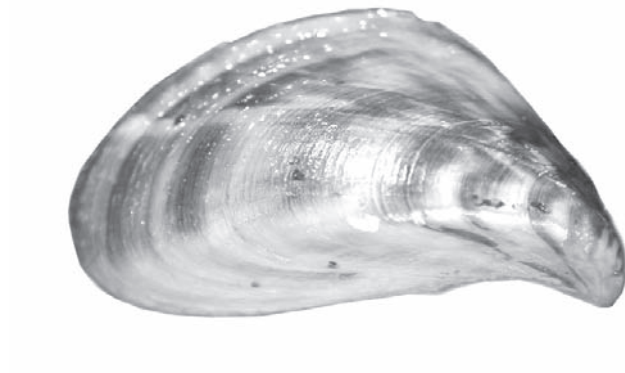


The Zebra Mussel in Europe



edited by
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Abraham bij de Vaate



Backhuys Publishers, Leiden
Margraf Publishers, Weikersheim

ISBN 978-3-8236-1594-1
ISBN 978-90-5782-189-9

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Preface

The zebra mussel *Dreissena polymorpha* (Pallas, 1771) invaded the Great Lakes about 1987 or some years earlier. It spread so quickly and reached such high densities that this sessile filter feeder had an impact on these ecosystems and became the most serious biofouling pest as well. In due course, zebra mussels became synonymous with invasions of aquatic nuisance species. Projects, conferences, workshops, publications, theses, proceedings, newsletters, reports and websites concerning this species became booming business. However, international books dealing exclusively with zebra mussels and their relatives are only a few. One of the most important books with contributions from North American as well as non-North American authors is a 810 pages thick book edited by Thomas F. Nalepa and Donald W. Schloesser (1993) dealing with all aspects of Zebra mussels biology, impacts and control summarizing the European experience and knowledge thus far completed with recent studies from North America. One year later in 1994 another book of 227 pages was published by Renata Claudi and Gerald L. Mackie entitled "Practical manual for zebra mussel monitoring and control". This practical, well-written guide was intended for engineers, technicians and operators at power utilities, industries and water or wastewater treatment plants. In 1997, another book appeared edited by Frank M. D'Itri, entitled "Zebra mussels and aquatic nuisance species" (638 pages), which was, in fact, the proceedings of the Sixth International Zebra Mussel and Other Aquatic Nuisance Species Conference held in Dearborn in 1996.

The Europeans produced in 1992 also a book on the zebra mussel, the result of a meeting of German, Dutch and French researchers involved in studies on population dynamics, ecophysiology, ecotoxicology and biomonitoring. This book edited by Dietrich Neumann and Henk A. Jenner was entitled "The zebra mussel *Dreissena polymorpha*" with the subtitle ecology, biological monitoring and first applications in the water quality management (262 pages). This book has emphasized the use of zebra mussels as early warning systems for water quality control and as biological filter to mitigate the effects of eutrophication and other pollution. Why should we add a new book to the 1937 pages of information available in these four books? We noticed that a book specialized on the European experience with the zebra mussel and its relatives was lacking in spite of the origin from and early invasions in that continent. Furthermore, we have 10 years more experience with the zebra mussel since the last book was published. The last decades represent a new phase of zebra mussel invasions in Europe with range extensions towards other countries such as Ireland and Spain, as well as range extensions within countries. The latter probably is generated by increased economic and recreational activities as vectors for dispersal coinciding with water quality improvement and with climate change. Another argument in support of this book is that the literature on the zebra mussel is nowadays so numerous and widely spread, that a new overview is long overdue in order not to get lost in heaps of publications and grey literature.

The present book is an up-to-date overview of specialists with contributions on all aspects of the zebra mussel. It gives information on fossil and recent species, distribution and dispersal, genetics, food, growth and life history, ecology and ecological impacts, endosymbionts, parasites, predation, indication for water quality and applications, biofouling and control.

We sincerely hope the book serves the function it is intended to and becomes a valuable addition to the literature on zebra mussels.

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Sanjeevi Rajagopal
Abraham bij de Vaate

Acknowledgements

We gratefully acknowledge the important contribution of various reviewers for their valuable and constructive comments on the drafts of the different chapters of the book. Many thanks are due to Gerard Dekkers of the Illustration department of Radboud University Nijmegen, Netherlands for improving the quality of figures, wherever necessary and to Peter Charpentier, Institute of Water and Wetland Research (Radboud University Nijmegen) for checking the references. Thanks are also due to Dr. V.P. Venugopalan, Bhabha Atomic Research Centre, Kalpakkam, India for valuable comments on the manuscripts. We are deeply indebted to Elizabeth Muckle-Jeffs (The Professional Edge, Pembroke, Canada), Conference Administrator, International Conference on Aquatic Invasive Species (ICAIS), who successfully organized the 16 conferences in last 20 years, the proceedings of which formed the basis for this book. SR was partly supported by the European Commission in the Community's Sixth Frame work Programme (Contract number: PL510658, Assessing impacts of TBT on multiple coastal uses) and The Netherlands Organisation for Scientific Research (NWO), The Hague (Contract number: B 84-667). We are indebted to our colleagues of Department of Animal Ecology and Ecophysiology (Radboud University Nijmegen) for their unstinting support and help at various stages of this book.

