



## Zoo Animal & Wildlife Immobilization and Anesthesia

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**Zoo Animal & Wildlife Immobilization and Anesthesia.** Edited by Gary West, Darryl Heard, and Nigel Caulkett, Blackwell Publishing, 2121 State Avenue, Ames, Iowa 50014, USA. 2007. 718 pp. ISBN 978-0-8138-2566-3. US \$149.99 (hardback).

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*Review by Carrie A. Cizauskas*

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For anyone who has ever wanted to successfully and safely wrestle a crocodile, walk a drowsy rhino, and then anesthetize an octopus without hunting down a bookshelf's worth of resources, this first edition of *Zoo Animal & Wildlife Immobilization and Anesthesia* will provide an excellent start. This industrious undertaking—a 60-chapter volume authored by more than 70 zoo and wildlife veterinarians, veterinary anesthesiologists, and researchers—is the first text that attempts to combine both general information about zoo and wildlife anesthesia with 47 chapters of specific information on capture and anesthesia of a diverse array of animal orders.

The book is organized into six sections: *Pharmacology and Drug Delivery* (five chapters); *Supportive Care, Monitoring, and Complications* (six chapters); *Physical Restraint* (one chapter); *Invertebrate, Fish, Amphibian, and Reptile Anesthesia* (nine chapters); *Bird Anesthesia* (three chapters); and *Mammal Anesthesia* (36 chapters). The best chapters in the final three sections include introductions to relevant anatomy and physiology, physical restraint and capture methods, pre-anesthesia evaluation regimens (including physical examination methods, guides to vascular access sites, and intubation techniques), anesthesia induction and maintenance protocols (including detailed information about drug doses and combinations), monitoring methods, discussions of supportive and emergency care, recovery methods, and field anesthetic and immobilization techniques. Many chapters also contain well-organized tables of drug doses for different species, and some include tables of physiological parameters for the species covered. Unfortunately, text and table contents and formats are inconsistent throughout the book, and although several chapters are amazingly thorough and well-organized resources, others will need to be revised and fleshed out in future editions.

The target audience for this volume is zoo and wildlife veterinarians, although wildlife researchers with medical guidance and a good physiology background will also benefit from

using this book. Zoo animal anesthesia is given a much more thorough treatment here, however, than are wildlife capture and field methods, and many chapters unfortunately give short shrift to wildlife capture scenarios or omit them completely. The editors will have to decide for future editions if this text is to truly become both a zoo and a wildlife anesthesia manual, or if it will remain in its present form as an excellent captive animal anesthesia guide with some wildlife asides.

Section I, *Pharmacology and Drug Delivery*, is an excellent review for those who have previous knowledge in these areas, although it is often comprehensive enough to act as a first resource for non-vets. The clinical pharmacology chapter contains good overviews of relevant pharmacology, different anesthetic drug classes, and physiological aspects of anesthesia. The information included here is, however, sometimes more thorough than is strictly necessary for practical use, and the long and detailed NSAIDs section is redundant with information presented in the wildlife analgesia chapter. Many drugs are covered in detail, with an excellent use of up-to-date references, but some important opioids and their antagonists are given rather cursory treatment compared to their common usage in wildlife captures. Very little information is given on etorphine and carfentanil, two opioid anesthetic agents used extensively for wildlife immobilizations, especially outside the United States. Thiopentanyl, diprenorphine, and nalorphine are not mentioned at all, and little is written about naltrexone, a common opioid antagonist that is also the antidote of choice for accidental human exposure to opioids in the field. Similarly, there is no mention of short-acting sedatives such as benzodiazepines; also omitted are long-acting sedatives and anxiolytics used for long-term wildlife holding and transport. This chapter, like several others, appears aimed more toward zoo medicine than to wildlife immobilization and should be supplemented with this information in the future.

