



BOOK REVIEW

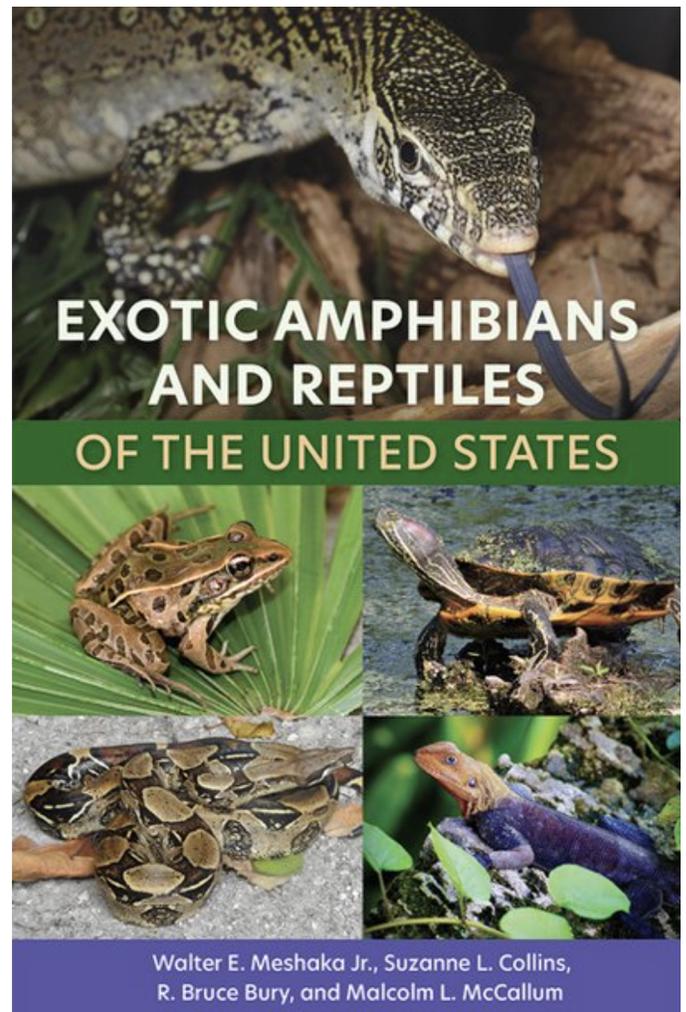
The New and the Relocated: Non-native Amphibians and Reptiles in the Continental US and Hawaii

Exotic Amphibians and Reptiles of the United States. 2022. Walter E. Meshaka Jr., Suzanne L. Collins, R. Bruce Bury, and Malcolm L. McCallum. University Press of Florida, Gainesville, Florida, USA. [13] + 245 pp. ISBN 9780813066967 (hardback). US \$55.00.

In 2004, Meshaka and colleagues published *The Exotic Amphibians and Reptiles of Florida*, a 155-page book devoted to almost 60 non-native species then known from the state. This was not the first such effort. Two decades earlier, Wilson and Porras (1983) spent a fair portion of their slim volume on introduced herpetofauna in Florida. A decade earlier still, Bury and Luckenbach (1976) attempted to summarize what was then known about non-native amphibians and reptiles in California. In between, Simberloff et al. (1997) edited a volume dealing with all non-native species in Florida, and Rodda et al. (1999) focused much of their book on the problems caused by introduced Brown Treesnakes (*Boiga irregularis*) on Guam. More recently, Lever (2003) and Kraus (2009) summarized the global knowledge of non-native amphibians and reptiles, and Powell et al. (2011, 2013) did so for the West Indies. This is by no means a complete list — introduced species have received growing attention over the past few decades, and rightly so. Invasive species are now seen by biologists as a major conservation problem, although the policy response can still most charitably be described as lagging (Perry et al. 2020). Regrettably, reptiles and amphibians have been some of the most obvious vertebrate invaders — and Florida owns the dubious distinction of leading the nation and perhaps the world in herpetological introductions.

Unfortunately, regular reports of new records in *Reptiles & Amphibians*, *Herpetological Review*, and elsewhere, have provided considerable new material on which to base the new book. The 59 species included in Meshaka et al. (2004) have now given way to 103 accounts. Seventy-four are of species rigorously documented as established in the continental United States and Hawaii. Also described in the current volume are 29 species that are native to the mainland USA but have now spread because of human activity beyond their original ranges. Not included are species that have not been

conclusively shown to be established and those known to be established in U.S. affiliated entities in the Caribbean (Puerto Rico, U.S. Virgin Islands) or the Pacific (Guam and other islands). Thus, the Brown Treesnake, for example, does not make an appearance, despite being established on Guam and recorded from Hawaii and even Texas (Rodda et al. 1999). The criteria for choosing which species to include and definitions of the terms “exotic,” “invasive,” and “native” are provided in the 12-page introduction. The main part of the



