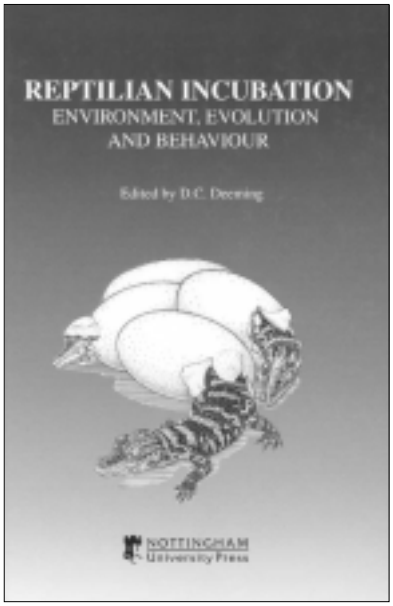
BOOK REVIEWS

Herpetological Review, 2006, 37(1), 117–119.

Reptilian Incubation: Environment, Evolution and Behaviour, edited by D.C. Deeming. 2004. Nottingham University Press, Thrumpton, Nottingham, United Kingdom (www.nup.com). xiv + 349 pp. Hardcover. £50.00 (approx. US $90.00). ISBN 1-897676-11-5.

BRETT A. GOODMAN
Department of Zoology & Tropical Ecology
School of Tropical Biology, James Cook University
Townsville, 4811, Queensland, Australia
e-mail: brett.goodman@jcu.edu.au



Given that the majority of the world's reptile species are oviparous (Zug et al. 2001), one could be excused for assuming that the environmental influence of incubation in reptiles had been comprehensively covered long ago. However, while the captive effects of incubation in reptiles have been explored recently (Köhler 1997), this treatment provides little evidence of potential environmental effects. *Reptilian Incubation* fills this void by examining the environmental effects of incubation and their implications for the evolution and behavior of reptiles. In short, this book aims to develop a comprehensive understanding of the way eggs are incubated outside the maternal body. Arranged in three parts, the book deals with how the incubation environment affects nests, eggs and embryos, and the repercussions of any long-term effects for reptilian biology.

In Chapter One, Deeming and Unwin focus on the origin and evolution of the reptilian amniotic egg, and review the evidence for reptilian incubation in the fossil record. They highlight important evolutionary stages in the development of eggs, egg shells, nests and the implications for embryos. The negative relationship between the degree of egg shell calcification and gas conductance means that, with some knowledge of egg shell formation and egg composition, it is possible to gain an idea of the nest environment in which many taxa evolved. In general, the eggs of lepidosaurs (with the exception of some geckos) and *Sphenodon* are poorly calcified and require moist environments, whereas the more extensively calcified eggs of chelonians and crocodilians are less reliant on external water for incubation. While the fossil egg record is limited to relatively few taxa, many of which are dinosaurs, it does provide a useful starting point for inferring the ovipositional environments in which these taxa evolved. The presence of fully formed embryos in the abdominal cavity of a mosasaur fossil strongly suggests that some forms were probably viviparous (Caldwell and Lee 2001), and that the fossil record can provide insight into the evolution of novel traits.

Ackerman and Lott (Chapter Two) focus on the thermal, hydric and respiratory environments likely to occur in soils surrounding buried and incubating reptile eggs, with a major focus on chelonians. The authors acknowledge that there are relatively few available data describing these variables for incubating eggs and offer at least one possible shortcut — the use of data from climatic archives, many of which are available on the web. Such data should provide a general starting point for those intending to examine species for which actual nest temperature data are unavailable or incomplete. Data on the temperatures experienced by eggs in natural nests is still scarce, but this situation appears to be changing rapidly (e.g., Shine and Harlow 1996). However, there remains a need for appropriate long-term measures of temperatures of the soil surrounding reptile nests incorporating techniques from soil science.

Thompson and Speak examine the morphology and composition of modern reptile eggs (Chapter Three). Separate descriptions place emphasis on those features salient to each lineage, with comparisons to birds. Data from all known studies detailing egg chemical compositions are clearly displayed in a series of tables. In summary, while the lipid, protein and energy content is generally similar across taxa (mean lipid : protein ratio 2:1), the evolution of the reptilian egg from that of amphibians was accompanied by a proportional increase in protein. Interestingly, the proportion that certain lipids occur in the eggs of several scincids differs from that in the maternal diet, and possibly reflects what remains of a phylogenetically conserved trait or dietary shift in these taxa.

In Chapter Four, Andrews discusses patterns of embryonic development with reference to the "evo-devo" (evolution and development) debate and the role of developmental biology and regulatory genes (e.g., Hox genes) in determining morphological traits and body plans (West-Eberhard 2003). Andrews reviews the qualitative and quantitative aspects of embryonic development, developmental arrest, egg and nest emergence, and factors affecting hatchling size. While both reptile and bird development are highly conservative, biologically significant differences do exist among reptiles. Hox and other genes associated with development provide some evidence for the absence of forelimbs and the reduction in limb size in various limb-reduced taxa. Another trend is for the chorioallantoic membrane to change size in response to the degree of water uptake and egg surface area in squamates, but remain of a fixed size in rigid shelled taxa (e.g., chelonians, crocodilians, etc.). In general, the earlier stages of development are most sensitive to temperature, with low temperatures and moist conditions producing larger hatchlings, with a relatively low proportion of residual yolk. One interesting consequence of the thin permeable shell of squamate eggs, which facilitates gaseous and fluid exchange *in utero*, may provide a mechanistic explanation for why viviparity has evolved so frequently in this lineage.

Birchard (Chapter Five) reviews the effects of temperature on embryonic development. Specifically, the thermal environment, the temperatures tolerated and a description of the effects of temperature on growth and physiological rates. Birchard incorporates

much additional information since the publication of earlier reviews of reptilian incubation (Deeming and Ferguson 1991; Ackerman 1994). In general reptile nests typically occur in sites where eggs experience a non-lethal range of temperatures. One interesting distinction being that between developmental period and incubation period — the former referring to the period during which temperatures exceed the minimum suitable for development; the latter to the overall period from laying to hatching. Strangely, despite the biological relevance of this distinction it has rarely been used. Further evidence for the importance of defining those temperatures experienced in natural nests comes from the effect of out-of-phase oscillations between surface soil and the deeper soil surrounding the nest, which can have important consequences for water and respiratory gas exchange in eggs.

In Chapter Six, Belinsky, Ackerman, Dmi'el and Ar, explore the delicate balance between the various environmental factors to which reptile eggs are exposed. Thus, while initial water content varies among taxonomic groups and environmental conditions, under most incubation and hydric conditions the majority of yolk-free hatchlings have relatively similar water content. Similarly, variation in egg shell types leads to equally varied changes in hydric conditions, with some lizard eggs gaining more than three times the original mass during incubation! Data are summarized in several tables presenting wet and dry egg masses. Compared to other taxa lizards typically have higher hatchling wet mass to egg wet mass ratios. Clearly, egg size and shell type are important for initial egg water concentrations. It seems likely that the plasticity of reptilian nest-site selection along with incubation conditions that affect the mass and water content of hatchlings and residual yolk have played a major role in reptilian evolution.