Chapters on euthanasia and wildlife analgesia cover subjects often overlooked and provide useful information on difficult subjects that often do not have well-defined parameters and study data. The analgesia chapter contains notes on pain management by animal class; the information given here is commendable in its inclusion, but more clear recommendations, especially for invertebrates and mammals, should be given. The remote drug delivery chapter gives helpful step-by-step instructions on how to prepare different types of darts, although the dart diagrams provided are

somewhat crude. This chapter also provides thorough information on several different kinds of remote drug delivery systems and includes an excellent summary table with details about dart types and sizes, needle sizes, dart tailpieces, and recommended projectors for each dart class. The last chapter in this section, "Mobile Inhalant and Anesthesia Techniques," makes good use of references and provides readers with information on where to find equipment and whom to contact regarding study findings. This chapter is somewhat haltingly and informally written, however, and contains quite a bit of information that overlaps with that presented in other chapters.

Section II, *Supportive Care, Monitoring, and Complications*, starts off with a chapter on monitoring. Although this is a potentially enormous subject to tackle, the author deals nicely with the problem of addressing monitoring methods for thousands of species by providing a list of several additional resources for physiological and pharmacological parameters for many animal orders. The author also weaves into the narrative several examples of species differences that must be taken into account during monitoring; thus, this chapter is not simply redundant with the information provided in a typical veterinary anesthesia text. The cardiovascular and pulmonary support chapter provides good general information regarding the diagnosis and treatment (including an overview of fluid therapy) of the most common cardiovascular and respiratory anesthetic complications. However, information regarding nonmammalian species is lacking, other than an acknowledgment that assessing and treating complications in these classes can be difficult. A chapter on animal stress is included, and, although this gives an excellent overview of the physiological basis of the stress hormone response, no mention is made of using fecal glucocorticoid metabolites as a measurement of long-term stress hormone changes, and discussion of stress responses in nonmammalian species is again largely omitted. Thermoregulation of captured animals is discussed in Chapter 9, although this chapter deals almost exclusively with hypothermia. Capture myopathy is given an excellent overview in Chapter 10, although this chapter again is mammalian dominant. The last chapter in this section, "Human Safety during Wildlife Capture," is an important inclusion to the book. However, it would be helpful here to add important information in easy-to-locate tabular form, such as doses for opioid reversal agents and alpha-2 antagonists in case of accidental human injection during capture

events. More information, perhaps in the form of a list of additional resources, would have been helpful regarding helicopter and rifle safety.

Several restraining devices and capture methods are discussed in good detail in Section III, *Physical Restraint*, which contains one chapter, although pictures of each of these devices would be helpful additions. The authors discuss the restraint of most of the mammalian families and several families of birds. Only one paragraph discusses reptilian restraint, although this subject is discussed in greater detail later in the book. This section of the text perhaps would benefit from expanding this information into more than one chapter. More information could then be included regarding large-scale physical restraint methods commonly used in African wildlife captures (e.g., boma captures); such methods are not currently discussed.

This text is revolutionary in its inclusion of a detailed section of invertebrate and fish anesthesia (Section IV) alongside the more commonly discussed immobilization methods for birds and mammals. Chapters 13 (invertebrates), 14 (boney fish), and 15 (elasmobranchs) are excellent reviews of the most recent and relevant anesthetic studies regarding these animals. The invertebrate chapter includes information on the most economically and scientifically "visual" invertebrate species, including the most commonly encountered mollusks, arachnids, crustaceans, insects, and echinoderms for vets and researchers. Although anesthesia, analgesia, and euthanasia protocols for these species are still in their infancy, the authors do a commendable job of discussing what is known and why there is a need for proper pain management in these species. The boney fish chapter also discusses recent conclusions regarding nociception in fish and is again commendable in its promotion of pain and stress management for species that have been traditionally ignored in these respects. This chapter includes an enormous (19 pages!) table of anesthetic and analgesic drug doses for a large number of fish species, complete with study references and summaries. Detailed information regarding the most commonly used fish anesthetics is also included.

