NORTH AMERICAN FRESHWATER MUSSELS

Natural History, Ecology, and Conservation

Interest in freshwater mussels is growing for two important reasons. First, freshwater mussels are among the most endangered organisms on Earth, and many species are already extinct or face imminent extinction. Their desperate conservation plight has gained intense interest from natural resource agencies, nongovernmental conservation organizations, academia, and industry, and mussels are now the centerpiece of conservation initiatives ranging from local watershed groups to global programs. Second, recent research on mussel ecology, spurred in large part by the needs of the conservation community, has revealed much about the remarkable life history of these animals.

This well-illustrated book highlights freshwater mussels' fabulous diversity, amazing array of often bizarre ecological adaptations, and the history and causes of their decline. Summarizing and synthesizing historical and contemporary information as well as original research and analysis, the book builds a cohesive narrative culminating in the development of explicit frameworks to explain pervasive patterns in mussel ecology. The book dispels the notion that all mussel species are ecologically equivalent and shows how their diverse life history strategies influence assemblage structure, vulnerability to human impacts, and probability of extinction.

The fascinating and colorful role of mussels in human society is also described in detail, including the little-known pearl button industry of the early 1900s and the wild and often violent shell harvests of the 1990s. The final chapter details humans' efforts to save these fascinating animals and gives a prognosis for the future of the North American fauna.

The book provides the first comprehensive review of a wide variety of topics in mussel ecology and conservation for scientists and natural resource professionals in aquatic ecology, conservation biology, fisheries management, and evolutionary biology as well as for freshwater biology students and natural history enthusiasts.

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This book is dedicated to the small but growing group of people worldwide who have devoted themselves to the study and protection of freshwater mussels. These people come from diverse backgrounds but are united in their abiding affection for the unsung bivalved treasures of our rivers and lakes.

As a rule . . . we have to take nature as we find her, and for those who expect always to find a raison d'être for each creature, this nursing of the yellow sand shell by the voracious gar will satisfy the belief that things are as they should be.

Arthur D. Howard, 1914:44

After people have destroyed all people everywhere, I see heaping mounds of money strewn over the earth, floating on and sinking into the sea. The animals and fish, who have no use for money, are kicking it out of the way and splattering it with dung. Money and stink, the stink of dung, the stink of money, so foul that in order for the flowers to get a breath of fresh air, the winds will come together and whip the sea into a rage, and blow across the land. Then the green leaves of trees, and grass, will give up their chlorophyll, so that the sea, the wind, the beasts, and the birds will play and sing Nature's old, sweet melody and rhythm.

Duke Ellington,
Music Is My Mistress, 1973

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Preface

"Why do you want to study mussels? They don't do anything."

This question was posed to me as an undergraduate student by one of my great natural history mentors, who was interested in salamanders, orchids, and other more flashy creatures and who thought mussels were little more than living rocks. Granted, at first glance, mussels are not the most dynamic animals. But his question deflated me only briefly because by that time, I had come firmly under the spell of freshwater mussels. I'm not the only one; mussels have fascinated people for thousands of years. Prehistoric people used mussel shells and pearls to adorn themselves and their dead, and they ate prodigious quantities of mussels. During the natural history craze of the 1800s, mussels were a particular obsession of many Victorian naturalists, who amassed great collections of shells. In recent times, interest in mussels has burgeoned along with the growth of environmental and conservation professions. Lots of people just seem to like mussels, and they often get dangerously hooked.

Why are mussels so fascinating? As odd as it may sound, I think mussels have a certain aura of mystery. The idea of a great but unsung fauna hidden in the gravel of rivers in our very backyards is compelling to many people. When I was about 10 years old, my family was camping along the Red River not far from our home in Lexington, Kentucky. While wading in the river, I stumbled onto a bed of freshwater mussels. I was stunned. I thought shells could only be found at the faraway ocean and had no idea such exotic gems lived in my own neighborhood. I took some shells home and set them on my desk alongside my seashells from the beach. Like me, many people are intrigued first by mussel shells: "the most careless observer could not but be struck with their beauty, and led to admire their rich pearly luster, and variegated surface. But the more carefully they are inspected, the more beauties he will find to attract his attention and call forth his wonder" (Hildreth 1828, 276).

