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Biology of Freshwater Corbiculid and Sphaeriid Clams of North America

Gerald L. Mackie



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Biology of Freshwater Corbiculid and Sphaeriid Clams of North America

by

Gerald L. Mackie
Department of Integrative Biology
University of Guelph
Guelph, Ontario
Canada

with contributions by

Robert C. Bailey
Ismo J. Holopainen
Daniel J. Hornbach
Carl M. Way

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Abstract

Although genetic evidence shows corbiculid and sphaeriid clams to be separate heterodont bivalve radiations into freshwater environments and are not within a monophyletic group in the superfamily Corbiculacea, the term "Corbiculacea" is retained here for convenience when discussing them as a group, particularly since much of the literature up to 2000 uses the term. North America in the context used here is the 50 states of the United States and the 10 provinces and 3 territories of Canada. There are eleven chapters. Chapter 1 describes the anatomy of corbiculids and sphaeriids, including shell structure and all the organ systems. Chapter 2 describes the reproductive and developmental biology of the two families, beginning with maturation of the gonads, gametogenesis, cleavage of the embryo, and larval development. Chapter 3 describes the zoogeography of all thirty-eight species of Sphaeriidae and one species of Corbiculidae. Summaries of the habitats and geologic range are given for each species as well as lists of species found in each state and province/territory. Chapter 4 describes the ecology, including food and feeding processes, growth dynamics, life history, population dynamics and energetics, respiratory physiology, the indicator value of different species and predation and parasitism of corbiculids and sphaeriids. Chapter 5 gives analytical techniques for identification, culturing, and statistical analyses. Chapter 6 is devoted to phyogeny and classification based on ligament and shell structures and siphon morphologies. Chapter 7 gives definitions and a key to the families. Chapter 8 provides keys to all genera and species of corbiculids and sphaeriids found in North America. The diagnostic features of each species are given, along with notes on the shell dimensions, anatomy and life history. Chapter 9 gives a complete synonymy for all species. Chapter 10 is a glossary of terms used throughout the book and Chapter 11 is an annotated bibliography for all references cited in the text.

Acknowledgements

A book of this magnitude comes with loads of gratitude to a multitude of people. I first have to thank Reverend H. B. Herrington for being my mentor and encouraging me to make sphaeriids my life's work. My first introduction to the sphaeriids was during my M.Sc. (and Ph.D.) program at the University of Ottawa and I thank Dr. Sami Qadri and Dr. Arthur H. Clarke for providing the research funding and years of guidance and mentoring to finish and publish widely on the projects. The National Museums of Canada (now called Canadian Museum of Nature) provided space and materials for studying the taxonomy of sphaeriids. I am most grateful to the National Research Council of Canada who continuously supported my research from the days of my Postdoctorate studies at the Canadian Museum of Nature in 1973-74 up to and including my retirement in September 2003 at the University of Guelph. Funding was also provided through the years by Ontario Ministry of Natural Resources, Ontario Ministry of Environment, Environment Canada, and Department of Fisheries and Oceans. I thank Dan Hornbach for setting up my sabbatical at Mountain Lake and Ismo Holopainen for arranging my sabbatical at Joensuu, Finland. I thank Dr. Robert McMahon for inviting me to his laboratory at the University of Texas at Arlington, Texas, and for providing information on the physiological ecology and population bioenergetics of *Corbicula*. Much of the information on population energetics of sphaeriids in the mid 1980s was emanating from Dr. Albert Burky's students at the University of Dayton, Dayton, OH and he extended an invitation to visit him and his students (Dan Hornbach and Carl Way were among them). My knowledge of the ecology of sphaeriids is also in large part due to my own graduate students. They include in chronological order of research: the late Paul McKee; the late Peter Seidl; Dr. Brian Rooke; Dr. Malcolm Stephenson; Dr. Robert Bailey; Chris McCall. And last but not least, I thank my wife for watching and supporting me to try to retire, so far unsuccessfully.

Preface

This book has been a long time in the making. My introduction to the sphaeriids began when I was working on my M.Sc. in 1968-70 looking at the impact of pulp mill effluent on benthic communities. Reverend H. B. Herrington was the North American guru on sphaeriid identification and he taught me and verified the different species in the Ottawa River. Reverend Herrington encouraged me to do my Ph.D. on ecology of sphaeriids so from 1970-73 I chose to examine differences in life history traits among populations of *Musculium securis* in a wide variety of habitats. I really got to know the sphaeriids while doing a post doctorate with Arthur Clarke at what is now the Canadian Museum of Nature. Thanks to Reverend Herrington who put me up for a week at his place while examining and making cuts from his collections in his basement, and to Arthur Clarke who gave me cuts from the Canadian Museum of Nature, I grappled with the variation in shell forms within species, particularly *Pisidium casertanum*. I hired on at the University of Guelph in 1974 and decided to make it my life's ambition to learn everything I could about sphaeriids. I gave numerous talks at conferences and met other people working on sphaeriids, like Dan Hornbach and Carl Way while they were working on their Ph.Ds at Miami University, Oxford Ohio.

The ideas for this book first came when I spent a sabbatical in Mountain Lake, Virginia in 1984. Mountain Lake, nestled in the New River Valley of the Appalachian Mountains in Southwest Virginia, was not only an inspirational atmosphere but close to Virginia Tech (Blacksburg, Virginia), which has one of the most complete libraries that I have ever seen, and thanks to an efficient photocopier, I built up my reference collection on sphaeriids. I also was fortunate to collaborate with Dan Hornbach who was teaching at the University of Virginia at the time and he contributed immensely to this book. Dan's ideas are incorporated in several sections in the book, in Chapter 4, Ecology (population dynamics and energetics), Chapter 11, Annotated Bibliography, and electrophoretic evidence in phylogeny and classification of sphaeriids in Chapter 7. After two months at Mountain Lake I traveled to Joensuu, Finland where Ismo Holopainen was working on the ecology and physiology of Finnish species of sphaeriids. I spent three weeks in Finland, much of this time at Lake Mekrijärvi field Station taking notes on Finnish sphaeriids. Ismo wrote the sections on food and feeding, growth dynamics and respiratory physiology in Chapter 4 and provided some innovative photographs (see Fig. 1.22) on anatomy of four species of sphaeriids (Chapter 1). The ecology chapter was missing information on life history traits of sphaeriids so I asked Carl Way to write this section, as well as contribute his data to the section on population dynamics and energetics. Bob Bailey was my M.Sc student when I started the book and he has since established himself as an authority on multivariate statistical analyses and wrote the section on statistical analyses in Chapter 5. The other chapters (2, 3, 6, 7, 8, 9, 10) were written by me.

My intention for this book is to be a sole-source of information on all aspects of corbiculacea (formerly a monophyletic group that included corbiculids, sphaeriids and dreissenids) of North America, up to 2005. It is hoped that the book will stimulate more research into biology, ecology and taxonomy of sphaeriids, and most importantly on the electrophoretic and morphological similarities among species.

Gerry Mackie

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