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Source: BioScience, 53(3) : 290-291

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1641/0006-3568(2003)053[0290:GGP]2.0.CO;2

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Studying Amphibians and Reptiles

Herpetology: An Introductory Biology of Amphibians and Reptiles. 2nd ed. George R. Zug, Laurie J. Vitt, and Janalee P. Caldwell. Academic Press, San Diego, 2001. 630 pp., illus. $69.95 (ISBN 012782622X cloth).

The study of herpetology is a nonmonophyletic academic discipline, encompassing organisms as vastly different as frogs and crocodiles. Summarizing this eclectic group of organisms—including the subdisciplines of morphology, evolution, ecology, behavior, and taxonomy—in textbook form is a daunting task. Perhaps for this reason, comprehensive herpetology textbooks have been slow in coming until very recently. Early volumes, such as those by Goin and Goin (1962), Porter (1972), and Goin, Goin, and Zug (1978), were relatively limited in range.

The first edition of *Herpetology: An Introductory Biology of Amphibians and Reptiles* appeared in 1993 (Zug 1993). This second edition benefits from an expanded team of authors, all of whom are leaders in the field and each of whom brings specific areas of taxonomic and topical expertise. It represents a substantial improvement on the first. This revision is larger in size, better illustrated, more up-to-date, and more accurate than the first edition.

Herpetology: An Introductory Biology of Amphibians and Reptiles is intended to appeal to advanced undergraduates and graduate students in herpetology. The book is divided into six sections (evolutionary history, reproduction and life histories, physiological ecology, behavioral ecology, population and community ecology, and classification and diversity) with 21 chapters. Each chapter concludes with an "additional reading" section and a reference list, both of which are useful additions. The broad coverage of research areas and topics makes this edition very appropriate for undergraduate classes.

In addition to these chapters, a glossary of terms, a taxonomic index, a bibliography of over 2000 cited references (the most recent of which is 1999), a subject index, and an author index are also included. Most of these indexes work well, but the glossary seems inadequate—less than six pages in length, with 208 terms defined. Many common herpetological terms, such as *ectotherm, venom,* and *plastron,* are absent. The authors state that the glossary is not intended to be complete, but a comprehensive glossary in a textbook intended for undergraduates would seem important.

The production value of this book is quite high, a major improvement on the first edition. Most of the figures are nicely reproduced, and the format of the figure legends has been standardized. This edition also includes 141 black-and-white photos and 184 color photos. The print legibility of the text is high. The numerous color photos that accompany the chapters on the diversity of groups in part VI make the text even more valuable as a teaching aid.

Part I covers the evolutionary history of amphibians and reptiles. Chapter 1 discusses basic systematics concepts such as monophyly, types of characters used in phylogenetic analysis, methods of analysis, nomenclature, and taxonomy, all of which lay the groundwork for later group descriptions. Chapter 2 covers the anatomy of amphibians and reptiles, including development, growth, and basic anatomical systems. This chapter is generally well conceived, but it was surprising to find that some inaccuracies pointed out in the first edition (Wiens 1993) have not been corrected (for example, in the identification and figuring of some skull bones). Chapter 3 summarizes the fossil history of amphibians and reptiles with fairly comprehensive coverage of the herpetological fossil record. Some inaccuracies exist in this chapter as well. As one example, the early amphisbaenian fossil *Oligodontosaurus* is said to be a "shovel-headed form" when it is known only from a partial lower jaw. Despite such errors, this chapter is an impressive overview of the relevant fossil record, something often missing from organismal textbooks.

Part II presents the reproduction and life histories of amphibians and reptiles. Chapter 4 describes courtship and fertilization in various groups, as well as sexual versus asexual reproduction and parental care. Chapter 5 nicely covers such topics as temperature-dependent sex determination, the evolution of viviparity in various groups, and life history evolution.

Part III is dedicated to the physiological ecology of amphibians and reptiles. Chapter 6 is concerned with water balance and gas exchange, chapter 7 with bioenergetics and thermoregulation. These topics are considered in much greater depth than in the first edition.

