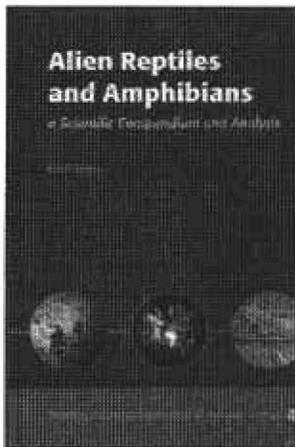


BOOK REVIEWS

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Alien Reptiles and Amphibians: A Scientific Compendium and Analysis

By Fred Kraus. 2009. Springer Verlag (www.springer.com). Hardcover. x + 563 pp. + CD-ROM. US \$169. ISBN 978-1-4020-8945-9.



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Invasive species are increasingly recognized as one of the leading threats to global biodiversity. The field has grown complex enough to deserve its own journal (*Biological Invasions*) and encyclopedia (Simberloff and Rejmánek 2011), but the lion's share of attention has been paid to a few groups of organisms, such as rodents, plants, and ballast-water contaminants. While a few species of introduced reptiles and amphibians and certain geographic areas (Florida, Hawaii) have received research attention, most herp introductions have been largely ignored by the herpetological community. Instead, available knowledge of the great majority of herp introductions is scattered throughout a vast body of literature, often as short notes or as minor addenda to papers on tangentially related topics. In this volume, Fred Kraus offers the definitive literature-based treatment of the subject. Lever (2003) was the first to attempt a summary of herpetofaunal introductions, but Kraus goes far beyond Lever on both conceptual and taxonomic grounds, while correcting a number of errors in Lever's summary. For those desiring a general overview of his conclusions but not willing to suffer through this review, Kraus (2010) is brief and accessible.

A prodigious amount of data is shoehorned into the book, and is summarized with prose that is clear and readable. In

fact, my overall impression is that this is a great book to read if one has a perverse desire to feel that, comparatively speaking, one's own scholarship is mediocre. I will present relevant statistics first, because an understanding of the volume of literature-based support behind the text will be an important factor for those deciding whether to purchase the book. The five written chapters sum to only 131 pages, but as noted below these five chapters are meaty and deserving of careful reading—they are also profusely illustrated with pertinent figures and graphs (Chapter 2, Introduction Patterns, alone includes 36 figures). These chapters are followed by two appendices of herpetofaunal introductions, with records dating back to 1850. If there's a bigger table than Kraus' Database of Introduction Records (Table A.1) in the herpetological literature, I'd like to see it—the table spans 220 pages. It is followed by a shorter table of erroneous and uncertain introduction claims. The Literature Cited is also massive, covering 167 pages despite a small font size. The sheer size of the tables would make data extraction by the reader a plodding exercise were not an accompanying CD included with the volume, containing a MS Excel file version of the database of 5,745 introductions. The file can be sorted, allowing readers to quickly extract data corresponding to their taxonomic or geographic interests.

Editorial oversight of the book was very good; I noticed only a few minor errors (e.g., p. 3, l. 22, 'than' should be 'that'; p. 60, l. 26, 'on' should be 'of', p. 87, l. 17, 'It's' should be 'Its', p. 32, Table 2.2, 'Teidae' should be 'Teiidae'). The binding has held up to repeated consultations of the text and tables over the last few months, although I did not subject it to the more rigorous Crombie Binding Test (Crombie 1992). I found an important indexing error on p. 557 of the Geographic Index—no entries past p. 217 of the text are indexed for the state of Florida, despite the fact that >80% of the entries for that state are found past this page. Spot-checks for other geographic areas did not reveal this error to be systemic, and the ability to sort the electronic database on the CD should obviate this issue.

Chapter 1 (*Background to invasive reptiles and amphibians*) is a concise introduction to invasive species concepts, including the gamut of processes from transportation and establishment through spread and impacts, as well as a concise history of research on invasive herps. This chapter would serve admirably as part of the introductory readings