The same authors follow on with the longest chapter (Chapter Seven, 42 pages, 8 Tables, 7 Figures), presenting new and published data on energy density values for the components of reptilian eggs and hatchlings (26 species), as well as new data on oxygen consumption (25 species). Indeed, much of this chapter is taken up with data presented in tables and figures. They indicate that reptiles are a homogeneous group in terms of energy use, relative to birds, which exploit a wide range of incubation temperatures. An interesting finding being the similar mass-specific energy use efficiency of reptiles and birds, which appears suggestive of their common ancestry. However, compared to other reptiles, lizards differ as a group due to their greater oxygen-use efficiency.

Shine (Chapter Eight) examines the effects of the nest environment of squamate reptiles, using much of his data to explore the adaptive role of maternal exploitation of embryonic sensitivity, and in particular the role it has played in the evolution of maternal behavior and physiology. Specifically, where incubation-induced effects are of sufficient magnitude and duration to substantially affect offspring fitness, they are also likely to have a significant role in the evolution of maternal behavior and physiology. As such, there is a real need to identify those traits potentially under maternal control (e.g., nest site selection). The review begins with a description of those traits found within squamates (the group with the greatest range of reproductive traits), before incorporating information on other reptile groups and comparing forms of maternal manipulation of offspring phenotypes. Shine also highlights areas of future importance, including the use of intraspecific comparative studies to detect microevolutionary processes, defining and verifying the link between phenotypic traits and fitness, and using incubation conditions that resemble those of natural nests (Shine and Harlow 1996). Indeed, such studies may also be informative with respect to other adaptive processes (e.g., Temperature-dependent sex determination, TSD; Elphick and Shine 1999). While the effects of nest temperature on hatchling size, shape and locomotor performance may have important fitness consequences such effects may be offset if hatching occurs during a less favorable period. Nonetheless, while there is a need to mimic the conditions of natural nests in studies of the evolution of maternal manipulation of hatchling phenotypes, whether studies of other evolutionary phenomena based on constant temperature incubation are any less informative may be dependent on the system examined (e.g., Vanhooydonck et al. 2001; Kearney and Shine 2004). The next portion of the book focuses on the effects of incubation on TSD. In short, because reptiles possess both genotypic-sex determination (GSD) and TSD they are ideal for comparative studies of sex determination in vertebrates (Bull 1980). Valenzuela (Chapter Nine) focuses on how the environment affects sex determination from the thermal and biochemical standpoint in reptiles, with a consideration of the evolution of TSD. A large table provides details of species from families for which TSD is known and for which it is absent. Unfortunately, while a search using comparisons of thermal, physiological and molecular mechanisms of both TSD and GSD seems promising, they offer little insight into those factors occurring in nature. Nonetheless, Valenzuela provides several testable predictions for the evolution of TSD, including examples of conditions under which TSD is unlikely to occur. Despite the large number of examples, conclusive evidence of an adaptive explanation of TSD in vertebrates is known only from one species each of fish and lizard. Yet, while this is an extensive list of criteria the prospect that a species may have more than one explanation of TSD ensures that this will remain a challenging area of research (Valenzuela et al. 2003).

In Chapter Ten, Deeming reviews the post-hatching effects of incubation on reptile phenotypes. Laboratory and field studies indicate that the incubation environment of reptile eggs affects a wide variety of post-hatching traits including morphology, physiology and behavior. He also proposes that at present relatively few trends can be drawn from most taxonomic groups, as conclusions have typically been biased toward a few well studied species. Further, there remains the possibility that life histories of individual species may be important in the expression of post-hatching phenotypes, with the suggestion of future work increasing the current species database to identify trends and those physiological mechanisms that influence the phenotype long after hatching. Clearly, identifying incubation regimes for which post-hatching performance is compromised will have major value for conservation and management programs.

In the shortest chapter (Chapter Eleven; 11 pages), Booth reviews the role of artificial incubation for both experimental and captive research, and covers obtaining eggs, the movement of eggs, incubation temperatures, hydric conditions and microbial infections. In general, most reptile eggs incubate over a wider range of temperature than birds (e.g., 5–8˚C). For maximal hatching success, Booth advocates the use of sterilized substrates, minimal egg movement, and the use of a different range of temperatures for reptiles from temperate and tropical regions. In the final chapter

(Chapter Twelve), Deeming overviews details of the previous eleven chapters. What becomes apparent is that current knowledge about both the eggs and nesting environments of reptiles is still poorly known. This is, in part, no doubt the result of the phylogenetic diversity, the range of reproductive modes exhibited and the range of habitats occupied, both within and among extant reptile groups, and because much of this research has focussed on a few key species from each group. In closing, Deeming makes various suggestions for future research.

In summary, Deeming has done a fine job in assembling the extensive range of contributors and researchers that have participated in this book. All chapters are thoroughly researched and well referenced and the most recent publications and many unpublished data have been incorporated. It is refreshing to observe that the Squamata have been afforded additional space, which likely reflects the increasing amount of research conducted on this group. Nonetheless, while there is some overlap among most chapters, which enables the reader to begin at any chapter, others may find the continued reintroduction of specific, key features somewhat redundant. The text is well complemented with numerous tables (33) and figures and black and white photographic plates (38), which are especially useful for some of the more theoretical chapters (e.g., Chapters 6 & 7). On the downside, there are many typographical errors throughout the text, with all chapters having at least one such obvious error. While this problem could have easily been avoided with more rigorous proofreading during the editing phase, it does little to detract from the breadth and quality of material presented. *Reptilian Incubation* promises to be a substantial addition to this field, and a worthy and helpful guide for students and researchers of herpetology and evolutionary ecology for years to come.

Literature Cited

Ackerman, R. A. 1994. Temperature, time and reptile egg water exchange. Israel J. Zool. 40:293–306.

Bull, J. J. 1980. Sex determination in reptiles. Q. Rev. Biol 55:3–21.

Caldwell, M. W., and M. S. Y. Lee 2001. Live birth in Cretaceous marine lizards (Mosasauroids). Proc. Roy. Soc., London, Series B 268:2397–2401.

Deeming, D. C., and M. W. J. Ferguson 1991. Egg Incubation: Its Effects on Embryonic Development in Birds and Reptiles. Cambridge University Press, Cambridge.

Elphick, M. J., and R. Shine 1999. Sex differences in optimal incubation temperatures in a scincid lizard species. Oecologia 118:431–437.

Kearney, M., and R. Shine 2004. Developmental success, stability and plasticity in closely related parthenogenic and sexual lizards (*Heteronotia*, Gekkonidae). Evolution 58:1560–1572.

Köhler, G. 1997. Inkubation von Reptilieneiern, Grundlagen, Anleitungen und Erfahrungen. Herpeton Verlag, Offenbach.

Shine, R., and P. S. Harlow 1996. Maternal manipulation of offspring phenotypes: nest-site selection in an oviparous reptile. Ecology 77:1808–1817.

Vanhooydonck, B., R. Van Damme, T. J. M. Van Dooren, and D. Bauwens 2001. Intraspecific variation in lizard locomotor performance. Physiol. Biochem. Zool. 74:937–945.

Velenzuela, N., D. C. Adams, and F. J. Janzen. 2003. Pattern does not equal process: exactly when is sex environmentally determined? Am. Nat. 161:676–683.

