



The Pearl Oyster

*Paul C. Southgate
John S. Lucas*

The Pearl Oyster

The Pearl Oyster

Edited By

Paul C. Southgate
John S. Lucas



ELSEVIER

Amsterdam • Boston • Heidelberg • London • New York • Oxford
Paris • San Diego • San Francisco • Singapore • Sydney • Tokyo

Elsevier

The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK
Radarweg 29, PO Box 211, 1000 AE Amsterdam, The Netherlands

First edition 2008

Copyright © 2008 Elsevier BV. All rights reserved

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher.

Permissions may be sought directly from Elsevier's Science & Technology Rights Department in Oxford, UK; phone: (+44) (0) 1865 843830; fax: (+44) (0) 1865 853333; email: permissions@elsevier.com. Alternatively you can submit your request online by visiting the Elsevier web site at <http://elsevier.com/locate/permissions>, and selecting *Obtaining permission to use Elsevier material*.

Notice

No responsibility is assumed by the publisher for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. Because of rapid advances in the medical sciences, in particular, independent verification of diagnoses and drug dosages should be made.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

ISBN-13: 978-0-44-452976-3

For information on all Elsevier publications
visit our website at elsevierdirect.com

Printed and bound in Hungary

08 09 10 11 12 10 9 8 7 6 5 4 3 2 1

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER BOOK AID International Sabre Foundation

CONTENTS

<i>Preface</i>	vii
<i>List of Contributors</i>	ix
<i>Dedication</i>	xi
<i>Acknowledgments</i>	xiii
1. Introduction	1
<i>Elisabeth Strack</i>	
2. Taxonomy and Phylogeny	37
<i>Katsuhiko T. Wada and Ilya Tëmkin</i>	
3. Soft Tissue Anatomy, Shell Structure and Biomineralization	77
<i>Angelique Fougerouse, Marthe Rousseau and John S. Lucas</i>	
4. Feeding and Metabolism	103
<i>John S. Lucas</i>	
5. Reproduction, Development and Growth	131
<i>Pedro E. Saucedo and Paul C. Southgate</i>	
6. Environmental Influences	187
<i>John S. Lucas</i>	
7. Pearl Oyster Culture	231
<i>Paul C. Southgate</i>	
8. Pearl Production	273
<i>Joseph Taylor and Elisabeth Strack</i>	
9. Exploitation and Culture of Major Commercial Species	303
<i>Paul C. Southgate, Elisabeth Strack, Anthony Hart, Katsuhiko T. Wada, Mario Monteforte, Micheline Cariño, Sandra Langy, Cedrik Lo, Héctor Acosta-Salmón and Aimin Wang</i>	
10. The Pearl Market	357
<i>Richard D. Torrey and Brigitte Sheung</i>	

11. Disease and Predation	367
<i>John D. Humphrey</i>	
12. Population Genetics and Stock Improvement	437
<i>Katsuhiko T. Wada and Dean R. Jerry</i>	
13. Economics of Pearl Farming	473
<i>Clem Tisdell and Bernard Poirine</i>	
14. Environmental Impacts of Pearl Farming	497
<i>Wayne A. O'Connor and Scott P. Gifford</i>	
15. Biofouling	527
<i>Rocky de Nys and Odette Ison</i>	
16. Future Developments	555
<i>Paul C. Southgate, John S. Lucas and Richard D. Torrey</i>	
<i>Index</i>	567

PREFACE

The plain outer surfaces of pearl oyster shells conceal the lustrous beauty of their mother-of-pearl lining. Pearl oysters of the family Pteriidae have been fished for thousands of years to satisfy human fascination with mother-of-pearl, an activity which occasionally uncovered rare and highly prized natural pearls. In the early 1900s, the ability of pearl oyster tissue to secrete mother-of-pearl was harnessed for production of cultured pearls. This process, which has changed little since, provides the basis for a cultured marine pearl industry with a current value of around US\$ 500 million per annum.

Exploitation of pearl oysters by fishermen seeking natural pearls and mother-of-pearl, or by pearl farmers, has a rich and fascinating history and the modern pearling industry does not necessarily reflect the past glories of some countries. While many of us associate pearls with fashionable jewelry-shop windows and glossy magazines, it is an industry which also offers economic opportunities to coastal communities in less developed countries; an industry which involves individuals, co-operatives and families, as well as large multinational companies. This book presents an overview of the utilization of pearl oysters through history, from ancient pearl fisheries to modern pearl farming.

