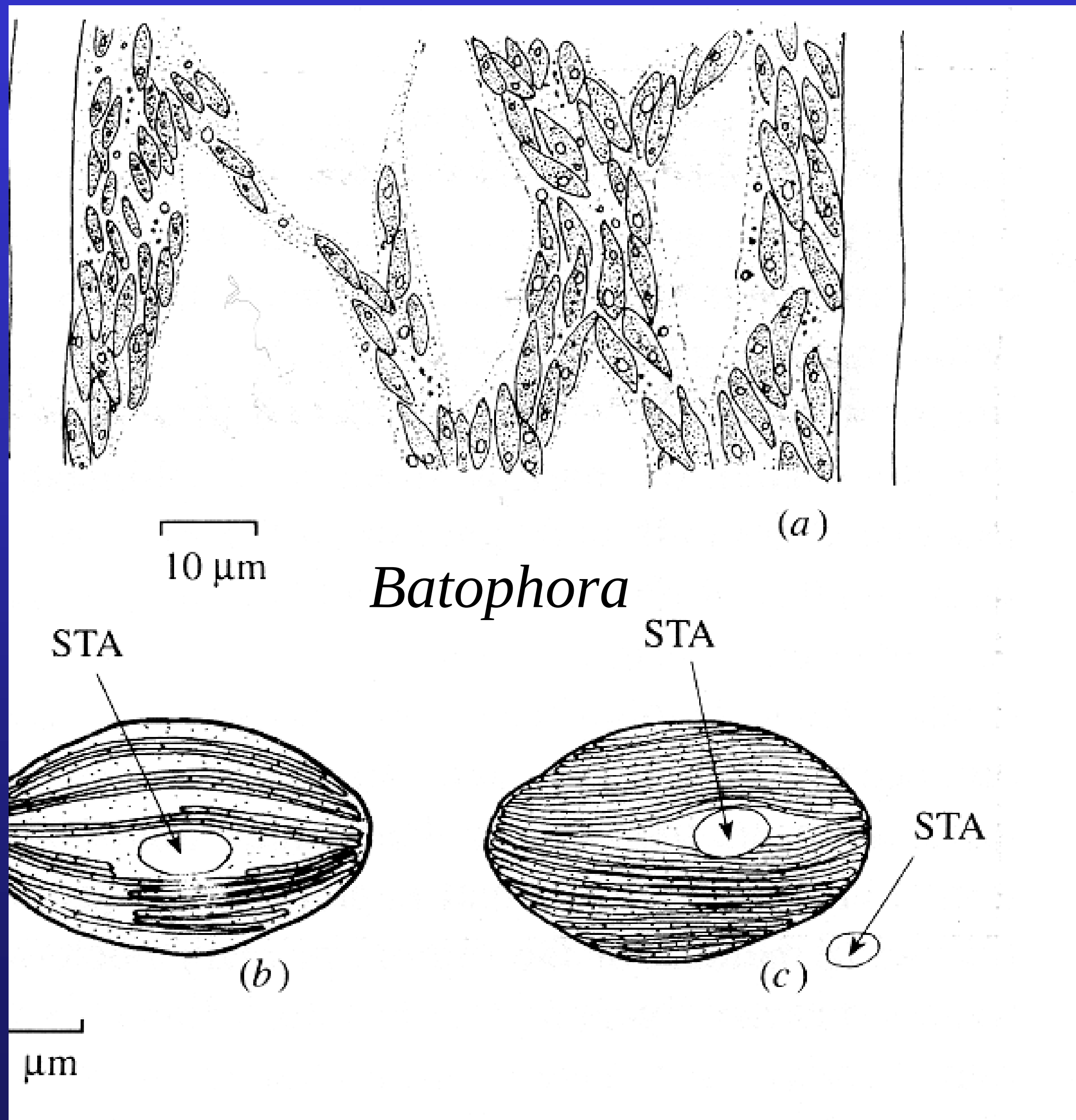
Verbruggen et al. 2009



700 druhů z fosil. záznamů (nejbohatší flora během Ordoviku (480-423 mil. let) a Siluru (423-416), diverzita klesá během Devonu (416-359)– ve prospěch kalcifikovaných druhů – selekce na rezistenci vůči herbivorům), dnes 37 druhů

Chloroplasts

Chloroplast transport –úzké (60-120 µm/min) a široké pásy cytoplasmy (200-600 µm/min)