book is organized taxonomically. Part 1 is devoted to salamanders (3 species, all of them extralimital native species); part 2 to frogs and toads (7 non-native, 11 extralimital); part 3 to turtles (2 non-native, 10 extralimital); part 4, the largest, to lizards (60 non-native, 2 extralimital); part 5 to snakes (4 non-native, 3 extralimital); and part 6 to a single crocodylian. In each part, species accounts are preceded by one or more in-depth essays by one of the authors or other contributors, each only a few pages long and lacking references, on problems related to the taxa covered. In part 1, McCallum discusses the role of aquaculture as a source of not just salamanders but also frogs and, of course, fish. In part 2, Karen H. Beard focuses on the Puerto Rican Coqui (*Eleutherodactylus coqui*) and Brian Gratwicke delves into the complexity of that species, which in its native range of Puerto Rico is “a cherished animal and important symbol,” yet where introduced in Hawaii, has become a nuisance. With additional examples, the emphasis is that “in the fight to save frogs, context matters.” In part 3, Bury and Brent M. Matsuda provide a regional focus on non-local freshwater turtles introduced to the Pacific Northwest of North America. Three essays address lizards. Jesse Rothacker writes from the perspective of a reptile rescue center (one that I particularly appreciate because of my own work with the South Plains Wildlife Rehabilitation Center in Lubbock, Texas, which has seen some similar patterns; McGaughey et al. 2011). Frank J. Mazzotti, one of the most prolific reporters of new introductions in Florida, recounts the story of the Argentine Giant Tegu (*Salvator merianae*) in the state and how a slow bureaucracy ensured that the species would become established. Finally, Meshaka briefly touches on the how and why of counting herps, something to which entire, albeit somewhat more technical, books have been devoted. In part 5, Michael R. Rochford recounts the story of how Burmese Pythons (*Python bivittatus*) have come to take over the Everglades and makes a convincing case that efforts at eradication, although ongoing, have failed. Part 6, the shortest by far, lacks an essay.

Within each section, species accounts are arranged alphabetically, first by family and then by scientific name. Each account includes the common and scientific names, a description and at least one color photograph, a map of the introduced range, a history of the introduction and text describing the current distribution, and ecological information that provides an indication of how the species is likely to interact with native taxa in its new range and what kinds of impacts it might have. Closing the book’s 245 pages are a bibliography, a list of source journals, author information, and an index of common and scientific names.

At its most basic, this book provides an updated snapshot of translocated species of amphibians and reptiles in the mainland U.S. and Hawaii. Some time has passed since the monumental effort of Kraus (2009), and the update is wel-

come. Considerable effort has gone into putting it together, and this is particularly evident, for example, in the detailed maps. Although greatly expanding the task of the authors, I would have liked to have seen reports of introduced species that have not (yet) established reproducing populations, as I think those can help managers and policy makers assess levels of risk and the pathways and localities most in need of monitoring. For example, McGaughey et al. (2011) indicated that several crocodylians had been found in Lubbock, Texas, where at least one was believed to have survived for years. Also, popular media stories (e.g., Steinbuch 2022) periodically describe crocodylians found in houses and even cars, many associated with criminal activity and presumably one step away from release somewhere they do not belong. As it is, maps of widely dispersed species, such as the Indo-Pacific House Gecko (*Hemidactylus garnotii*), now found all the way from the East to the West Coast, can be so busy with county lines that discerning details is difficult, although enlarged inset maps help. In any case, this book provides a valuable service to anyone trying to identify what they are seeing and whether the observation is sufficiently novel to merit a report. The information in the book also can help managers plan for a likely arrival and its possible impacts and mount an early and aggressive response to a species likely to become established and negatively affect native taxa. That alone would make this a worthwhile contribution. As publications increasingly move to the digital realm, we have to determine how authors and staff required to make their products accessible and attractive, are recognized and rewarded for the kind of effort required to produce this kind of work.

However, the value of this work goes one step further. Starting with the introduction, the authors point out the problematic nature of species introductions, something that many enthusiasts, let alone the pet trade industry and the policy makers setting the rules, have yet to fully understand. By choosing a non-technical tone, Meshaka and his coauthors have provided an accessible text that might reach far beyond an expected technical audience — and that must happen if we are to have an impact on the problem. As the authors point out, most of the covered species remain fairly localized, although some have already spread widely. Most introduced amphibians and reptiles are found in warm and humid Hawaii and especially Florida. While we might be suffering from confirmation bias — we know that searching in a few locations associated with the pet trade has been successful, so we keep going back to those sites and finding more species, but we do not look elsewhere with the same intensity — Florida appears to be suffering from a mix of a permissive climate, what the authors call “past lax regulations” (p. 5), the lack of an effective policy response, and what multiple authors have described as irresponsible behavior on the part of particular pet traders. Overall, the picture that emerges from

