Book Reviews

**Animal Osmoregulation. Tim Bradley.**


Tim Bradley’s book, “Animal Osmoregulation,” is a part of a relatively new Oxford University Press series that has been developed to provide short monographs that complement the coverage of central topics normally offered in comparative animal biology classes. These volumes allow students to pursue key subjects such as vision, locomotion, and biomechanics in greater depth. “Animal Osmoregulation” concentrates on two issues that are of universal importance to living systems, animal, or otherwise. One concerns the importance of defending cellular volume in the face of osmotic stress and the varied mechanisms by which these defenses are achieved. The second issue involves the “choices” animals make in accumulating specific types of low-molecular mass solutes that serve as the primary osmolytes in cells. By what criteria are these osmolytes selected, and by what mechanisms are their concentrations adjusted in the face of osmotic stress? These two basic issues are addressed using appropriate examples from terrestrial, marine, and freshwater animals, both vertebrate and invertebrate.

The author does an excellent job of fulfilling a primary goal of this series: “...identifying common themes that transcend taxonomy.” Thus, the reader gains a sense of the commonality of the problems being faced from osmotic stress and the diversity of mechanisms used to regulate the volume and composition in widely different circumstances.

Tim Bradley, one of the leading scholars in the comparative biology of osmotic regulation, sets up the problems that animals face very clearly in the opening section of the book. He establishes a solid foundation in the physical chemistry of water and water–solute interactions on which he builds his subsequent analysis. This is an excellent didactic approach, one that gives the reader a sense of why water is so important to cellular function and why regulation of volume and osmolytes is pivotal to the survival and success of cells. The concept of “activity” is treated in a lucid manner, an important brick in the conceptual foundation that needs to be developed. Bradley’s treatment of the basic physics of water is presented with minimal amounts of mathematics and should be accessible to all readers, even those with minimal backgrounds in the subject.

The remainder of the book builds on this foundation to illustrate the challenging problems that animals face and the remarkably varied “solutions”—relevant in two senses of that term—they have evolved in ways that cope with osmotically based stresses. The choice of study systems is very appropriate for giving the reader a sense of how animals with widely different phylogenetic histories and current ecological relationships solve common problems in the regulation of volume and osmolytes. A major strength of the coverage is its multi-level approach. One is taken from a description of the environmental challenges an animal faces, through a description of the organ systems that manage volume and osmolyte regulation in the particular species to the physiological and (sometimes) biochemical mechanisms that are the chief effectors of osmoregulation. This comparative approach succeeds admirably in illustrating how diverse solutions to a common set of problems have evolved in different lineages of animals.

The primary shortcomings of the book relate not to its coverage of topics or the excellent synthesis the author provides of the key themes he develops, but rather to shortfalls in organization of the material, questionable choices in some of the levels of presentation, and some editorial sloppiness. The publisher states that the volumes in this series are targeted to “senior undergraduates and graduate students,” yet I found many of the sections to be basically at a freshman level of presentation, or below. We are told repeatedly that sodium chloride dissociates into sodium and chloride ions in solution, a fact that scarcely needs to be stated once, if at all, for the putative target audience. Repetitive presentation of topics, in fact, occurs far too often in the volume. We are told more than once how to calculate the molarity of water (pp. 12, 56), what the osmotic concentrations of different groups of animals are, what types of cells are found in fish gills (pp. 76, 89), and how regulation of volume is achieved in *Rhodnius*. Repetitive practice may be a good learning technique, but the level of redundancy found in the volume seemed excessive to me. Some editorial
pruning would have led to a book that can be read more smoothly.

The reviews given to the broad suite of topics are quite up to date, and I found few errors in the presentations and few obvious sins of omission. On page 136, pyruvate is said to combine with malate to form citrate. This is not the case. On page 58 in Table 4, urea is said to be a “compatible” solute, which is definitely not true because of urea’s potent disruption of protein structure. This error is later corrected on page 70, where urea is said to be noncompatible. In the context of the mammalian kidney, it would have been a good addition to state that the primary organic osmolyte whose concentration is regulated as urea concentrations vary is glycerophosphorylcholine. This important urea-counteracting osmolyte is not mentioned in the volume. Neither is uric acid, an important nitrogenous excretory product in many animals. A discussion of the interplay between water balance and choice of nitrogenous end product would have been a good addition to the book. Another sin of omission, in my view, is the way in which signaling processes are short changed. Only in one sentence at the bottom of page 159 is allusion made to kinase cascades. This is a topical area that should have received more attention.

A few sentences may leave the reader a bit mystified. For example, on page 65, we are told that “delicate, thin epithelia in intimate contact with their aqueous environment” dictate that “marine mollusks are by necessity osmoconformers.” The reader might come away wondering why all gill-breathing marine animals, including fishes, are not similarly forced “by necessity” to be osmoconformers. On page 75, seawater is said to be “contaminated with salts,” an odd way of presenting the challenges of osmotic regulation faced by marine teleosts.

A key shortfall in the volume is the sparse use of references within the text. The short bibliographies given at the end of the chapters are quite good in most cases, but few of these references are cited in the text. I found this especially problematic in the case of the tables, where lists of data are presented without attribution. Many readers wishing to dig into the literature on these topics will be disappointed that they are not pointed in the appropriate direction through use of in-text citations.

A final quibble relates to the occurrence of misspellings at many places in the text [“Artic” (p. 7), “More” for “Mole” (p. 13), “mantel” for “mantle” (p. 63), etc.]. Automatic spell-checking software and editorial eyeballs should not allow these sorts of errors to reach publication stage.

As most of my criticisms should indicate, the primary faults of the volume lie not in the author’s choice of topics or the high level of scholarship he manifests in presenting his main points. Rather, the shortcomings lie in what can be most simply termed editorial quality control. Based in part on my own experience, I have reached the conclusion that the process of “editing” by publishers often amounts to no more than up-loading the author’s digital file onto the printer’s computer (or shipping the file to another country where manufacturing costs are cheap) and hitting the “print” command to generate a book. This is the “value added” that publishers are increasingly touting as their reason for charging what they charge for their product. Authors are busy people who deserve the type of editorial assistance that seems to be an increasingly rare commodity, even for publishers with prestigious names. Readers of this volume will need to look beyond the often annoying shortcomings that I think have resulted from minimal editorial input and appreciate this short volume for what it is: an excellent overview and introduction to a topic that is central to the biology of all organisms.

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Joan Roughgarden is mildly infamous because she wants to dismiss sexual selection. Biological iconoclasts are not necessarily infamous, but they are likely to become so when their views contradict many important and well-established facts about nature. That is the case here, but the reader may gain some perverse pleasure in watching the author’s fact-dodging dance. The theme of this book is that sexual selection is a bad idea because it makes us conclude that animals (and by extension, humans) are selfish and competitive. It is clear that the author has