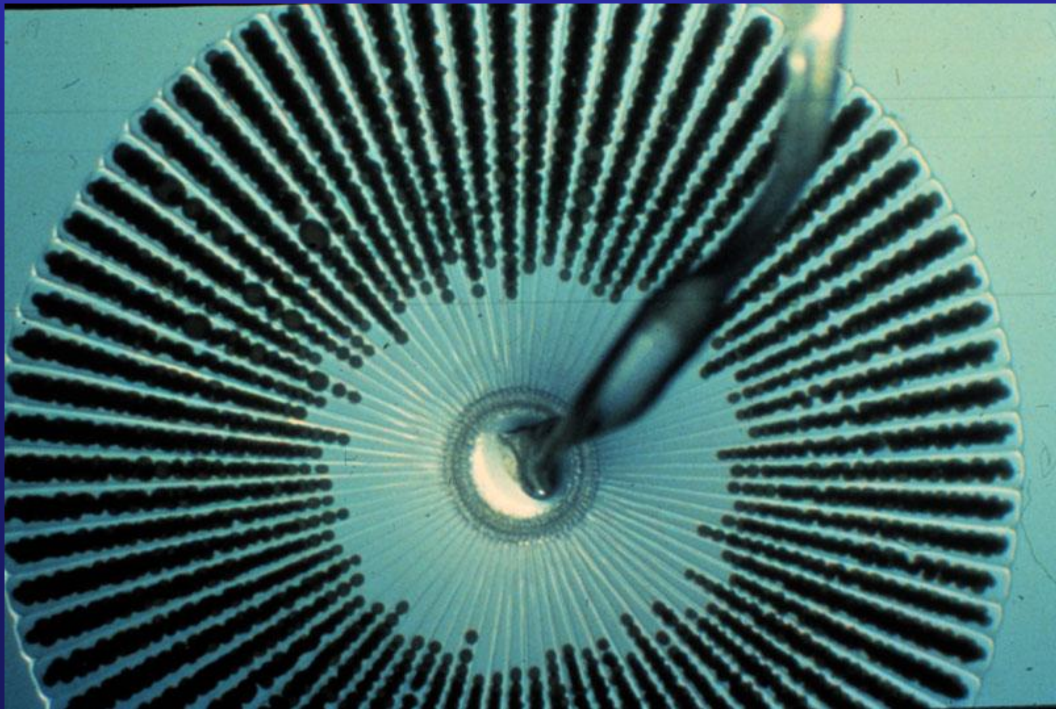
Acetabularia

Cymopodia

Acetabularia

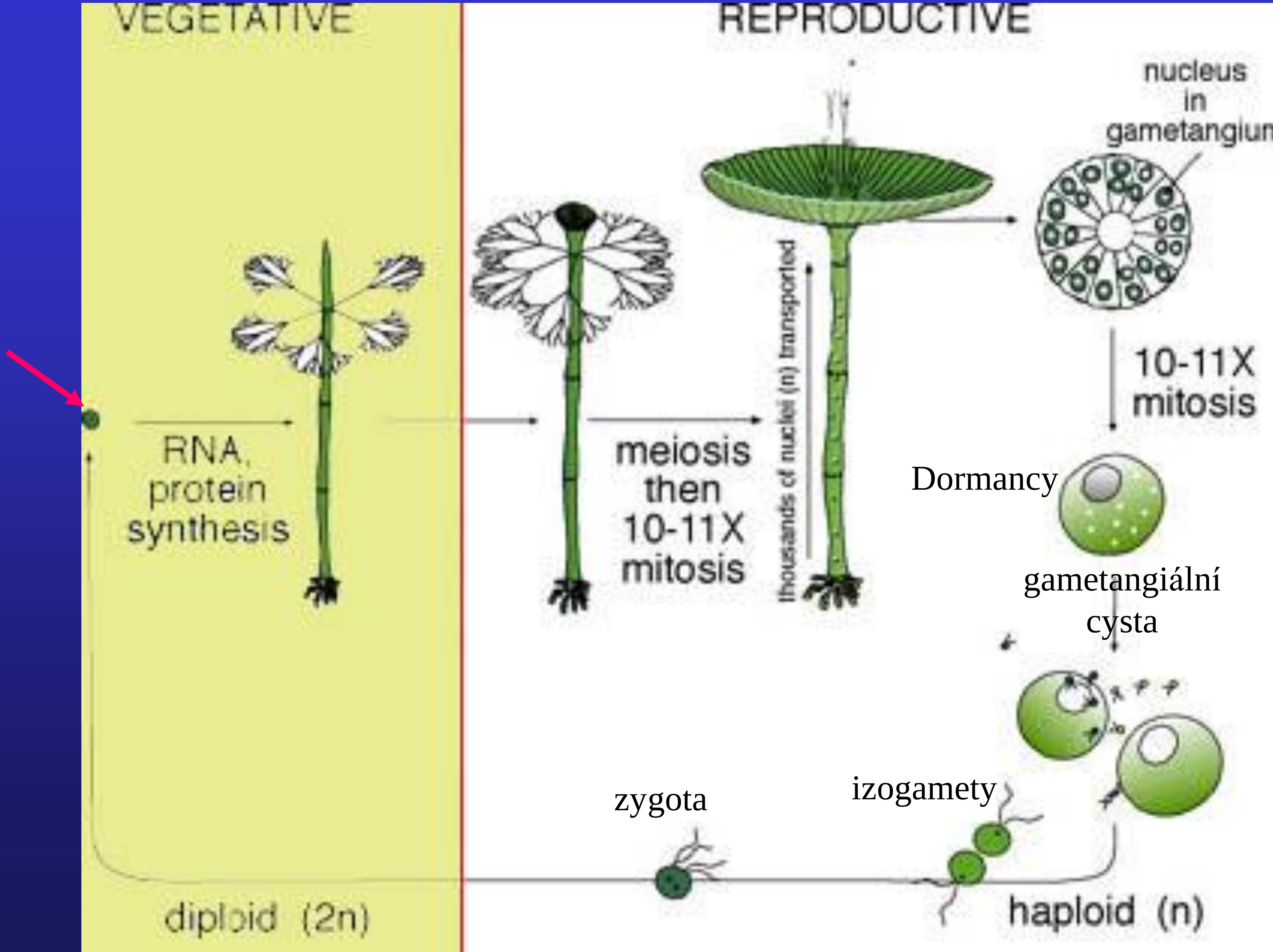
mermaid's wine glass

Acetabularia mediterranea displays two circadian rhythms: (*a*) in photosynthetic capacity and (*b*) in chloroplast shape



