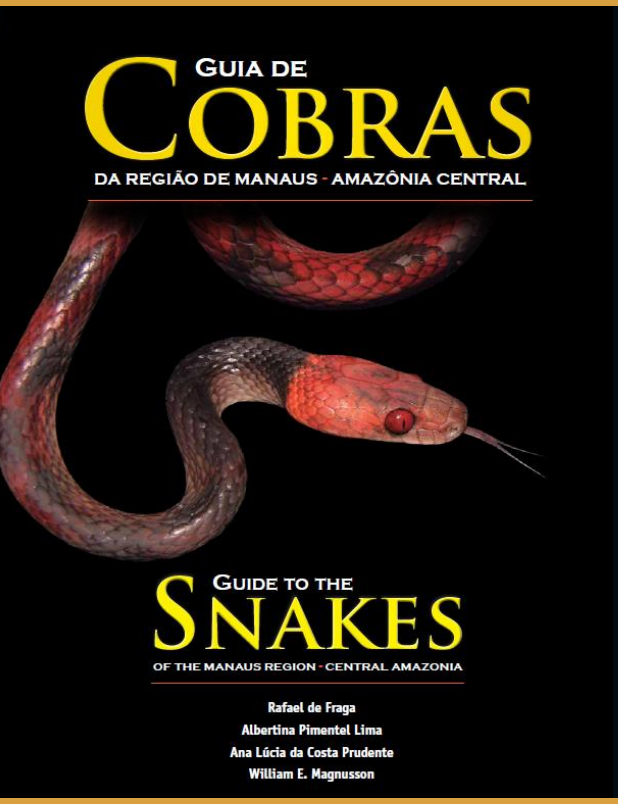
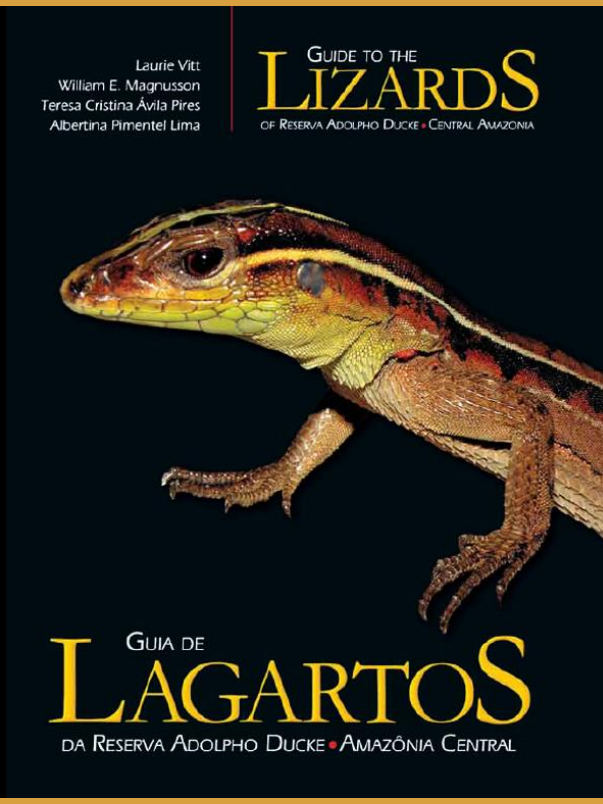
17

Two Books





Field guides are not only useful for professionals, they create new field naturalists!

As a child, I had only been able to identify lizards and snakes because of Eric Worrell's book. Much of the nomenclature changed and I later used Harold Cogger's guide[184]. Without them, it is unlikely that I would have appreciated the diversity of lizards around me. Later generations could use Rick Shine's book on Australian snakes[185]. When I got to the Amazon, I used Osvaldo Cunha's and Francisco Nascimento's guide to the snakes of eastern Pará State[186] and Afrânio do Amaral's iconography[187] to identify most of the snakes, but their photographs were mostly of preserved specimens and were not very attractive. Marinus Hoogmoed's book on the lizards and amphisbaenians of Surinam[188] allowed me to identify most of the lizards, or at least to get a lead into the literature, much of which Paulo Vanzolini made available to me. However, I realized that these books and papers only allowed me to identify the lizards because I was already very interested in them, and that it was unlikely that the general public or school children would go to the trouble of digging through literature rich in technical terms that meant nothing to lay readers.

