

Morphology, ultrastructure and molecular
phylogeny of *Wangodinium sinense* gen. et sp.
nov. (Gymnodiniales, Dinophyceae) and
revisiting of *Gymnodinium dorsalisulcum* and
Gymnodinium impudicum

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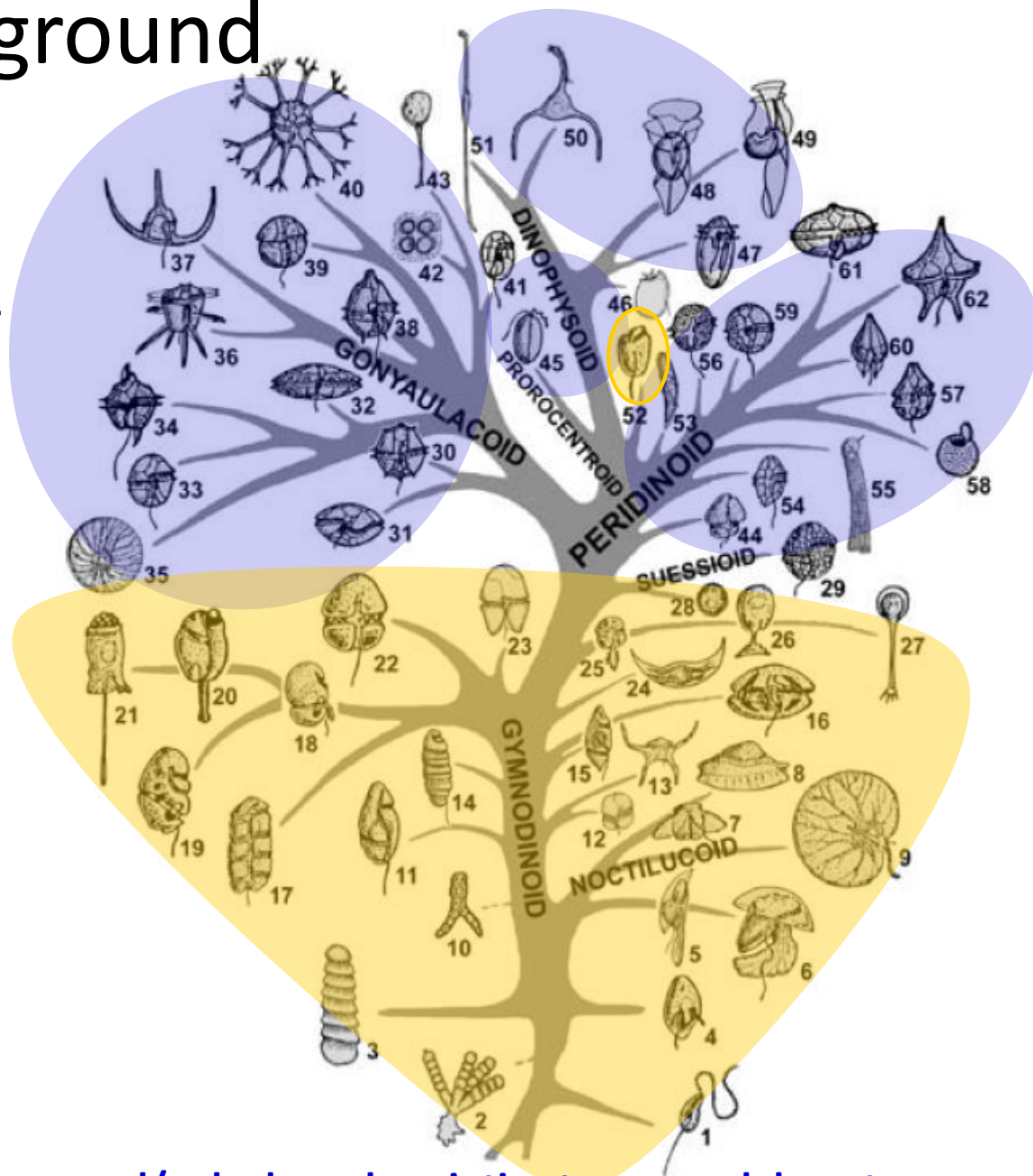
2018.9.25

Outlines

- Background
- *Wangodinium sinense*
- *Gymnodinium dosalisulcum*
- *Gymnodinium impudicum*
- Conclusions

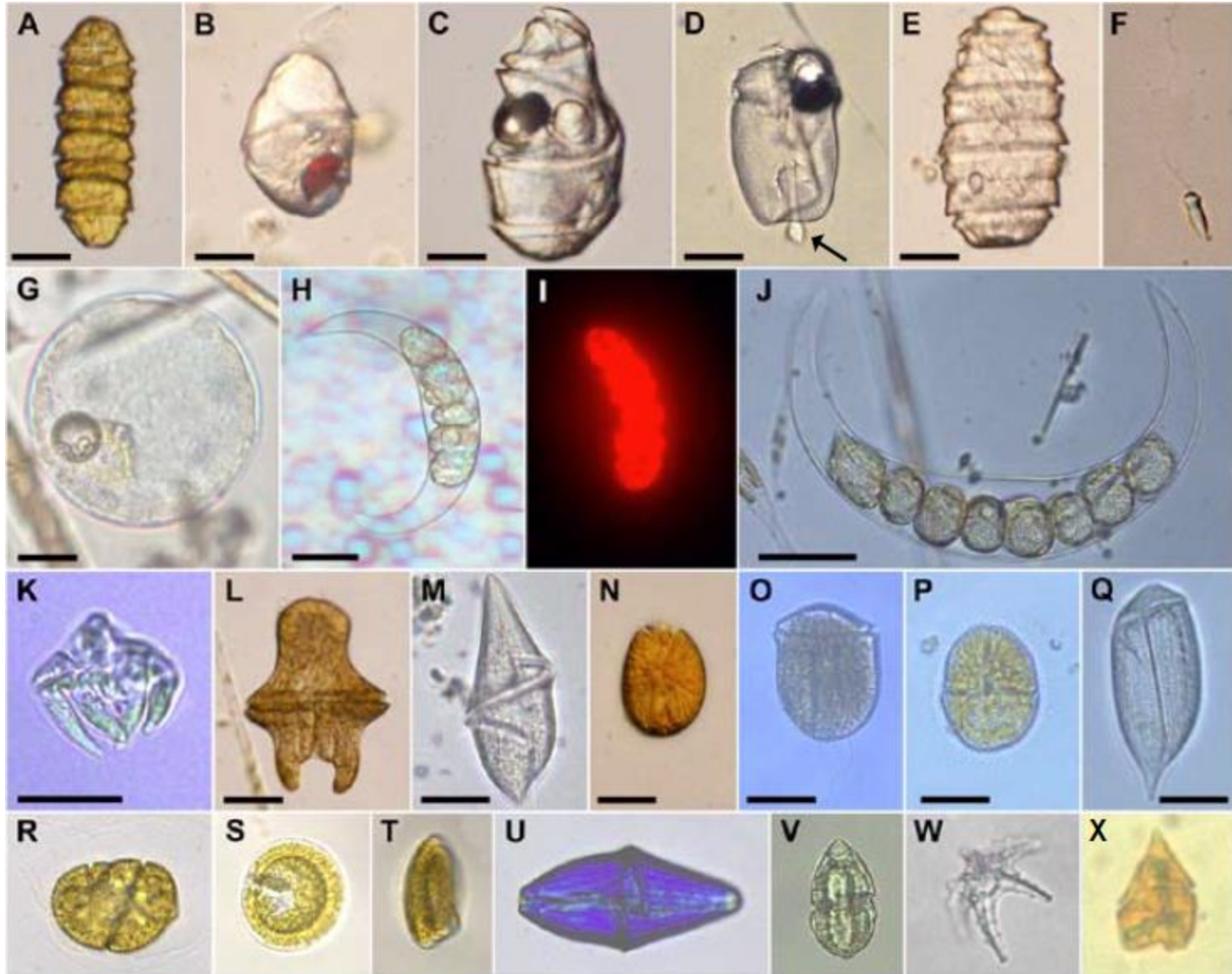
Background

- > 2000 dinoflagellate species
- Most species (about 1700) occur in marine habitats
- 600-700 are unarmoured (naked), e.g. *Amphidinium*, *Cochlodinium*, *Gymnodinium*, *Gyrodinium*,
- 1000 armoured species, e.g. *Dinophysis*, *Prorocentrum*, *Protoperidinium*, *Alexandrium*, *Gonyaulax*.



The terms armoured/thecate vs. unarmoured/naked are descriptive terms, and do not carry any taxonomic meaning

Background



unarmoured/naked dinoflagellates

Background

Classic athecate genus (based on cingulum, artificial)

- *Amphidinium*, 76 spp
- *Cochlodinium*, 35 spp
- *Gymnodinium*, 173 spp
- *Gyrodinium*, 87 spp
- *Katodinium*, 11 spp

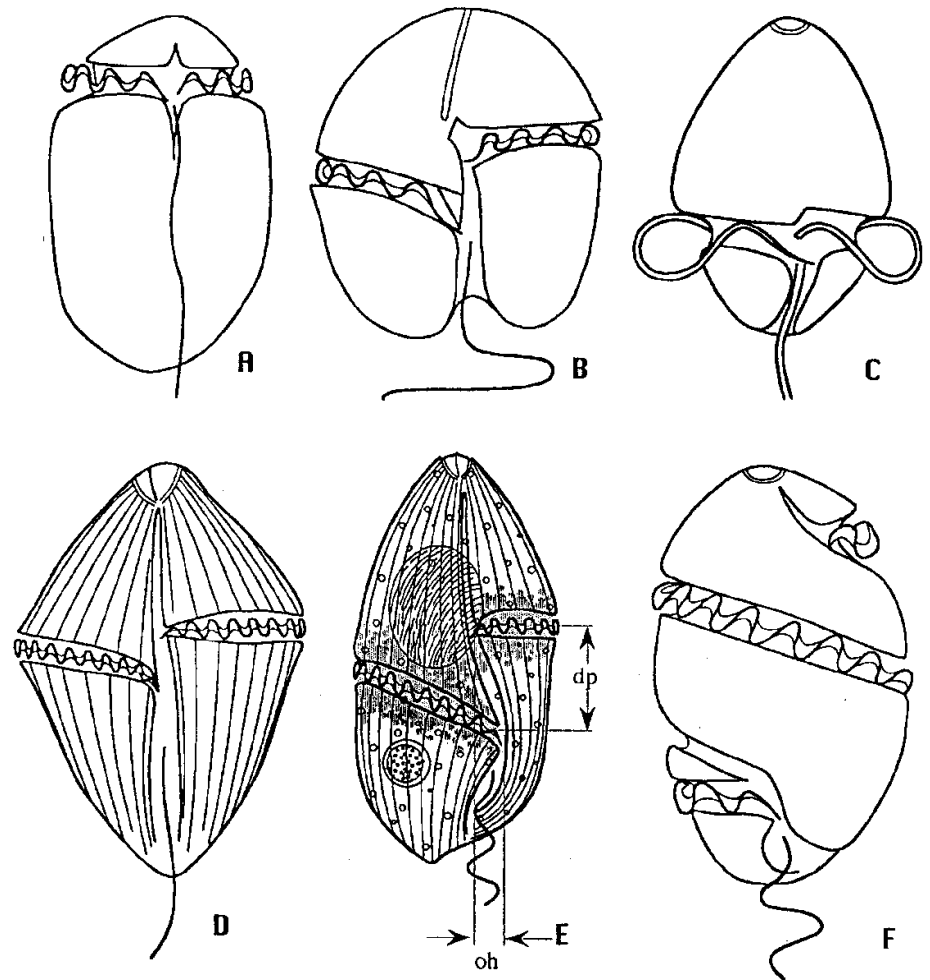
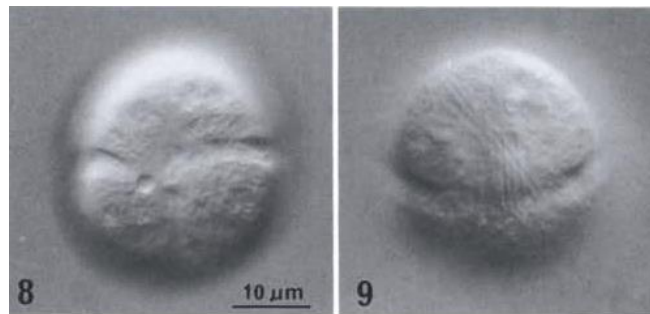