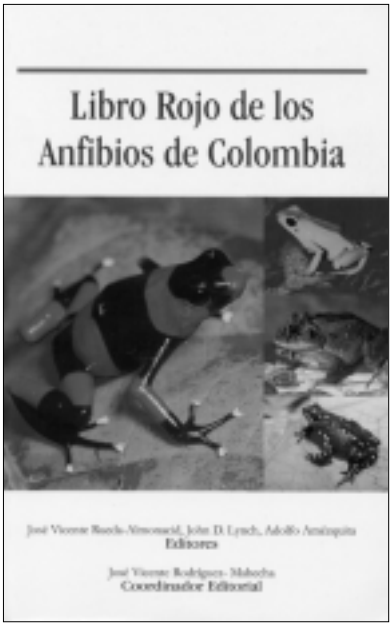
West-Eberhard, M. J. 2003. Developmental Plasticity and Evolution. Oxford University Press, Oxford.

Zug, G. R., L. J. Vitt, and J. P. Caldwell. 2001. Herpetology: An Introductory Biology of Amphibians and Reptiles. Academic Press, London.

Herpetological Review, 2006, 37(1), 119–121.

Libro Rojo de los Anfibios de Colombia, edited by José Vicente Rueda-Almonacid, John D. Lynch, and Adolfo Amézquita. 2004. Conservación Internacional Colombia, Instituto de Ciencias Naturales-Universidad nacional de Colombia, Ministerio de Medio Ambiente, Bogotá, Colombia. 384 pp. Softcover. Approx. US $25.00. ISBN 33-6070-8.

CÉSAR L. BARRIO-AMORÓS
Fundación AndígenA, Apartado Postal 210
5101-A Mérida, Venezuela
e-mail: atelopus@andigena.org



Many species and populations of amphibians are threatened, in severe decline, or have recently become extinct. With the problem at its zenith, concerned herpetologists and biologists around the world are trying to monitor populations, understand the reasons for such declines and extinctions, and provide possible solutions. National assessment of species at risk and the nature of the threats they face is an important step in this process. Amphibian richness in countries of tropical America is the highest in the world, but monitoring there has never been a priority, and thus information on amphibian populations is scarce and difficult to assess. *Libro Rojo de los Anfibios de Colombia*, published in the series Libros Rojos de Especies Amenazadas de Colombia, provides a comprehensive example for other countries to follow.

The book begins with two beautiful but small maps of the country, one political, the other physiographic. Following the table of contents, are prefaces by S. Suárez Pérez (Colombian Ministry of Environment, Housing and Territorial Development) and J. V. Rodríguez-Mahecha and F. Arjona (Conservation International, henceforth CI), acknowledgements, and a prologue by C. Gascon (CI). Colombia has the highest number of amphibian species (733) on Earth, making the task of the book a challenging one. The prologue emphasizes that the categorization of endangered amphibian species was a collective task that combined scarce quantitative data with the subjective interpretations of each specialist. The 24 contributors include specialists in each species or group of species and each taxon account is separately authored by one or more of these.

The Introduction is divided into several sections. "Generalidades de Colombia" includes geographic and hydrographic background and a very short explanation of Colombia's biogeography. I think that a more extensive introduction would have been more appropriate in order to place Colombia's high biodiversity (estimated to be 10% of the world total), in the context of the complex geography of Colombia.

Next a brief resumé of the history of herpetology in Colombia leads into an introduction of the general problem of endangered amphibians and the principal threats they face, like the destruction of natural habitats (e.g., only 1,200 km? or the original 80,000 km ? of deciduous and semi-deciduous forests of Colombia remain and only 27% of the original Andean forests persist). Other threats that amphibians confront are the fragmentation of habitats, the introduction of exotic species (e.g., pines, eucalyptus, fishes, and the bullfrog, *Rana catesbeiana*), pollution from herbicides, pesticides and acid rain, an increase in UV radiation and broader issues of climatic change, and overexploitation due to scientific collection and the pet trade. Another subchapter deals with recent amphibian declines, mentioning fungal infection and synergistic anthropogenic factors, and another discusses priority areas for amphibian conservation. Here the authors state the necessity to select such areas on the basis of their concentration of unique threatened species, but recognize that efforts to protect endangered amphibians are limited by the economic capacity to conserve them. The next subchapter is about the conservation *in situ*, and how existing protected areas can help. "Initiatives for Colombian amphibian conservation" deals with strategies such as, the modification of local cultivation practices (like coffee, which is highly destructive!) and promotion of corridors between protected areas. Another section of the introduction deals with the ecogeography of endangered species, showing that only seven of the 55 endangered species in this book occur below 1000 m, whereas 42 are from Andean forests, from which about 350 species are known. Finally, the methodology employed in assessing the species is provided along with a very useful explanation of the IUCN categories, and procedures for their application.

This is not a scientific book, but rather an identification guide for not only specialists, but government functionaries, naturalists, and those who are not very close to the amphibian world, but are interested in combating amphibian decline. This wide use is facilitated by a section explaining how to use the book, with an illustrated dichotomous key. Five color plates follow with small illustrations and photographs of the species mentioned. The illustrations are exactly the same as those appearing later in the species accounts, and do not follow the established systematic order for amphibians (e.g., Duellman 1993; Frost 1985, 2004). This arrangement is confusing; for example, in one plate salamanders are combined with several *Eleutherodactylus*, one *Osornophryne*, and one *Atelopus*, and in the next they are accompanied by *Phrynopus*, *Eleutherodactylus*, *Gastrotheca*, *Hyla*, and *Rhamphophryne*). Some order should have been followed, if not systematic at least one based on UICN categories. Regardless, as all these pictures are also presented in the species accounts, their inclusion here seems redundant. Before the species accounts, a list of species per threat categories is presented, but this includes only 48 species, not the full 55 treated in the accounts.

The first accounts are about the Critically Endangered (CR) species. For each account there is an illustration or photograph, all of good to very good quality, a common name, the scientific name, the family, and the category. This is followed by taxonomic comments (when considered important), the etymology of the scientific name, a description (which is really a short definition), the distribution (with a local map containing the known distribution at the end of each account), habitat, natural history, current status and threats. Under the last heading the most recent year of observation, conservation measures taken (if any), and the conservation measures proposed are provided. An additional helpful bit of information that could be included here in a future edition would be the number of specimens of each species in collections.

The last part of the book has a glossary of technical terms, followed by the acronyms used in the book, a literature section, and an index of common and scientific names. A map of the national parks of Colombia ends the book.

In general, I am happy to see this first step to do something about endangered amphibians in a neighboring country (I live in Venezuela), which is the first of its kind in Latin America. It is an attractive, well illustrated book, with a great deal of information on the general topics of amphibian decline and conservation and on the specific problems in Colombia. It meets all expectations for this first step by the authors.

One of the handicaps this book has is language, because it is written in Spanish. However, I think that all interested herpetologists working with tropical American species should be able to handle Spanish, at least to a reading level. I do, however, want to note some minor faults or details that could be improved in a subsequent edition. On page 76, in the section "How to use this book," a drawing of the dorsum of a frog appears, with some external anatomical features indicated. Two of these, "cloaca" and "glándula parotoidea" (parotoid gland) are not well delimited (especially the latter, because the frog is an *Eleutherodactylus*, which lack such glands!), and a non-frog specialist could be confused.