Jay Savage sent me a copy of his comprehensive book on Costa Rican reptiles and amphibians[189], which had beautiful photographs by Michael and Patricia Fogden, and he wrote "To Bill Magnusson. Looking forward to a book like this on the Amazonian herps." However, I realized how limited my studies were and that it would take hundreds of researchers a very long time to make a dent into our ignorance about Amazonian lizards and snakes. Therefore, I decided to produce field guides to just the local animals. I didn't want to make books that would only be of use to people already deeply interested in herpetology; I wanted to publish beautiful books that would inspire young people to see the beauty in the animals around them, like the guides to French Guiana[190] and Costa Rica.

Photo 17.1 *Snakes are beautiful, but they often lose their personalities when photographed in artificial settings. This* Corallus hortelanus *was searching bushes near our camp. Photo by Bill Magnusson.*

Color photographs would obviously be very important. I don't mean just images of the morphological details that allow you to distinguish between the species; I wanted pictures that would make people see more. I knew from experience that you can only see what you know you are looking for. Many species have intricate markings with incredible combinations of colors, but how do you distinguish a bright blue mark from a sun speck or subtle reticulations from leaf shadows if you only see the animal from a distance? Once you have seen the animal close up, your unconscious mind filters out the reflections and shadows and you can identify the real patterns easily from a long way off. However, if you have only ever seen the species in black and white photographs of preserved specimens, your unconscious mind has nothing to work with. Therefore, I wanted a visual guide with close-up photos that showed just how spectacular the creatures are.

I didn't have much experience with photography, but I had seen working professionals, such as Xavier Desmier, and I figured that I could learn. However, a field guide has to be more than a coffee-table book; it has to allow you to achieve a credible identification. Systematics and taxonomy involve a detailed knowledge of history and the ability to use new techniques, and even my knowledge of lizard and snake ecology was very basic. If I wanted to produce useful books, I would have to recruit researchers far more competent in those areas than I was.

Soon after I arrived in the Amazon, I went to a herpetology conference in the USA, and I was on the lookout for anyone who could deepen my knowledge of the South American herpetofauna. At the meeting barbecue, I met a very pretty herpetologist who introduced herself as Jan, and we talked about frogs. I was single at the time and finding an attractive lady who had similar interests to mine was appealing from points of view other than the purely professional. I made a mental note to try to find her later when she had to move off to talk to someone else.

I wandered around reading conference tags and looking for a familiar name. When I saw the name Laurie Vitt, I remembered the many papers on the ecology of Brazilian lizards that Paulo Vanzolini had shown me and I walked across and introduced myself. We had hardly started talking, when Jan came over and I asked Laurie "Do you know Jan?"

He replied "Yes, she's my wife."

I did a quick back pedal then and decided that my relationship with Jan would be different from that which I had been planning! Years later, she became a mentor for my future wife, Albertina Lima, and they published several papers together describing new species of Amazonian frogs.

Photo 17.2 *Jan Caldwell and Laurie Vitt inspecting an Indian dwelling in Oklahoma in 1998. They have contributed much to our knowledge of South American lizards and frogs. Photo by Bill Magnusson.*

Laurie was very friendly, and not the nerdy museum curator that you might have expected based on his publications. He was ruddy complexioned with ginger hair that, at the time I met him, was cut relatively short. In earlier years, he had played in a rock band and you can check out his compositions on YouTube.