Although we may be drawn initially to the beauty of their shells, the more we learn about mussels, the more surprises they reveal. First, one discovers the staggering diversity of mussels in North America, home to more than 300 species – the most

diverse mussel fauna on Earth. Second, one learns of the complex life histories of mussels, especially the remarkable host-fish relationship that includes elaborate mimicry and other bizarre strategies to attract the hosts necessary for survival of mussels' parasitic larvae. Living rocks indeed! Finally, one comes to the sad realization that these unique animals that have captivated so many people are disappearing rapidly.

The purpose of this book is to tell the story of freshwater mussels in both an ecological and human context, an endeavor that was not possible until recently. Thirty years ago, we knew virtually nothing about the basic ecology of freshwater mussels. With a few notable exceptions, mussel research prior to that time had focused on the important and necessary tasks of naming and classifying species and determining their geographical distributions. These pursuits usually involved collecting mussels, getting rid of the "meat" as quickly as possible, and whisking the shells away to museum drawers. Students of mussels during this period often tellingly referred to themselves as "conchologists" (those who study shells). This historical focus on shells is at least partially responsible for the long-standing perception of mussels as living rocks or, at best, quaint natural history curios. But during the last 30, and especially in the last 10–15, years, ever-increasing numbers of dedicated biologists have been spending long, cold hours with their faces in the water, studying mussels on their own terms. Only through these efforts has the story of the animals themselves finally begun to emerge.

This is essentially a natural history book. I don't use the term *natural history* in the old-fashioned or derogatory sense, which usually implies a lack of serious ecology or scientific rigor; rather, I use a definition proposed by Herman (2002, 934): "Natural history is the scientific study of plants and animals in their natural environments. It is concerned with levels of organization from the individual organism to the ecosystem, and stresses identification, life history, distribution, abundance, and inter-relationships. It often and appropriately includes an esthetic component." This succinctly describes what I will attempt to cover in this book (with the exception of identification). I agree that an aesthetic component is appropriate in a work such as this, at least in some places. People are drawn to mussels because they are beautiful and interesting. And one of the reasons we seek to conserve these animals is that we've made an aesthetic decision that they're worth having around in the future.

The book begins with an introduction to mussel ecology, followed by a discussion of diversity and biogeography at large scales. Next come several chapters dealing with specific aspects of mussel ecology and life history. This is followed by a discussion of how these factors interact to structure mussel assemblages and determine species' distributions and abundance. The book closes with three chapters on interactions between mussels and humans, including our efforts to exterminate them (wittingly and unwittingly) and our efforts to save them. This section is last because how successful we are in conservation depends, of course, on how well we understand mussel ecology. Furthermore, it is unavoidable that we will be forced to make some

painful decisions about conservation in the future. Because conservation is a uniquely human concern (as far as we know), these decisions will be based not only on objective scientific criteria and pragmatic realities but also on subjective, aesthetic values.

There are several purposes this book does not attempt to serve. This book is not a field guide to identification or a manual of field and laboratory methods; a number of excellent resources on these topics exist elsewhere. For the same reason, I do not delve deeply into mussel anatomy, physiology, or toxicology, except where these topics have direct bearing on ecology, natural history, or conservation (e.g., how physiological adaptations for desiccation resistance allow some species to persist in ephemeral habitats or the potential role of agricultural chemicals in mussel declines). I also focus mainly on the North American fauna, although I bring in findings from elsewhere in the world as appropriate. With the exception of the small European mussel fauna, we currently know much less about the ecology of mussels on other continents than we do about those in North America.

I certainly don't think I'll be able to tell the whole story of freshwater mussels or get it all right in this book. The study of freshwater mussel ecology is still in its infancy. My goal in telling this story now is to put disparate pieces of information about mussels into something of a cohesive framework for anyone interested in natural history and to assist future researchers in framing specific hypotheses about mussel ecology. By doing so, I hope this book will foster increased interest and research about freshwater mussels that will help to save these marvelous animals.

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