Fig. 1. Main genera of Gymnodiniaceae
A: *Amphidinium* B: *Gymnodinium* C: *Katodinium*
D: *Gymnodinium* E: *Gyrodinium* F: *Cochlodinium*
dp: displacement oh: overhanging

Gymnodiniales Lemmermann 1910

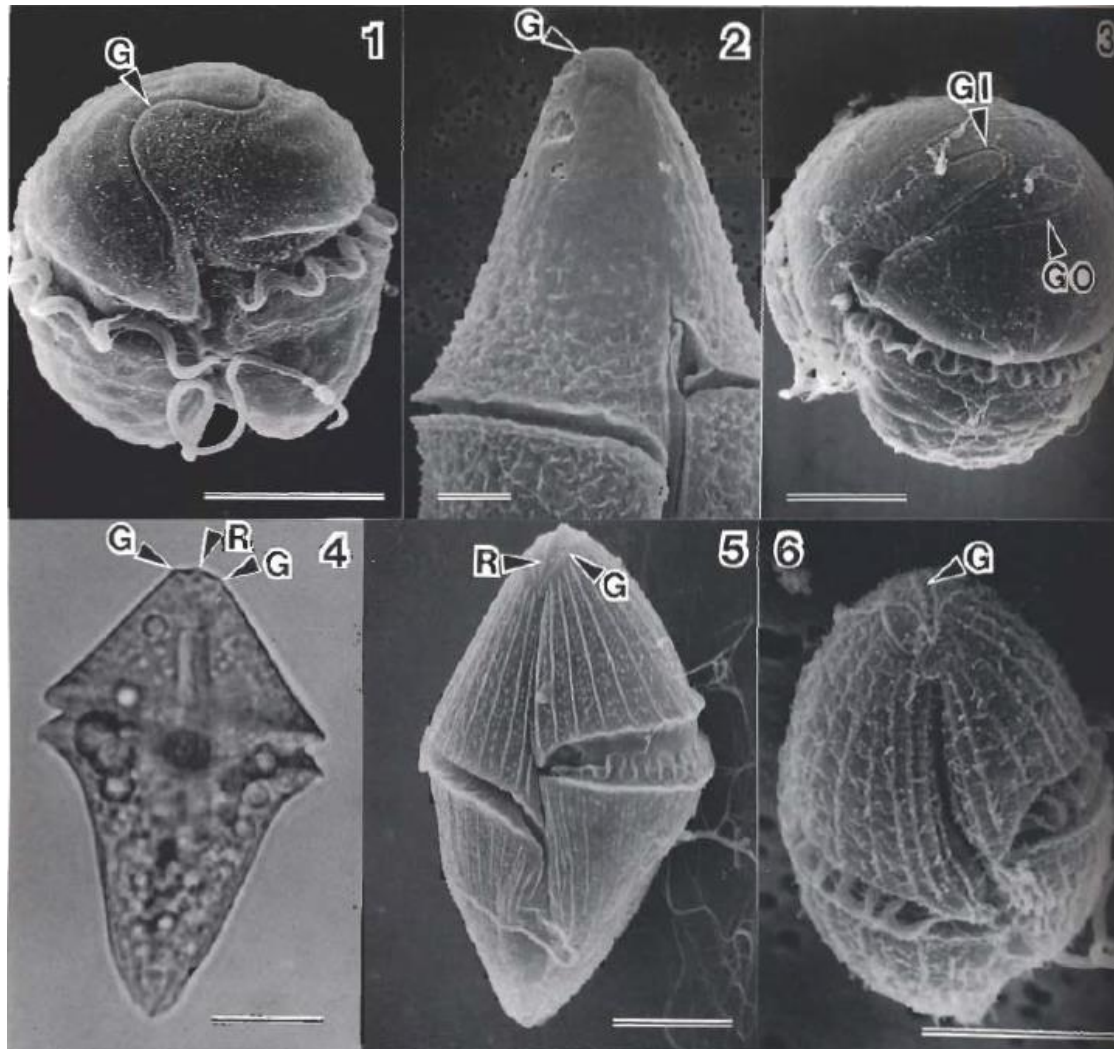
Gymnodinium Stein 1878

- comprises 268 spp.
- 103 have not been observed since their original description (38%)
 - Poorly described with ambiguous identity



Gymnodinium atomatum

Background

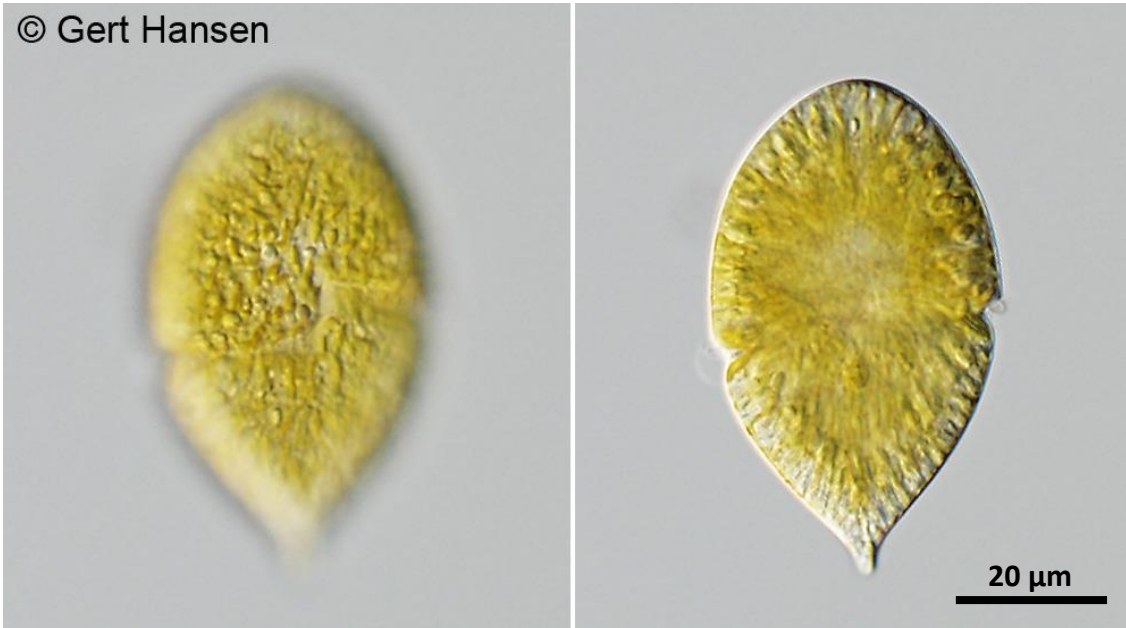


Apical grooves of unarmored dinoflagellates

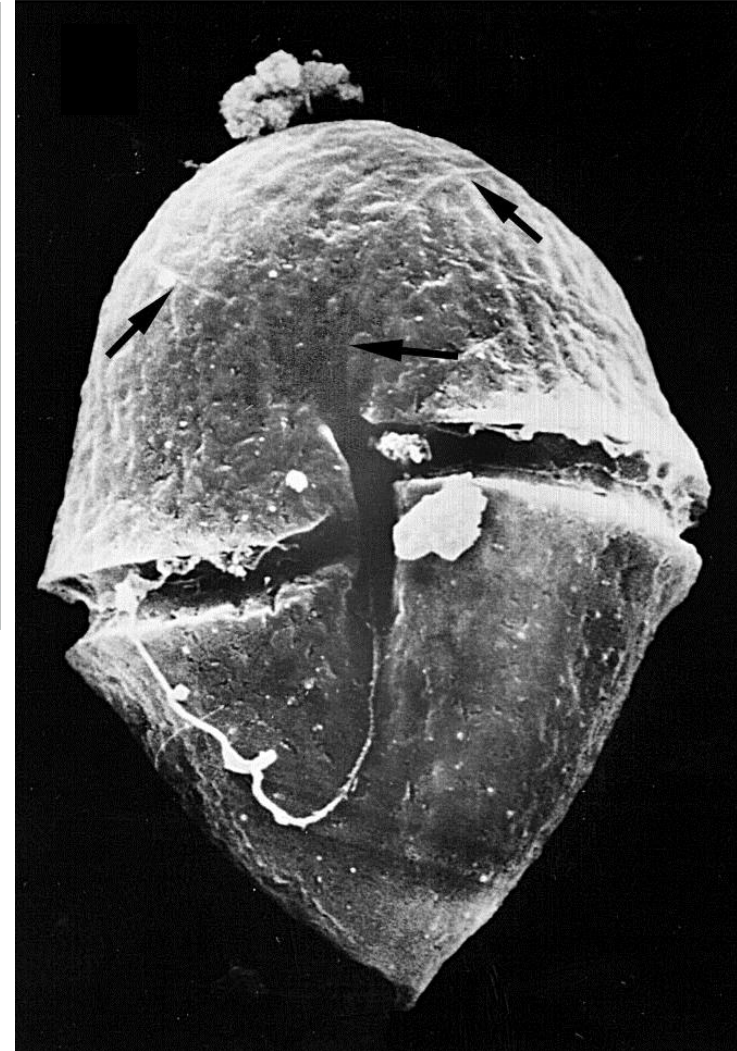
Gymnodinium Stein emend. Hansen et Moestrup 2000

Type species : *Gymnodinium fuscum* (Ehrenberg) Stein 1878

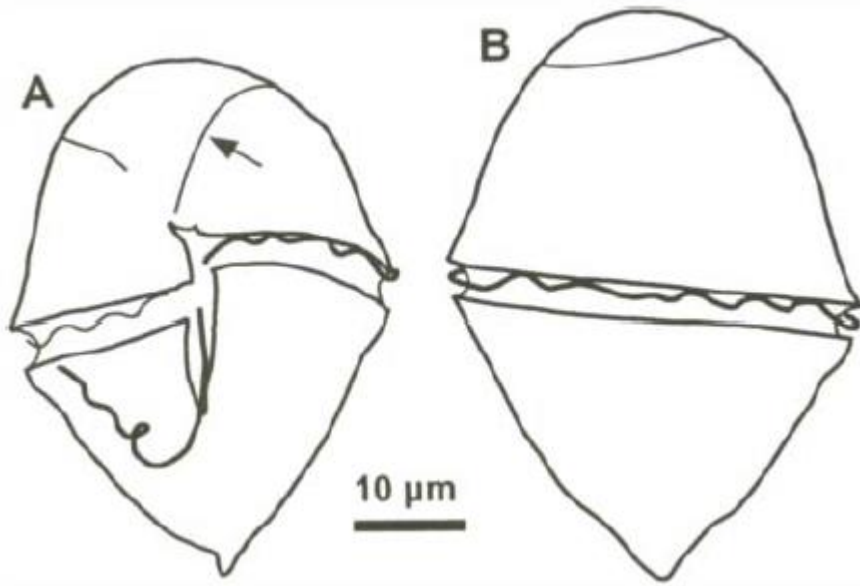
© Gert Hansen



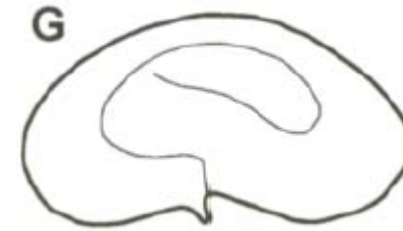
- Apical groove horseshoe-shaped, anti-clockwise
- Nuclear envelope with vesicular chambers
- Nuclear or dorsal fibrous connective present