for a course on invasion biology, regardless of the conceptual or taxonomic interest of the reader. By page 5, Kraus has already considered and dispensed with the notions that invasive species are beneficial because they increase biodiversity, and that human-caused movement of animals is a 'natural' process. I found Kraus' argument that loss of beauty is an underappreciated but vital aspect of exotic species introductions to be the most riveting part of the chapter. Policy-makers often stress economic or ecological impacts; while Kraus discusses these in depth, he also offers the following: "I suggest that the distinctive co-evolved, unique beauty of (natural ecological) systems is besmirched by the introduction of alien species—much as a beautiful beach or coastline may be impaired by an oil spill. Or perhaps more aptly, the facile pollution of these self-generated biotas by human introductions is equivalent to splattering the canvases in the Louvre with day-glo paint; the structural integrity of the canvases may not be marred, the added colors may be beautiful, but the aesthetic integrity of the artworks is thoroughly violated. The difference, of course is that the impact of an oil spill lasts for mere years, vandalization of a painting may be rectified by careful restoration, but alien invasions are most usually irreversible and irreparable."

Chapter 2 presents introduction patterns for herps. Before 1950, introductions were largely intentional and associated with food and biocontrol pathways, but in later decades the primary pathway switched to the pet trade and the rate of introductions increased exponentially. Kraus calculated this exponential equation and concluded that the number of introductions via the pet trade pathway has been doubling every 15.3 years for the last 10 decades. In terms of established species, the pet trade again leads the way, but release pathways including cargo, intentional releases, the nursery trade, human food source, and biocontrol have been important contributors to the sum total. It is unsurprising that Europe and North America have been the recipients of the most introductions since these regions are the primary consumers of wildlife as pets, but some readers will be discomfited by the U.S. contribution to introductions elsewhere—for example, Kraus reports >1400 records of Red-eared Slider (*Trachemys scripta*) introductions worldwide. Kraus considers the pet trade pathway as intentional introductions, because, "...the importation was intentional and because the consequence of irresponsible ownership of animals will be the frequent and predictable escape of the deliberately imported pets." Researchers do not escape scot-free in this analysis; Kraus presents multiple examples of intentional introductions for scientific purposes, with varying levels of justification for conducting the release. This pathway is important for some taxa, as nearly 40% of all salamander releases were deliberate in nature and associated with research (and >80% of these releases were done by a single researcher!).

While Kraus does a good job of discussing regional (availability of knowledgeable reporters) and climatic (e.g., rates of establishment are lower in Europe than in the U.S.) contributions to reporting bias in herp introductions in Chapter 2, I would have preferred a more direct discussion of taxonomic and perceptual biases. Large (e.g., pythons, crocodylians) or otherwise distinctive (e.g., chameleons) species are much more likely to be noticed and reported than are small, drab, or highly secretive species. This undoubtedly leads to biased interpretations of establishment success—because introductions of small species are less frequently observed, their perceived rate of establishment (no. established populations/no. introductions) is often high, but in reality the disparity in establishment success between obvious and less-obvious taxa may not be particularly striking. Failure to recognize the potential of taxonomic bias can have policy implications: representatives of the pet trade have used Kraus' calculation of low establishment success for the families Boidae and Pythonidae (they rank second to last and last, respectively, in his tabulation across herpetofaunal families) as 'proof' that large-bodied snakes represent low risk as invaders and therefore that regulatory efforts to reduce the odds of establishment are unnecessary.

Chapter 3 reviews impacts of introduced herps. Some authors have stated that herps tend to pose little threat as introduced species, which has tended to dampen researcher interest in documenting impacts that are assumed *a priori* to be minimal. Based on the few studies that have specifically examined deleterious impacts of introduced herps, Kraus reports that impacts have actually been recorded for a wide range of species. In Florida, for example, negative impacts of introduced herps have been demonstrated for virtually every species that has received research attention, although admittedly this conclusion is influenced by the fact that species that first receive research attention tend to be those that are most feared to have negative impacts. Looking farther abroad, most ecologists are familiar with the avifaunal devastation wrought by the Brown Treesnake (*Boiga irregularis*) on Guam, but may not be aware that, for example, Green Anoles (*Anolis carolinensis*) have caused the decline or extirpation of large numbers of insect species on Japanese islands or that Bullfrogs (*Lithobates catesbeiana*) have been implicated in the decline of a variety of vertebrate taxa at sites all over the globe. These are examples found under only one header (Removal of Native Prey Species) in the chapter; Kraus subsequently reviews ecological impacts including loss of native predators, changes in ecosystem dynamics, competition with natives, vectoring novel pathogens (e.g., chytridiomycosis), and community homogenization. He also examines evolutionary and social impacts, including scientific loss of knowledge based on confusion about native ranges, evolutionary status, or ecological relationships. Kraus ends by saying that 26 herp species can be credibly implicated in impacts

on native wildlife or humans, but that such a relatively low number can likely be ascribed to inattention to impacts and the difficulty of demonstrating such impacts.