Section IV also has five chapters on reptilian capture, restraint, and anesthesia: "Crocodilian Capture and Restraint," "Crocodilians," "Squamates," "Venomous Reptile Restraint and Handling," and "Chelonians." These chapters are, in general, well organized and sufficiently detailed and contain several good diagrams and reference tables. The chapters

dealing with physical restraint of crocodiles and venomous reptiles contain informative details on materials, planning, and environmental assessment prior to capture, although these chapters should have been included in Section III. Several of the caveats mentioned here regarding wildlife capture are important for animals other than reptiles and would be helpful to readers in the more general introductory chapters in the text. Unfortunately these detailed chapters highlight the deficiencies in others; after reading the crocodilian restraint chapter, a reader would feel perhaps unreasonably confident about capturing a crocodile, down to the rope sizes needed and the kind of tape used to restrain the animal's jaws, whereas the cursory, and sole, 4½-page amphibian chapter in this section leaves one with little more information than the fact that two drugs are commonly used to anesthetize amphibians and that these animals have sensitive skin.

Anesthesia of birds is discussed in Section V. The cagebirds chapter is another example of everything this text does well: it provides an excellent introduction to the relevant anatomy and physiology of birds in general, with several species examples; it contains great pictures, diagrams, and practical information regarding anesthetic methods and materials; it discusses supportive care and monitoring in a thorough manner; and it contains a well-organized table of drug dosages. Much of the information in the following chapter on free-living waterfowl and shorebirds should have been subsumed into the cagebirds chapter; a chapter covering general wild bird capture, restraint, and anesthesia would be more useful here. The third chapter in this section, "Ratites," nicely includes a table detailing arterial blood pressures for ratites under different anesthetic agents.

Section VI, *Mammal Anesthesia*, contains 36 chapters, again with varying degrees of detail and thoroughness. Although several chapters are sufficiently detailed to act as either standalone references for the immobilization of their namesake orders or families, or as essential complements to other anesthesia resources, others lend less information to the cause. The rhinoceroses chapter is a model chapter for this section and the book in general. In addition to its overview of anatomy and physiology, detailed discussion of monitoring, excellent drug doses table, and useful pictures, it is one of the only chapters to discuss trouble shooting in the face of an anesthetic event gone wrong, with detailed information on how to treat respiratory distress in anesthetized rhinos. It also is one

of the few chapters to sufficiently cover capture and anesthetic regimens for animals in both captive and field environments, and sums up its information with a great conclusion of bulleted caveats and strategies. Other particularly strong chapters in this section include the canids chapter, with its excellent table of average weights of all nondomestic canids, as well as thorough tables of analgesic and anesthetic drug doses; the cetaceans chapter, with its discussion of cetacean physiology and excellent anatomical pictures; and the hyenas chapter, which provides tables of normal complete blood count and chemistry panel values for this family.

This book is an overall impressive attempt to consolidate the knowledge and experience of many well-regarded veterinarians and scientists into a useful, one-stop exotic animal anesthesia reference. This author list is impressive, but one does wonder why only one African veterinarian was involved in the writing of one chapter; as the antelope chapter states, "South African veterinarians have been at the forefront of this development [of antelope anesthesia] and continue to set standards for wildlife capture." Indeed, other chapters on African wildlife, such as the nondomestic equids chapter, heavily reference studies and publications of African veterinarians. Future editions of this text would likely benefit from inclusion of African and other primarily wildlife veterinarians; by teaming up zoo vets with wildlife vets in the writing of this book (such as occurred in the rhinoceroses chapter), a better balance between zoo and wildlife anesthesia would likely be obtained. This strategy, plus the standardization of chapter formats and contents, would result in an even more powerful reference for both zoo and wildlife veterinarians and researchers.

Despite the first edition glitches from which the text sometimes suffers, this book is a very useful reference that fills an important niche in the zoo and wildlife veterinary and research worlds. Although those working with some species will have to supplement this source, sometimes heavily, with other materials, much of the information provided in this text is amazingly inclusive for a project so wide in scope. This book, and its future editions, will therefore likely become a must-have resource for anyone working with nondomestic animal immobilizations.

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