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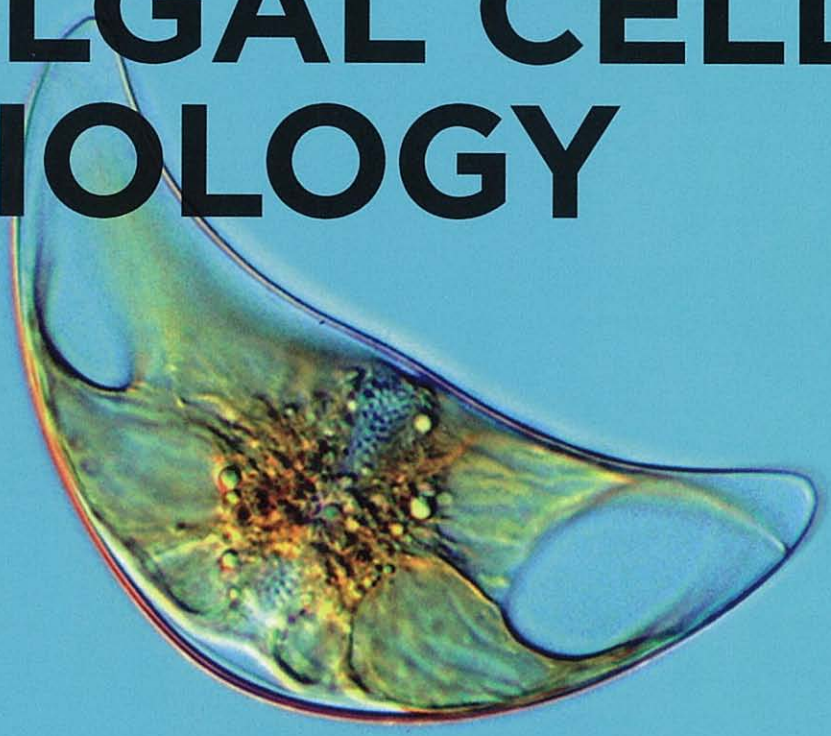

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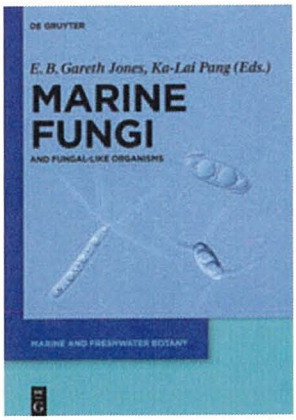

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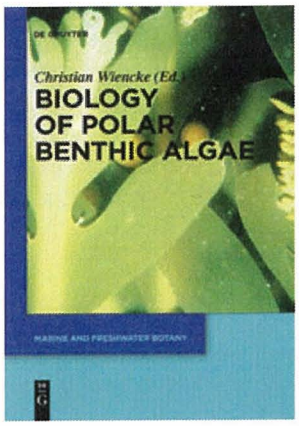

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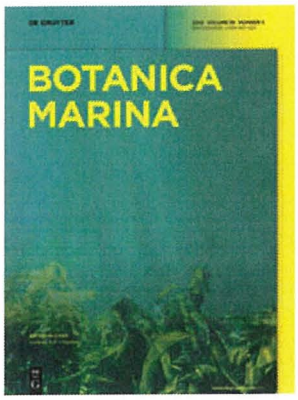

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Advances in Algal Cell Biology

Edited by Kirsten Heimann
and Christos Katsaros

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Editors
Prof. Dr. Kirsten Heimann
Director of NQAIF
School of Marine and Tropical Biology
James Cook University
Douglas Campus
Townsville QLD 4811
Australia
E-mail: kirsten.heimann@jcu.edu.au

Prof. Christos Katsaros
University of Athens
Faculty of Biology
Department of Botany
Panepistimiopolis
157 84 Athens
Greece
E-mail: christos.katsaros@biol.uoa.gr

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Preface

Almost every algal textbook starts by underlining the fundamental importance of algae. It is true that they are key primary producers in marine and freshwater environments and represent a relatively untapped resource for food, bioenergy and biopharmaceuticals. Knowledge of algal cell biology is indeed the successful recipe for the current boom of biotechnological applications of micro- and macroalgae. Apart from these indisputable features, algae have attracted the interest of researchers since the first studies in the plant kingdom.