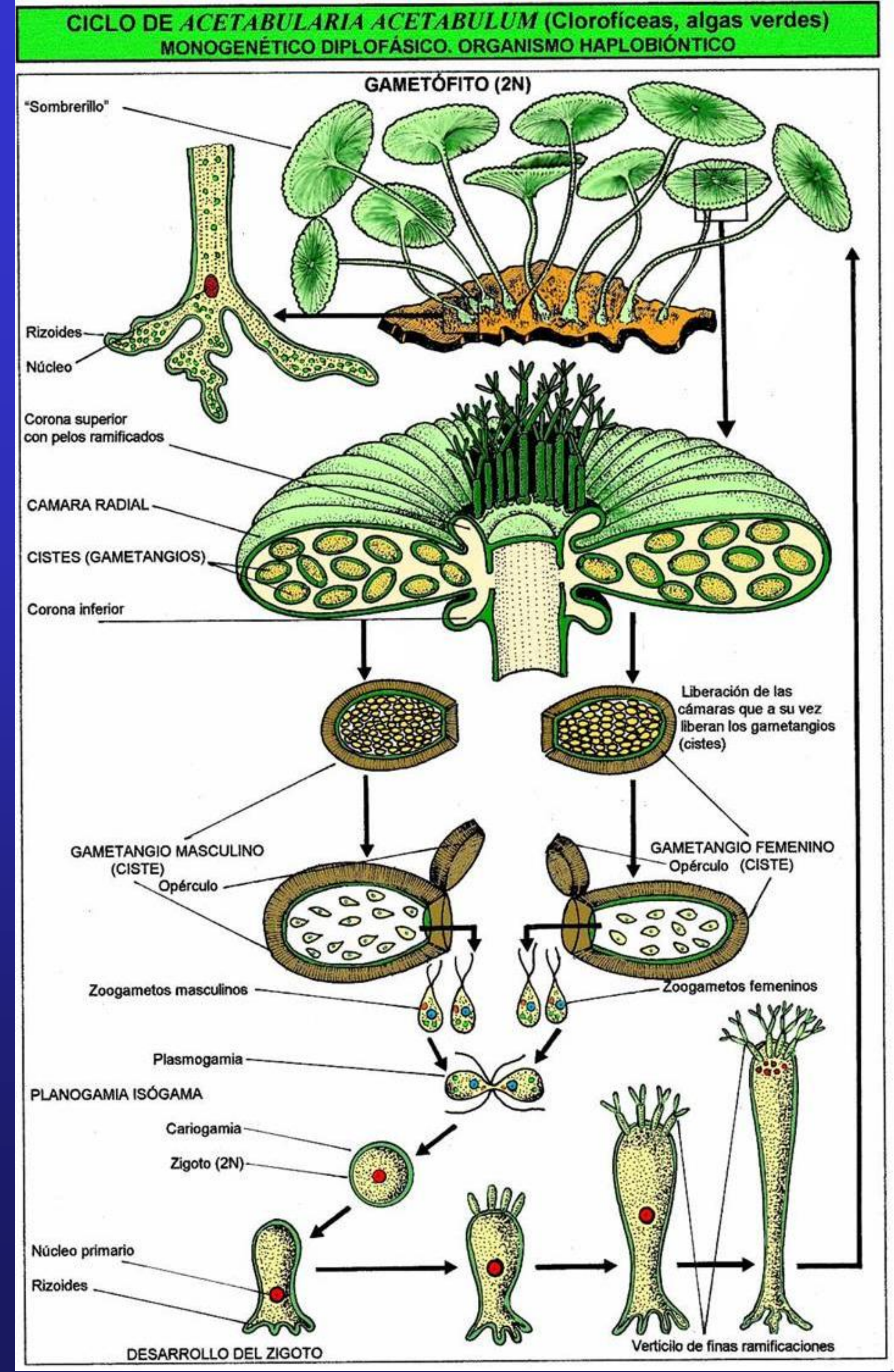

© Miranda van der Knaap

Acetabularia



Acetabularia

whorls of hairs



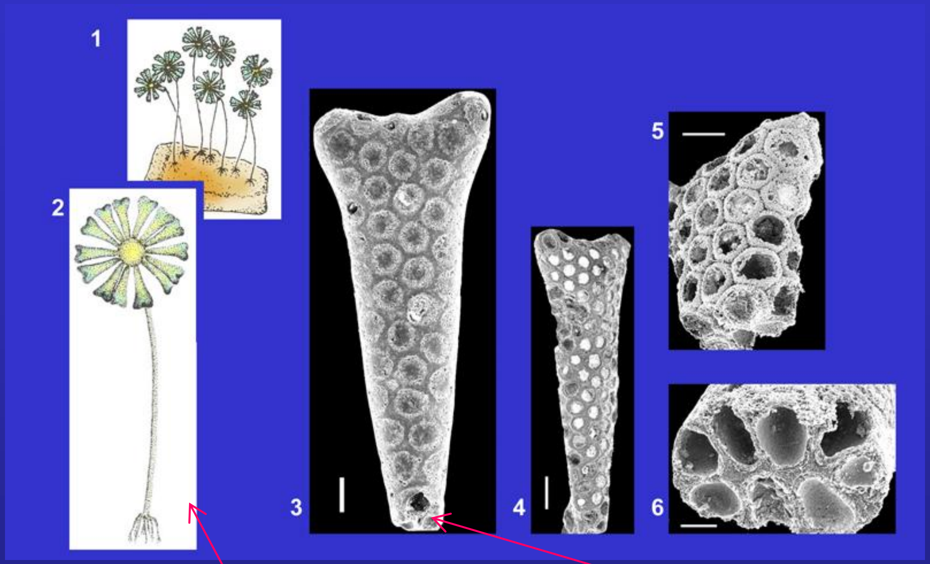
Cenozoic Dasycladales (Eocene)

Eocene 47.8- 41.2 Ma

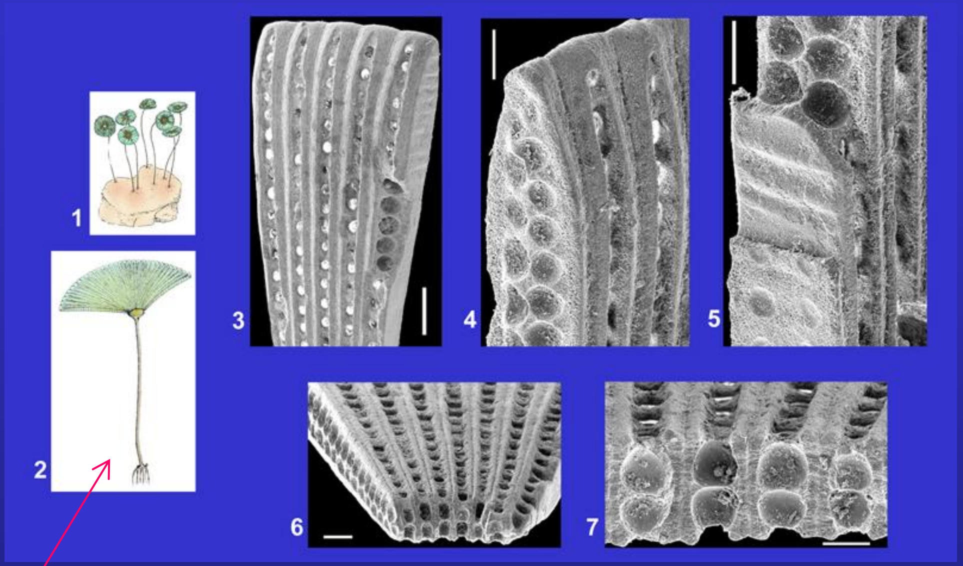
discovered in the Cenozoic strata of the French sedimentary basins

http://paleopolis.rediris.es/cg/CG2009_SP01/

Acicularia cornigera L. & J. MORELLET, 1922



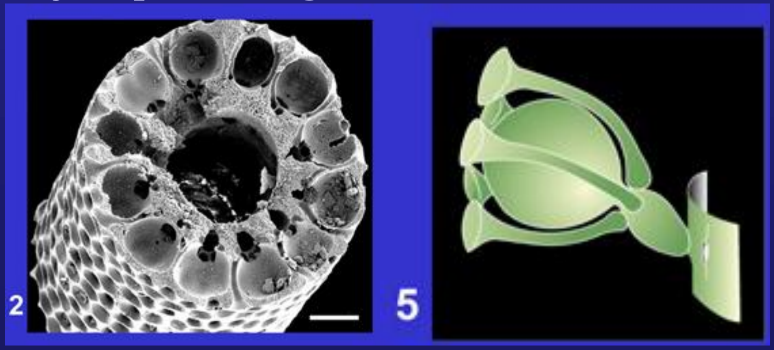
Acicularia costulata GÉNOT, 1987



External view of a gametophore

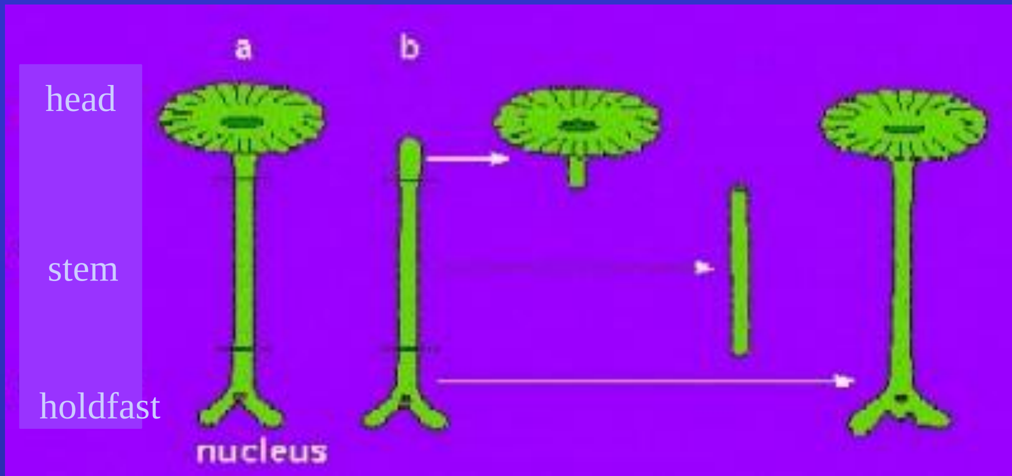
Reconstruction of a living representative