I had no trouble convincing Laurie to collaborate on the lizard book, and he already had extensive experience with the production of field guides and desk-top publishing. At the beginning of each book, I wanted to have introductory sections describing the natural history of the animals presented in an informal way that a high-school student could use for science projects. Laurie's experience of collecting in the field made him better suited for that task than anyone else I could imagine.

While both Laurie and I had experience with lizard ecology, we were not professional taxonomists. I had met a researcher from the Museu Paraense Emílio Goeldi in Belém and she had some times stayed at my house when in Manaus. Her name was Teresa Cristina Sauer de Avila-Pires, but her friends just called her TC. She had a Masters degree from the National Museum in Rio de Janeiro, where she had studied starfish. At the Goeldi Museum she had worked with Osvaldo da Cunha and Francisco do Nascimento, the authors of the guide to snakes that I had used.

TC told me that she was planning to do her doctorate with Carl Gans, one of the most famous herpetologists at the time and the chief editor of the series Biology of the Reptilia. I knew Carl and was impressed by his work on functional morphology, especially his studies on lizard movement. However, I didn't think that functional morphology was a priority area for the Amazon, where we knew very little about the basic taxonomy of lizards. I suggested that she contact Marinus Hoogmoed, the researcher from the Netherlands who had written the book on the lizards and amphisbaenians of Surinam.

I knew Marinus because he had visited Manaus and I took him to Reserva Ducke. Tall with a serious demeanor in that Dutch manner, he was meticulous about his studies and I was impressed by the detailed notes he took with tiny letters that looked as though they had been typed. The miniscule notebook with its microcalligraphy seemed out of place in his large hands.

Photo 17.3 *Teresa Cristina Avila-Pires and Marinus Hoogmoed at the Iguaçu falls in 2008. Photographer unknown.*

TC accepted my suggestion and went to study under Marinus at the University of Leiden. Her thesis was on the lizards of Brazilian Amazonia. I was pleased when she told me that she was going to Leiden, but later on, when she and Marinus fell in love with each other and married, I thought that I had done the Amazon a disservice. It seemed that her book might be the only contribution she would make to Amazonian herpetology as I assumed that she would stay in the Netherlands. Fortunately, I was wrong. She not only returned to the Museu Goeldi, she brought Marinus with her. They have produced many advances in the study of Amazonian reptiles and amphibians, and continue to do so.

One of TC's most important contributions to my work was that she came on board as an author of the guide to the lizards of the Manaus region. Her careful

revisions ensured that our descriptions were of the highest quality, and she wrote the taxonomic keys to the species.

The last author on the book was Albertina Lima. We have worked together so long that it is extremely difficult to distinguish my contributions from hers, and it was her expert eyes that had detected many of the species when we were studying their behavior. Most of the photographs were ours, one of us watching that the lizard didn't escape while the other photographed.

Just having experts for the writing was not enough. We also had to have access to much more of the reserve if we were to be confident that we had found most of the lizard species. In 2000, we installed the system of trails and plots known as RAPELD[191]. In Reserva Ducke, this consisted of 144 km of trails giving access to 72 permanent plots distributed uniformly across a 64 km^2 area.

I was keen to have someone survey the lizards, so when Maria Goretti de Melo Pinto asked me if I would be willing to supervise her doctoral thesis, I agreed. Goretti had done her Masters degree with Guarino Colli, Brazil's foremost expert on the lizards of the Cerrado Biome, which is a huge area dominated by savannas in central Brazil around the national capital, Bras Ília.

I met Goretti in Brasilia to discuss her thesis plan. The idea was to survey all the 72 plots in Reserva Ducke, which would mean a lot of hard field work. Most herpetologists collected by installing pit-fall traps: large plastic buckets buried in the ground that are connected by plastic fences to direct the lizards into the holes. However, I and Clarence Abercrombie had experimented with pit-fall traps in Reserva Ducke with very unpromising results. In fact, we had caught no lizards.