Part IV treats the behavioral ecology of amphibians and reptiles. Chapter 8 deals specifically with distribution, home ranges, movements, and migrations. In chapter 9, aspects of communication, mating systems, and sexual selection are described. Chapter 10 is concerned with diet and feeding ecology, including foraging modes and prey capture and ingestion behaviors. In chapter 11, modes of defense, including predator detection and avoidance, specialized predator escape mechanisms, and mimicry, are summarized. This excellent section of the book is one of the many areas where the combined strength of the new team of authors is apparent.

Part V presents population and community ecology, as well as conservation biology. Chapter 12 covers topics such as survivorship, population growth and

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density, and age distributions. Chapter 13 describes community ecology and includes a short treatment of historical biogeography. Chapter 14 discusses the importance of conservation biology to amphibian and reptile populations, with such topics as human impacts on herpetological communities and preservation and management techniques. This chapter is an important addition, considering the declining state of many populations of amphibians and reptiles.

Part VI is the most expansive section of the book (about half), covering the classification and diversity of caecilians, salamanders, frogs, turtles, crocodilians, "lizards," and snakes. This section is well organized and well illustrated, one of the major strengths of the book. The descriptions of each group include cladograms depicting higher-level relationships, distribution maps, extensive color photographs illustrating group diversity, and summaries of each group's overall biology. One problem in this section, however, is that some of the cladograms represent a single choice from among several competing phylogenetic hypotheses in the literature, which tends to obscure debate in the field and the controversial nature of the relationships among many groups. For example, figure 20.2 (p. 468) illustrates a fully resolved cladogram of squamate relationships for a group that has been, and continues to be, the subject of much debate. The descriptions of morphological characteristics that define groups in this chapter contain a few inaccuracies, and some of the distribution maps are slightly inaccurate or are inconsistent with the accompanying written descriptions of distribution.

In a textbook of this size and scope, errors are difficult to avoid, especially in the first few editions. In addition to the noted factual errors, a few typographical errors escaped the review process and there are some inconsistencies that point to errors in editorial oversight. These issues do not significantly detract from the overall high quality of this book, however.

Herpetology: An Introductory Biology of Amphibians and Reptiles is an impressive second edition, a major improvement on the first. It will serve as an important textbook for advanced undergraduate and graduate courses in herpetology, as well as a general reference book for herpetologists.

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BEYOND MARINE ORGANISMAL BIOLOGY

Marine Biology: Function, Biodiversity, Ecology. Jeffrey S. Levinton. Oxford University Press, New York, 2001. 515 pp., illus. $74.95 (ISBN 0195141725 cloth).

Jeffrey S. Levinton's broad background in marine ecology and evolution permeates the new edition of his textbook on marine biology. It's no surprise that

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the text's strong points lie in diverse aspects of benthic ecology, particularly of invertebrates. I especially appreciated the interdisciplinary approach to the topic. For example, Levinton discusses the importance of laminar and turbulent flow, which can affect many aspects of an organism's ecology, including mechanics of feeding, identification and location of prey, and success of fertilization during spawning. His explanations of Reynolds number, boundary layers, and the Bernoulli principle and their effects on marine biology are clear and concise.

Levinton's audience consists of upper-level undergraduate biology students who have some background in organismal biology and diversity. The progression of topics is logical, and, true to the subtitle, he emphasizes function, biodiversity, and ecology. Levinton does an excellent job of internal referencing, so it is easy to find pertinent information discussed in different chapters. He covers marine biology in 19 chapters, grouped into eight sections. The first section summarizes oceanographic, ecological, and evolutionary principles, and the second stresses how organisms function in aquatic systems. These two sections lay out the reasons why aquatic systems in general, and marine systems in particular, are so different from those we are familiar with as land-based organisms. Levinton repeatedly returns to concepts introduced in the first two sections to explore large- and small-scale questions, many of which are unique to marine systems. For example, the oceans are all linked, so the ability of many organisms to migrate and the prevalence of free-swimming or floating larvae provide means of worldwide dispersal. Most marine organisms, however, are not cosmopolitan. The many explanations for why some organisms have narrow distributions while others do not are rooted in biological, chemical, physical, and geological principles and can be explored at large scales (e.g., interactions between coastal environments and those in the deep sea) or smaller scales (answering such questions as why deposit feeders live in one area but not in an immediately adjacent area with a different soft substrate).