Gymnodinium Stein emend. Hansen et Moestrup 2000

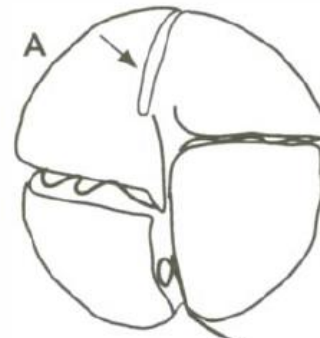


Gymnodinium fuscum



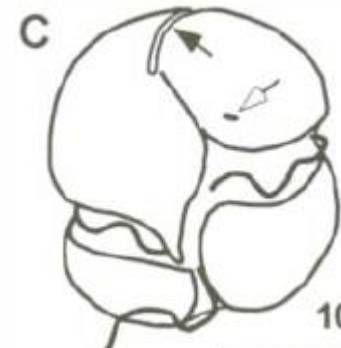
Gymnodinium sanguineum

→ Akashiwo



Gymnodinium mikimotoi

→ Karenia

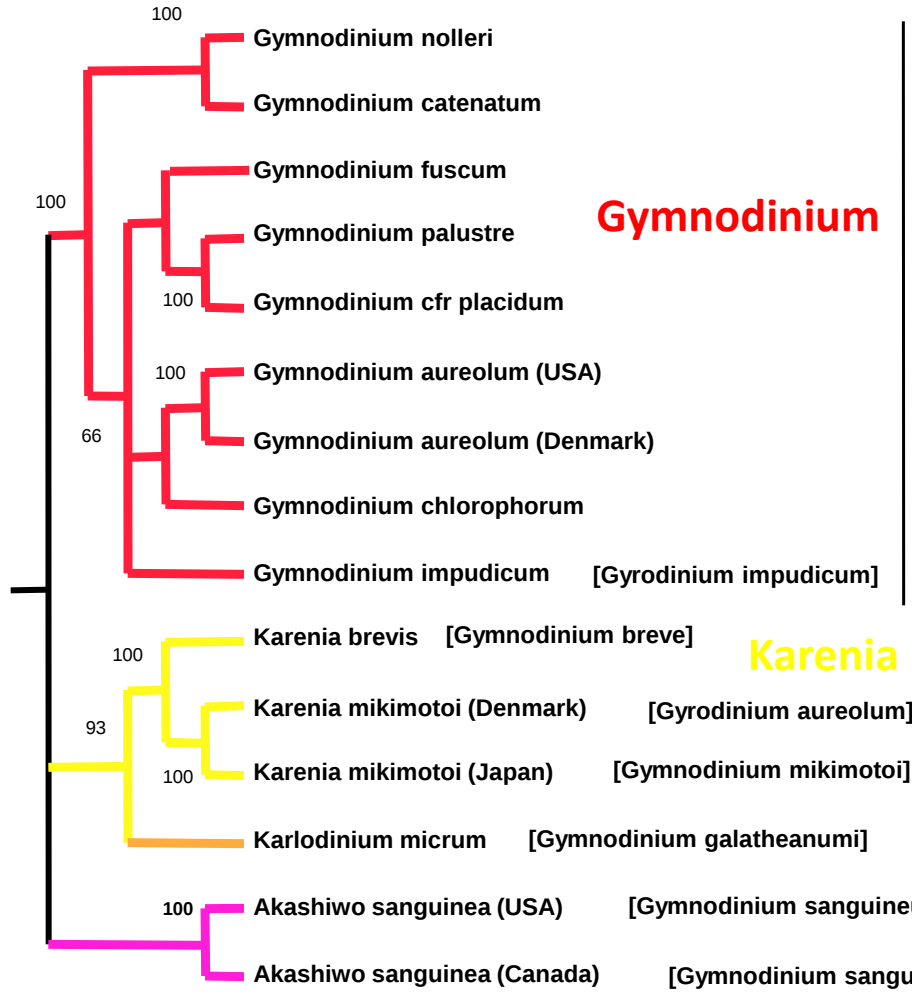


Gymnodinium veneficum

→ Karlodinium

Background

Emended definitions:



1. counterclockwise horseshoeshaped apical groove
2. nuclear chambers
3. nuclear fibrous connective

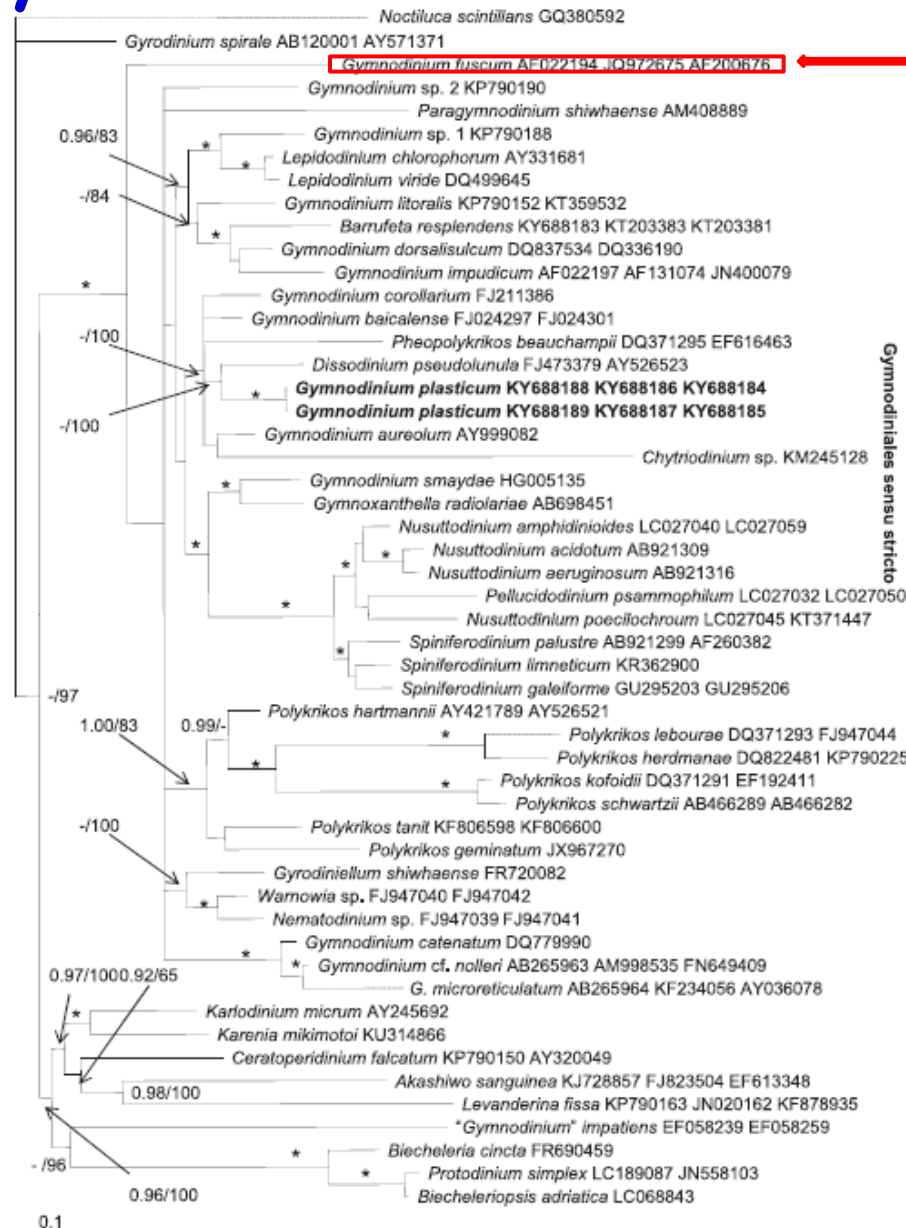
1. straight apical groove
2. major caretonoid pigments fucoxanthin and fucoxanthin derivatives

1. amphiesmal plugs
2. ventral pore

1. apical groove clockwise and loop-shaped

Many Gymnodinium species has been moved to new genera

Gymnodiniales sensu stricto



Type of Gymnodinium

Lepidodinium

Barrufeta

Nusuttodinium

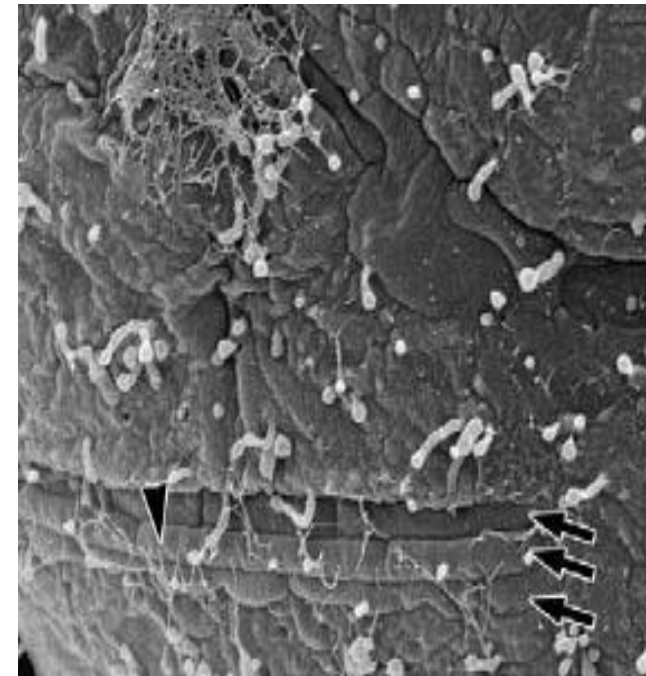
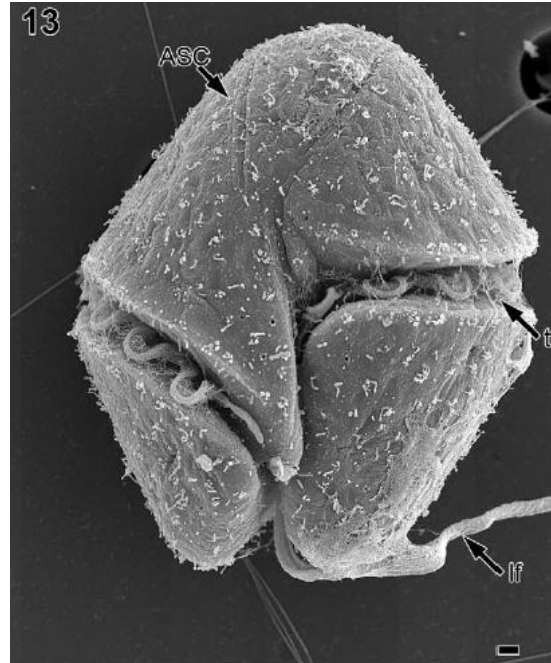
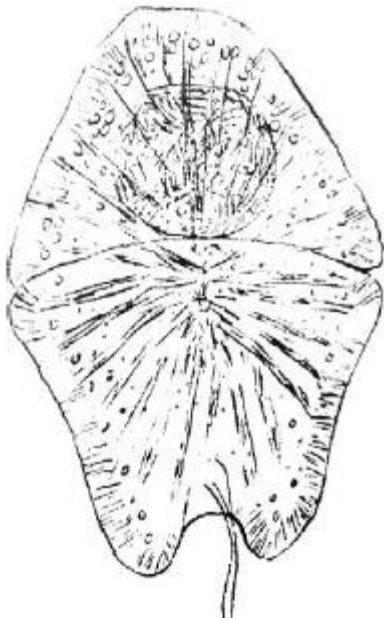
Spiniferodinium