Photo 17.4 *Goretti Pinto (front) and Bill Quatman (right) with a school group that helped with her research and learned about reptiles and amphibians in the process. Photographer unknown.*

As she would have to do visual searches for the lizards in an area of 64 km^2, I was worried that Goretti might get pregnant and not be able to do the field work. It sounds a very sexist attitude, but my last three students had fallen pregnant during their PhDs, which made it difficult to do field work, especially after they gave birth and had to look after young children. Goretti said in Portuguese "Don't worry, I promise I won't fall pregnant during the PhD," and her husband, Bill Quatman, standing beside her, nodded in agreement.

When Goretti arrived in Manaus five months later, she was seven months pregnant. I reminded her of her promise and she said in Portuguese "But I didn't get pregnant, I was already pregnant." She should have been a lawyer!

Fortunately, Bill Quatman is a retired zoo keeper with a deep love of reptiles. He was able to fill in when Goretti was involved in motherly responsibilities and helped her throughout the field work. Goretti and Bill named their daughter Naja, which is the generic name for the deadly elapids known in the English-speaking World as cobras. Goretti's sister, Dodora, also looked after Naja when her parents were in the field. Albertina brought Edivaldo Vasconcelos, better known as Ed, from Santarém to help survey the lizards. He had extensive experience surveying snakes and lizards in RAPELD plots, so we could be sure that any apparent absences of species were not because of Goretti's inexperience in the Amazon. In the acknowledgments to her thesis, Goretti called him, in Portuguese, "Eagle eyes".

Because of her work in the Cerrado, Goretti wanted to install pit traps as well as do the visual surveys of the plots. This was expensive because of the cost of the buckets and the labor to dig the holes to install them, but we got sufficient finance to put an array of pit falls beside thirty plots. The pit falls were useful because Goretti obtained a grant to involve local teachers and school children in the study. They would not have been able to do visual surveys, but had a great time checking the pit-fall traps.

Although they were a useful teaching aid, the pit-fall traps did not justify their cost in terms of revealing patterns in the distribution of the lizard assemblages. They were about ten times more expensive and captured only 206 individuals in the plots where over a thousand individuals were registered by visual search. By the end of the study, the pit-fall traps had captured two species not registered by visual search, but the active surveys had located seven species that did not fall into the buckets.

Photo 17.5 *Edivaldo (Eagle Eye) Vasconcelos lives in Alter do Chão but accompanies Albertina and her students in studies of lizards throughout the Amazon. Photo by Bill Magnusson.*

When Goretti calculated that the buckets only captured a little over one individual per bucket per month, I said in Portuguese "See, I told you that pit-fall traps are unusually unproductive in Reserva Ducke."

Goretti replied in Portuguese "I compared the results to nine other published studies. That is the third highest capture rate for pit-fall traps ever recorded in Brazil!"

As a result of Goretti's and other studies, we no longer recommend pit-fall traps for standardized surveying for lizards. They are a useful adjunct for use in places that don't have rocky soils or water tables close to the surface, but are hugely inefficient for most conservation-related research, especially in the

Amazon, where the places you cannot use them tend to have the most distinctive reptile faunas.

With the team together, both in the laboratory and in the field, it was just a matter of sitting down and writing. Fábio Sian Martins of Attema Design Editorial made the layout for the book, which ended up being a template for all our subsequent publications[192]. Eric Pianka wrote the Preface. When the book was finally published in 2008, about 25 years after I had first thought about the need for such a book, we thought that it was a comprehensive description of the lizards of the region.

In 2015, Albertina and I bought a new house in a suburb of Manaus just two kilometers from where we had lived for the past 30 years or so. As I was clearing the introduced shrubs to plant native species, I saw something blue flip between the leaves. It took me a while, but I finally caught one. It was a blue-tailed variety of *Gymnophthalmus underwoodi*, a parthenogenetic gymnophthalmid that we did not include in the book. We don't know where they came from or how long they have been in Manaus, but we do know that the book was out of date before it hit the printing presses! We hope that it will serve to stimulate some young person to keep studying the lizards of the region.