Cymopolia turgescens GÉNOT, 1987



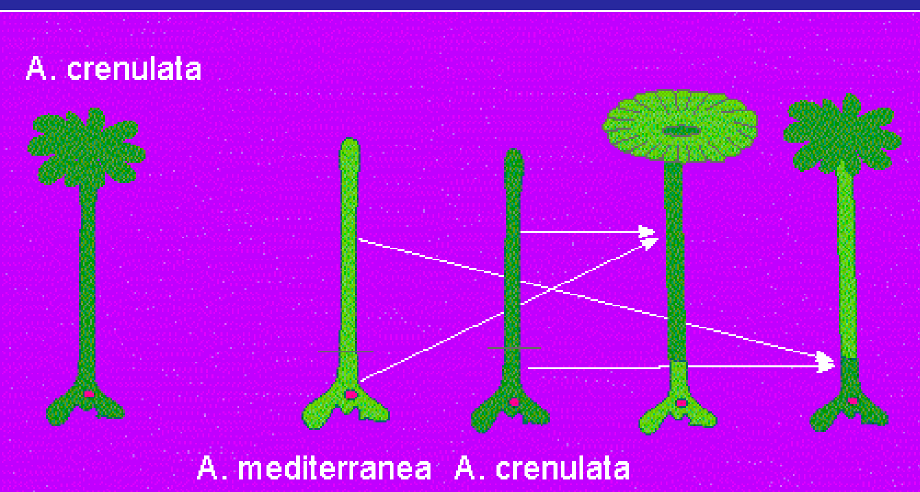
genus *Acetabularia* first appeared about 38 million years ago

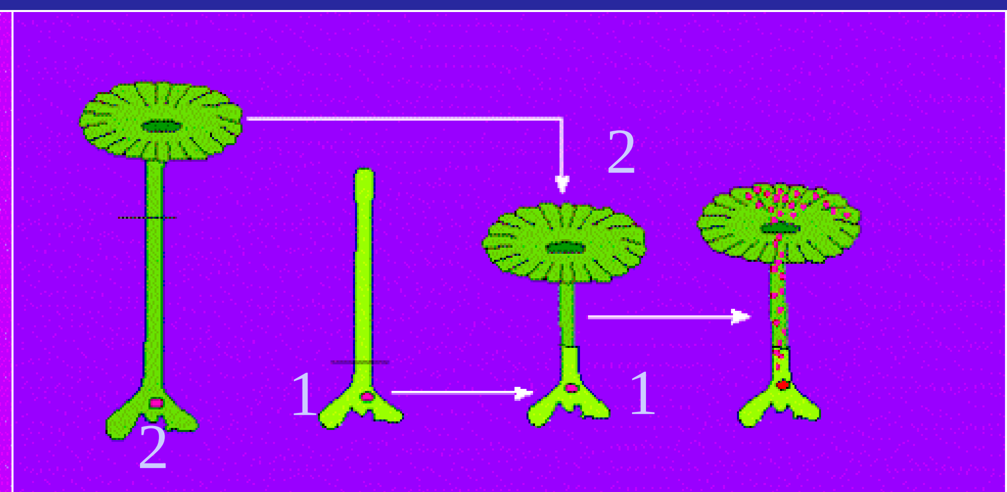
Hämmerlings reconstruction experiments in the 1930‘s



Regeneration of the head only occurs in the section carrying the nucleus --> thallus regeneration is under the control of the nucleus

Morphology of the head: stems of two different species with different head morphology are plugged on nucleus-carrying holdfast of two species; the new head corresponds to the species of the nucleus --> head morphology is controlled by the nucleus





Gamete production: stem and head of species 2 are plugged on holdfast of species 1; micronuclei and gametes are formed within the new (species 2) head by the nucleus of species 1


shallow tropic lagunes

Batophora

many whorls of repeatedly branched laterals. Gametangia at nodes of the laterals. Thalli are not calcified. Shallow lagoones. More tolerant to salinuty changes.

3-10 cm

Batophora

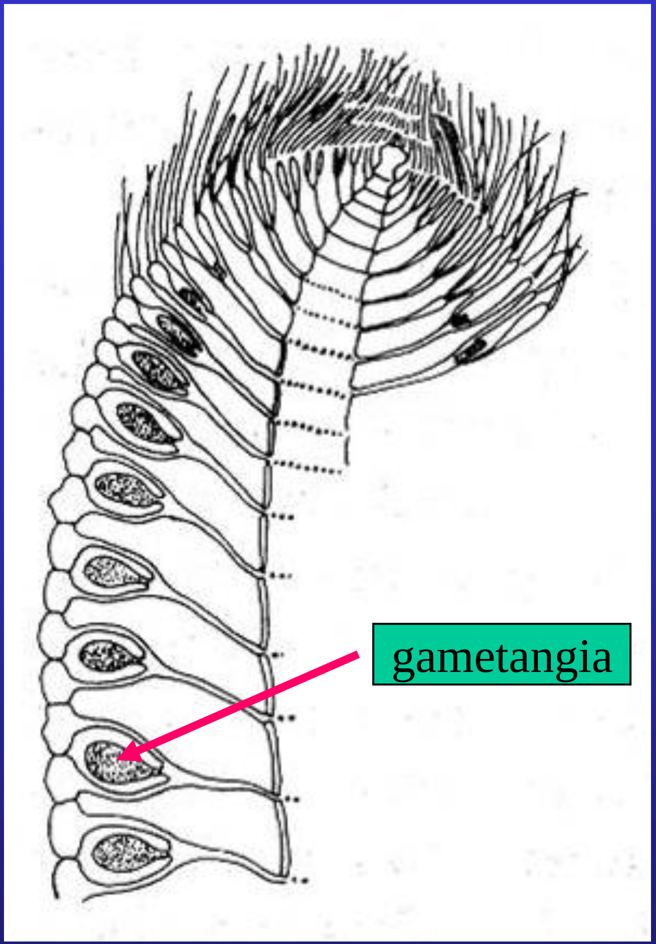
upper part of a gametophore-bearing cell

*Batophora*_Madeira_2022

Neomeris

Vertikální osa končí chomáčem světle zelených vlasovitých výběžků. Stélka silně inkrustována