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Gerard van der Velde was born on 7th September 1946 at Groningen, The Netherlands. After high school at Delft and military service, he studied biology at Leiden University. In 1974 he became a Ph.D. student at the Laboratory for Aquatic Ecology of the University of Nijmegen. After Ph.D., he became Associate Professor at the same laboratory. Presently, he is a member of the staff of the Department of Animal Ecology and Ecophysiology, Institute for Water and Wetland Research of the Radboud University Nijmegen.

He was Visiting Professor at the Vrije Universiteit Brussel (Belgium) lecturing tropical coastal marine ecology. He has been the President of the Dutch Malacological Society, Vice-President of the Netherlands-Flemish Society for Aquatic Ecology (NVAE), the President of the European Invertebrate Survey-Nederland, and member of the Scientific Council of the International Centre for Ecology of the Polish Academy of Sciences for several years. He is still a member of the sea team of the Netherlands Centre for Biodiversity Naturalis, Leiden.

He took part on several marine expeditions and was involved in research on marine coastal ecosystems, in particular the nursery function of back-reef habitats in the Indo-Pacific and the Caribbean. Another main topic of his research is Ecological Rehabilitation of Large Rivers and of wetlands. In cooperation with Abraham bij de Vaate, he was involved in large projects on the ecological rehabilitation of the River Rhine, where over the years more and more alien species became dominant. In cooperation with Sanjeevi Rajagopal he worked for several years on biological invasions and biofouling. Zebra mussels are one of the main study subjects.

Gerard van der Velde is author of more than 300 international publications and (co)promotor of more than 25 Ph.D. theses. He was in the editorial boards of Aquatic Botany, Biological Invasions, Aquatic Ecology, Chemistry & Ecology and currently serves on the editorial boards of Crustaceana, Crustaceana Monographs, Aquatic Invasions and Bacteria. Main topics of his group are biological invasions and biofouling, riverine, estuarine and tropical coastal ecosystems, macroinvertebrates and fish.



Sanjeevi Rajagopal was born on 14th May 1963 at Srirengapuram in the Southern part of India. He was an undergraduate in Zoology at the American College (Madurai, India). He did his Masters in Zoology at The Pachaiyappas College (Chennai, India) and M.Phil. in Zoology at Madras Christian College (Chennai, India). He earned a Ph.D. degree from University of Madras in 1991. For his Ph.D. degree, he worked on biofouling problems in cooling conduits of the Madras Atomic Power Station at Kalpakkam. Subsequently, he obtained a Ph.D. degree from University of Nijmegen, The Netherlands in February 1997.

In April 1991, he became Assistant Professor at the Department of Zoology, Thiagarajar College (Madurai Kamaraj University, India). In March 1994, he was selected for Group Study Exchange Programme (best Young Scientist) by the Rotary International (District 3000), Illinois, USA and visited Argentina, Paraguay and Brazil as a Rotary International Ambassador of goodwill and understanding. He joined the Department of Animal Ecology and Ecophysiology, Radboud University Nijmegen, Institute for Water and Wetland Research, The Netherlands in June 1994.

He is presently analyzing genetic diversity of European (Baltic, Atlantic and Mediterranean coasts) populations of *Mytilus* spp. and invasive routes including dispersal pathways of *Dreissena polymorpha* as determined by PCR-based AFLP fingerprinting. He is also studying the population structure of commercially important fish fauna in mangrove ecosystems, especially with reference to their recruitment patterns and trophic relationships in the Caribbean Sea and the Godavari estuary on the east coast of India. He is involved in the development of novel (carbon dioxide based), environmentally sound (heat treatment), chemical (chlorination) and non-chemical (biological control) technologies for the control of macro-fouling in raw water systems.

He is an Advisory Member of Grupo Ecologista, University of Misiones, Argentina and a Member of numerous societies, including the Marine Biological Association of the United Kingdom and The British Ecological Society, England. He has published more than 100 scientific papers in International journals and has edited two books.



Abraham bij de Vaate was born on 6th September 1945 at Zierikzee, The Netherlands. From the second half of the 1970's he has been involved in zebra mussel research that started when he was a staff member of the IJsselmeer Polders Development Authority. His research interest included macroinvertebrates and fish. In 1986 he moved to the Institute for Inland Water Management & Waste Water Treatment (RIZA), the national Dutch freshwater institute, to become a researcher and project manager in the field of river ecology. From that time his contacts with Gerard van der Velde intensified and resulted in several joint projects in the field of riverine macrozoobenthos. Their cooperation was enhanced since Ecological River Rehabilitation became a political issue from 1987, resulting in increasing concern for the aquatic life in rivers.

Non-indigenous macroinvertebrates became important in his studies since their number has been increasing considerably in the Dutch part of the River Rhine due to water quality improvement, intercontinental shipping (to the Port of Rotterdam) and connection of the Rhine and Danube basins after completion of the Main-Danube canal in 1992.

He has published many papers on benthic macroinvertebrate communities and fish migration. In 2003 he received his Ph.D. from Wageningen University for his thesis entitled 'The degradation and recovery of the freshwater fauna in the lower sections of the rivers Rhine and Meuse'.

In 2005 he retired from RIZA and started his consultancy in the field of aquatic ecology. Within his consultancy, Waterfauna Hydrobiologisch Adviesbureau, he focuses among other subjects on non-indigenous aquatic species. Dreissenidae remained subject of his interest; the discovery of the quagga mussel in The Netherlands gave a new impulse to that.

He was co-initiator and the first chairman of the Dutch Working Group on Aquatic Non-indigenous Species and chairman of the Technical Program Committee for the 15th International Conference on Aquatic Invasive Species, Nijmegen, The Netherlands, November 2007.

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