Polykrikos

The genus *Gymnodinium* is still polyphyletic

Wang et al. 2017

Background



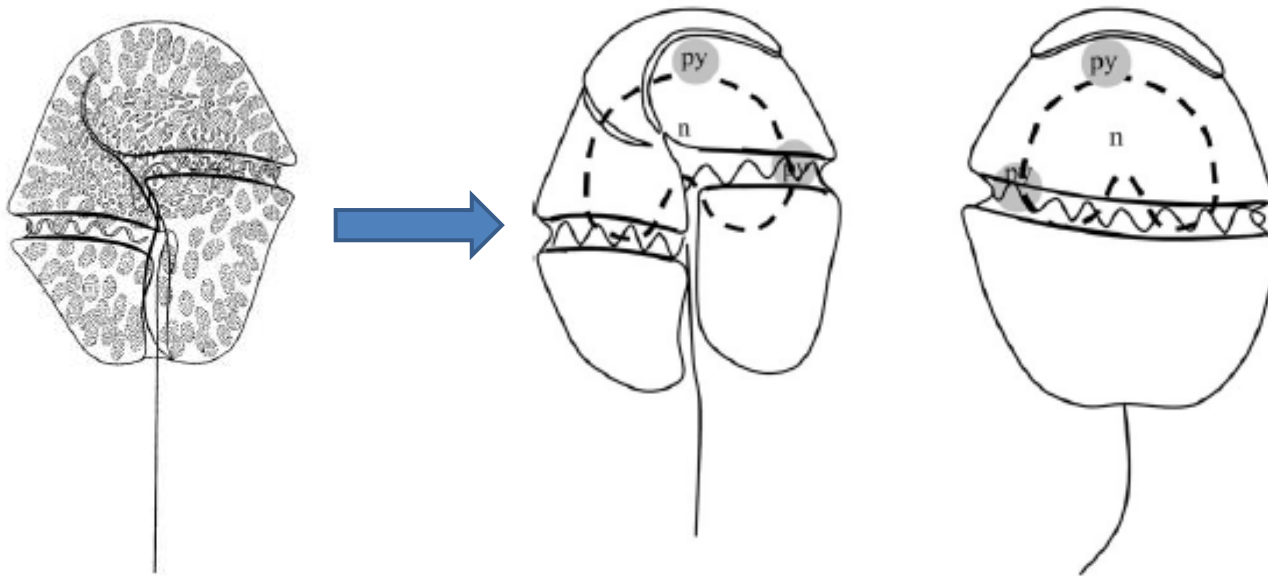
Gymnodinium fissum
Gyrodinium instriatum
Gyrodinium uncatenum

Levanderina fissa

Apical structure complex

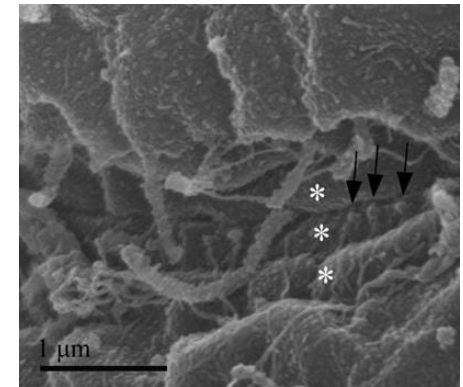
New genus for old *Gymnodinium* species

Background



Gyrodinium resplendens

Barrufeta resplendens



Apical structure complex

New genus for old *Gymnodinium* species

Question

- **More genera for naked species?**

Sampling map

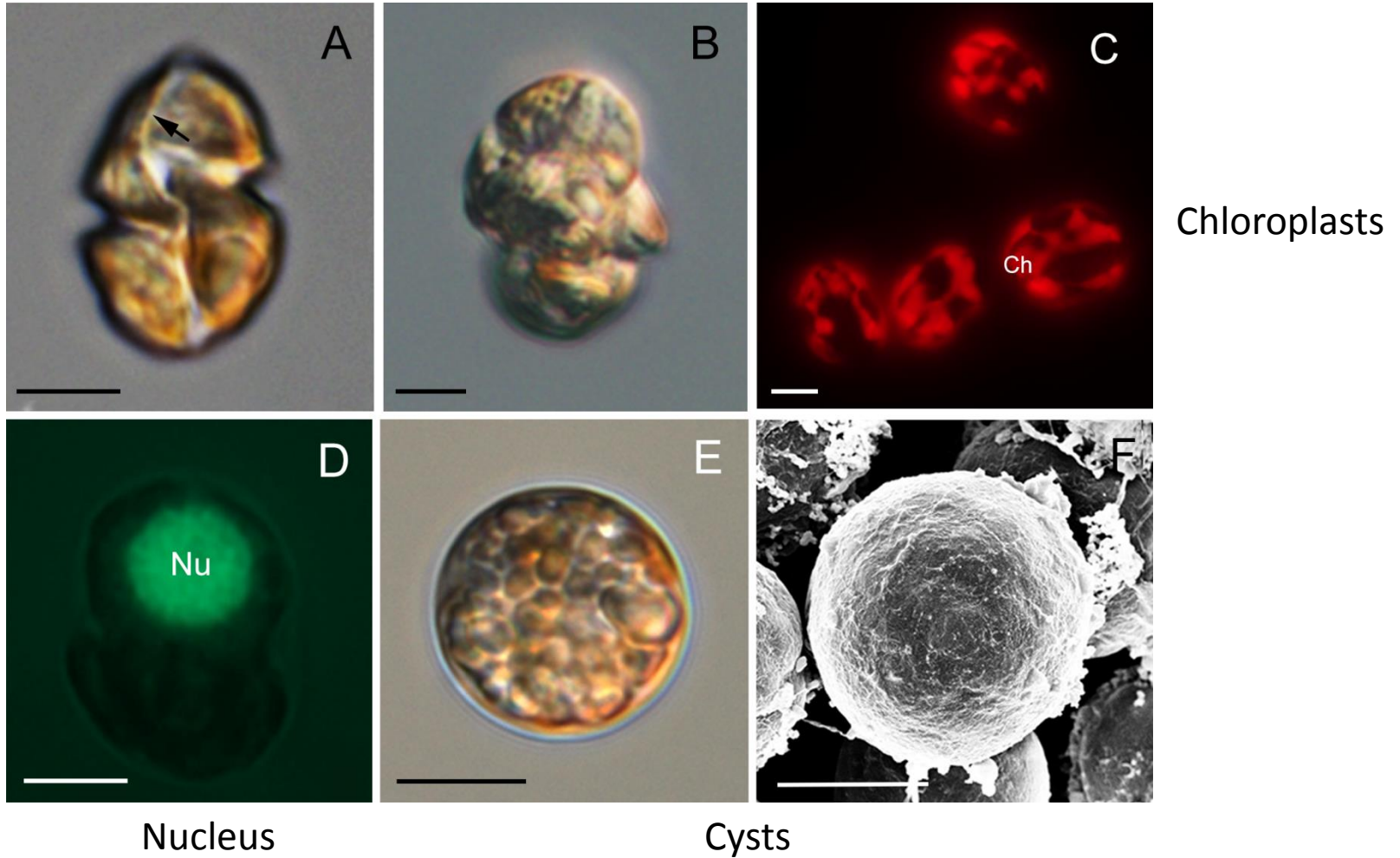


Six sediment samples were collected

***Wangodinium sinense* gen. et. sp. nov.**

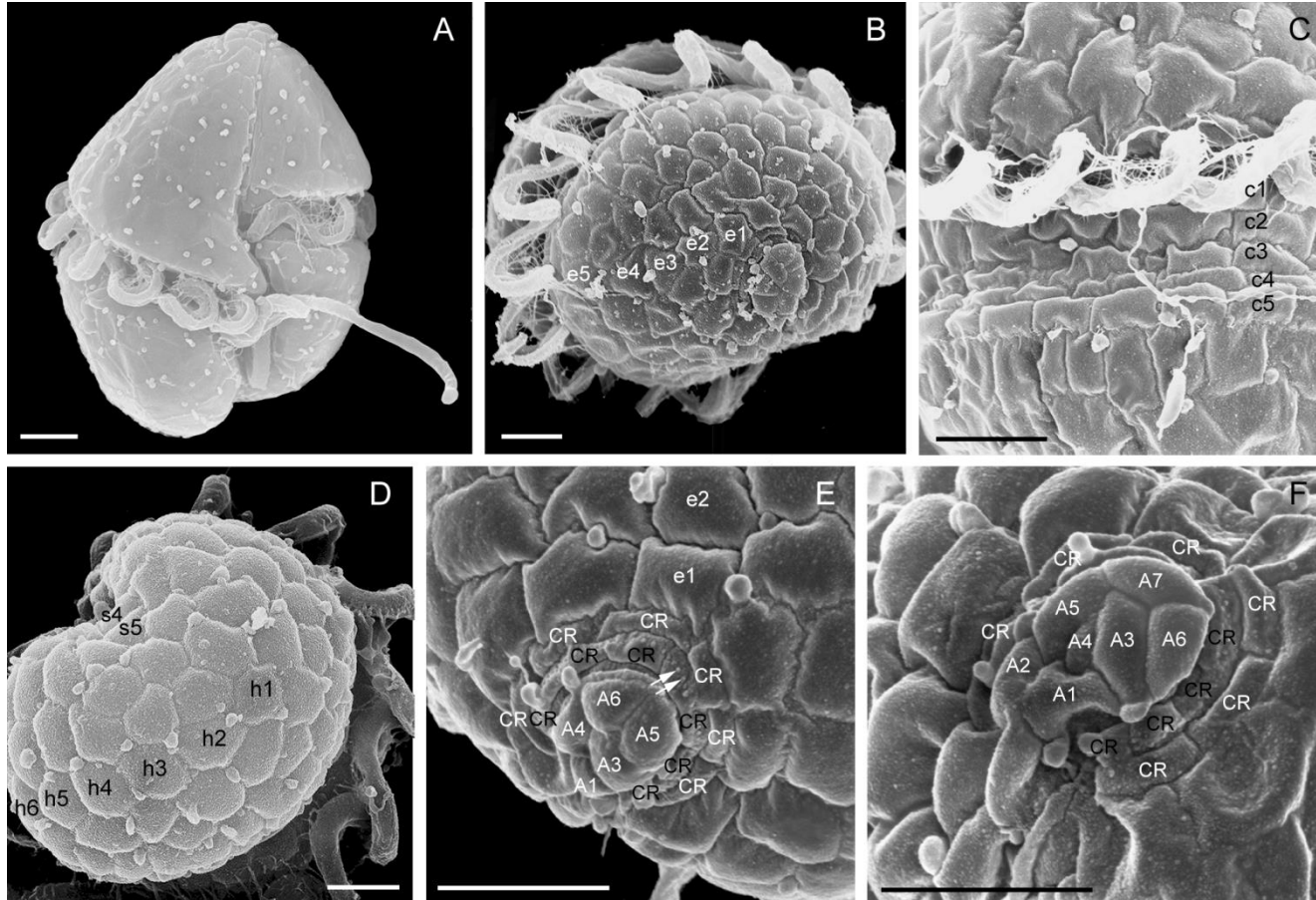
- *Etymology.* '*Wangodinium*' honours the Chinese protozoologist Jiaji Wang (also spelled as Chia Chi Wang; '*sinense*' refers to the type locality, the coasts of China.
- *Type locality.* Xiamen Harbour (24° 29'49"N, 118° 3'42" E), East China Sea.