0,5-2,5 cm



Podélný řez vrcholem stélky

Photo-Atlas of living Dasycladales S. Berger, 2006

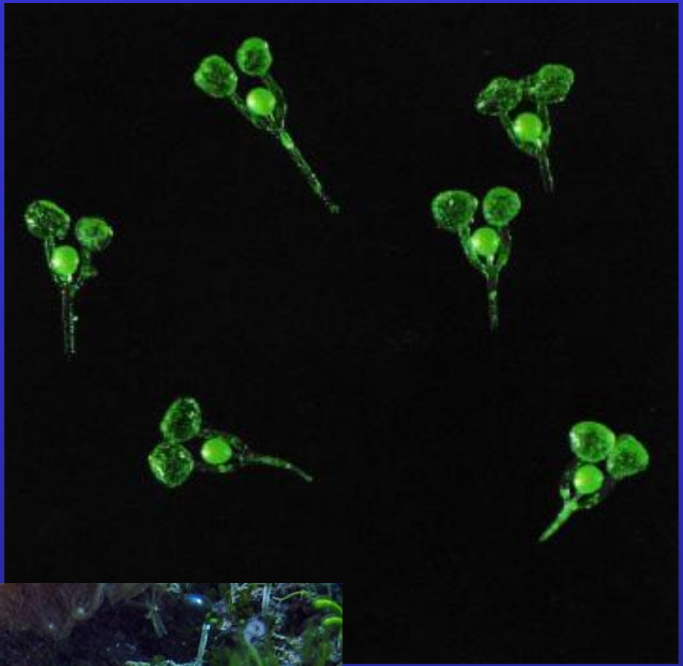
http://paleopolis.rediris.es/cg/CG2006_BOOK_02/#top

Neomeris

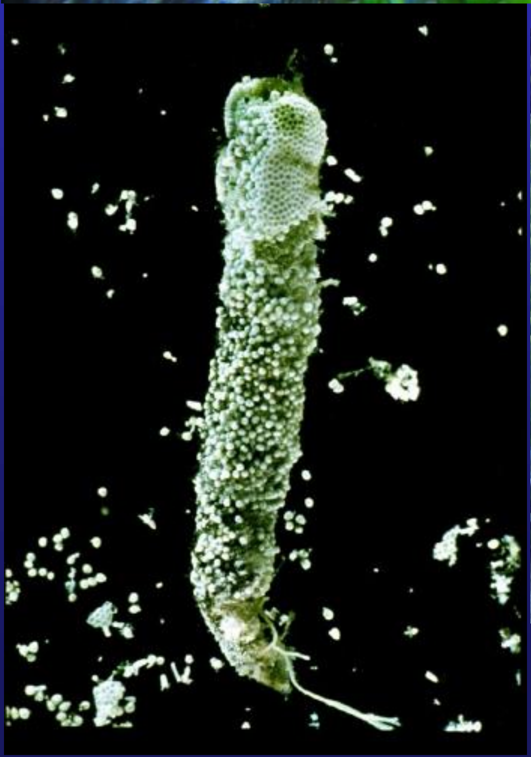
young cells

three cells

Neomeris

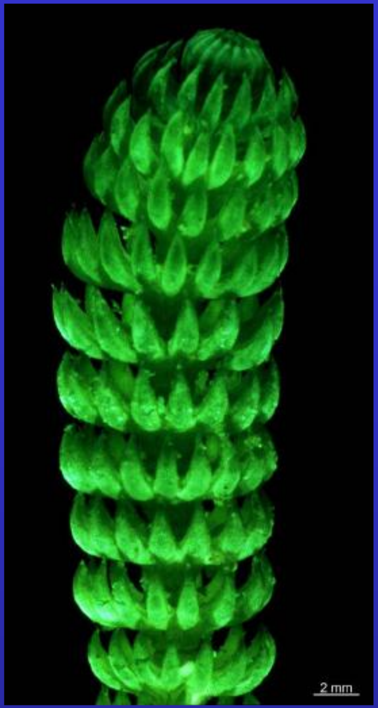


isolated laterals with gametophores



mature cell as it appears in its natural habitat

Halicoryne



upper part of a cell with gametangia

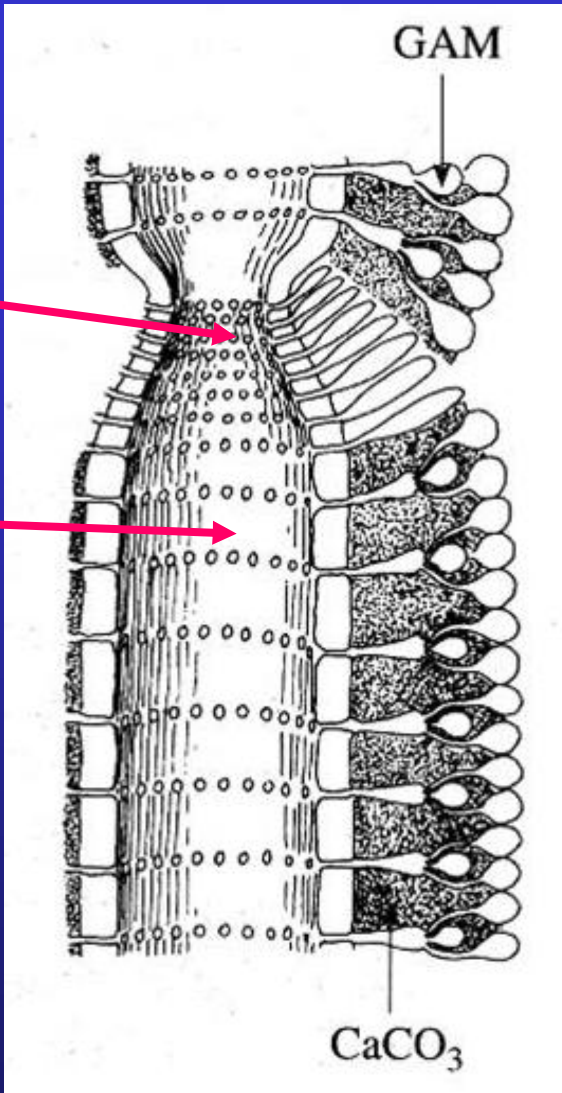
Halicoryne wrightii

Dense coverage of *Halicoryne spicata*

Cymopolia (Roman mythology – daughter of Neptune)

internodium

nodus



thalli have repeatedly branched construction. Branching occurs in a single plain.

