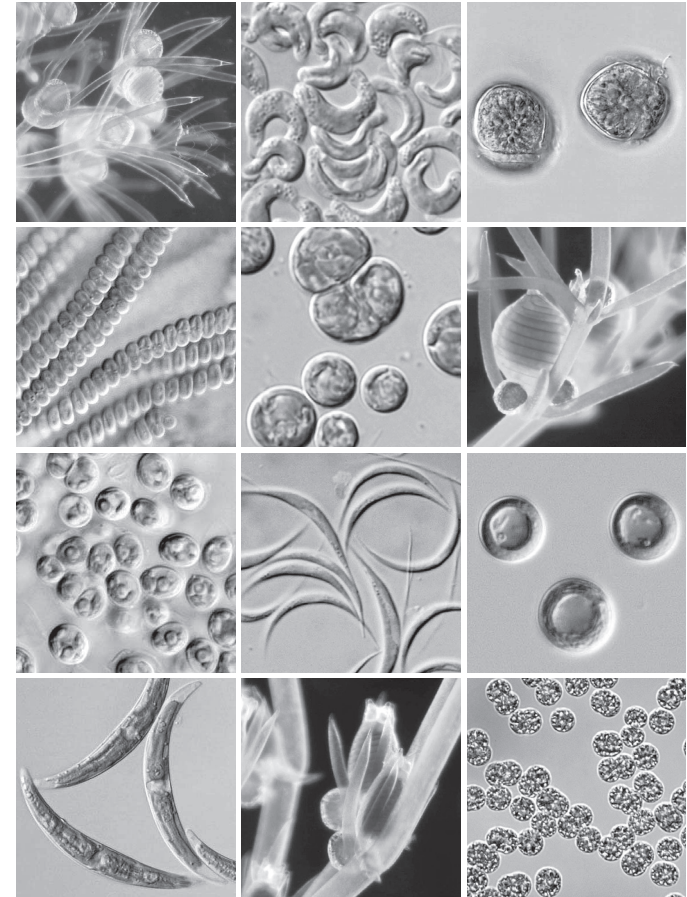


Algal Culture Collections and the Environment

Algal Culture Collections and the Environment

Edited by
Fumie Kasai, Kunimitsu Kaya & Makoto M. Watanabe



Cover -Algal photographs from the image collection of the NIES-Collection, and courtesy of M. Kawachi and S. Hirabayashi.

Algal Culture Collections and the Environment

Copyright © 2005 by Fumie Kasai et al.

All rights reserved, but the right to each figure belongs to the person stated in the caption.

No part of this book may be reproduced in any form by photostat, microfilm, or any other means, without the written permission of the publisher.

ISBN 4-486-01710-2

First edition October, 2005

Printed in Japan

Tokai University Press

Tokai University Alumni Hall 3-10-35 Minamiyana,

Hadano-shi, Kanagawa 257-0003, Japan

URL <http://www.press.tokai.ac.jp/>

Contributors

Robert A. Andersen: Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, ME 04575 USA
randersen@bigelow.org

Vullapa Arunpairojana: Thailand Institute of Scientific and Technological Research, 196 Phahonyothin Rd, Chatuchak, Bangkok 10900, Thailand

Susan I. Blackburn: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia
susan.blackburn@csiro.au

Christopher J. Bolch: School of Aquaculture, University of Tasmania, Locked Bag 1370, Launceston, Tasmania 7250, Australia

Malcolm R. Brown: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Wan-Loy Chu: International Medical University, Plaza Komanwel, Bukit Jalil 57000, Kuala Lumpur, Malaysia
loy008@imu.edu.my

John G. Day: Culture Collection of Algae and Protozoa, SAMS Research Services Ltd, Dunstaffnage Marine Laboratory, Oban, Argyll PA37 1QA, Scotland, United Kingdom
John.Day-SAMS@sams.ac.uk

Dion M. F. Frampton: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Nanqin Gan: Institute of Hydrobiology, The Chinese Academy of Science, Donghu Nanlu No.7, Wuchang, Wuhan 430072, Hubei, P. R. China