Algal research passed from different stages, reflecting not only the interest of the scientists, but also the dynamics and the facilities available in each of these time periods. External morphology was completed by (light and electron) microscopy, chemistry by biochemistry and finally molecular biology. The tremendous progress of biological research during the last decades of the 20th century, which has made biology the most important science of the 21st century, has been extended to algal research by giving the tools for specialized studies which provided deep insights into algal structural and functional organization. In this way, the application of modern techniques and sophisticated tools contributed drastically not only to the study of algal cell metabolism but also to algal evolution, the latter, in turn, contributing to species evolution in general.

These approaches were used not only to study the physiological mechanisms functioning during the life cycles of algae, but also to clarify the taxonomic and phylogenetic relationships between them.

However, despite the vast of information revealed from these studies and published in many scientific journals, there is a considerable lack of a book dealing with the structure and molecular biology of algae.

The publication of this book was the physical continuation of the publication of the Botanica Marina special issue entitled "Advances in algal cell biology and genomics". The high quality of the articles included in this issue, revealed the tremendous progress in the field of the biology of algal cells.

Having the above accumulated information in hands and considering the necessity of a book in which scientists (students, phycologists, etc.) would find answers to questions and/or triggers for further research, we proceeded to this publication.

Apoptosis or programmed cell death is a fundamental mechanism for the development and repair of tissues. Indeed the process of apoptosis has even been realised in cyanobacteria where if functions in bloom control. Given the importance of programmed cell death, this book starts out with a review on programmed cell death in multicellular algae. This chapter investigates the implication of programmed cell death for algal development, such as spore germination, hair development, the development of reticulate thallus structures, cell surface cleaning mechanisms, reactions to parasites, senescence and abscission. These developmental patterns are compared to analogous processes in terrestrial plants. It can be concluded that programmed cell death is yet another unifying concept in biology.

Algal biodiversity is extremely high compared to other groups of organisms. Hence the second chapter reviews the mechanism by which this diversity was generated.

Current knowledge of endosymbiosis giving rise to the highly diverse plastids in the algae is placed into context with gene transfer and algal evolution.

The third chapter pays tribute to the unusual pennate diatom, *Phaeodactylum tricorunutum*. It summarises knowledge regarding factors and mechanisms involved in the polymorphism of this organism. It also investigates possible drivers for the conversion of one morphotype into the other and mechanisms that make such tremendous morphological changes possible.

The fourth chapter reviews cytological and cytochemical aspects of carrageenophytes, a group of red algae that are growing steadily in commercial applications.

The fifth chapter presents the findings of a desktop study using a molecular approach to unravel algal protein trafficking, specifically vacuolar protein sorting and provide strong evidence that such investigations can assist in the assembly of a holistic picture of protist evolution.

The sixth chapter presents data on the function of contractile vacuoles in green algae and places these into context with protists used as models for studies on contractile vacuole function and mechanisms, such as ciliates, slime moulds and the parasitic trypanosomes.

Chapter seven reviews advances in our understanding of the mechanisms and structures required for cytokinesis in brown algae. Particular focus has been given to the role of the cytoskeleton in cell wall morphogenesis, the deposition of wall materials, the role of the centrosome in the determination of the division site, and the formation of plasmodesmata, The techniques used in these studies include not only conventional microscopy, but also immunofluorescence and TEM as well as cryofixation – freeze-substitution and electron tomography.

Chapter eight provides new insight in the function of the cytoskeleton for sperm release in *Chara*. This study uses cytoskeletal drugs to modulate cytoskeletal function and demonstrates, using scanning laser confocal immunofluorescence microscopy, that sperm release in *Chara* is a highly dynamic process.

Chapter nine presents findings on the involvement of the cytoskeleton for the regulation of an important marine phenomenon – bioluminescence. Using cytoskeleton modulating drugs, evidence is presented that the cytoskeleton is involved in the reciprocal movement of chloroplasts and bioluminescent organelles at the transition of photoperiods in the marine dinoflagellate, *Pyrocystis lunula*.