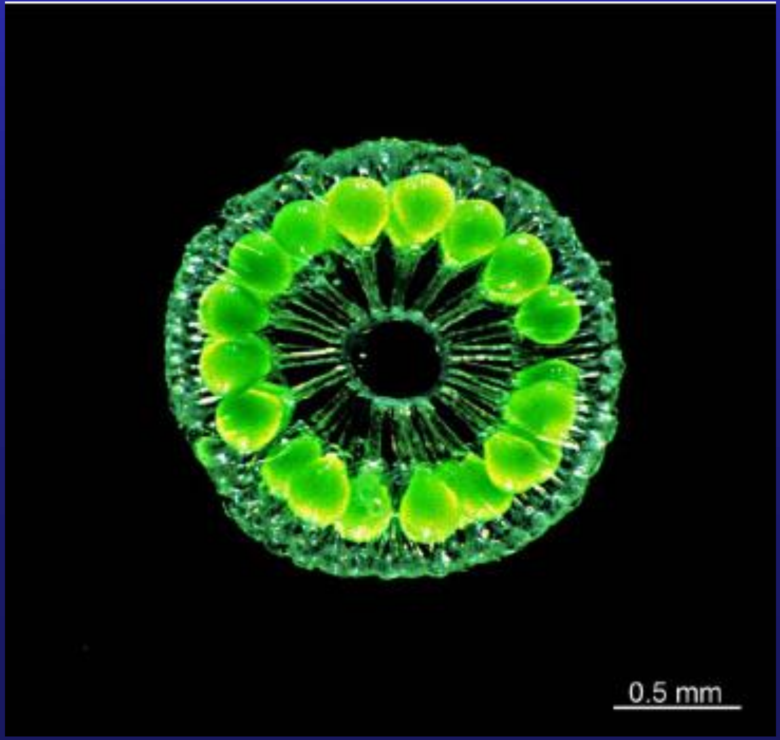
Calcified segments vs. uncalcified joints