It is telling that Chapter 4 (*Management Responses*) is the shortest chapter in the book, as delays in recognizing the potential impacts and scale of herp introductions has curtailed interest in developing such responses among stakeholders, and availability of funding for such endeavors remains anemic as compared to better-known invaders such as mammals, plants, and ballast-water contaminants. Kraus reviews the three legs of the management tripod for exotic species—prevention, early detection, and rapid response, and management of well-established pests. In most countries, prevention of new introductions via regulatory or incentivized means is uncommon, and typically reactive rather than proactive; in other words, importation or ownership bans are enacted only after a species proves pestiferous, thus closing the barn door after the horses have fled. This tendency to consider only some members of taxonomic groups for regulatory action allows the live-animal industry to make compensatory switches after taxon-specific bans, such as was seen when turtle exporters in the United States switched from Red-eared Sliders to Painted Turtles (*Chrysemys picta*) after importation of sliders was prohibited by the European Union (ironically, the painted turtle has a climate match with larger portions of the E.U. than does the slider).

Kraus summarizes the few successes in eradicating invasive amphibians at a local scale (usually single ponds or drainages), but he could find no examples of a successful eradication of an established reptile population anywhere in the world. While Chapter 4 gives the specific details to back up this depressing statistic, the issue is most lyrically summarized in Chapter 1: “A second generality of extremely practical importance is that alien-species naturalizations are usually irreversible. In most instances, once introductions have been allowed to establish, no amount of money or effort can change the situation—much as is widely recognized for other lamentable and irreversible developments such as death, amputation, or the invention of disco music.”

Because eradication of well-established populations has such a dismal record of success, Kraus next discusses long-term control. He largely focuses on the interdiction program for Brown Treesnakes (*Boiga irregularis*) on Guam, which aims to prevent the snake from reaching other areas, such as Hawaii, that are at risk of colonization by unintentional human transport of snakes. While this program has been successful in achieving its goals, it illustrates uncomfortable truths about the financial cost of long-term control and long timelines for research needed to develop effective control tools. The chapter ends with a discussion of limitations on our ability to manage introduced herps, focusing first on biology-related drivers (crypsis, high reproductive rates, and high population densities), then moving to social obstacles

(disbelief in the magnitude of the problem, widespread intentional releases, etc.) and a general lack of commitment to developing adequate tools for the job. Taking the chapter as a whole, the take-home message is that reducing the rate of future invasions must be heavily reliant on prevention programs.

The final chapter (*Implications for Policy and Research*) offers a concise roadmap for those interested in developing solutions from a regulatory standpoint as well as researchers interested in fleshing out our limited scientific understanding of an increasing problem. Kraus presents a scathing indictment of regulatory structures and regulatory timidity in the United States and the European Union (the primary consumers of imported reptiles). Especially striking is the comparison of New Zealand with the U.S.; the former country has a single agency charged with preventing and managing exotic species, and this agency employs the precautionary principle when screening potential imports. Meanwhile, 36 to 40 federal agencies (and orders of magnitude more at the state level) have some role with invasive species in the U.S., and collectively they exhibit a history of regulating species only after they have become problematic invaders. The U.S. has a regulatory patchwork quilt with more holes than patches, and the result is sadly predictable—New Zealand has had zero exotic herpetofaunal establishments since the 1960s, while the U.S. has experienced at least 110 establishments during the same period.

Kraus also bemoans the ‘dishonest market costing’ in pet-trade-related herp introductions. He notes that in much of the world, animal importers and dealers are able to market herps at extremely low prices, allowing them to maintain high trade volumes including species that are poorly suited to captivity but which are abundant in source countries. Release or escape of animals by poorly informed, overwhelmed, or negligent owners is the near-inevitable consequence, and taxpayers end up picking up the tab for management of established populations. Kraus opines that costs of screening potential imports, educating purchasers, and controlling established populations should be internalized in the live animal trade, instead of being externalized by denying culpability and dumping the problem on others. Among other benefits, this raises the price of potential pets, promoting responsible care by owners and reducing the number of ‘impulse buys’ by those lacking the knowledge or resources to properly care for an animal.