Ian D. Jameson: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Fumie Kasai: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan
kasaif@nies.go.jp

Hideo Kasaki: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

Nobuyoshi Kato: Faculty of Foreign Languages, Dokkyo University, 1-1 Gakuen-cho, Soka, Saitama 340-0042, Japan

Masanobu Kawachi: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

Kunimitsu Kaya: Graduate School of Environmental Studies, Tohoku University, Aoba 6-6-20, Aramaki, Aoba-ku, Sendai 980-8579, Japan
kaya@mail.kankyo.tohoku.ac.jp

Watcharee Kunyalung: Thailand Institute of Scientific and Technological Research, 196 Phahonyothin Rd, Chatuchak, Bangkok 10900, Thailand

Aparat Mahakhant: Thailand Institute of Scientific and Technological Research, 196 Phahonyothin Rd, Chatuchak, Bangkok 10900, Thailand
aparat@tistr.or.th

M. Peter Mansour: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Asira P. Munkhong: Faculty of Environment and Resources Studies, Mahidol University, 25/25 Puttamonthon Sai 4 Rd, Salaya, Nakhon Pathom 73170, Thailand

Andrew P. Negri: Australian Institute of Marine Science, PMB 3 Townsville MC, Queensland 4810, Australia

Peter D. Nichols: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Seiichi Nohara: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

Hisayoshi Nozaki: Department of Biological Sciences, Graduate School of Science, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

Yuji Omori: Yokosuka City Museum, 95 Fukadadai, Yokosuka, Kanagawa 238-0016, Japan

Hui Pan: Institute of Hydrobiology, The Chinese Academy of Science, Donghu Nanlu No.7, Wuchang, Wuhan 430072, Hubei, P. R. China

Naomi S. Parker: CSIRO Marine and Atmospheric Research and Department of Agriculture, Fisheries and Forestry, GPO Box 858, Canberra ACT, 2601, Australia

Siew-Moi Phang: Institute of Biological Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia
phang@um.edu.my

Stanley S. Robert: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Satomi Sano: Ichikawa-Nishi High School, 1-1-1 Higashi-kokubun, Ichikawa, Chiba 272-0832, Japan

Tomoharu Sano: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

Lirong Song: Institute of Hydrobiology, The Chinese Academy of Science, Donghu Nanlu No.7, Wuchang, Wuhan 430072, Hubei, P. R. China
lrsong@ihb.ac.cn

Ming-Li Teoh: Institute of Biological Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia

Patana Thavipoke: Faculty of Environment and Resources Studies, Mahidol University, 25/25 Puttamonthon Sai 4 Rd, Salaya, Nakhon Pathom 73170, Thailand

John K. Volkman: CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia

Makoto M. Watanabe: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan
mmw@nies.go.jp

Chiew-Yen Wong: Institute of Biological Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia

Preface

Algae are closely related to environmental problems in several respects. Eutrophication may cause blooms of algae such as cyanobacteria and dinoflagellates. Some macroalgae are affected negatively by environmental deterioration, such as eutrophication and habitat destruction, and are threatened with extinction. Algae sometimes produce toxins that have exerted harmful effects on humans and other organisms. In contrast, some algae synthesize beneficial compounds, such as carotenoids and PUFA, which are accumulated in aquatic organisms through food webs, and humans also share in the bounty of algae. Environmental changes may result in metabolic changes in algae, which, in turn, would affect organisms at higher trophic levels through the food web. In their roles as primary producers, algal species have been used to evaluate water quality and assess chemical substances.

When experiments are conducted to resolve environmental problems, researchers often use algal strains maintained in culture collections. In this sense, culture collections play an important role in environmental studies. Another role of culture collections is *ex situ* conservation of biodiversity and threatened species. Culture collections could contribute to various other fields of research as well, such as life sciences and aquaculture.