Wangodinium sinense



LM images of motile cells and cysts

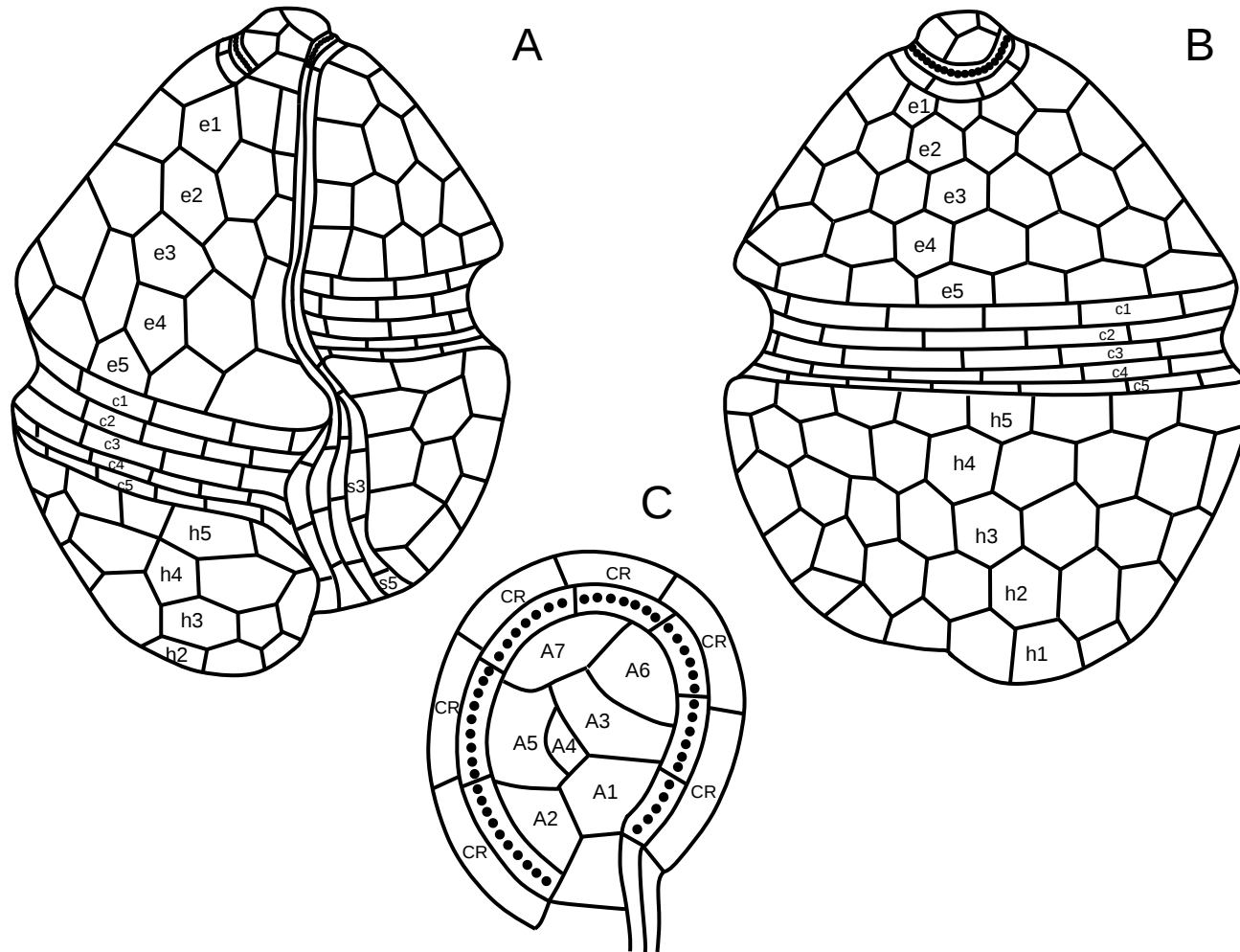
Wangodinium sinense



Type III Apical Structure complex

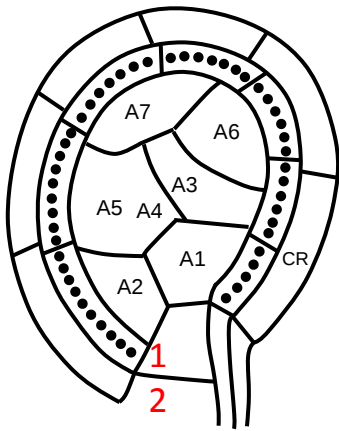
SEM images of motile cells

Wangodinium sinense

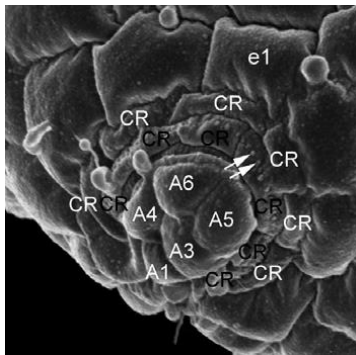


Line drawing of motile cells

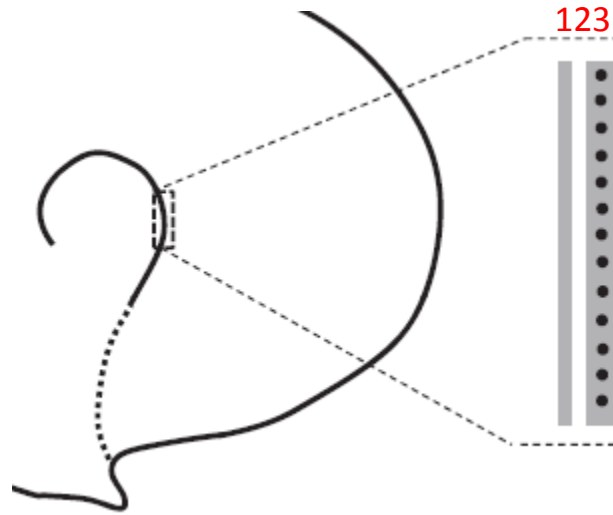
Why a new genus?