Cymopolia

C. barbata

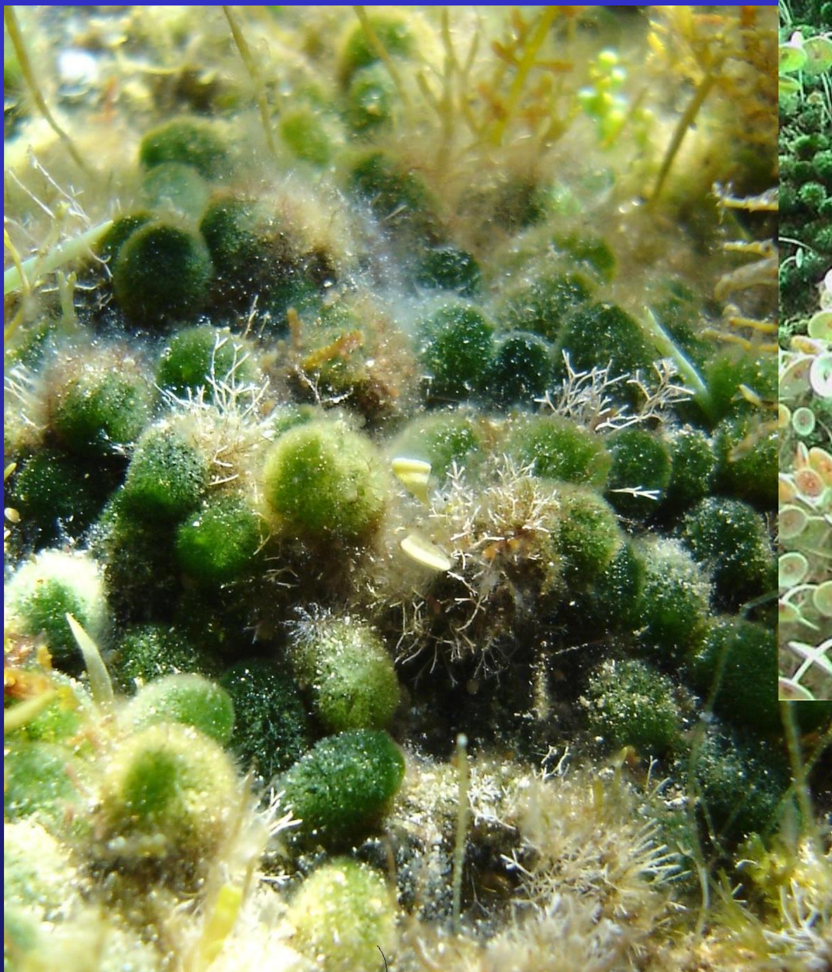
longitudinal section

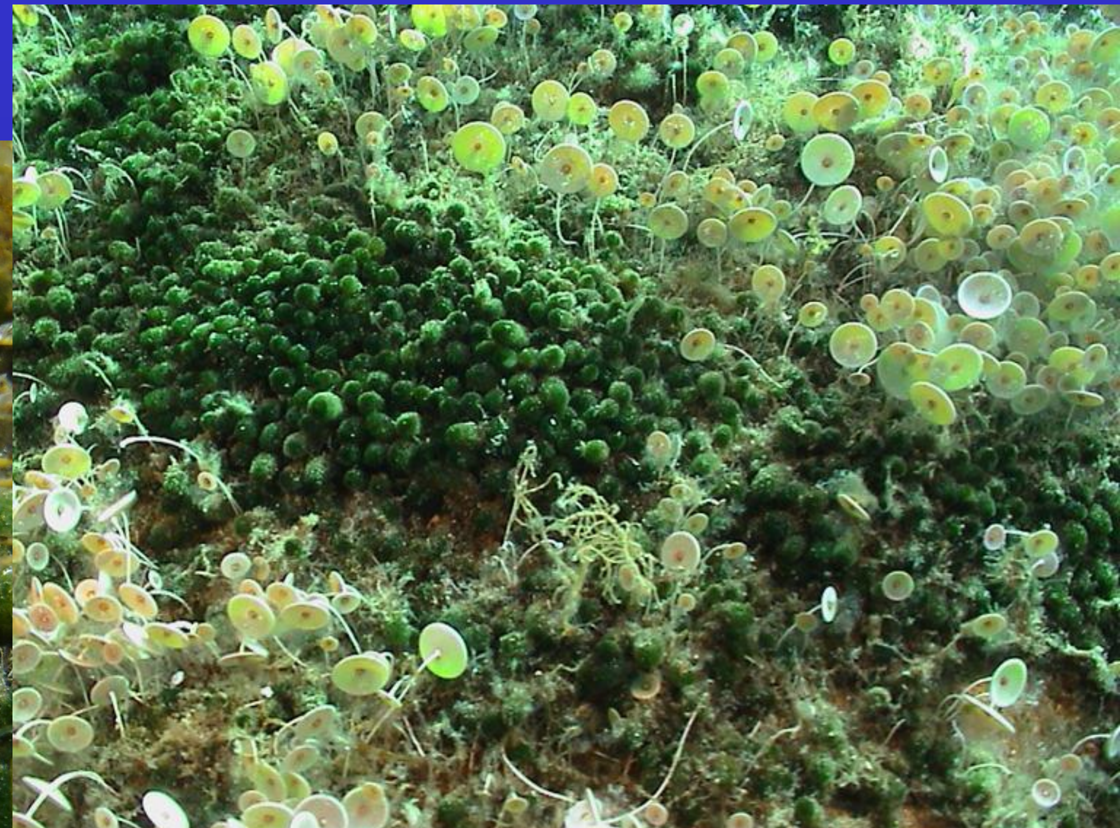
cross section



Southern Australia – Ocean Road 2023

Dasycladus

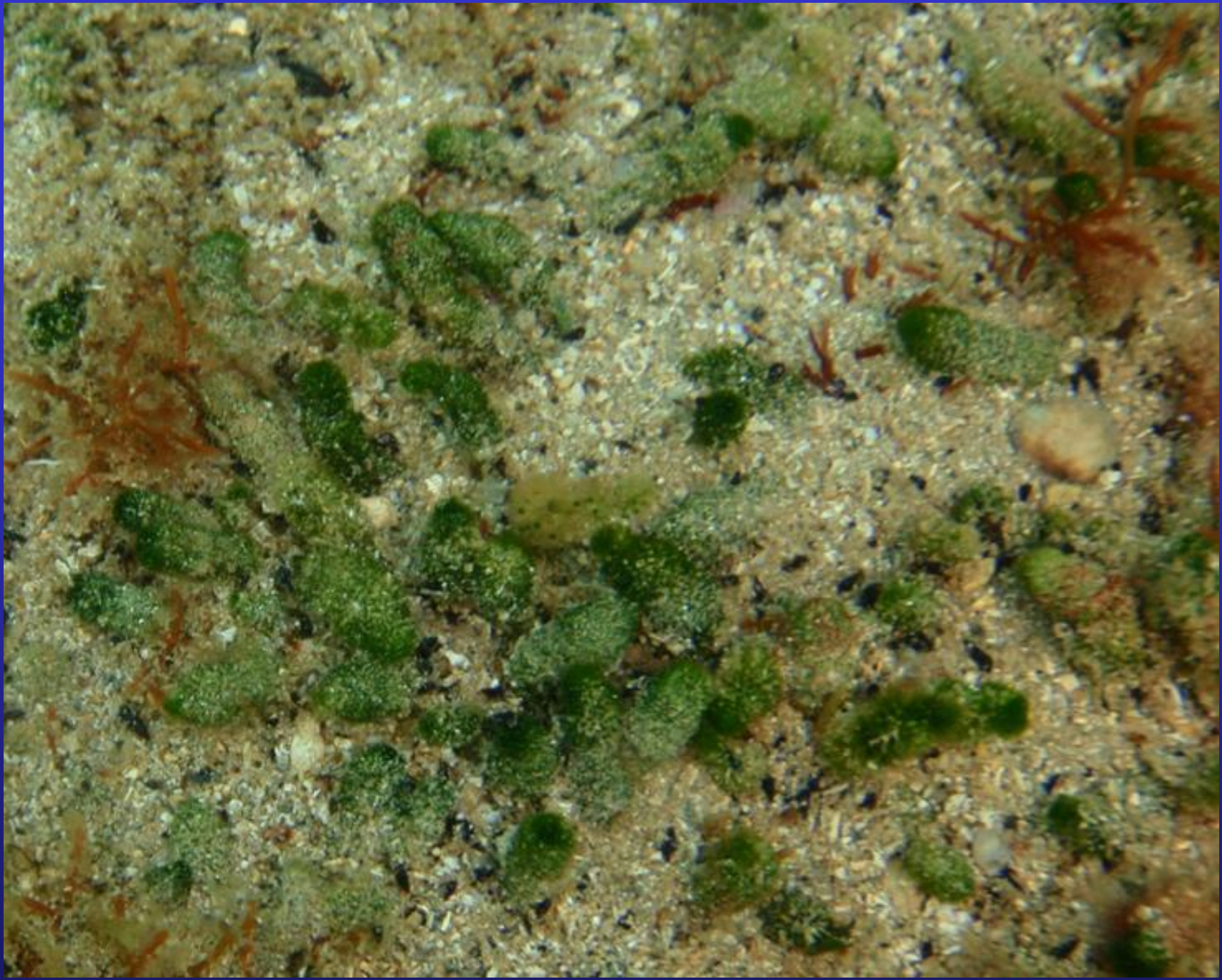




Dasycladus

Acetabularia


algaeBASE



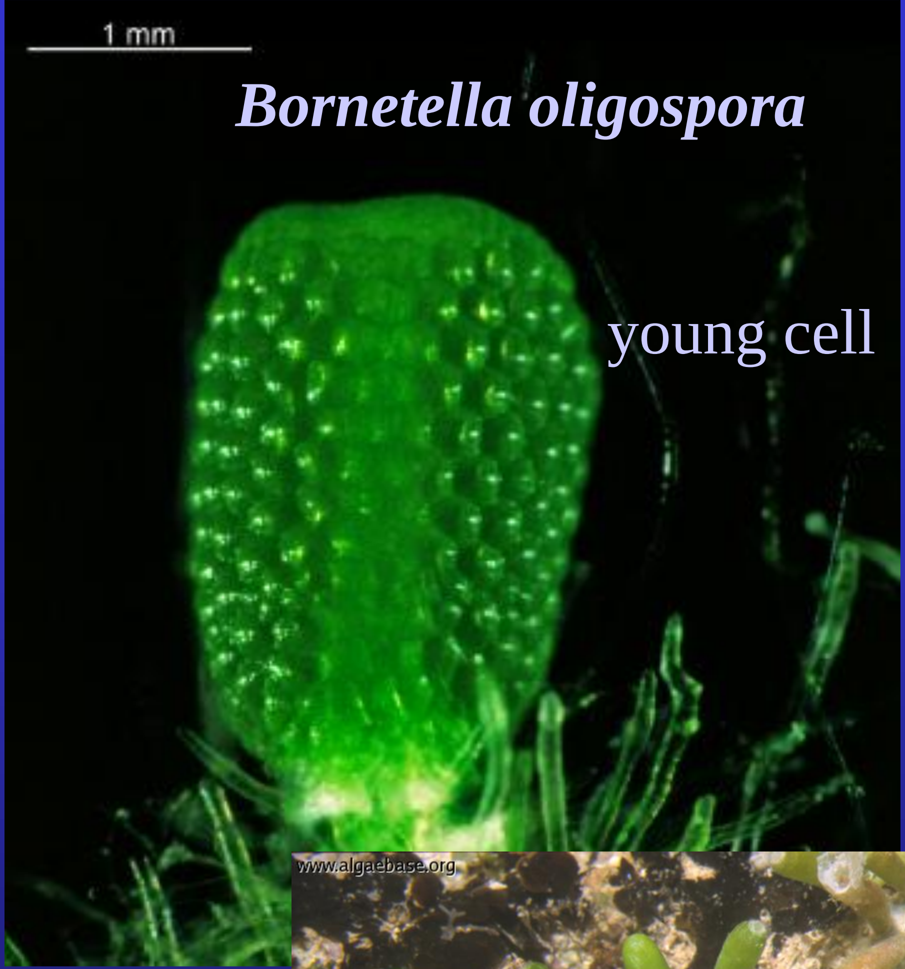
Zambratia_Chorvatsko_ KMA 2019

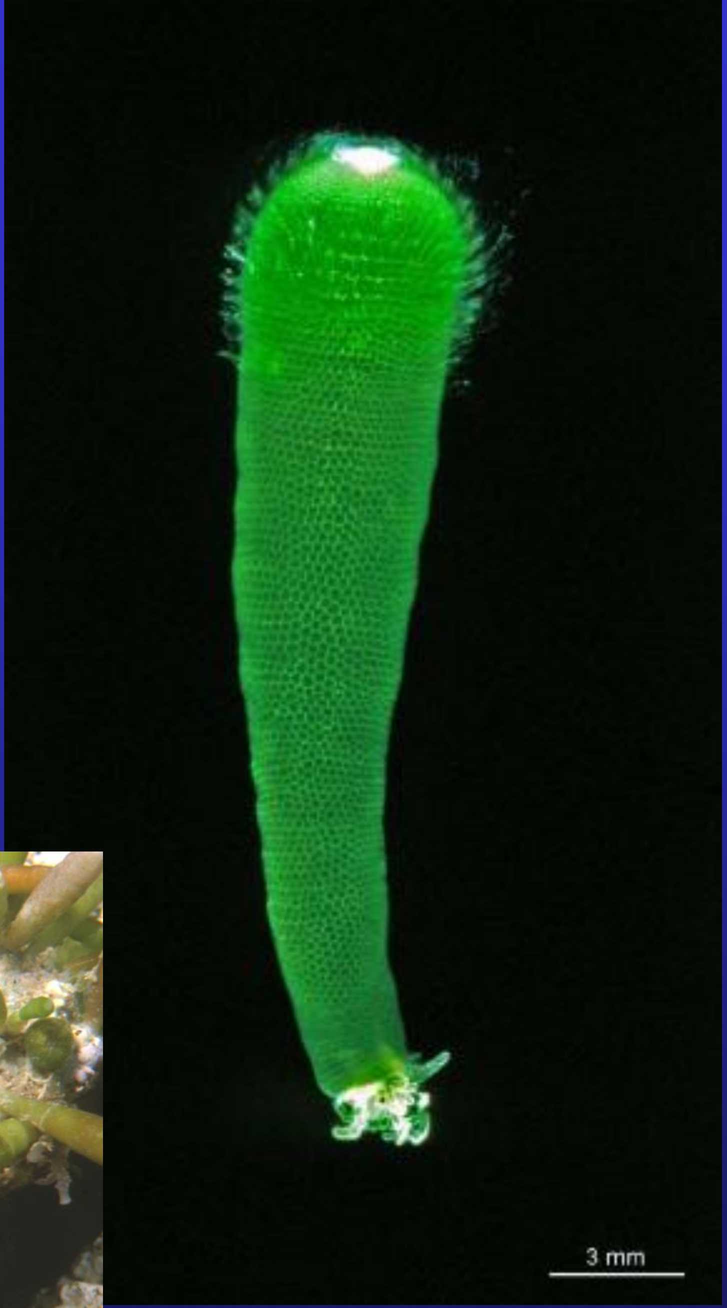
