



MORPHOLOGY, ULTRASTRUCTURE, AND MOLECULAR PHYLOGENY OF *WANGODINIUM SINENSE* GEN. ET SP. NOV. (GYMNODINIALES, DINOPHYCEAE) AND REVISITING OF *GYMNODINIUM DORSALISULCUM* AND *GYMNODINIUM IMPUDICUM*<sup>1</sup>

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The genus *Gymnodinium* includes many morphologically similar species, but molecular phylogenies show that it is polyphyletic. Eight strains of *Gymnodinium impudicum*, *Gymnodinium dorsalisulcum* and a novel *Gymnodinium*-like species from Chinese and Malaysian waters and the Mediterranean Sea were established. All of these strains were examined with light microscopy, scanning electron microscopy and transmission electron microscopy. SSU, LSU and internal transcribed spacers rDNA sequences were obtained. A new genus, *Wangodinium*, was erected to incorporate strains with a loop-shaped apical structure complex (ASC) comprising two rows of amphiesmal vesicles, here referred to as a new type of ASC. The chloroplasts of *Wangodinium sinense* are enveloped by two membranes. Pigment analysis shows that peridinin is the main accessory pigment in *W. sinense*. *Wangodinium* differs from other genera mainly in its unique ASC, and additionally differs from *Gymnodinium* in the absence of nuclear chambers, and from *Lepidodinium* in the absence of Chl *b* and nuclear chambers. New morphological information was provided for *G. dorsalisulcum* and *G. impudicum*, e.g., a short sulcal intrusion in *G. dorsalisulcum*; nuclear chambers in *G. impudicum* and *G. dorsalisulcum*; and a

chloroplast enveloped by two membranes in *G. impudicum*. Molecular phylogeny was inferred using maximum likelihood and Bayesian inference with independent SSU and LSU rDNA sequences. Our results support the classification of *Wangodinium* within the *Gymnodiniales* sensu stricto clade and it is close to *Lepidodinium*. Our results also 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.

**Key index words:** apical structure complex; cyst; dinoflagellate; *Lepidodinium*; nuclear chambers; pigment; pyrenoid; ultrastructure

**Abbreviations:** ASC, apical structure complex; AV, amphiesmal vesicles; BI, Bayesian inference; BPP, Bayesian posterior probabilities; BS, bootstrap support; DAPI, 4',6-diamidino-2-phenylindole dihydrochloride; DMF, N,N-dimethylformamide; GTR, general time-reversible; MCMC, Markov chain Monte Carlo; ML, maximum likelihood; Mv-chl *a*, monovinyl chlorophyll *a*; NFC, nuclear fibrous connector; RAxML, Randomized Axelerated Maximum Likelihood; Tchl *a*, total chlorophyll *a*

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Many athecate dinoflagellates have been classified in the genus *Gymnodinium*, which originally encompassed gymnodinioid species with a cingulum