The third and fourth sections address organisms and processes in the open sea, whereas sections 5 through 7 deal with benthic organisms, environments, and processes. The final section concerns human–ocean interactions. Some students may be disappointed by the relatively small role that vertebrates, particularly mammals, play in the book. Levinton has expanded on the treatment of mammals relative to the earlier edition. He is justified in concentrating on invertebrates, however, given their relative importance in ecosystems.

Marine Biology includes an adequate index, a glossary, review questions, and 32 pages of color plates. It also includes numerous high-quality gray-tone photographs and illustrations that enhance the text. The color illustrations and color versions of many of the gray-tone photographs can all be found on the accompanying CD. The color illustrations and CD will be of particular importance to the student who has little direct experience working with marine organisms and environments—these tools serve to bring the subject to life. (Unfortunately, I was unable to open the CD on three different Macintosh computers; I eventually managed to open it on a PC, but not by following the instructions. Once opened, it was easy to explore the 450+ annotated photographs grouped mainly by environments.) The book is well edited; I found only one mistake in perusing the text. (Chlorophyll *a* absorbs in the blue and red regions, not blue and green as stated in the text box on p. 207.)

Marine Biology is an excellent choice for a nonintroductory course. I highly recommend it for all the reasons mentioned above, in addition to three characteristics that make it particularly student friendly. First, the topic summary statements clearly stand out in blue.

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Perusal of these statements allows the student to quickly review the chapter contents or locate information to read about in greater depth. Second, the "hot topics," 20 well-selected minireviews, are scattered throughout most sections. The subjects range from mechanical analysis of claws to whale evolution to the use of DNA fingerprinting in determining the source of invading species or in monitoring illegal whaling. The hot topics are excellent examples of concise reviews of the primary literature. Third, the references—listed at the end of each chapter (grouped according to subtopics), in the hot topics, and on the CD—provide the students and instructors an easy avenue for investigating the primary literature on a variety of topics. The summary statements, hot topics, and excellent literature citations will make this book a great reference for the student even after completing the course.

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GENOMICS 2002: GETTING PRIMED

A Primer of Genome Science. Greg Gibson and Spencer Muse. Sinauer Associates, Sunderland MA, 2002. 347 pp, illus. $49.95 (ISBN 0878932348 paper).

My summers at Saint Michael's College are the time that I plan new courses, reinvigorate my research program, and catch up on my science fiction reading. I spent part of this summer developing a new undergraduate course on genomics and bioinformatics by perusing several recently published texts in this area. My search for an appropriate undergraduate genomics text led me to a recently published book entitled *A Primer of Genome Science,* by North Carolina State University professors Greg Gibson and Spencer Muse. Both authors are well qualified to write this text, for their research interests involve genomics and span multiple disciplines. Gibson is a developmental biologist who works with *Drosophila,* and his research incorporates molecular biology, genetics, and genomics. Muse, a geneticist and statistician, represents the next generation of quantitative biologists who are part geneticist, statistician, programmer, and molecular biologist.

The postgenomic era has sparked a cultural and intellectual revolution among biologists and is embodied by a shift from linear thinking to a systems approach in molecular biology, biochemistry, and genetics. The questions we are asking ourselves are, What is this new field, how did it evolve, and how does it differ from molecular biology on steroids? Although this book does not answer these questions, it will provide you with an up-to-date introduction to the tools of the genomicist.

Perhaps understanding any new field begins by defining the language, and Muse and Gibson do a wonderful job of introducing genomics vocabulary. If you continue to confuse words like "phred" and "phrap" or if you haven't yet learned them, then this text will be of use to you. In addition to defining the unique terminology of this new field, the text also contains a tour de force of emerging technologies, molecular biology techniques, sequence analysis tools, and information about useful databases and Web sites. The authors have clearly made a concerted effort to be comprehensive in their summary and touch upon topics such as shotgun sequencing, library construction, microarrays, SAGE, SNPs, and two-hybrid screens, just to name a few. This thorough coverage also applies to the current databases and sequencing projects. I was pleased to see that less publicized projects, such as those on grasses and legumes, are presented in addition to the yeast, fruitfly, worm, and human genome projects.