In the key (p. 81), couplet 3 leading to frog families says "palmeaduras sólo en las patas" (webs only on the feet) and is applied to dendrobatids and leptodactylids, although there are some dendrobatids with reduced webs and many *Eleutherodactylus* have no webs between the toes. On page 92, pictures of what I recognize as *Bufo granulosus* as an example of granular or tubercular skin, and the skin of *Atelopus farci* demonstrating a skin with warts, are not very adequate for the leptodactylids (mostly *Eleutherodactylus*). Likewise, illustrations (p. 93) of *Eleutherodactylus mnionaetes* dorsal skin as having "pliegues dorsolaterales cortos no extendidos" (dorsolateral folds short and not extended), and *Dendrobates lehmani* as illustrating "piel del dorso con tubérculos o gránulos bajos" (dorsal skin with low warts) are not the best examples to use (*D. lehmani* has completely smooth skin!). On page 96 there is a mention of "ranas grandes, LRC superior a 35 mm" (big frogs, SVL superior to 35 mm), and on page 98 the text reads "[ranas de] tamaño mediano, LRC= 56 mm)" (medium sized frogs, SVL = 56 mm). Although a specialist should understand that a dendrobatid of >35 mm can be considered big, and that an hylid of 56 mm can be considered of medium size, this is again confusing for non-specialists. Also, some terminology employed in the key, like "cabeza en forma de casco" (casque-headed form) for *Gastrotheca*, may have little meaning for non specialists. Even I do not find any similarity between a casque and

the head of a *Gastrotheca*.

In the current status and threats section of the *Atelopus ebenoides*, it is stated that *A. e. marinkellei* was last seen in 1995, but this information is not provided for *A. e. ebenoides*. In the same account the authors state that the species decline is related to global warming. Although all herpetologists are sure that global warming has a lot to do with the decline of some species, there is no direct evidence of such a link for this particular species.

The etymology of *Atopophrynus syntomopus* is not complete (the meaning of the generic name is not explained). That for *Atelopus subornatus* is inaccurate; the epithet makes reference to the fact that the species is ornately patterned on the underparts, not specifically that they are red or orange below. No meaning is given for the meaning of the specific epithet of *Atelopus farci*, although Lynch (1993) clearly stated that the nominative was "the acronym for a guerrilla group in Colombia (FARC) that frequents forests (especially cloud forests) and is dressed in khaki. Although FARC disrupt Colombian society, it does provide protection to the endangered cloud forests and their non-human inhabitants. The species is dedicated to FARC for its conservation, but not political, efforts." Indeed, it is strange that the armed conflict between the national army, the two main guerrilla groups (FARC and ELN), and the paramilitaries, which has catastrophic consequences for nature in general (e.g., deforestation, coca cultivation, use of herbicides) is hardly mentioned in the text at all.

Several illustrations are reproduced from other sources without attribution. For example, drawings of *Cryptobatrachus nicefori* (p. 160) from Cochran and Goin (1970) appear without citation, and in *Atelopus minutulus* account (p. 191) an unreferenced drawing of *Atelopus* sp. eggs comes from Lynch (1986). Illustrations of two types of *Atelopus* (*ignescens* and *longirostris* groups; p. 196), also unattributed, are derived from Peters (1973). References for illustrations are also lacking for should appear in pages 285, 290, 294, 320, 324 and 363, for *Phrynopus adenobrachius* (p. 285), *Rhamphophryne rostrata* (p. 290), *R. truebae* (p. 294), *Eleutherodactylus carranguerorum* (p. 320), *E. fallax* (p. 324), and *Rhamphophryne macrorhina* (p. 363).

In the account for *Colostethus edwarsi*, the description uses the webbing formula of Savage and Heyer (1967), although it cites Heyer (1967). Anyway, I do not understand why this old formula is used when an improved version was provided by Myers and Duellman (1982) and more recently by the original authors (Savage and Heyer 1997).

In the taxonomic comments for *Eleutherodactylus lichenoides* (p. 231), the author (Lynch) states that there are almost 200 species in the *E. unistrigatus* group, when on page 260, other authors (Rueda-Martínez and Rueda-Almonacid) say that there are about 150 species in the group. This is especially strange given that Lynch and Rueda-Almonacid have collaborated in many descriptions of *Eleutherodactylus*. Elsewhere it is stated that the lowland frogs of the *Atelopus longirostris* are not referred to in the book, but in fact *A. minutulus*, which has a species account, is referable to this group.

On page 276 photos two species of *Gastrotheca* appear, but these are not identified. The same is true of two species of *Dendrobates* appearing on page 306. A series of photos showing individual variation appears in the account of *Dendrobates occultator* (p. 311), but to me the species shown actually appears to be *D. bombetes*.

Finally, I will comment on the common Spanish names given to taxa in the *Libro Rojo*. Although it is perhaps odd to assign such names to species that are referred to only by specialists using their scientific names, it may be necessary for official purposes. I dealt with a similar issue in my list of Venezuelan amphibians (Barrio-Amorós 1998). While many names coined here make sense, others seem less appropriate. For example "rana saltona" (jumping frog) is given for *Colostethus*, which are usually called rocket frogs, and the "salamandra corpulenta café" (coffee robust salamander) for *Bolitoglossa lozanoi* seems less useful than "salamandra de Lozano." "Rana de lluvia de ojos rojos y amarillos" (red and yellow eyed rain frog) is provided as a common name for *Eleutherodactylus actinolaimus*, which has neither red nor yellow eyes! This might be better called "rana de lluvia de gola rayada" (throat striped rain frog). Perhaps strangest of all is "rana ladrona de azúcar" (sugar burglar frog), a strange name that makes no sense, applied to *Eleutherodactylus phragmipleuron*, for which something like "rana de lluvia [almost all *Eleutherodactylus* are called rain frogs] de Medellin" would have been more appropriate.

Despite my criticisms, I consider all these issues easy to solve in a future second edition of the *Libro Rojo*. This is a book of fundamental importance for all those who are concerned with amphibian declines, even if it is in Spanish (a good opportunity to learn a new language for some!), and a benchmark for all other countries in the Americas to aim for.

Acknowledgments.—I appreciate the comments of Ángela Suárez Mayorga on an earlier version of this book review.

LITERATURE CITED

BARRIO, C. L. 1998. Sistemática y Biogeografía de los Anfibios (Amphibia) de Venezuela. Acta Biol. Venez. 18(2):1–93.

COCHRAN, D., AND C. GOIN. 1970. Frogs of Colombia. U.S. Natl. Mus. Bull. 288:1–655.

DUELLMAN, W. E., 1993. Amphibian Species of the World. Additions and Corrections. Univ. Kansas Mus. Nat. Hist. Spec. Publ. 21. 372 pp.

FROST, D. R. 1985. Amphibian Species of the World. Allen Press Inc. & Association of Systematic Collections, Lawrence, Kansas. 732 pp.

———. 2004. Amphibian Species of the World: An Online Reference. http://research.amnh.org/herpetology/amphibia/index.html.

LYNCH, J. D. 1986. Notes on the reproductive biology of *Atelopus subornatus*. J. Herpetol. 20:126–129.

MYERS, C., AND W. E. DUELLMAN. 1982. A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama. Amer. Mus. Novitates (2752):1–32.

PETERS, J. A. 1973. The frog genus *Atelopus* in Ecuador (Anura: Bufonidae). Smithson. Contr. Zool. 145:1–49.

