# Phycological Research

Volume 54 · Issue 4 · December 2006

ISSN 1322-0829



Blackwell Publishing

The Japanese Society of Phycology

# Phycological Research

### EDITOR-IN-CHIEF

Kazuo Okuda

Graduate School of Kuroshio Science, Kochi University, Kochi, Japan

#### ASSOCIATE EDITORS

Antonio Flores-Moya Faculty of Science University of Málaga Spain

Christos Katsaros Faculty of Biology University of Athens Greece

Ichiro Mine Graduate School of Kuroshio Science, Kochi University Japan

Giuseppe C. Zuccarello School of Biological Sciences Victoria University of Wellington New Zealand Daisuke Fujita
Department of Marine
Biosciences
Tokyo University of
Marine Science and
Technology
Japan

Jeong Ha Kim Department of Biological Sciences Sungkyunkwan University Korea

Taizo Motomura Field Science Center for Nothern Biosphere Hokkaido University Japan Gert Hansen Botanical Institute Univeristy of Copenhagen Denmark

Gwang Hoon Kim Department of Biology Kongju National University Korea

Orlando Necchi Jr Zoology and Botany Department São Paulo State University Brazil Ken-ichiro Ishida Graduate School of Natural Science & Technology Kanazawa Univeristy Japan

Kazuhiro Kogame Graduate School of Science Hokkaido University Japan

Hisayoshi Nozaki Graduate School of Science University of Tokyo Japan Ulf Karsten Institute of Aquatic Ecology - Applied Ecology - University of Rostock Germany

John W. La Claire II Section of Molecular Cell and Developmental Biology University of Texas at Austin USA

John West School of Botany University of Melbourne Australia

#### EDITORIAL ADVISORY BOARD

Yuji Fujita *Nagasaki, Japan* Takeo Horiguchi *Hokkaido, Japan* Ichiro Imai *Kyoto, Japan* Hironao Kataoka *Sendai, Japan* 

Hiroshi Kawai *Kobe, Japan* Dieter G. Müller *Konstanz, Germany* Masao Ohno *Kochi, Japan* Megumi Okazaki *Tokyo, Japan*  Robert Sheath *Guelph, Canada* Makoto M. Watanabe *Tsukuba, Japan* Yasutsugu Yokohama *Shizugawa, Japan* Isao Inouye *Tsukuba, Japan* 

This journal is available online at Blackwell synergy. Visit http://www.blackwell-synergy.com to search the articles and register for table of contents email alerts.

Access to this journal is available free online within institutions in the developing world through the AGORA initiative with the FAO. For information, visit http://www.aginternetwork.org.

AIMS AND SCOPE Phycological Research is published by the Japanese Society of Phycology and complements the Japanese Journal of Phycology. The Journal publishes international, peer-reviewed research dealing with all aspects of phycology to facilitate the international exchange of results. All articles are peer-reviewed by at least two researchers expert in the field of the submitted paper. Phycological Research has been credited by the International Association for Plant Taxonomy for the purpose of registration of new non-vascular plant names (including fossils). For further information see http://bgbm3.bgbm.fuberlin.de/iapt/registration/journals/htm.

ABSTRACTING AND INDEXING SERVICES The journal is indexed by BIOSIS Database, Cambridge Scientific Abstracts, Chemical Abstracts Service, Ecological Abstracts, EMBASE/Excerpta Medica, GEOBASE, ProQuest (previously University Microfilms), Science Citation Index (ISI), Zoological Record and National Inquiry Services Centre.

THE JAPANESE SOCIETY OF PHYCOLOGY We invite anyone who is interested in any aspect of phycology to become a member of the Society. As a member you will receive *Phycological Research* and the *Japanese Journal of Phycology* free of charge. The annual membership fee for individuals ¥8000. (Members who reside outside Japan will receive only the English language journal *Phycological Research* and the annual membership fee is ¥7000 (standard), ¥5000 student).)

Those who wish to join the Society should send the application form (at the back of each issue of the Journal), together with payment, to the Membership Secretary, Dr Mitsunobu Kamiya, at the address given on the form. Members who wish to claim for missing or damaged issues should contact the Membership Secretary.

ADDRESS FOR EDITORIAL CORRESPONDENCE Kazuo Okuda, Graduate School of Kuroshio Science, Kochi University, 2-5-1 Akebono-cho, Kochi 780-8520, Japan (email okuda@cc.kochi-u.ac.jp).

**DISCLAIMER** The Publisher, Society and Editors cannot be held responsible for errors or any consequences arising from the use of information contained in this journal; the views and opinions expressed do not necessarily rflect those of the Publisher, Society and Editors, neither does the publication of advertisements constitute any endorsement by the Publisher, Society and Editors of the products advertised.

### © 2006 Japanese Society of Phycology.

This publication is supported in part by a Grant-Aid for Publication of Scientific Research Results from the Japan Society for the Promotion of Science (JSPS).

Cover Microfilaments (red) and nuclei (blue) at the early stage of segregative cell division in the green alga Dictyoshaeria cavernosa. Photographed by Dr. Kazuo Okuda.

