

Book Review: The Zebra Mussel in Europe

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When the zebra mussel *Dreissena polymorpha* staged a trans-Atlantic invasion of North America in the late 1980s, jumping from its native Europe, it set off a major new international research initiative to study not only the biology of invasion by this species, but of invasive aquatic organisms in general. Over the last 20 years, more has been published on the zebra mussel than in all the previous years, mostly relating to its impact on North American systems. However, in the last decade, much of the interest in the zebra mussel has shifted back to its native continent, due in part to the invasion of new European regions such as Ireland and Spain. At the same time, its success in newly invaded areas has caused a resurgence of interest in its original biogeographical range. With the release of a new major book, *The Zebra Mussel in Europe*, editors Gerard van der Velde, Sanjeevi Rajagopal, and Abraham bij de Vaate have brought a compilation and synthesis of knowledge on this species and related freshwater and brackish water bivalves. This work is a grand achievement, and will serve not only to consolidate the disparate literature on the subject, but will undoubtedly stimulate even more work on this species and, perhaps more importantly, the globally emerging field of aquatic invasion biology.

The book certainly lives up to its title in being an international work. Geographically, chapters and authors span countries across Europe, from Ireland and Great Britain to Poland and Russia, from southern Spain to Norway, from Macedonia to Belgium, and most of the areas and watersheds between. In all, the impressive 95 contributing authors represent home institutions in 18 countries, and most of the authors reflect on their extensive experiences in countries other than those in which they are based. Most of the

coverage is of Europe, as the designated topic, but the global impact of zebra mussel invasions gains coverage from treatment of other areas that have been invaded or are considered potential sites of future invasions. Thus, chapter authors from the United States, Canada, and New Zealand add to the geographic breadth of the book. Clearly, from a geographical standpoint, biologists from around the world will find much of value in this book.

Physically, the book is handsomely designed to be a major reference work, crafted from archival quality materials including acid-free hard-stock paper, bound into signatures in a single hard-cover volume. The book is of large format, approximating a standard A4 page size, thus making the book very effective for highly functional layouts that include text, halftone photographs, and numerous graphs and line art. The many illustrations are generally very good in quality throughout. The line art is very good to excellent, varying somewhat in quality from chapter to chapter. The authors have been very generous in their use of line art and graphics, which give the book much of its utility and will result in its frequent use for teaching and research. Halftones are good but not excellent, with contrast and resolution slightly below optimum due to medium-resolution screening, and thus low number of dots per inch, combined with the low-gloss paper stock. The few color photographs are nicely reproduced, as the four-color screening renders better results in these media than with halftones. Nevertheless, there are many photographs, ranging from histological sections to riverine landscapes, and the quality is more than adequate.

The book is arranged into six sections, which incorporate 41 chapters. The topics are comprehensive, ranging from basic biology of

zebra mussels provided by several authors, to historical biology and paleontology coverage. There is excellent coverage of monitoring and surveillance, including in-depth treatment by Verween et al. of the related brackish-water species, *Mytilopsis leucophaeata*, which was introduced into Europe from North America, thus reversing the invasion direction of *Dreissena* spp., and providing a good comparative model. Distribution, dispersal and genetics are covered in 11 far-ranging chapters, spanning the areas of classical ecology through modern molecular genomics. Five chapters are devoted to food, growth and life history, including larval development, nutrition, reproductive behavior, and other topics. Ecology and ecological impacts of the mussels in both native and invaded waters receive in-depth coverage in seven chapters, including treatment of interactions with aquatic plants, predation by waterfowl, and associations with endosymbionts. The fifth section deals with indicators of water quality, exploring aspects of ecotoxicology, histopathology, and genotoxic effects, along with applications such as biofiltration, biomonitoring of pollution, and potential mitigation of eutrophication, in seven chapters. The last section devotes seven chapters to covering the consequences of biofouling, and control measures ranging from chemical to physical and thermal to biological control. Finally, the editors provide a brief summary and synthesis, which provides a coherent contextual conclusion to the work. The combination of this final chapter and the opening preface and introductory chapter do a commendable job of creating a unified work from what might otherwise break down into a somewhat fragmented compilation. The organization of the chapters and sections contributes to this unifying character, as does the single and extensive index. Finally, the work is unified by consolidation of all references for the book into a single alphabetical reference list, which includes highly valuable and comprehensive full citations of nearly 2000 references.

There are some expected problems with a book of this scope. The authors have done a good job of integrating disparate chapters into a cohesive volume, but as expected in a multi-author edited work, there is variation in style across chapters, and there are some gaps that undoubtedly resulted from authors not crossing beyond the specific topics of their individual treatments. Another deficiency is that there is little or no coverage of some important areas that are of interest to many biologists. An example is the lack of coverage of using zebra mussels as sentinel organisms for human and animal pathogens, despite the significant studies on this topic published in recent years, and despite the fact that the book devotes part of a section to the mussels as indicators for other aspects of water quality.

For those who wish to extract or cite individual chapters, there will be some frustration from the fact that the references from literature cited are published in a single section at the end of the book. As pointed out above, this makes the entire book hold together better as a composite work, but the pagination for citing an individual chapter of the book thus becomes a bit awkward.

But the shortcomings are very few in this magnificent opus. Overall, this book is a superb contribution to the literature of both science and management policy for zebra mussels and other aquatic invasive species. It is a must-have for the library of anyone involved with freshwater biology in Europe, and anyone involved with aquatic resources or biotic invasions in any part of the world. Invertebrate biologists will also find this to be a valuable treatise on the impact of one highly successful and adaptable species. As one of the best and most comprehensive works produced on aquatic invasions, this will set the new standard for similar works in the future.

References

- Van der Velde G, Rajogopal S, bij de Vaate A (eds) (2010) *The Zebra Mussel in Europe*, Backhuys Publishers, Leiden (2010), 490 pp