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Amphibians of Costa Rica. A field guide

Leenders, Twan

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There is no doubt that Costa Rica has one of the best well-known Tropical herpetofauna in the world. It has been studied by single herpetologists and also teams for more than two centuries. It is also the only Neotropical country with more comprehensive books about its own herpetofauna (Savage 2002, Solórzano 2004, Kubicki 2004, 2007; Muñoz-Chacón & Johnston 2013, etc.).

For those reasons, everyone interested in amphibians and reptiles (professional or amateur) in Costa Rica were happy to have on hand several references that allow them to easily identify the species they could find over there (with only a few exceptions). However, the main reference that was written so far, Savage's masterwork (popularly called "the Bible"), has been paying the price of time. Treating it only the amphibians, it is now obsolete and has never been a true field guide. It was an encyclopedic volume that helps to identify the specimens once at home or at the laboratory. Kubicki's two books about leaf frogs (Phyllomedusidae) and glass frogs (Centrolenidae) are very complete, but also suffer from becoming out of date and most of the species have changed their generic names ever since. The mini-guide by Muñoz-Chacón & Johnston (2013) is more recent, having scientific names in order, but the presented information is too basic to help identifications, and the pictures are too small and not always good. *The Amphibians of Central America* by Köhler (2011) is a valid reference, and uses dichotomous keys that I am not sure how accurate they are, but also need important information about the morphology of each species; further, it has a wider scope and its strength is limited for Costa Rica. So, we herpetologists have so far believed to have all under control... until this new book arrived, making a triumphal entrance!

And that's why. We really needed a modern book dealing with Costa Rican amphibians (as we do about reptiles!), presenting an easy way to check species and identify them. Maybe we did not miss it, but now that we have it, I really want to thank Twan for that marvelous present.

The book, in field guide format, is small and prepared for action. It is easily portable to the ground, making the identification an easy goal. How? Actually, this book has not dichotomous keys, however, they probably are a little obsolete as well. New generation field guides, led in the Neotropics by masterpiece *Amphibians and Reptiles from*

Mindo Ecuador (Arteaga *et al.* 2013; see book review by Barrio-Amorós 2015), show a different panorama, with all species depicted in white background, and highlighting taxonomic characters useful to recognize every species. It is much more visual and appealing than boring and usually difficult to interpret key. It is also outstanding how the author made not only the distribution maps, but also the technical drawings, and how he also prepared (and cut) all images to fit the white background rule.

Step by step, the book starts with a cover which actually is not very appealing. For such a great effort inside, I think both the authors and editors should have selected a more interesting presentation. The letter font is ugly and the picture of a walking *Agalychnis callidryas* is predictable and non-breathtaking. The inside cover explains how the distribution maps are presented and show a small and convenient map with ecoregions division of Costa Rica. It follows explaining how to take measurements to caecilians, salamanders, and anurans. A foreword by Robin Moore and the acknowledgments by the author are next. An introduction to the book, talking about the geography, climate and weather of the country, its ecoregions; a word on classification and scientific names, on how to observe and identify amphibians, and a necessary explanation about one of the amphibian modern nemesis, the amphibian decline, is after. Then, the author encourages readers to share their observations with other naturalists and specialists, as part of the newly recognized citizen science, which will be greatly benefited by this book.

Continues an introduction to each order; first the caecilians (same with salamanders and anurans), a very useful two pages pamphlet "Costa Rican Caecilians at a glance" (also the same later with salamanders and anurans) which depicts the three genera of the country with its main external characters. In the case of "Costa Rican frogs and toads at a glance" every family is introduced with its main characters using a single species as a representative. For each Order, will appear a short introduction (in one page) to the family (e. g. Caeciliidae), another short introduction on another page to each genus (e. g., *Oscaecilia*), and then, the formal account for each species. The accounts are usually two to three pages long, and include the scientific and common names, its IUCN status; a short paragraph of definition; a distribution map, highlighting by number the ecoregions where it is distributed, and a comment on the general and local distribution; a natural history section which is quite complete and resumes most of the general knowledge on the species in question (not as deep as in Savage 2002), and a description section with a picture of the taxon on white background, where external obvious characters are highlighted and pointed out, bringing the attention of the reader to help identification. Finally, a very interesting and visual section is "Similar Species", in which it is possible to check closely the main differences with most of their alike taxa.

A glossary of technical terms follows every account; then a Bibliography, very short to me, although it is not intended to provide an extensive list of references; furthermore, the author suggests consulting the references in Savage (2002) volume and some websites, among which, I miss the *Amphibian Species of the World* (Frost 2016). The penultimate section is devoted to credit the photos in the book, and the last is a taxonomic index, useful to quickly locate the species, genus or family. Two pages in blank for notes and the inside back cover is a little more detailed physical map of the country. The cover shows two short blurbs and a presentation of the book and its author.

Now that I have presented the book and that I really enjoyed reading it, there are some little details to mention, which I hope will help to improve a future edition.