For submission instructions, subscription and all other information visit http://www.blackwellpublishing.com/pre

ISSN 1322-0829 (Print) ISSN 1440-183 (online)

## The Japanese Society of Phycology

Officers for 2005-2006

President: Hiroshi Kawai, Kobe University Research Center for Inland Seas, Kobe 657-8501, Japan Secretary: Takeaki Hanyuda, Kobe University Research Center for Inland Seas, Kobe 657-8501,

Public Relations Secretary: Satoshi Shimada, Center for Advanced Science and Technology, Hokkaido University, Sapporo 060-0810, Japan

Membership Secretary: Mitsunobu Kamiya, Faculty of Biotechnology, Fukui Prefectural University, Obama 917-0003, Japan

Secretary for International Affairs: Ken-ichiro Ishida. Faculty of Science, Kanazawa University, Kanazawa 920-1192, Japan

Treasurer: Daiske Honda, Faculty of Science and Engineering, Konan University, Kobe 658-8501, Japan.

### Members of Executive Council 2005-2006

Tetsuro Ajisaka Kyoto University

Daisuke Fujita Tokyo University of Marine Science and

Technology

Yoshiaki Hara Yamagata University Takeo Horiguchi Hokkaido University Masahiko Idei Bunkyo University Ichiro Imai Kvoto University Isao Inouye University of Tsukuba Ken-ichiro Ishida Kanazawa University

Tadahiko Kajiwara Yamaguchi University Shigeo Kawaguchi Kyushu University Akira Kurashima Mie University Miyuki Maegawa Mie University

Tamotsu Nagumo The Nippon Dental University

Tadahide Noro Kagoshima University Kazuo Okuda Kochi University Naotsune Saga Hokkaido University Makoto Yoshizaki Toho University

### JOIN THE JAPANESE SOCIETY OF PHYCOLOGY AND RECEIVE FOUR ISSUES OF PHYCOLOGICAL RESEARCH PER YEAR FREE OF CHARGE

The Japanese Society of Phycology, founded in 1952, currently has 760 members (including 105 overseas members). The Society is open to anyone who is interested in pure or applied aspects of phycology.

### **Application for membership**

(Please type or write in block I		Membership starts from 2005			
		(Given name and initials)			
Mailing address:					
Telephone:		Fax:	(Postal code)		
E-mail:					
Signature:		Date:			
(¥7000 for members w		Japan, ¥500			
Payment by:	sa □ MasterCard	□ American E	Express		
Card number:	Ex	piry date:			
Signature:					
<ul> <li>□ International giro postal trans</li> <li>□ International postal money or</li> </ul>		o.: 01320-4-487	748)		

Send application form to: Dr Mitsunobu Kamiya

Faculty of Biotechnology Fukui Prefectural University 1-1 Gakuen-cho,

Obama 917-0003, Japan

Fax: +81 770 52 6003; email:jsp@wwwsoc.nii.ac.jp

# Phycological Research

### Volume 54 • Issue 4 • December 2006

Arthur Ramazanov and Zakir Ramazanov Isolation and characterization of a starchless mutant of Chlorella pyrenoidosa STL-PI with a high growth rate, and high protein and polyunsaturated fatty acid content	255
Chung-Ching Liao, Shao-Lun Liu and Wei-Lung Wang  Effects of temperature and pH on growth and photosynthesis of the thermophilic  cyanobacterium Synechococcus lividus as measured by pulse-amplitude modulated  fluorometry	260
Norishige Yotsukura, Tadashi Kawai, Shoji Kawashima, Hiroki Ebata and Terunobu Ichimura  Nucleotide sequence diversity of the 5S rDNA spacer in the simple blade kelp genera  Laminaria, Cymathaere and Kjellmaniella (Laminariales, Phaeophyceae) from northern Japan	269
Yoshimasa Yamamoto and Hiroyuki Nakahara Seasonal variations in the diel vertical distribution of phytoplankton and zooplankton in a shallow pond	280
Matthew L. Julius, Michael Curtin and Hiroyuki Tanaka Stephanodiscus kusuensis, sp. nov a new Pleistocene diatom from Southern Japan	294
Han Gil Choi, Ji Hee Lee, Young-Kug Choo, Kyu-Yun Chai, Young Sik Kim, Jung-Soo Han, Anchana Prathep and Ki Wan Nam Phenology of the rhodomelarian algae Neorhodomela aculeata and Ceramium kondoi and their survival strategies against herbivorous snails	302
Jeane R. Indy, Antoine D. R. N'Yeurt and Hajime Yasui Reproductive morphology and taxonomic reappraisal of Exophyllum wentii Weber-van Bosse (Rhodomelaceae, Rhodophyta) from Bali Island, Indonesia	308
Aika Yamaguchi, Hiroshi Kawamura and Takeo Horiguchi  A further phylogenetic study of the heterotrophic dinoflagellate genus, Protoperidinium  (Dinophyceae) based on small and large subunit ribosomal RNA gene sequences	317
Eréndira J. Cohen-Fernandez, Esther Meave Del Castillo, I. H. Salgado Ugarte and Francisco F. Pedroche  Contribution of external morphology in solving a species complex: The case of Prorocentrum micans, Prorocentrum gracile and Prorocentrum sigmoides (Dinoflagellata) from the Mexican Pacific Coast	330
Referees	341
Author index	342
Subject index	343