Lastly, chapter 10 explores how the bioluminescent system of *Pyrocystis lunula* and specific signal modulators can be used to unravel potential signal transduction cascades required for eliciting the touch-induced bioluminescent response. It also provides insights into potential mechanisms involved in the reduction of bioluminescence when exposed to heavy metals and explores the use of the herbicide oxyfluorfen, which inhibits chlorophyll biosynthesis, for determining the biosynthetic origin of the bioluminescent substrate luciferin.

Kirsten Heimann
Christos Katsaros

List of contributing authors

John Archibald
Department of Biochemistry &
Molecular Biology
Dalhousie University
Halifax, Canada
e-mail: JMARCHIB@dal.ca
Chapter 2

Burkhard Becker
Biozentrum Köln, Botanik
Universität zu Köln
Köln, Germany
e-mail: b.becker@uni-koeln.de
Chapter 5, 6

Karin Komsic-Buchmann
Biozentrum Köln, Botanik
Universität zu Köln
Köln, Germany
e-mail: karin.buchmann@uni-koeln.de
Chapter 6

Moira E. Galway
Department of Biology
St. Francis Xavier University
Antigonish, Canada
e-mail: mgalway@stfx.ca
Chapter 1

David J. Garbary
Department of Biology
St. Francis Xavier University
Antigonish, Canada
e-mail: dgarbary@gmail.com
Chapter 1

Arunika Gunawardena
Biology Department
Dalhousie University,
Halifax, Canada
e-mail: arunika.gunawardena@dal.ca
Chapter 1

Karl H. Hasenstein
Department of Biology
University of Louisiana
Lafayette, LA, USA
e-mail: Hasenstein@louisiana.edu
Chapter 8, 9

Kirsten Heimann
NQAIF
School of Marine & Tropical Biology
James Cook University
Townsville, Australia
e-mail: kirsten.heimann@jcu.edu.au
Chapter 9, 10

Kerstin Hoef-Emden
Biozentrum Köln, Botanik
Universität zu Köln
Köln, Germany
e-mail: kerstin.hoef-emden@uni-koeln.de
Chapter 5

Véronique Martin-Jézéquel
Faculté des Sciences et Techniques
Université de Nantes
Nantes, France
e-mail: Veronique.Martin-Jezequel@
univ-nantes.fr
Chapter 3

Qiaojun Jin
Max-Planck Institute of terrestrial
Microbiology
Marburg, Germany
e-mail: jqiaojun@yahoo.com
Chapter 8

Christos Katsaros
Department of Botany
Faculty of Biology
University of Athens
Athens, Greece
e-mail: Christos.Katsaros@biol.uoa.gr
Chapter 7

Paul L. Klerks
Department of Biology
University of Louisiana
Lafayette, LA, USA
e-mail: klerks@louisiana.edu
Chapter 9

Christina E. Lord
Biology Department
Dalhousie University
Halifax, Canada
e-mail: celord@dal.ca
Chapter 1

Shinichiro Maruyama
Department of Biochemistry & Molecular Biology
Dalhousie University
Halifax, Canada
e-mail: maruyama@dal.ca
Chapter 2

Taizo Motomura
Muroran Marine Station
Field Science Center for Northern Biosphere
Hokkaido University
Muroran 051-0013, Japan
e-mail: motomura@fsc.hokudai.ac.jp
Chapter 7

Chikako Nagasato
Muroran Marine Station
Field Science Center for Northern Biosphere
Hokkaido University
Muroran 051-0013, Japan
e-mail: nagasato@bio.sci.hokudai.ac.jp
Chapter 7

Leonel Pereira
Department of Life Sciences
Faculty of Sciences and Technology
University of Coimbra
Coimbra, Portugal
e-mail: leonel@bot.uc.pt
Chapter 4

Makoto Terauchi
Muroran Marine Station
Field Science Center for Northern Biosphere
Hokkaido University
Muroran 051-0013, Japan
e-mail: yellowplanterauchi@fsc.hokudai.ac.jp
Chapter 7

Benoit Tesson
University of California
San Diego, CA, USA
e-mail: btesson@ucsd.edu
Chapter 3

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