There is mention of three species of salamanders and two frogs that have never been recorded for Costa Rica: *Bolitoglossa indio, B. pygmea, Oedipina* sp. (which very probably is the newly described *O. berlini*), *Craugastor chingopetaca* and *Pristimantis taeniatus*. This is not bad per se... as the author states; *B. pygmea* is reported at 5 km of the border in Panama, therefore highly expected to occur in Costa Rica. *Bolitoglossa indio* was reported from close localities to the Costa Rican-Nicaraguan border, and one specimen is believed to be a record of this species from 1890. Of course, it can be very difficult to demonstrate this assessment without newly collected biological material. *Pristimantis taeniatus*, on the other hand, has been mentioned on an unpublished list from the Universidad de Costa Rica, and therefore it is included in the book without any distributional data. Gómez-Hoyos *et al.* (2018) will confirm the presence of the species through a picture taken recently.

I miss the accounts of some basic issues. First; scientific names should always be accompanied by their author(s) and year of description. This information helps to understand a lot about the history of the species at a glance. For example, if the species has been recently described or not, who is the authority to contact if the reader happens to have or require some information, etc. This should be linked to the reference (mentioned on the account and fully written on the bibliography section) of the original description. Also, there is no reason why there are sections with an appropriate heading (like Natural History, Description or Similar species) and others not mentioning it, as the Definition and Distribution. Also, and very important, it should be cited the origin of every speci-

men depicted, even if is not Costa Rica. As a photographer, I would also like to see the photographer's credits on each picture and not in a heavily charged page at the end. This gives information and makes easier to contact the photographer if you are interested in the species or locality. On the contrary, if you want to know who is the photographer of, for example, the lower right photo of *Bolitoglossa alvaradoi* on page 42, you go to page 525 and need to start searching among hundreds of very small page numbers.

Another issue that could be better resolved is the size of the letter font on the accounts. It is very small (am I picky with this? am I the only one who had a hard time reading the very small lines, especially under low light?) Probably my sight is becoming older and lazier. I know this is to save space!!

Only a few species lack their pictures, then it would be good to try an illustration of at least a preserved specimen.

A problem of design is that some species (e. g., *Oedipina alfaroi*, pp. 123) seem to have occupied only half page (and the remaining space white), which requires to turn to the next one to see the image of the species. This is confusing.

Dermophis gracilior (pp. 24) is a rare caecilian, but easy to distinguish due to its checkered belly. So, even if it is mentioned in the text, the best way to show it is with a good image.

About *Bolitoglossa colonnea* and *B. striatula*, both cases are common salamanders on the Caribbean versant or ecoregion 1, but they have been mentioned from the Pacific region without any proofs. These salamanders are difficult to distinguish from *B. lignicolor* (which can also have a striped pattern) to non-specialists, and I think they do not occur in the area. However, they are worthy of mention as any new report would bring light to the subject.

I cannot be completely sure, but in my experience, the male *Atelopus senex* (pp. 156) looks to me like a female.

About *Incilius fastidiosus* (pp. 170-171), the picture bottom line says that that species is a "usual" little toad. Probably the author meant "unusual", as nothing is normal in that toad, not the shape, and not the abundance, as it has disappeared for a long time. In the Similar species section, there should be a reference to *Incilius holdridgei*, which is the most alike species.

After Acevedo *et al.* (2016) the common cane toad of Central America and those from South America west of the Andes became *Rhinella horribilis* instead *R. marina*. I am not sure if Twan had the time to check this before closing the edition, but I see that there are even more recent data published which appear in the book.

Hyalinobatrachium fleischmanni is no longer recognized from Venezuela, as it says in pp. 208. Populations related to the species have been described as *H. guairarepanensis* and *H. tatayoi* recently (Señaris 1999, Castroviejo *et al*. 2007, Barrio-Amorós 2004). The author also states that this species is likely the most frequently encountered glass frog in Costa Rica. Well, this is so relative, as for me and according to my experience in the country, I have only seen two populations; it is true, however, that I don't move much around the central mountains; but this is a matter of where each person looks for. In my area, Costa Ballena in the southern Pacific (Barrio-Amorós 2016), *H. fleischmanni* is absent, and other species are dominant.

On page 217, *Sachatamia albomaculata* is not mentioned from Ecuador, and on pp. 219, *Sachatamia ilex* is mentioned on a locality (the Tarcoles river) where it has been accepted with doubts (Kubicki 2007).

On pages 227-228, the genus *Craugastor* is defined as containing some species groups, the *fitzingeri* s.g., the *gollmeri* s.g., the *rhodopis* s.g., the *rugulosus* s.g., and the *biporcatus* s.g. Actually, *biporcatus* is not a *Craugastor*, but a *Strabomantis* and the three species contained in Leenders's classification (*C. gulosus, C. megacephalus* and *C. rugosus*) are currently being under a *C. punctariolus* species group (after Padial *et al*. 2014).