The authors cast a wide net in defining the field of genomics and include topics such as proteomics and transcriptome analysis. The text is therefore remarkably comprehensive and organized given its length, covering most model organisms and many new and emerging techniques. Broad coverage in such a short text requires that all explanations be brief. I found the brevity of the explanations to be a plus, for the authors convey the information without overwhelming the reader. The text is roughly organized along the lines of "the central dogma": genome sequencing projects, transcriptome analyses, proteomics, and functional and integrative genomics. Furthermore, the text reads well, and each individual section is presented in a logical progression: principles, techniques, uses, databases, and limitations of the technology. The format makes the information readily accessible and lends itself well to use as a quick reference book, particularly for molecular biology and biochemistry labs that are trying to integrate genomic technologies into their research. I particularly appreciated the one- and two-page math boxes that explain the principles behind many of the commonly used algorithms. Topics such as hidden Markov models, pairwise sequence alignments, phylogenetics, and clustering methods are covered in these sections. Finally, illustrations and color figures, from simple sequence alignments to hierarchical clustering of microarray data, successfully complement the text.

The target audience of this introductory text is advanced undergraduates and early graduate students. While this text does a good job presenting the tools of the trade for this audience, I was hoping that more attention would be given to asking and answering biological questions within the field. Because understanding the text requires literacy in molecular biology, I would be hesitant about adopting it as the sole text for an advanced undergraduate course. For graduate students, it lacks the depth to be the basis of an entire genomics course but could be effectively used as a reference or supplemental text. *A Primer of Genome Science* will be most useful to those who are already primed, but it is a useful resource nevertheless.

The authors dedicate much of their writing to explaining standard molecular

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biology techniques as well as new technologies, and both sections are well reviewed. My only concern is that many standard molecular biology techniques are presented as recently developed genomic tools. The authors miss an opportunity to convey how established approaches and new approaches have been integrated into a new discipline. This text fails to illustrate that the genomics revolution is not only the technologies but also the way we view our field as a result of the technologies. For example, standard molecular biology techniques are presented as new science simply because they are being used on a larger scale. The field of genomics is not solely about the scale of experiments; rather, the cultural revolution of genomics is that molecular biologists and biochemists have been brought into the realm of systems biology. Despite this pedagogical oversight, I am glad I have a copy of the text in my lab and on my bioinformatics workstation. I foresee using it whenever I need a refresher on a database, algorithm, sequencing project, or molecular biology technique.

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AN INTEGRATED TEXTBOOK FOR CONSERVATION GENETICS

Introduction to Conservation Genetics. Richard Frankham, Jonathan D. Ballou, and David A. Briscoe. Cambridge University Press, Cambridge, United Kingdom, 2002. 617 pp., illus. $130.00 (ISBN 0521630142 cloth).

One can often recognize the maturation of a discrete field of research when two events occur, the inception of a specialty journal and the publication of a field-specific textbook. Arguably, the field of conservation genetics was born with the publication of *Conservation and Evolution* (Frankel and Soulé 1981, also published by Cambridge University Press), but it would take nearly 20 years before the journal *Conservation Genetics* was first published in 2000. This was soon followed by the publication of an introductory textbook. The authors of *Introduction to Conservation Genetics* are conservation biology heavyweights who bring a unique mix of perspectives to this book. Richard Frankham is professor of biology at Macquarie University, Sydney, Australia; his expertise is wide-ranging and includes quantitative genetics, estimation of genetically effective population size, and the relationship between quantitative variation, variability in neutral markers, and their relative

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significance in conservation genetics. Jon Ballou is population manager at the National Zoological Park, Smithsonian Institution, Washington, DC, and adjunct at the University of Maryland. As such, his expertise lies in the area of small population management. David Briscoe is associate professor of Biology at Macquarie University and has collaborated with Frankham on a number of projects, including the use of *Drosophila* to test conservation genetic hypotheses under laboratory conditions.

This textbook is intended to introduce advanced undergraduate and graduate students to the field of conservation genetics; it is also intended for professionals who wish to augment their knowledge in this area. The authors have compiled a set of concrete examples that could be used by instructors in population genetics and evolution courses to "enthuse their students." Details on experimental design and laboratory procedures are deliberately omitted so as to concentrate on general principles. A working knowledge of Mendelian genetics and elementary statistics is assumed.