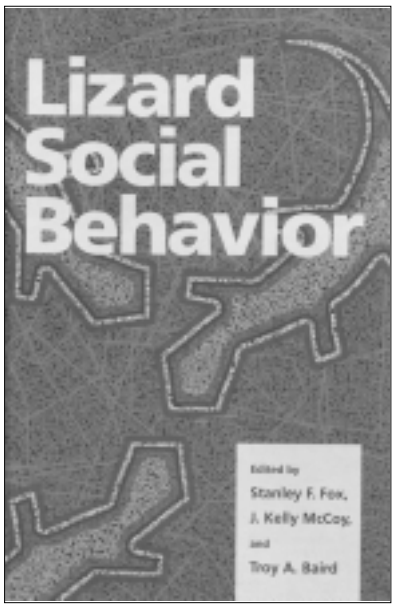
SAVAGE, J., AND R. HEYER. 1967. Variation and distribution in the tree frog genus *Phyllomedusa* in Costa Rica, Central America. Beitr. Neotrop. Fauna 5:111–131.

———, AND ———. 1997. Digital webbing formulae for anurans: a refinement. Herpetol. Rev. 28:131.

Herpetological Review, 2006, 37(1), 122–123

Lizard Social Behavior, edited by Stanley J. Fox, J. Kelly McCoy, and Troy A. Baird. 2003. Johns Hopkins University Press, Baltimore, Maryland (www.press.jhu.edu). xiv + 448 pp. Hardcover. US $89.95. ISBN 0-8018-6893-9.

EVGENY S. ROITBERG
Chair of General & Systematic Zoology, Rostock University
Universitätsplatz 2, D-18055 Rostock, Germany
e-mail: eroit@web.de



In recent decades, lizards have become model organisms for studying general problems of ecology and evolution. Three previous international symposia on lizard ecology have resulted in proceedings volumes (most recently Vitt and Pianka 1994) that acquired a wide audience, both in and outside the herpetological community. *Lizard Social Behavior* is the proceedings volume of another related symposium organized by J. K. McCoy, S. F. Fox, and T. A. Baird at the 1999 Joint Meeting of Ichthyologists and Herpetologists. This symposium gathered investigators who use lizard models to address theory in sexual selection and the evolution of social behavior. Due to a general lack of parental care and other complicated forms of behavior, and because of their particular convenience for field studies, it is often more advantageous to use lizards to test some basic predictions about mate choice and sexual selection determinants than birds and mammals. This book has demonstrated this convincingly and it has already been favorably reviewed in a number of behavioral and ecological journals (Otter 2003; Staple 2003; Goodman 2005).

The book includes 11 chapters divided into three major sections according to the level of variation studied: variation among individuals within populations; variation among conspecific populations; variation between species. Each section is supplied with an introduction by an eminent behavioral ecologist (P. Marler, G. H. Orians, and G. W. Barlow) that summarizes the contributions and evaluates their methodology. The editors' general introduction outlines the advantages and special properties of lizard models.

Baird, Timanus, and Sloan (Chapter 1) monitored and experimentally manipulated social behavior in two isolated populations of the collared lizard *Crotaphytus collaris*. They present uniquely thorough data on seasonal, ontogenetic, and individual differences for both sexes and discuss their determinants, mainly in terms of costs and benefits of territory defense in various natural contexts. The next three chapters are mostly restricted to male behavior. Whiting, Nagy and Bateman (Chapter 2) provide an extensive overview of research on the evolution and maintenance of social-status-signaling badges in different animal groups and put in this context their study of the bright ventral coloration in *Platysaurus capensis* (Cordylidae). The badge size tends to reflect true fighting capacity; when experimentally increased, it enhances the contest success of its owner. Zamudio and Sinervo (Chapter 3) explore a peculiar polymorphism for male mating strategies found in *Uta stansburiana*. Three behavioral morphs – territorial owners, moderately territorial female guards, and non-territorial sneakers – which also differ in throat coloration, are genetically fixed, and this polymorphism is balanced by a frequency-dependent sexual selection. A great advance of this study is a reliable method of measuring reproductive success using a molecular genetic procedure. Cooper (Chapter 4) thoroughly reviews relationships between antipredatory behavior and social behavior in light of predictions of optimal escape theory. The author's field observations and clever experiments on the skink *Eumeces laticeps* coupled with related studies on some other lizards, demonstrate that males often need to trade off time spent avoiding predators with time spent engaging in courtship, mate guarding, and territory defense. Social and mating costs of autotomy were also considered in depth in this chapter.

The second section of the book includes investigations of conspecific populations in different environments. Using both field and experimental approaches, McCoy, Baird and Fox (Chapter 5) studied sexual size dimorphism, sexual dichromatism, and various parameters of social and mating behavior of both sexes in three Oklahoma populations of *Crotaphytus collaris* (cf. Chapter 1). The results conform to their hypothesis that the study environments differ in their potential for intra- and intersexual selection — the phenotypic outcome (dimorphism, behavior) being additionally affected by natural counter-selection which also varies in intensity among habitats.

The next two chapters consider variation among island populations. Hasegawa's long-term investigation (Chapter 6) on the skink *Eumeces okadae*, which inhabits the Izu Islands of Japan, reveals an unusual, positive association of predation rate and sexual selection intensity. Under greater predation, females show a highly secretive behavior that results in a strongly biased operational sex ratio and exerts the male-male competition for mating opportunities.

An extensive study of lava lizards (*Microlophus* spp.) from the Galápagos Islands by Stone, Snell, and Snell (Chapter 7) addresses possible effects of the rates of predation, parasite infection, and food supply (these vary as predicted by island biogeography) on lizard population density, behavior, and morphology. The results suggest the importance of predation in shaping the inter-island variation in body size and shape, population density, and social system.

The final section addresses the variation between species; its contributions vary substantially in their research design and approach. Hews and Quinn (Chapter 8) explore the endocrine basis of signal coloration and behavior in a range of *Sceloporus* and *Urosaurus* species. Some of the species are dimorphic, with males differing from females in having a colorful patch and more aggressive behavior; the other species are not dimorphic, both sexes exhibiting either masculine or feminine pattern of the first group. Interspecific and sexual differences in target-tissue receptivity

(rather than hormone level) were identified as the primary proximate determinant for the observed diversity.

Gier (Chapter 9) compares two iguanid species, *Ctenosaura similes* and *Dipsosaurus dorsalis*, which occupy vastly different habitats (forest and desert), to reveal environmental correlates for the differences in their mating systems and sexual size dimorphism.

Fox and Shipman (Chapter 10) studied seven closely related *Liolaemus* species occupying different elevations in central Chile. Local environment was a more important determinant of social behavior than phylogeny. In this system, the highest study site (2900 m a.s.l.) provides the most optimal habitat (better thermal opportunities and food supply, low predation rate). The highland species, *L. bellii* and *L. leopardinus*, are more abundant and less aggressive than the other forms; also, they are more interactive, suggesting a more complex social behavior that has rarely been reported for other lizards (e.g., O'Connor and Shine 2003). This study uses original methods to quantify lizard thermal opportunities and to factor out phylogenetic effects.

The final chapter (Losos, Butler, and Schoener) discusses aspects of sexual dimorphism in body size and shape in the Caribbean anoles, whose repeated radiation on different islands produced the same set of ecomorphs adapted to particular habitats. The study offers further evidence that (1) local conditions, rather than phylogeny, determine patterns of sexual dimorphism in external morphology, and (2) habitat types can differ in their potential for sexual selection.