Dasycladus Kefalonia_2021

tropické a subtropické opblasti jižní polokoule, Forms colonies on rocks or dead coral branches in lower intertidal areas, sometimes exposed during low tide

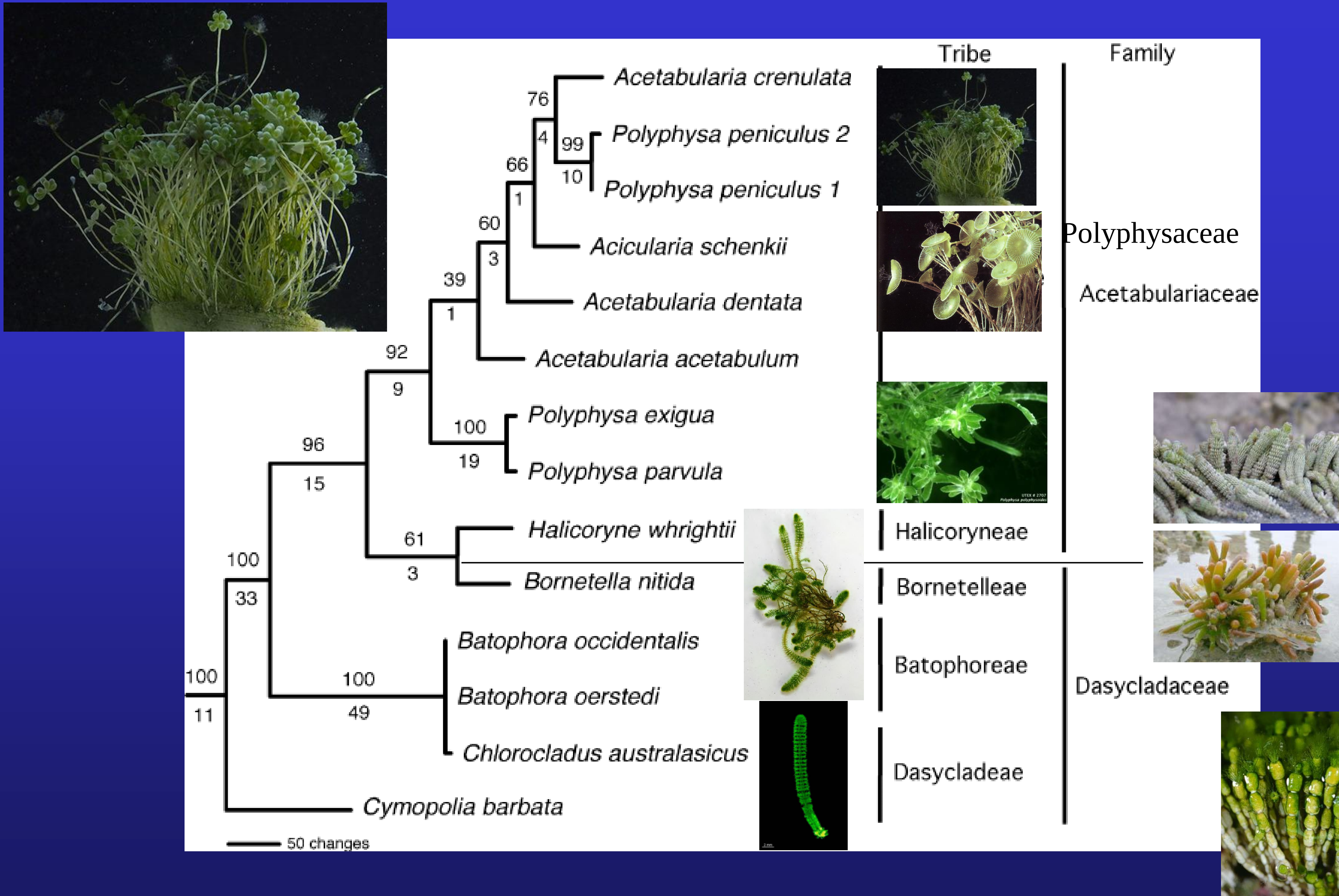
Bornetella sphaerica

Bornetella nitida





immature cell



One of two most parsimonious trees from unweighted MP analysis of *rbc*L sequence data (Zechman, 2003)