Today, the world's major culture collections are roughly estimated to maintain no more than 5000 species (from the reported numbers of species in SAG, CCMP, CSIRO, and NIES), representing at most 14% of the described and only a small percentage of the estimated numbers of algal species (36,000–43,000 described vs. 160,000–1,200,000 estimated species; Andersen, 1992). Researchers assume that a large number of species have yet to be discovered in the tropical Asia-Oceania region. Therefore, culture collections in this region would be important for countries in the vicinity and other countries as well.

This book was compiled based on the papers presented at the symposium “Algal Culture Collections and the Environment” held at the Third Asia Pacific Phycological Forum, Tsukuba, Japan (Algae 2002). This symposium represents the first small step toward the Asia Oceania Algal Culture Collection Network, which was launched during a roundtable discussion at the Tenth International Congress for Culture Collections (ICCC-10) in October 2004. The Asia Oceania Algal Culture Collection Network has been

realized gradually over the past three years, and now seems to be a suitable time to publish this book.

In “Roles of Culture Collections,” various aspects of algal culture collections are reported for representative collections in Asia and the Pacific region. In addition, cryopreservation, the most effective long-term preservation method of microalgae, and related problems of this method are discussed. This section explains efforts to maintain not only culture strains but also culture collections themselves. In “Environmental Aspects,” environmental topics are reported and reviewed: the water bloom-forming cyanobacterium *Microcystis* and its toxins; the bioactive compounds produced by freshwater cyanobacteria and their chemical structures; algal responses to environmental factors; and the threatened state of algae in Japan, with suggestions for a new role of algal culture collections. We hope that this book is helpful to those working with culture collections and those interested in the relationships of algae and the environment.

The editors are grateful Dr. S. I. Blackburn, Dr. A. Mahakhant, Dr. J. G. Day, all presenters at the symposium “Algal Culture Collections and the Environment,” and all members of NIES-Collection.

Fumie Kasai, Kunimitsu Kaya, and Makoto M. Watanabe

Contents

Contributors v

Preface ix

Roles of Culture Collections

- 1 History and Future Prospect of the Microbial Culture Collection at the National Institute for Environmental Studies (NIES-Collection)
M. M. Watanabe, F. Kasai, M. Kawachi 3
- 2 The University of Malaya Algae Culture Collection (UMACC): 1987-2005
S. M. Phang, W. L. Chu 13
- 3 Algal Culture Collection at MIRCEN, TISTR
W. Konyalung, A. Mahakhant 21
- 4 The CSIRO Collection of Living Microalgae: An Australian Perspective on Microalgal Biodiversity and Application
S. I. Blackburn, D. M. F. Frampton, I. D. Jameson, M. R. Brown, M. P. Mansour, A. P. Negri, P. D. Nichols, N. S. Parker, S. S. Robert, C. J. Bolch, J. K. Volkman 29
- 5 The Provasoli-Guillard National Center for Culture of Marine Phytoplankton: Past, Present and Future
R. A. Andersen 65
- 6 Cryopreservation and the Problem of Freeze-Recalcitrance in Algal Culture Collections
J. G. Day 73

Environmental Aspects

- 7 Toxic *Microcystis* Blooms and Microcystin Composition in Eutrophic Lakes of China
L. R. Song, N. Q. Gan, H. Pan 89
- 8 Lysis of *Microcystis* Cells and Degradation of Microcystins by Soil Bacteria
A. Munkhong, A. Mahakhant, P. Thavipoke, V. Arunpairrojana 109
- 9 Bioactive Compounds of Freshwater Cyanobacteria
K. Kaya, T. Sano 121
- 10 Response and Adaptation of Algae to the Changing Global Environment
W. L. Chu, C. Y. Wong, M. L. Teoh, S. M. Phang 177

11 Response of Algae to Herbicides	
F. Kasai	197
12 Threatened States of the Charales in the Lakes of Japan	
M. M. Watanabe, H. Nozaki, H. Kasaki, S. Sano, N. Kato, Y. Omori, S. Nohara	217
Appendix	
Algal culture collections in the world	237
Useful websites	238
Index	239