The chapter concludes with a list of vital research questions that are needed to better understand the drivers of, and results of, herp introductions. This section could be a well-spring of ideas for new graduate students looking for thesis projects in applied herpetology. Kraus’ recommendations on information that should be included in reports of new introductions or naturalizations should be of particular interest for readers of *Herpetological Review*, as this journal publishes

many Geographic Distribution notes for introduced herps. He recommends including information on when the introduction occurred, how many introductions were involved (and numbers of individual organisms when these data are available), identification of relevant pathways and motivations for release, and the status of the current population. With the recent demise of the journal *Applied Herpetology*, the importance of *Herpetological Review* and *IRCF Reptiles and Amphibians Conservation and Natural History* (which has taken over the peer-reviewed section on exotic herps from *Applied Herpetology*) as outlets for such reports will likely increase.

In a recent conversation, Kraus indicated no desire to continue the Sisyphean task of compiling literature records on this subject. Where will be found the sucker who will take up the mantle of Assembler of Arcane Introduction Records? While there are myriad, and often competing, databases that attempt to track introduced organisms, most of these rely on volunteers posting new finds to the site or a few flustered agency employees attempting to compile records across all organismal taxa. This approach lends itself to fragmentary and taxonomically or regionally biased perceptions of introductions. It is also worth noting that while Kraus has assembled a monumental dataset, this is likely an *underestimate* of the numbers and taxonomic diversity of introduced herps. By including only those records reported in the peer-reviewed literature, Kraus ignored media accounts, unpublished observations, and unpublished museum records. Accurate and complete introduction databases will be vital to answering some of the most basic questions that are of interest to preventing and managing future herp invasions, but the task is large and the payoff often small (Kraus notes that, "To put it bluntly, applied herpetologists don't get tenure").

Kraus' opus will be of great interest to a wide range of scientists, land managers, and policy makers, and its distribution would help dispel many of the common myths and laissez-faire attitudes about introduced herps. Unfortunately, the book's price will reduce its penetration in the groups that would most benefit from reading it (in fact, certain cheap-skate herpetologists might accept an invitation to write a book review in order to get a free copy). The book is currently available online for about 20% less than the suggested price. It is really a steal at this price when considering its scholarly treatment of the subject matter, lively prose, and a trove of easily mined data.

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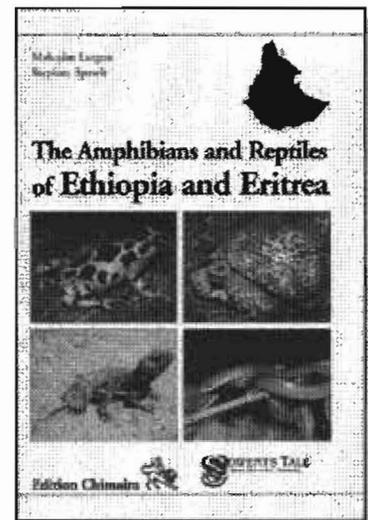
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The Amphibians and Reptiles of Ethiopia and Eritrea

By Malcolm Lagen and Stephen Spawls. 2010. Edition Chimaira (www.chimaira.de). Hardcover. 693 pp. 98,00 Euros (approximately US \$140.00). ISBN 978-3-89973-466-9.

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Ethiopia is a special place, not only because of its history but also because of its stunning geographical and biological diversity, and the amphibians and reptiles of the area are no exception. Ethiopia

and Eritrea are home to some 285 species of amphibians and reptiles and especially among amphibians, the level of endemism is high, with over 40% of all anuran species being endemic to Ethiopia. At the same time, the highlands of Ethiopia are among the most densely settled areas in Africa and the human pressure on the environment is immense, which makes this area one of the most threatened global biodiversity hotspots. It is, therefore, all the more laudable that the two foremost experts on the amphibians and reptiles of Ethiopia and Eritrea have teamed up to produce a guide book that will serve as a concise introduction to the herpetofauna of the area. As the authors state in the introduction, the targeted audience is less the seasoned herpetologist but more the interested novice and especially young, local herpetologists who are sorely needed to help preserve this unique place.

The book is lavishly illustrated with over 380 color and 25 black and white photographs, in addition to some 23 black and white drawings and 282 distribution maps. The photographs are usually arranged two to a page but a fair number