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Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations

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BOOK REVIEW . . .

Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations, W. N. Beyer, G. H. Heinz, and A. W. Redmon-Norwood, editors. SETAC Special Publications Series, Lewis Publishers, Boca Raton, Florida, USA. $79.95 US 494 pp.

The purpose of this book, as described in the forward, is to address the question "How much of a chemical must be in the tissues of a wild animal to cause harm?" The chapters, each written by a well-known expert, cover all the important persistent bioaccumulative chemicals including chlorinated pesticides (DDT and its derivatives), the cyclodiene pesticides (dieldrin, endrin, and their derivatives), other chlorinated compounds (PCBs, dioxins, dibenzofurans), polycyclic aromatic hydrocarbons (benzo(a)-pyrene, phenanthrene, naphthalene, anthracene, etc.), and metals (especially mercury, lead, cadmium, and selenium). Study organisms include terrestrial wildlife, marine mammals, sea birds, fish, and both freshwater and marine invertebrates. Each chapter covers a particular chemical class for one of these animal groups, beginning with an overview of the chemical, followed by a discussion of potential effects, and then a presentation on tissue concentration. Most chapters emphasize the relationship between tissue concentration and effects; authors attempt to examine both sublethal and lethal effects, laboratory and field settings, and observations on individuals and populations. Chapters conclude with a summary section presenting toxicity threshold concentrations in various tissues without the details and references found in the chapter's main section.

While the book contains a wealth of useful information, it suffers from being overly repetitive in the introductory sections of the chapters. For example, each of three chapters on PCBs reviews the chemistry and history of environmental contamination of these compounds. Additionally, many chapters stray from the main goal of the book and discuss dose-response relationships at length, rather than focusing on the relationship of tissue concentration to effects. This tendency is understandable, however, as a great deal more is known about intake-response than about tissue-response relationships. Indeed, if the book were truly focused on tissue concentrations, it would be considerably shorter.

The major shortcoming of the book is the failure of many chapters to state whether tissue and dietary concentrations are expressed as wet-weight or dry-weight. Some authors, in an attempt to standardize their reporting, convert all data to a wet-weight basis, using a single assumed percent dry matter. This adds some ambiguity to the results but facilitates comparisons among studies.

Jocelyne Hellou, in her chapter on polycyclic aromatic hydrocarbons, questions the interpretation of analytical chemistry data from studies conducted over a 30 yr period. Methods have changed significantly during this time, with detection limits decreasing, the ability to separate various compounds and isomers increasing, and standards used for chemical recognition changing. This concern applies to other compounds as well, most notably the PCBs and dioxins, but is not addressed in those chapters.

In their chapter on PCB residues in mammals, Michael Kamrin and Robert Ringer discuss the problems of attributing cause-and-effect to a particular chemical when in reality animals are exposed to many chemicals at the same time. This caveat applies as well to the potential for interactive effects among all the chlorinated compounds and even some metals.

As pointed out by J. Christian Franson in his chapter on lead residues in birds, a residue value alone is never diagnostic of death or injury; confirmatory observations of gross and microscopic lesions or obvious signs of exposure also are required for definitive diagnosis. Thus, many of the field studies cited as providing evidence of tissue concentration thresholds associated with effects may suffer from incomplete diagnostics. Field studies may also miss potential interactive effects of multiple chemical exposures or infectious and parasitic diseases. While laboratory studies can focus on the effects of a single contaminant, many of the authors point out the uncertainties in extrapolating laboratory effects studies to field situations, especially across species. Interspecific differences, while touched upon by several of the authors, are never fully discussed.

Philip Rainbow's chapter on heavy metals in aquatic invertebrates is an excellent review, and clearly points out that these organisms concentrate metals in their tissues as a means of sequestering them, rendering them unavailable and thus nontoxic. Therefore, measurements of metal concentrations in aquatic invertebrates cannot tell us directly whether the organism is being poisoned. The same likely is true for marine mammals that sequester materials in blubber, with the exception that some portion of the blubber may be mobilized during times of nutritional stress. Robin Law points out that marine mammals have adapted to the naturally

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higher concentrations of metals in the marine environment through evolution of metallothioneins or through specific adaptations such as the ability to demethylate mercury.

This book clearly captures a great deal of information. It is an excellent review of the known effects to wildlife of the most common persistent bioaccumulative chemicals. It would be wonderful if we could simply read the summary at the end of each chapter, extract tissue concentrations that indicate toxic effects, and make management decisions. However, the available data are insufficient to allow such definitive conclusions, and most of the authors include appropriate warnings about the shortcomings of their threshold concentration estimates. The reader should read each chapter thoroughly and with a healthy dose of skepticism and then refer to the well referenced literature to review relevant studies prior to using the information for management purposes. If this approach is used, this text will prove to be a valuable resource for regulators, resource managers, contractors, and industry professionals.

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