Book Reviews

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Merging chemical ecology studies across the salinity divide

Brönmark, Christer, and Lars-Anders Hansson, editors. 2012. **Chemical ecology in aquatic systems.** Oxford University Press, New York. xix +291 p. $135.00 (cloth), ISBN: 978-0-19-958309-6; $69.99 (paper), ISBN: 978-0-19-958310-2.

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Several recent studies highlight citation biases that permeate ecology and impair our ability to find general patterns that apply across species and systems. While aquatic and terrestrial ecologists are becoming notorious for poorly citing papers from the other systems, similar notoriety is being realized within aquatic ecology. As an example, although chemical interactions between species in rivers, lakes, and oceans may share similarities because they evolved in aquatic habitats, the decades-old fields of freshwater and marine chemical ecology have proceeded along separate paths. Unfortunately, these fields diverged with respect to types of chemically mediated interactions and focal organisms studied, and approaches. Thus, we need synthetic works that encourage the merging of studies of freshwater and marine habitats so that we may begin to develop more general understandings of aquatic ecosystems.

Chemical ecology in aquatic systems brings together a well-balanced group of prominent ecologists with freshwater and marine interests. The book is primarily organized into chapters that tackle a specific ecological function of infochemicals (e.g., finding a mate, finding food, recognizing kin, selecting habitats). The book, like the discipline, emphasizes defenses of animals and primary producers that are induced by infochemicals, or defenses that contain chemicals themselves. Half of the chapters examine some aspect of chemically mediated interactions between consumers and their prey. Additional chapters explore the consequences of chemically mediated interactions, infodisruption, and the physics and scale of odor dispersal fields. Because of the diversity of systems and taxa covered, this book presents a needed addition to previous texts in the field.

The contributing authors clearly meet the editors' overall aims of (1) illustrating the importance of chemically mediated interactions in aquatic systems, (2) assessing the present status of the field, and (3) identifying areas where more research is needed. Although the first aim is already featured in several prominent review papers, the book successfully makes the case that infochemicals are pervasive and important in aquatic systems. The chapters are not exhaustive reviews, nor are they meant to be. A key emphasis is placed on describing needed research such as expanding studies of inducible defense beyond pairwise comparisons and conducting allelopathy studies under more realistic scenarios.

Although each chapter provides unique examples of needed research, two gaps were repeatedly emphasized throughout the book. First, the identities of most aquatic chemical signal compounds remain unknown. While previous chemical ecology studies contributed much to our understanding of the structure of aquatic communities even in the absence of identification of specific infochemicals, there is a clear need to isolate and identify ecologically important compounds. A need for chemical identifications in chemical ecology has long been argued, and recent technological advances should improve our ability to answer these calls. Second, the interference of these interactions by pollutants (i.e., infodisruption) is a growing area of concern. Several chapter sections and an entire chapter on infodisruption (Miquel Lürling) convincingly make the case that infodisruption warrants further attention. The infodisruption chapter contains an informative table identifying tested pollutants, concentrations, and their effects on chemical signaling.

Two of the strongest chapters examine (1) chemosensory navigation and predator-prey processes (Marc Weissburg) and (2) unusual chemistry of aquatic defense chemicals (Georg Pohnert). The navigation chapter quickly gets the reader up to speed on fluid dynamical parameters (e.g., Re, Re*, and RMS). It also provides a compelling argument for updating the idea that turbulence reduces predator effectiveness in a linear manner because of differential effects of turbulence on predators and prey (a point further emphasized in Andrew Turner and Scott Peacor's chapter). The chapter on unusual chemistry includes critical sections that review structural elucidation methods and modern techniques that are improving our ability to determine ecologically relevant metabolite concentrations.

Grad students (and their mentors) interested in developing new projects in aquatic chemical ecology would benefit from this book. Presumably, anyone looking to broaden their knowledge about this field would appreciate the diversity of habitats covered. This book could easily form the foundation of an upper-division undergraduate course in aquatic chemical ecology. Such a course would likely be broader than most current course offerings, including my own, that presumably display bias towards the instructor's ecosystem of interest. The number of times I have heard colleagues inquire about a general chemical ecology text for a course indicates a clear demand for this book. Also, the number of chapters (18) and typical chapter length (15–20 pages) would be appropriate for a semester-long course.

While the demand for this book is apparent, an opportunity was missed in merging research on freshwater and marine systems. Yes, the diverse author list and abundant cross-referencing between chapters should initiate dialogue between scientists across the salinity divide. However, because the chapters usually focus on model organisms within the author's field of study, there is limited comparison of the interactions between these habitats. Thus, the reader is left wondering if the divergence between freshwater and marine chemical ecology reflects bias in approach or real differences between habitats. In the case of the latter, are there general differences in internal factors (e.g., turbidity, dispersal, organisms, or the predictability and intensity of consumer pressure) that could influence the evolution of chemical signaling in freshwater and marine systems? Speculation on the evolution of these interactions would have been warranted and appreciated, even if comparative studies between these habitats are lacking.

The separation of chapters into ecological functions of chemical signals is logical and should quickly guide readers using the book as a reference. Yet I have two concerns about the organization of the book. First, the 18 chapters are not organized with respect to each other. Such organization would

have improved the connectivity of the nine chapters on consumer-prey interactions. Second, the chapters themselves are often organized around model organisms (e.g., invertebrates vs. fish). I don't argue against the value of selecting model organisms but rather that caution should be emphasized when using models to predict the behaviors of non-model organisms, especially when they differ in important ways (such as mobility of foragers as noted by Weissburg). The organization of chapters around model organisms needed to better emphasize this limitation.

The bulk of the text is accurate with two minor exceptions. First, chemical defenses are sometimes assumed to be toxic. This assumption ignores evidence to the contrary—unpalatable chemicals do not always negatively influence consumer performance and fitness. Second, defenses of field-collected organisms are assumed to be constitutive. This assumption is unwarranted given that previous studies rarely know the history of the prey prior to experimentation and extraction.

Chemical ecology in aquatic systems provides clear insight into our current understanding and needed experiments in this field. Despite the limited comparisons of interactions in freshwater vs. marine habitats, this book represents an important first step in bringing together scientists across the salinity divide to develop more general hypotheses and predictions.

Jeremy D. Long

San Diego State University
Coastal and Marine Institute Laboratory
San Diego, California 92182-4614 USA

E-mail: jlong@mail.sdsu.edu