A large volume of research on the biology and culture of pearl oysters has been published, predominantly since the 1950s. Major databases show a rapid growth from 55 publications in the 1950s to around 400 in the 1980s and to 860 in the 1990s. Over the past 20–25 years pearl oyster biology has well and truly become a science. Now there are new focuses for research in this field including genetics and inheritance, structure and properties of mother-of-pearl (nacre), mechanisms of nacre formation and the potential of this process in medical science.

In seeking to be comprehensive, this book brings together contributors from a broad range of fields, including commercial pearl farming, economics, fisheries biology, gemology and jewelry retail, humanities and science, to provide an overview of pearl oyster biology, culture techniques, global pearl production, and the current pearl market. We trust that it will be of much interest and assistance to all those who share our fascination with pearl oysters and their products.

*Paul Southgate
John Lucas*

LIST OF CONTRIBUTORS

Héctor Acosta-Salmón, Center for Aquaculture and Stock Enhancement, Harbor Branch Oceanographic Institute at Florida Atlantic University, 5600 US 1 North, Fort Pierce, FL 34946, USA

Micheline Cariño, Department of Humanities, Universidad Autónoma de Baja California Sur, La Paz, B.C.S., Mexico

Angelique Fougerouse, Pearl Culture Agency, P.O. Box 9047, Motu Uta 98715, Tahiti, French Polynesia

Scott P. Gifford, School of Environmental and Life Sciences, University of Newcastle, Callaghan, NSW, 2308, Australia

Anthony Hart, West Australian Fisheries Research Laboratories, P.O. Box 20, North Beach, WA 6920, Australia

John D. Humphrey, Aquatic Animal Health, Department of Primary Industry, Fisheries and Mines, GPO Box 3000, Darwin, NT 0801, Australia

Odette Ison, School of Marine and Tropical Biology, James Cook University, Townsville, Qld. 4811, Australia

Dean R. Jerry, School of Marine and Tropical Biology, James Cook University, Townsville, Qld. 4811, Australia

Sandra Langy, Ministry of Sea Fisheries Aquaculture and Research, P.O. Box 2551, Papeete 98713, Tahiti, French Polynesia

Cedrik Lo, Pearl Culture Agency, P.O. Box 9047, Motnuka 98715, Tahiti, French Polynesia

John S. Lucas, Centre for Marine Studies, University of Queensland, St. Lucia, Qld 4072, Australia

Mario Monteforte, Centro de Investigaciones Biologicas del Noroeste, S.C., Mar Bermejo 195, Col. Playa Palo de Santa Rita, La Paz, B.C.S., Mexico

Rocky de Nys, School of Marine and Tropical Biology, James Cook University, Townsville, Qld. 4811, Australia

Wayne A. O'Connor, NSW Department of Primary Industries, Port Stephens Fisheries Centre, Locked Bag 1, Nelson Bay, NSW 2315

Bernard Poirine, Université de la Polynésie Française, BP 5670, Tahiti, French Polynesia

Marthe Rousseau, MNHN Département Milieux et Peuplements, Aquatiques, UMR 5178, Biologie des Organismes Marins et Ecosystèmes, CP26 43, rue Cuvier, 75005 Paris, France

Pedro E. Saucedo, Centro de Investigaciones Biologicas del Noroeste, S.C., Mar Bermejo 195, Col. Playa Palo de Santa Rita, La Paz, B.C.S., Mexico

Brigitte Sheung, Golay Buchel & Cie SA, Avenue De Rhodanie 60, CH-1000 Lausanne 3 Cour, Switzerland

Paul C. Southgate, School of Marine and Tropical Biology, James Cook University, Townsville, Qld. 4811, Australia

Elisabeth Strack, Gemmologisches Institut Hamburg, Gerhofstr 19, 20354 Hamburg, Germany

Joseph Taylor, Pertokoan Sanur Raya NO. 10–19, Jalan Bypass Ngurah Rai, Sanur – Denpasar Selatan 80227, Bali, Republic of Indonesia

Ilya Tëmkin, Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, USA

Clem Tisdell, School of Economics, University of Queensland, Brisbane, Qld. 4072, Australia

Richard D. Torrey, *Pearl World: The International Pearling Journal*, 302 West Kaler Drive, Phoenix, Arizona 85021-724302, USA

Katsuhiko T. Wada, Research Planning and Coordination Division, National Research Institute of Aquaculture (NRIA), Fisheries Research Agency (FRA), Nansei, Mie 5160193, Japan

Aimin Wang, Ocean College, Hainan University, Haikou 570228, China

DEDICATION

We dedicate this book to our “pearls” Dawn and Helen

ACKNOWLEDGMENTS

We acknowledge that many people have assisted the editors and authors of chapters with photographs, translations, information, and in other ways. We express our sincere gratitude for their contributions.