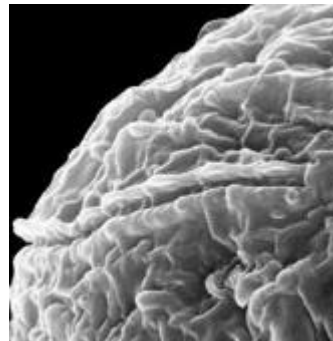
Wangodinium



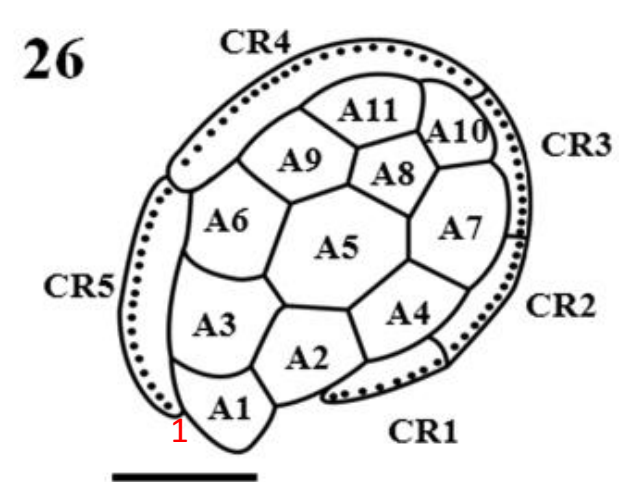
Type III



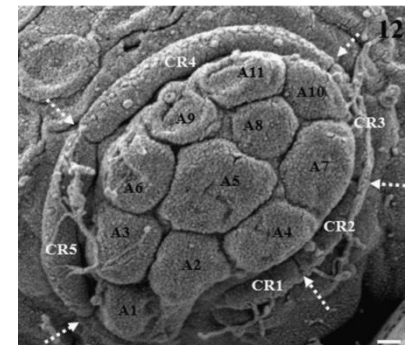
Gymnodinium



Type I



Gyrodiniellum

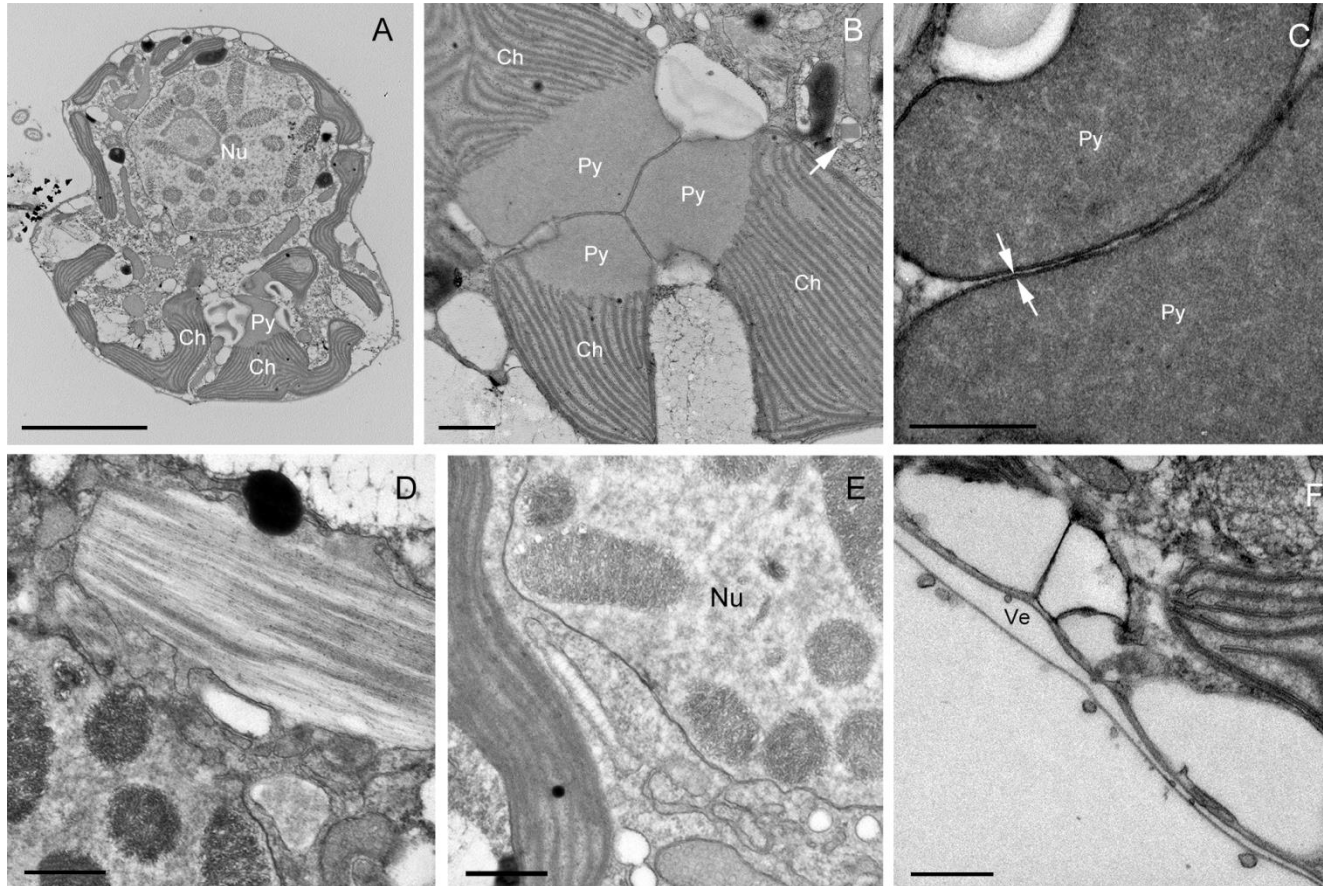


Type II

Apical structure complex of different genera

Wangodinium sinense

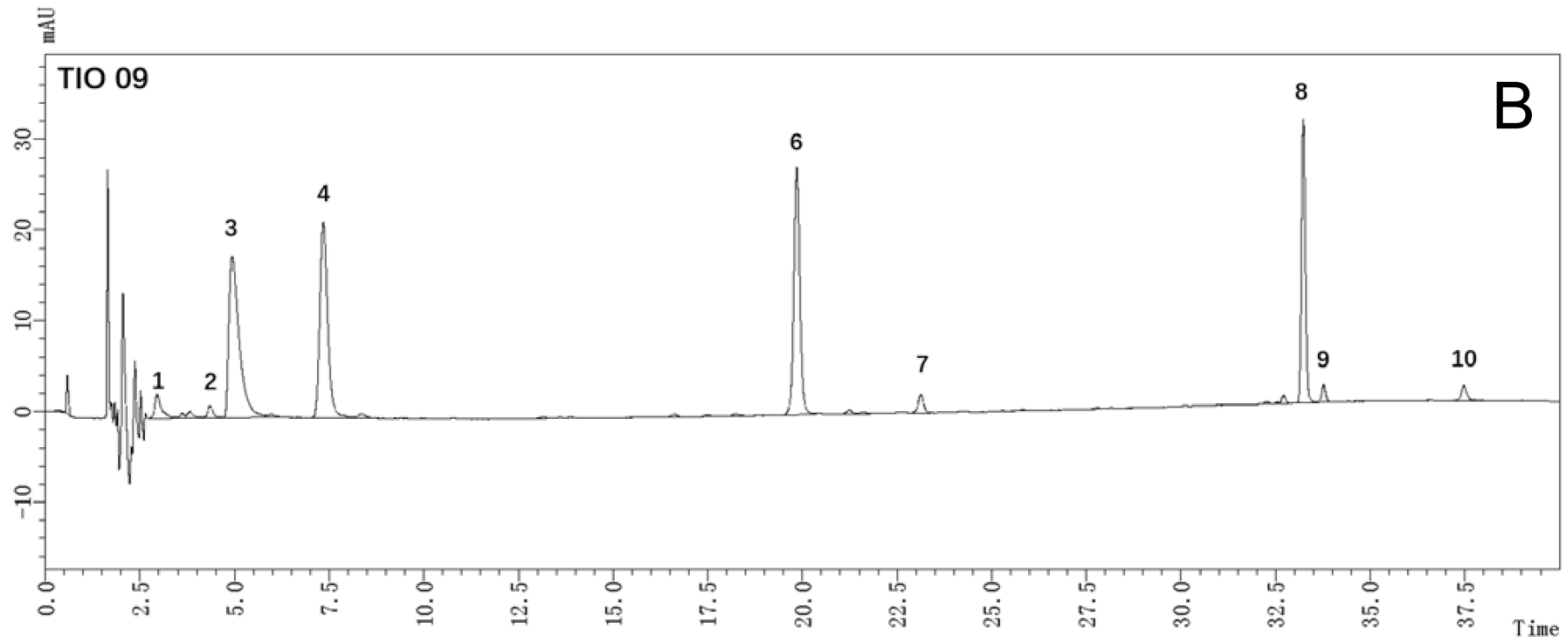
Two membranes of chloroplast



Without nuclear chambers

TEM images of motile cells

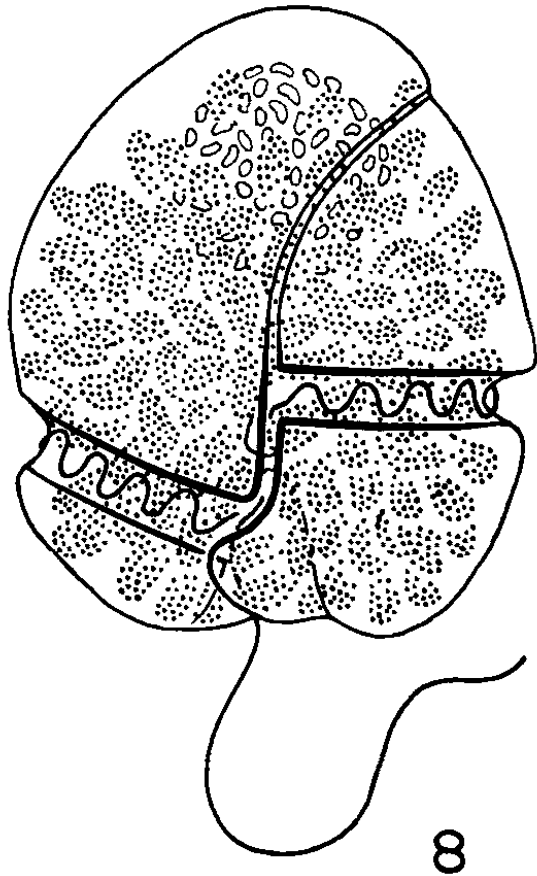
Wangodinium sinense



Pigment chromatogram of *Wangodinium sinense*

1: Chlorophyll c3; 2: Chlorophyllide a; 3: Chlorophyll c2; 4: Peridinin; 5: Diadinoxanthin; 6: Antheraxanthin; 7: Diatoxanthin; 8: Chlorophyll a; 9: Pheophorbide; 10: β , β -carotene No Chlorophyll b

Gymnodinium dorsalisulcum



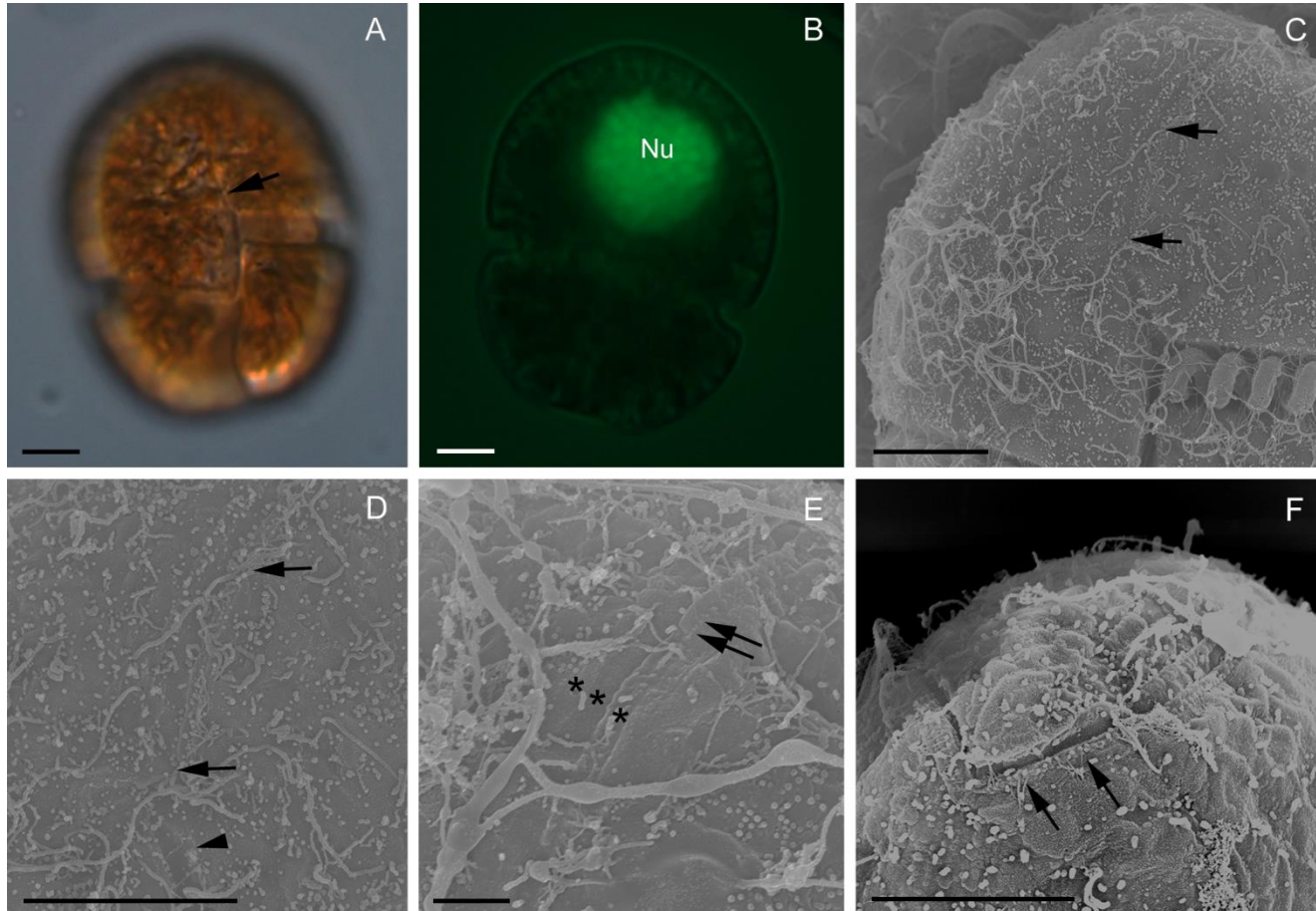
Katodinium dorsalisulcum



Gymnodinium dorsalisulcum

New genus for old species?