Table 1. Sources of species introductions identified in the text of species accounts in Meshaka et al. (2022). Note that some species, for which sources of multiple populations are listed, are represented more than once. Taxa are organized in the order in which they appear in the text. Accidental introductions appear related to commercial activity in ports and nurseries. Unknown sources are indicated by the question mark (?).

| Taxon | Pet Trade | Fishbait | Deliberate Biocontrol | Other | Nursery | Accidental Other | ? | Total |
|-----------------|-----------|----------|-----------------------|-----------|----------|------------------|-----------|------------|
| Salamanders | — | 2 | — | 1 | — | — | — | 3 |
| Frogs and toads | 1 | — | 3 | 7 | 4 | 2 | 4 | 21 |
| Turtles | 1 | — | — | 4 | — | 1 | 6 | 12 |
| Lizards | 39 | — | 2 | 8 | 3 | 19 | 6 | 77 |
| Snakes | 3 | — | — | — | 1 | — | 3 | 7 |
| Crocodylians | 1 | — | — | — | — | — | — | 1 |
| Total | 45 | 2 | 5 | 20 | 8 | 22 | 19 | 121 |

summarizing the known sources of introduction listed by the authors (Table 1) is more nuanced and shows geographic and taxonomic variation. Geographically, many of the arrivals in Hawaii appear to be accidental, most of those in Florida are associated with the pet trade, and populations elsewhere show a more mixed pattern, with port cities often having a number of unintentional arrivals associated with trade. Taxonomically, treefrogs and geckos have often found their own way to arrive, usually associated with ornamental plants or other trade, whereas most other lizards and many snakes, especially the larger constrictors, are believed to be associated with the pet trade, which, in any case, is the largest single contributor to the total number of herpetological introductions in this region (Table 1).

The primary importance of the pet trade as an introduction vector remains consistent with the conclusions presented in the previous effort from Meshaka et al. (2004, p. 127): “the recent spike of exotic amphibian and reptile introductions to Florida” — and elsewhere — “... has been primarily through the pet trade.” Although counter to the generally accepted view in the early days of invasion biology, namely that most introductions are accidental, other authors have reached similar conclusions about many species of “pets” in various other localities. Unfortunately, outright bans can “raise the value of these products on the black market” (McCallum; p. 19). Also, misleading trade practices exacerbate the mere availability of animals. For example, Rothacker (p. 93) points out that “the main reasons we see specific reptiles” at their rescue center “are that they are inexpensive to bring home, expensive to keep, grow quickly to undesirable sizes, and they may live several times longer than other pets.” Those issues could easily be addressed by mandating that an accurate information sheet associated with each animal is available *before* purchase. Although Meshaka et al. (2004) drew attention to the need to deal more effectively with the pet trade and continue to do so in the current volume, an initial approach to using market-based approaches to encourage the industry to improve its

record was proposed over a decade ago (Perry and Farmer 2011). The amnesty approach instituted in Florida, which allows owners to surrender unwanted animals with no consequences (Mazzotti, p. 95), is a step in the right direction.

Meshaka et al. (2004) also pointed out that managers and policymakers often dismiss herpetological introductions as harmless, despite the extreme example set by the Brown Treesnake (Rodda et al. 1999). Meshaka et al. (2004) clearly thought that was wrong, and this book shares the same view. Introductions “can result in dramatically altered food webs” (p. 5), with species such as the Cuban Treefrog (*Osteopilus septentrionalis*) and the Burmese Python serving as obvious cases in point. Delayed policy responses, a lack of enforcement, and inadequate funding for control activities have been persistent problems (Bury and Matsuda, p. 68; Mazzotti, pp. 96–98; and especially Rochford, pp. 205–206). Policy makers often choose to ignore warnings because they require inconvenient actions or prevent desired outcomes (Perry et al. 2020). At the same time, and as several of the essays in this volume point out, even biologists tend to want more information before committing to a course of action — by which time the species may be too entrenched for eradication to be feasible.

I want to end with what may seem like a quibble. This book is about “exotic” species. The online Merriam-Webster dictionary offers two definitions for that word (<https://www.merriam-webster.com/dictionary/exotic>). The first is very much in line with the book’s title: “introduced from another country: not native to the place where found.” However, I worry about the second one: “strikingly, excitingly, or mysteriously different or unusual.” Words matter, or we would not still be disagreeing whether the lizard climbing on the tree outside should be called “*Anolis*” or “*Norops*.” If part of the goal of this book is to create change, whether in the minds of pet owners, pet dealers, or policy makers, perhaps we should use a term that only encourages one emotion. That aside, this book should be of interest to a broad range of readers and offers important lessons, particularly in the essays, for manag-

ers and policymakers not necessarily focusing on amphibians and reptiles.

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