Each chapter clearly outlines its hypotheses and how they were tested. Extensive reviews of relevant literature include both special and more general contexts, and the pooled reference list (pp. 381–434) is valuable *per se*. This makes the book useful for both experienced researchers and students.

My minor criticism concerns an editing issue. In a number of places (particularly Chapter 5) the book contains sentences or larger text blocks that seem unnecessarily complicated, including apparent redundancies or other faults.

Overall, *Lizard Social Behavior* is an outstanding contribution to reptilian behavioral ecology, a must-have for everybody from this field and those who are dealing with sexual dimorphism and sexual selection. This book is also of great interest for students of life-history, ecological morphology, and particularly for evolutionists. Indeed, it may well have been appropriate for the book to have been entitled *Lizard Social Behavior: Evolutionary Implications.*

Literature Cited

Goodman, B. A. 2005. Book Review: Lizard Social Behavior. Austral Ecol. 30:488–489.

O'Connor, D., and R. Shine. 2003. Lizards in 'nuclear families': a novel reptilian social system in *Egernia saxatilis* (Scincidae). Mol. Ecol. 12:743–752.

Otter, K. 2003. Book Review: Lizard Social Behavior. ISBE Newsl. 5:13–14.

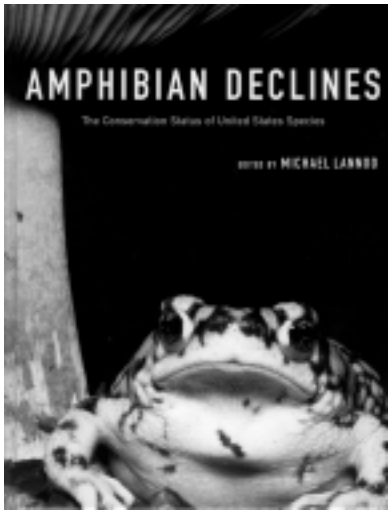
Staple, J. 2003. Book Review: Lizard Social Behavior. Anim. Behav. 66:197–198.

Vitt, L.J., and E. R. Pianka (eds.). 1994. Lizard Ecology. Historical and Experimental Perspectives. Princeton University Press, Princeton, New Jersey. 403 pp.

Herpetological Review, 2006, 37(1), 123–125.

Amphibian Declines: The Conservation Status of United States Species, edited by Michael Lannoo. 2005. University of California Press, Berkeley, California, USA (www.ucpress.edu). xxi + 1094 pp. Hardcover. US $95.00. ISBN 0-520- 23592-4

DAVID K. SKELLY
School of Forestry & Environmental Studies
and Peabody Museum of Natural History
Yale University, New Haven, Connecticut 06511, USA
e-mail: david.skelly@yale.edu



Fifteen years have elapsed since 'amphibian' and 'decline' first became welded together in our imaginations. Prior to the recognition of decline phenomena, amphibian conservation was a sleepy corner of our science. A Web of Science query (conducted 10 October 2005) reveals that of 392 articles answering to a subject search for 'amphibian and conservation' just one was published prior to 1990. During the ensuing explosion in research we have learned our initial suspicions were largely correct: the problem of declining amphibian species is widespread and severe enough to lead to multiple species extinctions in some regions (Houlahan et al. 2000; Stuart et al. 2004). Early on there were some, particularly in the media, who sought to characterize declines as emanating from a single mystery cause. Many biologists argued back that there was not enough known to decide what factors were responsible. While we still may claim ignorance, anyone concerned about the issue can now heft the 1100+ page volume entitled *Amphibian Declines: The Conservation Status of United States Species*, edited by Michael Lannoo.

The proportions of this book offer the first important clue about its contents. Lannoo has adopted an 'all flowers shall bloom' approach to amphibian declines. There are no fewer than 215 contributors; there is a decent chance you are one of them. So let me begin by noting that the book offers a definitive look at the issue of amphibian declines. While the stated geographic scope is the United States, several of the authors work elsewhere in the world. Issues which might not be expected to get top billing in a book on the U.S. are dutifully covered as are essays (52 in total) on every other potential cause of declines you may have heard of. In fact, it would be extremely difficult to fault the book for topics it fails to touch on. If amphibian declines are important to you, and they should be, then you should read this book.

But what does it mean to read a book like this? This was the first question crossing my mind as I attempted, unsuccessfully, to fit the new volume in my bookbag. Lannoo states that his intent is to "assemble and integrate" what we know about declines. A quick scan of the table of contents suggests this process has not incorpo-

rated meaningful triage. That job has been left to readers who must decide why, for example, there is an entire chapter on renal adenocarcinoma. If you were wondering whether there is any evidence to link this cancer to declines, the authors helpfully put that concern to rest: "…there appears to be little about the Lucké renal adenocarcinoma to concern population biologists (p. 101)." Other chapters focus on limb malformations. One can argue the case for inclusion: we still don't know whether abnormal limb development is a threat to amphibian populations. But why are there two of them and by what criteria is an additional chapter on the basic biology of trematodes justified (Trematode parasites *may* be responsible for some limb deformity outbreaks in nature and limb deformities *may* cause declines)? Chapters with dubious claims on the attentions of readers interested in declines are numerous. Fortunately, there are also outstanding, topical essays that will leave readers informed and intrigued.

The many essays offering overviews of research areas (e.g., Ecotoxicology authored by Ray Semlitsch and Christine Bridges) offer brief, informative summaries that give an idea of what has happened and where the field is headed. Many are structured like primers and are likely to be most useful for the uninitiated. Other more targeted essays are likely to be more appealing to specialists. As one example, a series of three essays on the Cricket Frogs (*Acris crepitans*) of the upper Midwest leaves readers with a well developed picture of a regional decline. While the authors of these studies are still far from determining the cause for declines, they have been unusually thorough in their use of observational data in the development of their research. In the study of some other North American declines there has been a tendency to rush immediately to experimentation without clearly describing the phenomenon to be understood. While the observation first approach is not fast, it is far more likely to lead to robust inferences (Storfer 2003).

Other essays are less about science than its context. A well titled chapter on "Houston toads and Texas politics," authored by Lauren Brown and Ann Mesrobian, leads the reader through an agonizing series of events and decisions that provides a warning to be heeded by all involved in amphibian conservation. The Houston Toad (*Bufo houstonensis*), a federally listed species, has gotten the kind of protective status and public attention that many biologists can only dream of garnering for their imperiled species. Nevertheless, there is little evidence that this has helped the toads much. This essay shows in stark terms that while we continue to toil to raise public awareness and provide evidence of threat, we will do well to consider what will or won't happen next. This theme is echoed in an excellent essay written not by a biologist, but a journalist. William Souder argues that amphibian biologists have been largely ineffective in communicating their findings to the public and offers some reasons why. His sobering chapter makes it clear that some of the obstacles are inherent in the way the media covers science—amphibian biologists hoping to surpass these hurdles will do well to consider his counsel closely.