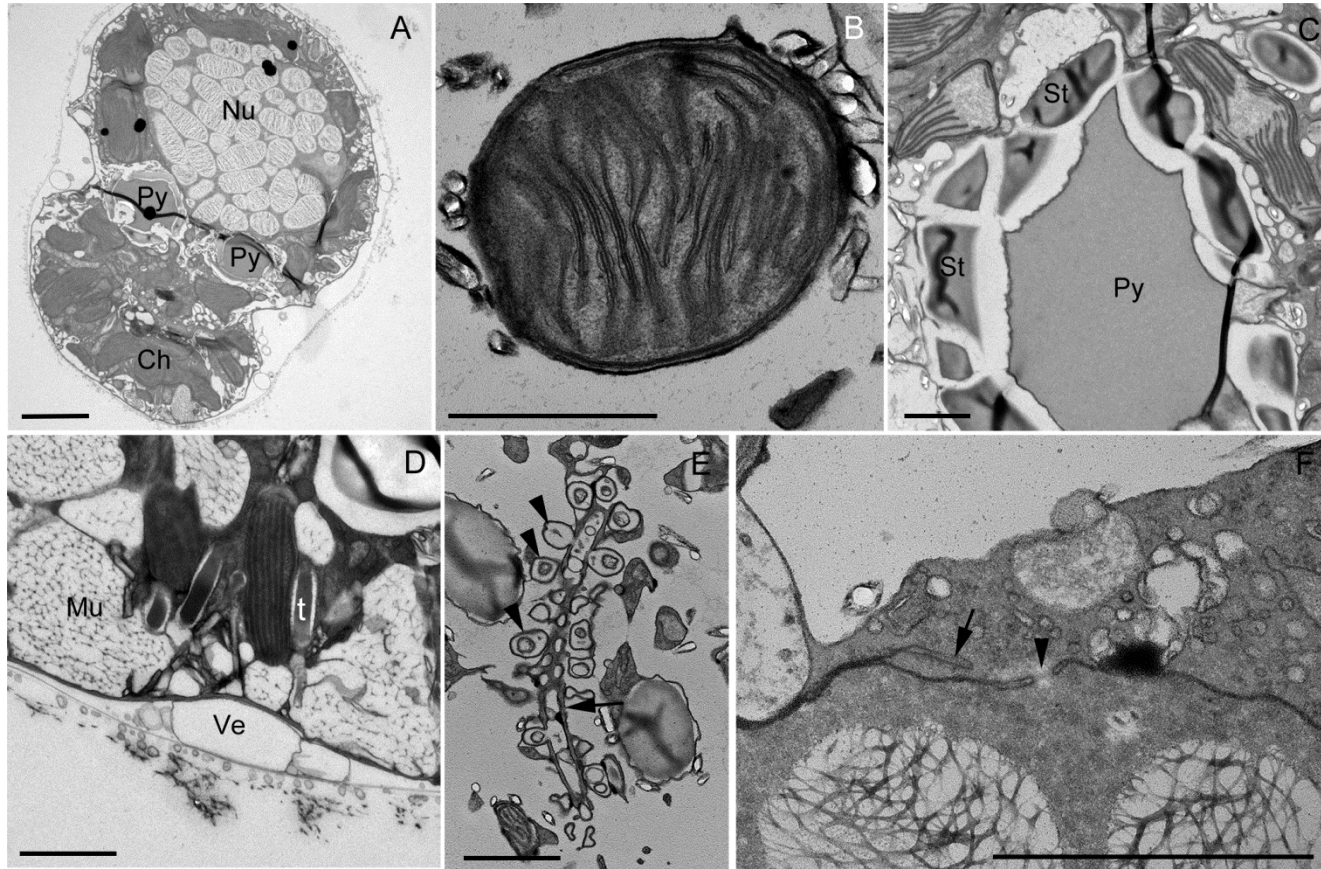
Gymnodinium dorsalisulcum



Type I Apical Structure complex

LM and SEM images of motile cells

Gymnodinium dorsalisulcum



pyrenoid

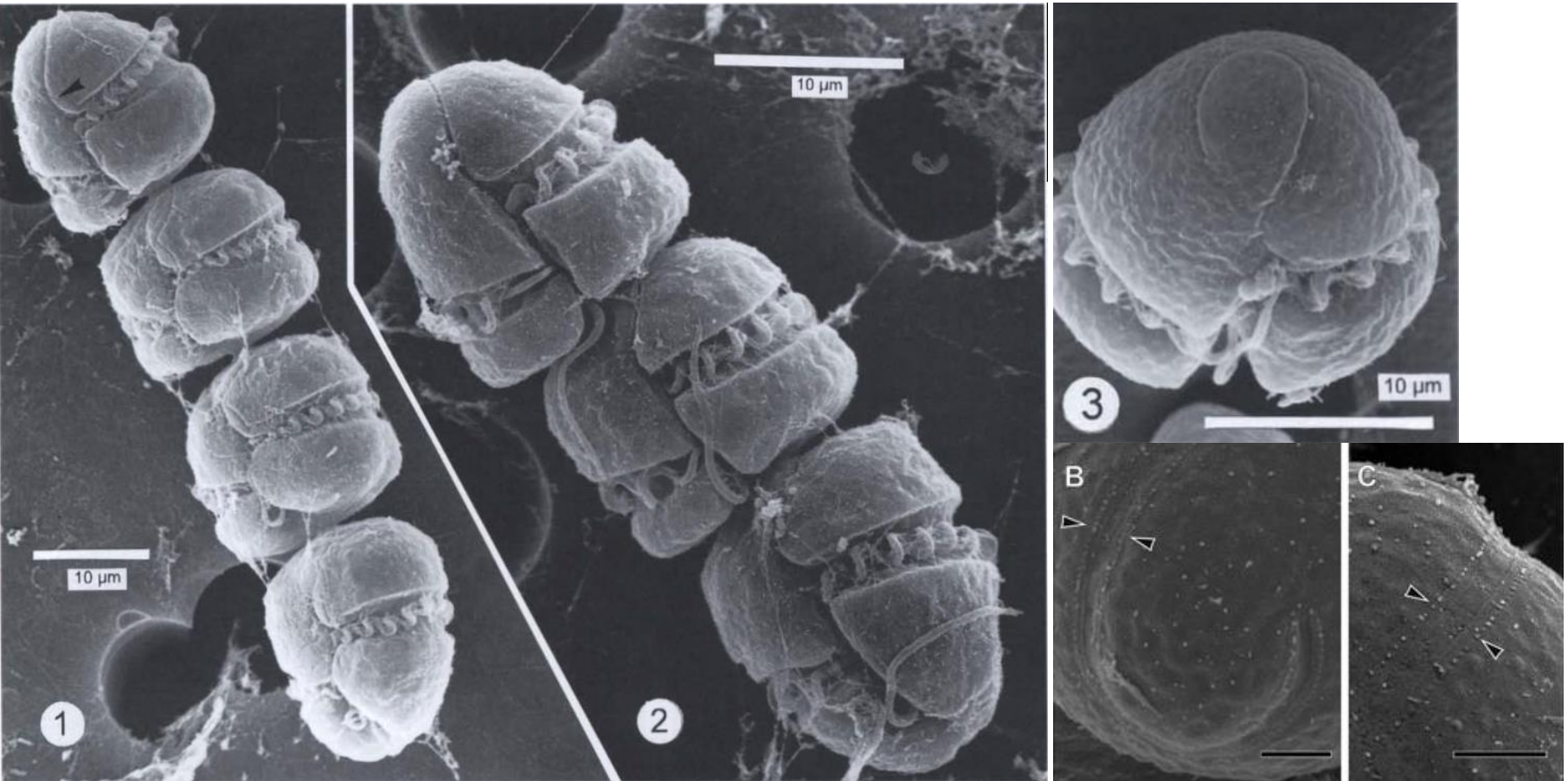
extrusomes

pusule

nuclear chambers

TEM images of motile cells

Gymnodinium impudicum



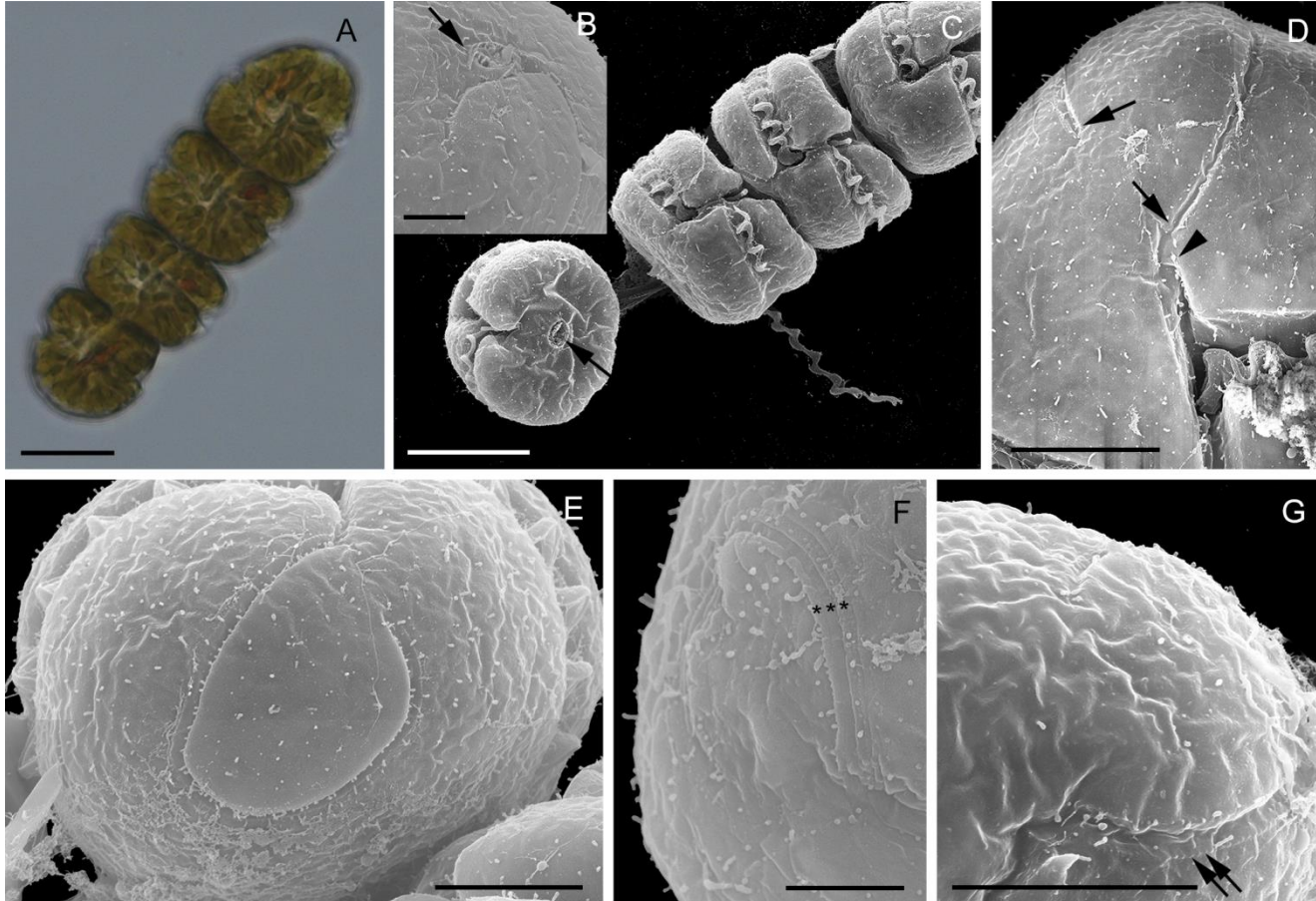
Gyrodinium impudicum



Gymnodinium impudicum

Is it a true *Gymnodinium*?