The idea for a book on the lizards we call snakes came much later than for the book on what most people call lizards. The main reason was that it did not seem feasible to systematically study the snakes. They popped into and out of our World so haphazardly that it appeared that it would take a cadre of very dedicated people working for decades to start to get a hold on the number of snakes in Reserva Ducke, and that is what it took!

Photo 17.6 *A* Gymnophthalmus underwoodi *in the backyard of the house we bought in 2015. It is not in the book on the lizards of the Manaus region we published in 2008! Photo by Bill Magnusson.*

Many students asked me to supervise their theses on snakes, but I always refused, partly because of my lack of experience, but mainly because I didn't think that it would be possible to collect enough data in a reasonable time frame. Márcio Martins is a dedicated snake researcher and he did his PhD research on the Reserva Ducke snakes, mainly in an area near the administrative buildings, between 1991 and 1994, supervised by Ivan Sazima of the University of Campinas. Márcio found 685 individuals distributed in 50 species, but he found less than one snake for every twenty hours of search during the day and spent more than four hours for every snake he found during the night.

Marcio's studies formed the basis of a paper he published in 1998 with Ermelinda Oliveira in which they described the natural history and presented color photographs of 66 species, mostly from Reserva Ducke. That paper

required 1595 person hours of search; the equivalent of one person collecting day and night without stop for more than two months. This was only a small part of the effort, because they then had to consult museum collections, especially those of Osvaldo Cunha and Francisco Nascimento in the Goeldi Museum, as well as undertake extensive literature reviews.

The paper by Márcio and Ermelinda greatly facilitated future studies, but the effort involved only deepened my conviction that studying snakes is generally too difficult for Masters dissertations. Fortunately, I couldn't convince Albertina of that and she agreed to supervise the Masters thesis of Carlos Abrahão, who went by the nickname of Feliz, and the Masters and Doctoral theses of Rafael da Fraga, known to everyone as Rato.

We knew that we might find species not listed by Márcio and Ermelinda because I had found a spectacular snake with salmon pink sides and a black back many years before. I saw it moving fast across the leaf litter and grabbed it at midbody. Fortunately, it was calm and didn't bite me. I took photographs, but did not want to kill it for the museum collection. If I had known that it was an undescribed species, I probably would have. There is a photograph of a juvenile in Márcio's and Ermelinda's paper taken by Karlheinz Jungfer, but the species would not be described until 2008, when Ermelinda with two coauthors named it *Pseudoboa martinsi* in honor or Márcio Martins.

Finding new species was not the objective of Feliz's study, however. He wanted to know how the arrow-head vipers were distributed in relation to the environmental characteristics of different parts of the reserve, especially the distance to the stream. The area covered by the 144 km of trails was too big for a Masters student to survey, but Feliz studied the snakes in a 30 km^2 area that had 30 uniformly-distributed plots and 16 plots installed beside streams. The data he collected were not sufficient for publication by themselves, but Rato, the undergraduate student who had served as his assistant, carried the torch forward.

He resurveyed the plots during the studies for his Masters thesis, which was about variation in the overall snake assemblages in relation to the same factors that Feliz had studied for arrow-head vipers[193].

Photo 17.7 Pseudoboa martinsi *is a spectacular snake that occurs in Reserva Ducke, but was only named in 2008. Photo by Bill Magnusson.*

Feliz likes snakes, and now works for the Federal Government in the Center for the Study of Reptiles and Amphibians - RAN, where his experience as a biologist and training as a veterinarian allow him to make decisions about reptile and amphibian conservation. Rato, however, is a snake fanatic. He lives for studying them and they occupied all his time when he was not womanizing or binge drinking. This sort of dedication is needed to study these elusive creatures. Many snake fanatics just end up being dedicated amateurs, but Rato's snake fixation extends to the complex laboratory and statistical analyses

necessary to understand their biology, and he publishes results of his studies in leading journals[194].