Furthermore, the *Craugastor* species groups used by Leenders are obsolete, and they must change as follows: the *Craugastor gollmeri* species group is now the *C. laticeps* series (after Hedges *et al*. 2008, Frost 2017). The *Craugastor rhodopis* species group is no longer stand, and all species in it belong to the *C. podiciferus* s.g. The *Craugastor rugulosus* species group as defined by Leenders must be understood as the *C. punctariolus* s.g.

Craugastor rugosus has become very scarce and difficult to observe, at least in the adult stage, while juveniles are often reported. I miss a picture of an adult specimen on its account.

Craugastor stejnegerianus is one of the most polychromatic and abundant species of its genus; still, there are only two chromotypes depicted, which could lead to confusing many of these patterns with other species.

One of the most common mistakes that so many authors drag is to name familiarly the dendrobatid frogs as poison arrow or dart frogs. I really see this as confusing and misleading. Only two or three species (in the genus *Phyllobates*) are really used to poison darts (and none arrows), and they live in Chocoan Colombia. So, the rest of them, including all in Costa Rica, must be named poison frogs. To use the impractical and inadequate "dart" only generates more confusion.

Treating *Dendrobates auratus* would be welcome to show the sexual dimorphism on the disk size and shape.

I also miss more chromotypes depicted for *Oophaga granulifera*, which is only shown as the Osa population (red anterodorsally and blue posteroventrally) and the Green one from Central Pacific. Where I live the chromotype is red with only greenish blue hands and feet. Populations northwards are yellow and orange.

Same is valid for *Oophaga pumilio*, a highly variable species. In Costa Rica, there are at least a dozen variants. Depicted is the typical blue jeans from La Selva and Sarapiquí to the North, and a reticulated variant (page 302) with no locality data.

Silverstoneia flotator, as all dendrobatids in Costa Rica, breeds in the rainy season. Its breeding activity is along the same season, never during the dry season, as the book states (pp. 310). It is true that during the dry season, many specimens can be gathering at small creeks and some can call, but this is not the real peak of breeding activity.

After Duellman *et al*. (2016) –probably the author did not receive the reference at time-, the panorama of the family Hylidae changed, and Phyllomedusidae raised to family in its own right. The author states that there are 8 species of the genus *Agalychnis*, which is not correct, being 13 after the change of the *Phyllomedusa buckleyi* group to the genus (Faivovich *et al.* 2010).

The size of the female of *Agalychnis spurrelli* is wrong, it says up to 72 mm, but Savage (2002) already stated that it was up to 93 mm. Populations from the southern Pacific are much smaller, with males up to 50 mm (Duellman 1970), and are differentiable from the larger Caribbean populations. I miss some information and at least a picture of an individual of the Pacific populations, to be used for comparison. However, the maximum size mentioned in Leenders might refer to the mean between both data, instead of the maximum size for the species.

The genus *Ecnomiohyla* is no longer formed by 14 species but 12, after *E. miotympanum* and *E. tuberculosa* changed of the genus (now in the genera *Rheohyla* and *Tepuihyla* respectively after Duellman *et al.* 2016 and Ron *et al.* 2016).

Scinax elaeochrous is the proper naming for the species (not *elaeochroa*) since *Scinax* is masculine and not neuter (see Duellman *et al.* 2016).

About *Engystomops pustulosus* (pp. 451), there is a mention of the bat *Trachops cirrhosus* as predator, but the common name used for it was wrong. I am not a friend of common names, but in this case, I am sure *Trachops* is not the "common fishing bat". I found a more accepted common name as a fringe-lipped bat.

About the size of *Leptodactylus insularum*, there is an error that has been dragged by Savage (2002) himself to date. For example, Savage (*op. cit*.) states that females of *Leptodactylus insularum* (as *L. bolivianus* in that book) are larger than males, and it is also repeated by Leenders. Actually, males of many *Leptodactylus* species are larger than females, and so, males of *L. insularum* can reach up to 104 mm and females up to 99 mm (Heyer & De Sá 2011). Also, the main character to recognize and distinguish *L. insularum* among other congeners is the presence of two thumb spines, instead of one in *L. bolivianus* (Barrio-Amorós 2004), which should have been shown.

Since the publication of this very recent field guide, two latest publications added two new species to the Costa Rican panorama, reaching the number of 209 species. These new species added in 2016 are *Bolitoglossa aurea* Kubicki & Arias, 2016, and *Oedipina berlini* Kubicki, 2016. Costa Rica, aside from its immense diversity does not seem to expect many more discoveries of new amphibians as in other Latin American countries. The small size of the country (51.11 km^2) and the continuous work by many herpetologists from around the world in a territory filled with biological stations, make new taxonomic discoveries every day less probable. However, we are aware of some new surprises to arise soon enough.

This book, aside from its minor details, is a must in any herpetologist library, but very especially on Neotropical research libraries, universities, and interested people. From any naturalist that comes to Costa Rica just for a few weeks to enjoy nature and photograph a few frogs, to the hardcore herper that needs all species identified on its list, Leender's book will be highly appreciated.

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