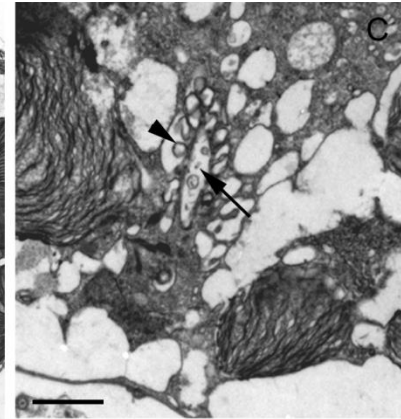
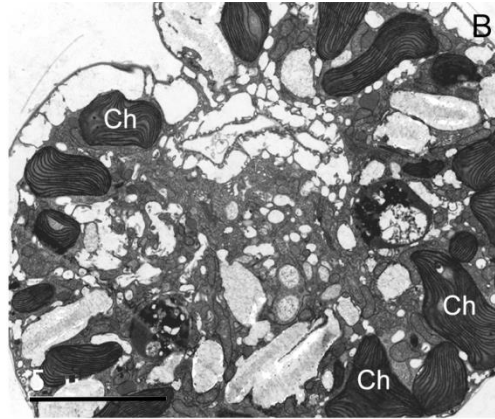
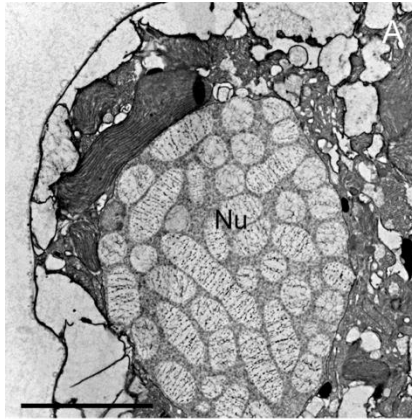
Gymnodinium impudicum



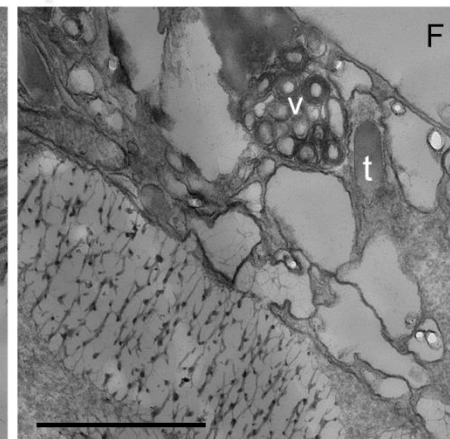
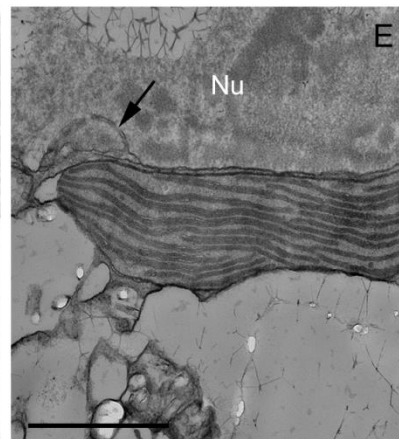
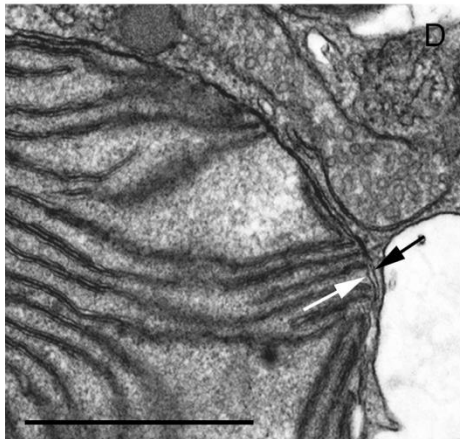
Type I Apical Structure complex

LM and SEM images of motile cells

Gymnodinium impudicum



Pusule

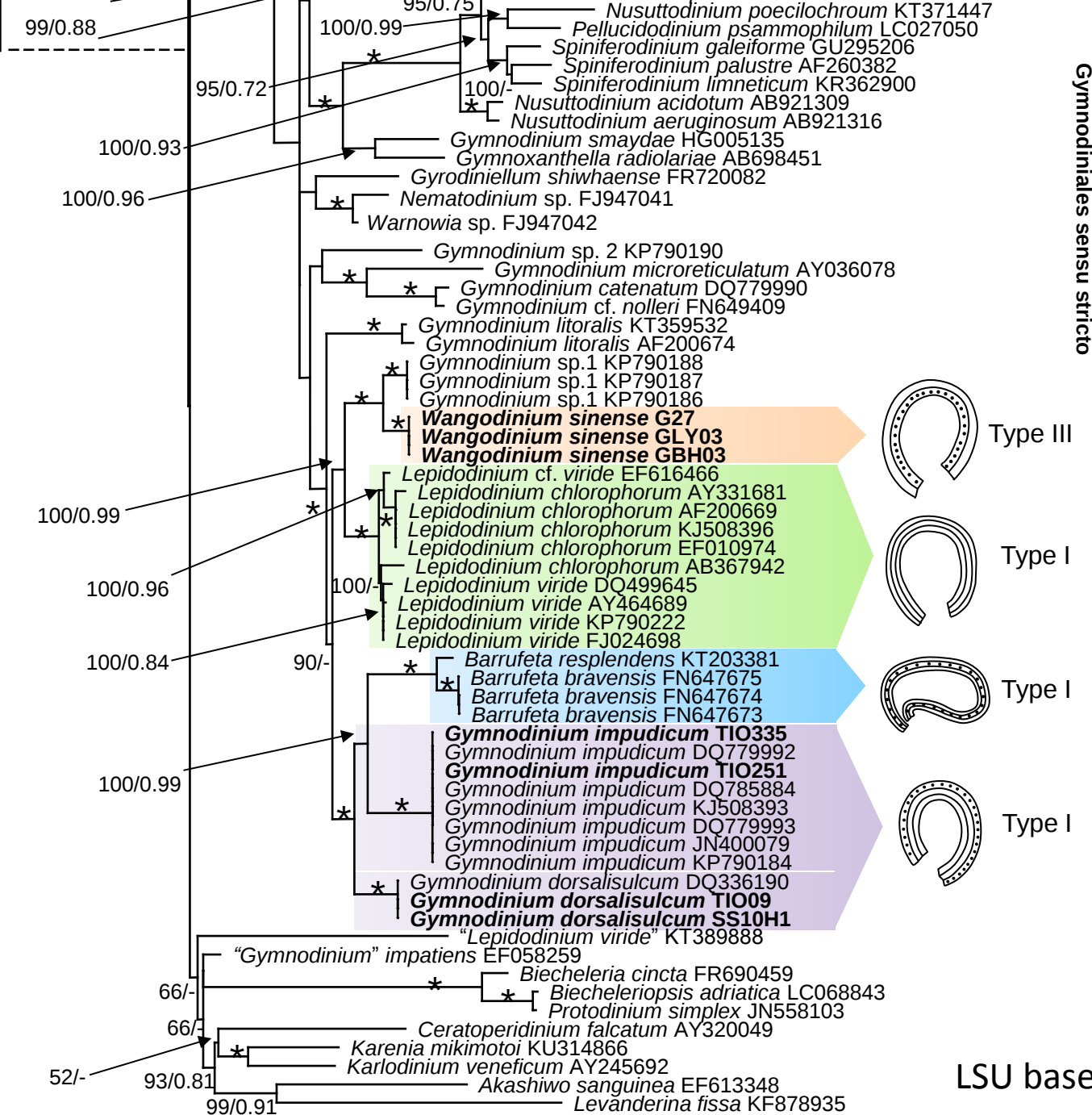


Two membranes of chloroplast

Nuclear chambers

Extrusomes

TEM images of motile cells



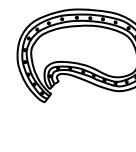
Gymnodiniales sensu stricto



Type III



Type I



Type I



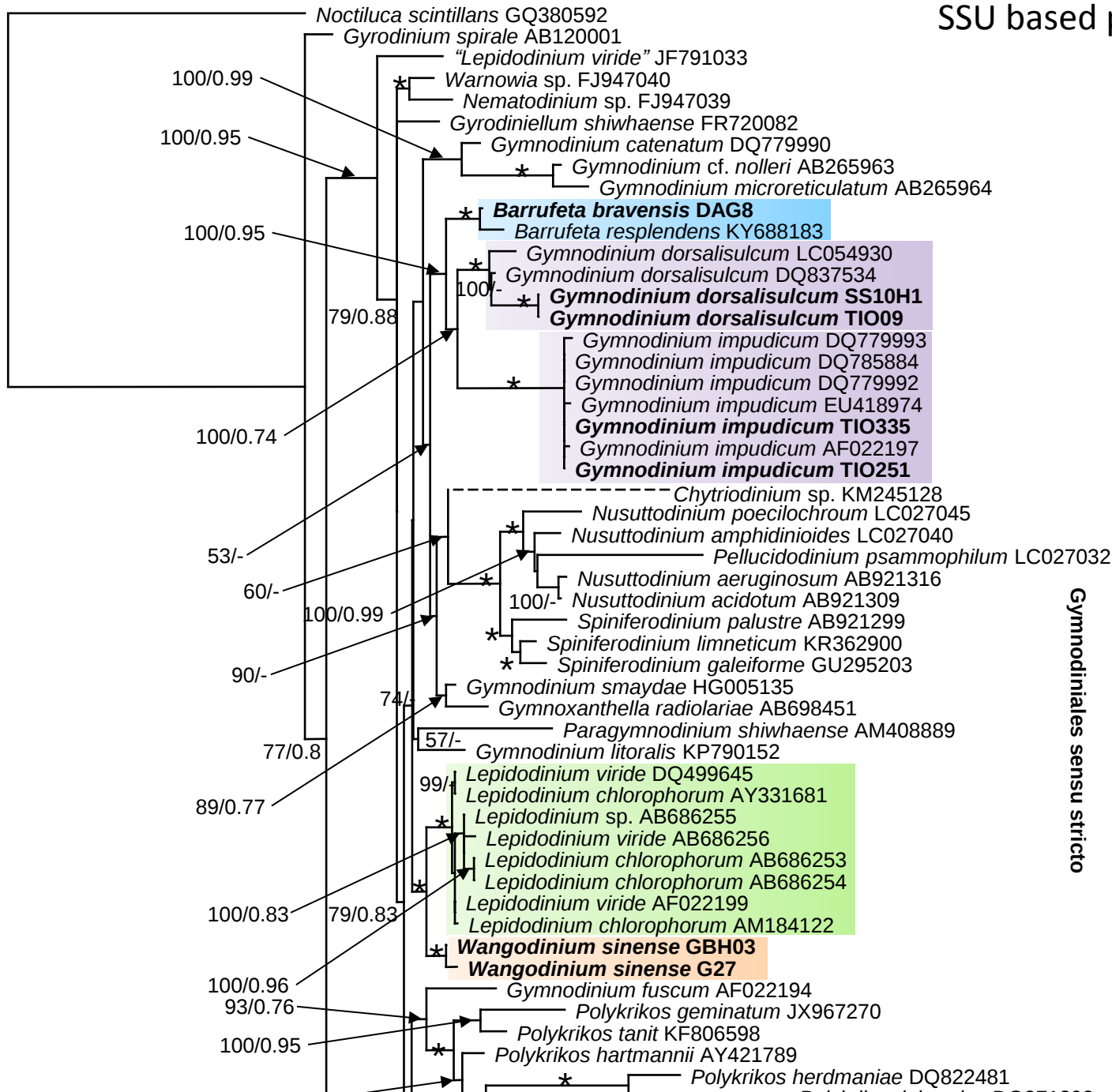
Type I

Chlorophyll *b*

Barrufeta?
two new genera?

LSU based phylogeny

SSU based phylogeny



Barrufeta?
One new genus?

Chlorophyll *b*

Conclusions

- A new genus, *Wangodinium*, was erected to incorporate strains with a loop-shaped apical structure complex (ASC) comprising two rows of amphiesmal vesicles.
- Our results support the close relationship among *G. dorsalisulcum*, *G. impudicum* and *Barrufeta*.
- Further research is needed to assign these *Gymnodinium* species to *Barrufeta* or to erect new genera.

THANKS!