The data collected by Feliz and Rato showed that the composition of the snake assemblages was strongly affected by the distance from streams, important information for the definition of legally protected areas around water courses as defined in Brazilian legislation. It also made us realize the difference between densities and overall numbers. The studies corroborated our subjective impression that there were more arrow-head vipers per meter squared near streams[195]. In fact, you are about six times as likely to find an arrow-head viper within ten meters of the stream as you are to find one further away with the same search effort.

The higher density does not, however, mean that most of the arrow-head vipers in Reserva Ducke are near streams. Most of the Reserve covers areas that are more than 10 m from the stream. If you take into account the area available, about three times more of the snakes are further from the streams than close to them. Even the snakes that live near the streams do not spend all their time there. Our radio-telemetry studies had shown that individual snakes roamed near and far from streams.

The importance of the difference between densities and numbers depends on your objective. If you are worried about snake bite, it is best to keep away from streams or use protective clothing when walking the banks. If you are more preoccupied with conserving the species, the areas far from streams hold much more of the population and are therefore important when calculating estimates of the minimal viable population size and how much area is needed to avoid inbreeding depression.

Photo 17.8 *Albertina Lima and Rafael de Fraga (Rato) waiting for the time to start looking for snakes in a survey plot. Photo by Bill Magnusson.*

Rato liked the idea of producing a book and made it one of the chapters for his PhD thesis. However, he had no formal taxonomic training. We therefore invited Ana Lúcia da Costa Prudente, who had taken over Osvaldo Cunha's role as specialist in snakes at the Goeldi Museum, to be a coauthor. She checked our identifications and wrote the taxonomic keys.

Albertina and I took most of the photographs. I hadn't thought about how difficult it might be to have such a picky coauthor. Snakes are generally hard to photograph. They are long and thin, so they don't easily fill a square frame, and if you make them curl up, often they don't look natural. However, that wasn't the main problem. When I secured the animal so that I could get a close up of the head, Albertina said "It's not happy; you can see from its expression." I tried to explain that snakes don't smile, but I had to admit that she was right, and it

was one of the reasons that I didn't like the photos in many field guides. The only option was to make large sets, which were usually in our bathroom, where the snake could move around naturally. This even meant photographing the aquatic species underwater. It took a long time to get enough photographs that passed Albertina's stern eye.

By 2012 we had descriptions of all the species known to be in the area and Rick Shine wrote a Preface for the book. It was the result of the most intensive snake studies done anywhere in the tropics. Reserva Ducke is only 10 km by 10 km and is the most intensively studied biological field site in the Amazon and the Andes[196]. Besides the many famous naturalists that had passed through, two Masters dissertations and two Doctoral theses on the snakes had been largely or completely undertaken in the reserve. We even included species known to be in the area, but that had not been collected in the reserve[197] - we were content.

In 2013, shortly before the book was to be sent off to the printer, I participated in a training course for researchers and technicians responsible for evaluating long-term monitoring studies. One of the activities involved catching fish in a small stream near the Reserva Ducke administration buildings, and when I was walking back with Jansen Zuanon, our fish expert, he stopped, pointed to a small snake crossing the track and said in Portuguese "What's that?"

I picked up the snake, which was prettily marked with a yellow collar and red eyes, and said "It's a species of *Liophis*. There are several in the reserve and I can't tell which one because it has juvenile coloring and I only know the adults."

Wrong again! When I showed it to Rato he said in Portuguese "I did the scale counts and that isn't a juvenile of any species known from Reserva Ducke." In fact, it doesn't appear to be a juvenile of any species known from the Amazon, and it entered the book as *Liophis sp*.; a tribute to our continued ignorance about the best-studied field site in the Amazon. There are probably many other species

occupying parallel dimensions that will pop into our World if enough young biologists are enthralled enough to go out and look for them!

Photo 17.9 *A species of* Liophis *we could not identify that was found a few weeks before the book on the snakes of Reserva Ducke went to press. There are likely to be other undescribed species in the reserve. Photo by Bill Magnusson.*