Close followers of the amphibian decline literature will know that the last few years have witnessed the publication of a great deal of important research. This fact makes it especially disappointing that many of the essays in a book with a 2005 publication date appear to be a few years old or older. Whether this delay is a byproduct of attempting such a large publishing project is not clear. Regardless of its origin, the effect for readers is unfortunate. While it remains true that many of the essays still offer the most recent treatment of their respective topics, several have been superceded; for the remainder, readers will be left wondering how they might have changed given consideration of more recent work.

Another critical aspect of the book is tipped by its title. *Amphibian Declines: The Conservation Status of United States Species* is actually two books in one. The second half of the book is comprised of species accounts focusing on "the conservation status of United States species." Each account is divided into four categories (Historical versus current distribution, Historical versus current abundance, Life history features, and Conservation). Within the life history section there are 18 subheadings covering everything from breeding mode to longevity to anti-predator mechanisms. Anyone familiar with the amphibian literature will not be surprised that for most of these categories we know next to nothing for many of the 289 species recognized. However, the accounts offer nice summaries of what we do know and even experts can expect to learn new information about their own study species.

These accounts will undoubtedly be enormously useful to people interested in amphibian conservation as well as basic researchers. However, I must admit believing that a tremendous opportunity remains. The authors of the accounts invoke classic volumes such as Wright and Wright (1949) as the inspiration for their national scale effort. However, in 2005 should reference information like this be distributed in a printed book when it is so much more suited for distribution via the Web? To answer this question for yourself, check out the British Trust for Ornithology's Birdfacts database (http://www.bto.org/birdfacts/) and compare it with this or any book attempting to relate comparable information. Many of the same categories appear in Birdfacts which also includes legible maps and figures that can be easily updated as new information appears. Even the underlying data can be made available to users who can then readily generate their own summaries and customized comparisons. With apologies to salamander biologists, a "Frogfacts" database based on Lannoo et al.'s efforts could offer a highly useful complement to existing sites relating information on amphibian population monitoring (http://www.pwrc.usgs.gov/naamp/) and malformations (http://frogweb.nbii.gov/narcam/).

While perhaps cumbersome in their present form, one great benefit of including the species accounts in the book is the opportunity to summarize what they tell us about the overall status of the U.S. amphibian fauna. David Bradford takes on this challenge in what is arguably the most important essay in the book. His chapter is full of information that is clearly presented and, possibly, more striking and important than the understated and businesslike delivery will suggest to many readers. In fact, it leaves a large elephant in the room.

Amphibian biologists have spent 15 years amassing and supporting various hypotheses without doing much to eliminate them. Bradford's review offers one of the few opportunities in the book to get an overview of what we have learned and to decide where to go next. He shows very clearly that just three decline mechanisms can be considered broadly relevant to U.S. species: land use, exotic species and chemical contaminants. Of these land use is far and away the most often cited. The essay relates this finding with very little comment, but comment it deserves. If those interested in conservation want to take on the most important threats to amphibian populations in the United States, the most comprehen-

sive, national scale consideration has a clear answer—and it will be surprising to many people.

These findings, presented at the end of the book, offer a nice bookend to Tim Halliday's opening chapter in which he notes that we have excellent evidence that there is no 'smoking gun,' if by smoking gun we mean a single cryptic cause. He argues that it is high time to follow a critical consideration of what we have learned with a refocusing of our efforts on the factors that do matter. This will mean deciding that some avenues of research deserve less attention. One of the most critical unspoken conclusions from Bradford's essay is that ultraviolet radiation can now be placed in such a category. UV was one of the first nominated causes for declines and has received more attention than perhaps any other hypothesis. Bradford's review suggests that as a threat to U.S. species, UV ranks along with harvest as a minor issue. Recent work, not cited here, has called the relevance of UV for declines into serious doubt even for those species and regions where it was initially studied (e.g., Biek et al. 2002; Palen et al. 2002). If amphibian biologists are serious about achieving conservation goals, Halliday cogently argues that we will have to shift some of our attention to understanding demography of amphibians in human affected landscapes and their reliance on connections between wetland and upland, and among populations.

In the early 1990's declining amphibian populations attracted the notice of biologists and the public in large part because there was a strong suspicion that something unusual was happening. In essay after essay the veterans of the research campaign report that it is quite likely that there is nothing unusual about many U.S. amphibian declines. Amphibians offer typical stories from the conservation front: a set of factors, predominantly related to human use and alteration of the environment, is acting to reduce and eliminate populations and species. Along the way, biologists have also shown that amphibians may need to yield their unique 'canary' status—several authors note that it is time to stop considering amphibians to be unusual or particularly sensitive to environmental insult. Curiously, in being typical, future studies of declining amphibians may be in an even better position to offer lessons for the conservation of other animals less amenable to study and for which a book of the size and thoroughness of "Amphibian Declines: The Conservation Status of United States Species" is unlikely to appear for a long time to come.

Literature Cited

Beebee T. J. C., and R. A. Griffiths. 2005. The amphibian decline crisis: A watershed for conservation biology? Biol. Conserv. 125:271–285.

Biek, R., W. C. Funk, B. A. Maxell, and L. S. Mills. 2002. What is missing in amphibian decline research: Insights from ecological sensitivity analysis. Conserv. Biol. 16:728–734.

Houlahan J.E., C. S. Findlay, B. R. Schmidt, A. H. Meyer, and S. L. Kuzmin. 2000. Quantitative evidence for global amphibian population declines. Nature 404:752–755.

Palen, W.J., D. E. Schindler, M. J. Adams, C. A. Pearl, R. B. Bury, and S. A. Diamoind. 2002. Optical characteristics of natural waters protect amphibians from UV-B in the US Pacific Northwest. Ecology 83:2951–2957.

Storfer, A. 2003. Amphibian declines: future directions. Diversity and Distributions 9:151–163.

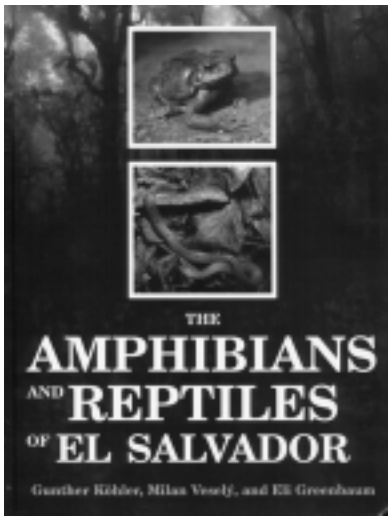
Stuart S.N., J. S. Chanson , N. A. Cox, B. E. Young, A. S. L. Rodrigues, D. L. Fischman, and R. W. Waller. 2004. Status and trends of amphibian declines and extinctions worldwide. Science 306:1783–1786.

Wright, A. H., and A. A. Wright. 1949. Handbook of Frogs and Toads of the United States and Canada, Third Edition. Ithaca, New York, Comstock Publishing Associates. xii + 640 pp.

Herpetological Review, 2006, 37(1), 125–126.

The Amphibians and Reptiles of El Salvador, by Gunther Köhler, Milan Vesely, and Eli Greenbaum. 2005 (dated 2006). Krieger Publishing Company, 1725 Krieger Drive, Malabar, Florida 32950–3323, USA (www.krieger-publishing.com). ix + 238 pp. Hardcover. US $49.50. ISBN 1–57524–252–4.