The text begins by introducing the reader to conservation genetics as a distinct discipline, to the need for and utility of conservation genetics given our current extinction spasm, and to themes that are recurrent throughout the book. The second chapter addresses the direct connection between species persistence and genetic variability. It is important to explicitly address this issue because the argument has been made (e.g., Lande 1988) that demographic events lead to species extinctions long before a lack of genetic variability can become important to species persistence. Three sections follow. Section I (seven chapters) contains a short course in population genetics. Population genetic theory generally addresses evolutionary changes within large populations. One reviewer of this book (Smith 2002) suggested that the introductory material in section I was geared too heavily toward uninformed readers. I think that the inclusion of basic concepts of population genetics is appropriate in a textbook intended for a wide audience of advanced undergraduates, graduate students, and management professionals. At worst, much of this section could be skipped over or assigned as additional reading in advanced conservation genetics courses. Turning the argument around, section I could serve as the basis for a brief introduction to population genetics in courses such as evolution or population genetics.

Section II contains five chapters dealing with the population genetic consequences of small population size. The effects of small population size on genetic variability and population persistence are what set conservation genetics apart from the larger fields of evolutionary and population genetics. Small population size is the common thread that defines species of conservation concern despite a large diversity of life histories and ecologies among them. Inbreeding and its effects on population persistence are discussed in two chapters within section II and provide follow-up to the discussion begun in chapter 2. Although some might find this approach repetitive (Hedrick 2002), inbreeding and the inbreeding-like effects of drift (discussed in a different chapter in section II) are at the heart of the argument for maintaining genetic diversity in endangered species. Inbreeding provides a direct link between population genetics and population persistence.

Section III (six chapters) is perhaps the most interesting from my perspective as a conservation geneticist who has worked with a number of species of conservation concern. This section is replete

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with examples and discusses applications of population genetics theory to conservation problems. It is in this realm that conservation genetics can be truly distinguished from the fields of population and evolutionary genetics, which provide its theoretical underpinnings. Chapters on genetic management of wild populations, genetic management of captive populations, and the genetics of reintroductions are included in this final section.

Frankham and his colleagues have done a good job of providing the extras that make for a user-friendly textbook. Features include an opening précis for each chapter and a list of important terms. Chapters are divided into logically ordered sections, and marginal text boxes highlight the important points in each section. Many of the data figures (graphs and tables) are accompanied by well-done ink drawings of the relevant organism. A few black-and-white photographs also accompany the text. Highlighted text boxes are used to set aside in-depth consideration of specific examples. Each chapter is provided with a summary and an annotated list of further reading that usually includes review articles on the chapter topic. Finally, each chapter ends with a problem set, and many have a set of practical exercises as well. Most of these problems are quantitative and appear ideal for take-home assignments. Although at first glance the practical exercises do not appear all that useful from an instructor's point of view, it should be noted that most of the resources needed to do the exercises (e.g., simulation programs and data files) are available for downloading from a Web site that is maintained in conjunction with the book *(http://consgen.mq.edu.au)*. At the end of the book are 17 "take-home messages" intended to provide a concise summary of the important themes in the book. When combined with the chapter-opening main points and marginal text boxes, these messages may provide those more befuddled students with a starting point for understanding the more central concepts. A 12-page glossary follows the messages. The reference section is extensive, spanning 39 pages, and most of the references are quite recent (many were published within the last two or three years).

Despite the length of the text, the writing style remains succinct and crisp throughout. Furthermore, the style is very clinical in the sense that the authors assume that the reader is already concerned about the loss of all forms of biodiversity and does not have to be told about this aspect of the problem. While some conservation biologists advocate a more activist role for researchers in all aspects of the field (e.g., Noss 1996), Frankham and colleagues take what is, in my opinion, the appropriate approach by confining their discussion to empirical results without overt emotional appeals.

This book is a very welcome addition to my library. As an instructor in undergraduate and graduate evolution, population genetics, and conservation genetics courses, I found it unfortunate that no synthetic treatment of conservation

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genetics was available as a class textbook. As a result, I depended on population genetics texts (Hartl and Clark 1997) and compilations of case studies (e.g., Soulé 1986, Avise and Hamrick 1996). Although adequate for the task, these works were not really designed for use in undergraduate instruction. I am looking forward to teaching conservation genetics from this text. Its strengths lie in the thorough discussion of quantitative genetics and the chapters dealing with genetic management of captive and reintroduced populations. Above all, we finally have a text that does a good job of integrating population and evolutionary genetic theory with real-world conservation genetic examples and applications.

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