JAMES R. McCRANIE
10770 SW 164th Street
Miami, Florida 33157–2933, USA
e-mail: jmccrani@bellsouth.net



El Salvador (ES) is the smallest of the seven Central American countries and the only one located entirely on the Pacific versant. As such, its known herpetofauna of 130 species (32 amphibians and 98 reptiles) is also the lowest total for the seven nations. Nonetheless, a comprehensive synthesis of the ES herpetofauna was previously lacking (Mertens 1952, in his review of the ES herpetofauna, treated 23 amphibian and 75 reptilian species that were largely collected by German naturalists) and this book admirably fills that void.

The book begins with a short (1 p.) introduction followed by a two page materials and methods, each listed as a separate chapter. Chapter 3 (5 pp.) is on the environment and provides short descriptions of the country's physiography, climate, and vegetation. Chapter 3 also includes two maps, one showing the political boundaries of the country's departments and the other showing the country's "ecoregions." Ten plates showing various vegetation types accompany this chapter. Chapter 4 (4 pp.) is titled "Composition of the Herpetofauna" and includes a table on the taxonomic composition of the ES herpetofauna and another listing those taxa with a type locality in ES. A section on erroneous and questionable records is also included. Chapter 5 (64 pp.) treats the Class Amphibia and includes bilingual (English and Spanish) dichotomous keys to the adults of the three amphibian orders found in ES, the four salamander species, the 27 anuran species, and the larvae of 23 (counting both *Hypopachus barberi* and *H. variolosus*, which cannot be distinguished from one another morphologically) anuran species (not 20 as stated by the authors). Chapter 5 also includes the species accounts of the 32 amphibians known from the country. Each species account includes the scientific name (along with authorship), a suggested Spanish common name, a partial synonymy, geographic distribution (overall), ecological

distribution (in ES), description, call (anurans only), natural history, conservation status, and specimens examined (including precise locality records and museum numbers). Some of these species accounts also include a list of published locality records of specimens not examined by the authors, and occasional accounts also contain a section on taxonomic comments. Each species account also includes a color photograph of the animal and a map with the ES localities plotted. Drawings of some features of many of these species are also included. Drawings of the oral discs of 12 species of anuran larvae also complement the tadpole keys. Chapter 6 (141 pp.) treats the Class Reptilia. Bilingual dichotomous keys are also included for the "major groups" ("Serpentes, Testudines, Crocodylia, and Sauria"), the two crocodilian species, the eight turtle species, the 30 lizard species, and the 58 snake species. The reptile species accounts follow the same general format as those of the amphibians, except that the conservation status of most species is not given and the natural history sections are omitted from the *Drymobius chloroticus* and *Leptophis modestus* accounts. These reptile species accounts also include a color photograph of each species, a dot locality map for each species, and numerous drawings. Following Chapter 6 is a 16-page Literature Cited section that has 392 references listed (including several to web sites). The final section is a four page index that includes scientific names (species names listed by genus), higher rank names, and selected other names or words mentioned in the first three chapters.

The species descriptions are usually based on data taken from ES specimens, but occasionally information had to be taken from the literature (e.g., much of the sea turtle and crocodilian descriptions) or on data from specimens from other Central American countries or from southern Mexico (e.g., *Hyalinobatrachium fleischmanni*). These species descriptions necessarily vary in length, but I found them all to be well done. These descriptions used along with the identification keys should allow one to correctly identify any specimen of amphibian and reptile in hand from the country. The only complaint I have about the descriptions and identification keys is that there is no glossary to identify the numerous terms used. Given that the identification keys are not illustrated, it is even more desirable to have had a glossary included. Also, the meanings of ecomorphological guild (e.g., nektonic) and developmental mode (e.g., exotrophic) terms used for anuran larvae should have been explained in a glossary.

The natural history sections include information from the authors' field notes when available, field notes of others who have worked in the country, and published data from ES and other Central American countries. The information presented in this section nicely summarizes the available information on the natural history of each species. The call sections of each anuran species account also summarize what is known and point the interested reader to the pertinent literature.

I was especially pleased to see the detailed locality data and museum numbers for the voucher specimens included in the "Specimens examined" and "Published locality records" sections. Compiling these types of lists are very time consuming and tedious, but add greatly to the usefulness of these types of books. However, I would have liked for the authors to have included an accompanying gazetteer that gave the location, elevation, and coordinates for each locality. Also, the locality maps for each species account would have benefited from having the departmental boundaries identified. I also found one error in that the map of *Eleutherodactylus rupinius* has the open squares wrongly placed.

Putting together color photographs of 130 species of amphibians and reptiles is a time consuming and difficult task. This task was complicated by the authors' understandable desire to use photographs of ES specimens when possible. As a result, several of the used photographs are poorly focused or too dark. Two photographs that were used, indeed do demonstrate the desirability of using ES photographs when possible. The photograph of *Dryadophis* (= *Mastigodryas*) *melanolomus* used (from Nicaragua) shows a salmon colored venter, which color is restricted to populations from northeastern Honduras southward through Costa Rica, and that of the *Leptotyphlops goudotii* used (from the Islas de la Bahía, Honduras) shows a vividly striped pattern and large yellow snout and tail spots, whereas those from ES are typically essentially black with smaller snout and tail spots.

The drawings accompanying the species accounts are well done and add greatly to the overall appearance of the book. I found two errors with these drawings as follows: Figs. 9a = *Ptychohyla salvadorensis* and 9b = *P. euthysanota* instead of the opposite as stated in the figure legend; Fig. 41 shows the color pattern of a *Pliocercus elapoides* on a drawing of the head scales of a somewhat modified *Micrurus nigrocinctus* (compare with their Fig. 48a).

This book is remarkably free of typographical errors; I was able to find only Santa Lucia (= Santa Lucía) on Page 165, Tala (= Tela) on Page 210, and Ophidea (= Ophidia) twice on Page 219. Errors of other types also seem to be largely lacking. Three I found are: the reference Campbell (1989) on Page 12 is not included in the Literature Cited; the statement on Page 43 (Taxonomic comments), attributed to McCranie and Wilson (1999), that the prepollical width/prepollical length of the single male *Plectrohyla psiloderma* from ES falls within the range of *P. glandulosa* is erroneous; and the correct locality data for the *Rhinophrynus dorsalis* in Plate 42 is "HONDURAS: Yoro: Tegucigalpita (20 m)." I would also take exception to the statement on Page 82 that members of the family Cheloniidae are "Closely related to the leatherback turtle (Dermochelydidae)."

The layout of this book is attractive with the photographs and species maps placed nicely within the species accounts. The text is not right-hand-justified, which is unusual among herpetological books, but does not detract from the overall appearance of the book.

Despite my minor criticisms, the authors have combined their knowledge of the ES herpetofauna to produce a very useful and detailed book on the herpetofauna of that Central American country. The authors certainly succeeded in summarizing the morphological variation and distribution of the amphibians and reptiles of ES as they stated was their goal in their Introduction. Anyone with an interest in the natural history of Central America should own a copy of this book.

Literature Cited

McCranie, J. R., and L. D. Wilson. 1999. Description of a new species of *Plectrohyla* from Cerro Celaque, Honduras, formerly referred to *Plectrohyla glandulosa* (Amphibia, Anura, Hylidae). Senckenb. biol. 78:231–236.

Mertens, R. 1952. Die Amphibien und Reptilien von El Salvador, auf Grund der Reisen von R. Mertens und A. Zilch. Abh. senckenb. naturf. Ges. 487:1–120.