## 8

## **A New World**



Coral snakes, such as this *Micrurus lemniscatus*, are the only elapids in the Americas. Photo by Bill Magnusson.

The road made of cement blocks that meandered through the dense forest was bordered by heliconias with broad leaves and bright flowers. Philodendrons and other climbing plants adorned the trees above it and giant blue morpho butterflies flitted in the patches of sunlight. I was looking for the office of the Director of the National Institute for Amazonian Research, better known by its acronym, INPA. The institute had been created in 1952 and its buildings were nestled unobtrusively amongst the vegetation on a large block of land on the outskirts of the city of Manaus, near the center of the Brazilian Amazon.

I had been contracted as a researcher by INPA, but I had no experience in the American tropics, and did not speak a word of Portuguese. This made difficult even simple tasks, such as asking for directions. Nonetheless, I was enjoying myself, and every wrong turn seemed to lead to a new discovery. Blue and green lizards, two hand spans long and as thick as a carrot, were poking around on the road, flicking their forked tongues into any crevices that might hold a juicy insect. They acted like large versions of the active desert skinks I had seen in Australia, but these were giant ameivas<sup>99</sup> in the family Teiidae, which does not occur in Australia.

A very large lizard, as thick as my forearm crashed off into the bush before I could get a good look at it and I had the impression that it was a land mullet, but I knew that those giant skinks didn't occur in the Americas. I crawled into the undergrowth far enough to identify the lizard as one of the big teiids known as golden tegus<sup>100</sup>, which look like a cross between land mullets and goannas. I found one that had been run over on a road, and when I dissected it I was surprised to discover that its stomach was full of palm fruits.



*Photo 8.1* The golden tegu, Tupinambis teguixin, is a large active lizard with habits intermediate between Australian monitor lizards and giant forest skinks. Photo by Bill Magnusson.

Smaller brown lizards with green heads, about as thick as my thumb were fossicking in the leaf litter on the side of the road. It took me a while to realize that most of these were juvenile giant ameivas. They have green heads when young, but as they mature the green migrates back along their bodies, so adults are mottled brown or black with green or blue tails. Some of the lizards had green stripes on the head that became less distinct with age, but the green never migrated backwards. These were striped forest whitptails<sup>101</sup>, another species of teiid with habits similar to those of the giant ameiva, but which preferred the forest to the open areas.

The forest whiptails became one of my favorite species of lizard. I could follow them foraging in the forest from just a few meters away without



frightening them. In contrast, if I got close to a giant ameiva, it would shoot off much farther and faster than I could run.

Many of my discoveries about Amazonian lizards were made with Albertina Lima, a dark-haired, lightly built girl who had come from the township of Santar én to work as my research assistant<sup>102</sup>. We were exploring a sandy area with many dead trees that had been formed by the washout from the BR 174 highway just north of Manaus when we found a rotting tree stump in the middle of the stream. The stump was thigh high and five tiny striped forest whiptails were perched on the top of the log. By peering into the top of the stump we could see many empty egg shells about the size of a human fingernail lodged in a cavity.

We dug down into the crumbling wood in the middle of the cavity and found many more egg shells, 779 to be exact, as well as 21 whole eggs. The species is known to only produce around four to seven eggs per clutch, so that number of eggs must have been the work of many females. We replaced most of the egg shells, and another six clutches containing a total of 23 eggs were deposited over the next seven months.

I had seen communal nests of garden skinks in Australia and many lizards are known to use communal nests, but nobody had ever found a nest with over 800 eggs before<sup>103</sup>. We wondered if the lizards nested together because nest sites were limited or because there was some advantage to putting all their eggs in one basket. Searching the area for other potential nest sites seemed like a good idea, but it was more complicated than I had imagined.

Albertina had chopped into many dead stumps and palm trunks with a machete and was systematically working her way along the stream. I took another machete and hacked into a rotting tree trunk. As soon as the blade hit the wood, a tiny wasp emerged from a hole I hadn't seen and flew directly for my forehead. The sting from the wasp was not very painful, but I collapsed

immediately and lay sprawled on the ground. After laying there for a few minutes, I regained my feet and backed groggily away from the tree trunk.



*Photo 8.2* This nest of the striped forest whiptail, Kentropyx calcarata, contained 800 eggs and egg shells, the largest recorded lizard communal nest, even though females generally only lay about 4 eggs at a time. Photo by Bill Magnusson.

The fact that the wasp had been able to knock me down almost instantly did not make sense. I could think of no way that its venom could reach important nerve centers instantaneously, and I had never heard of a wasp with a knock-out punch. I sat on a log to regain my composure and watched Albertina happily chopping into logs and giving shouts of joy when she found lizard eggs.

After about fifteen minutes, I felt well enough to start work again, but I carefully avoided the trunk with the wasp nest and looked for a tree near where Albertina was digging into a rotting log. Before hitting it with the machete, I carefully inspected the trunk to make sure that there were no tiny holes that



might contain wasps. Reassured, I hacked into a patch of rotting wood. The wasp came out of a tiny hole I hadn't seen, made for my forehead and left me stretched out on my back again.

Albertina ended up doing most of the work that day, and I sat trying to control my wooziness. On other trips, I helped look for lizard nests, but my timidness meant that Albertina made most of the discoveries. We found three other nests in rotting logs, one with 136 eggs and shells, another with 45 and a small one with only six, all within 300 m of the first nest. There were many apparently suitable logs that were not used, so a lack of good sites did not seem to be the reason that the lizards nested together.

Many lizards are known to use communal nests, but I had to stumble onto the World's largest known communal lizard nest to stop thinking about lizards as solitary beasts with little social interaction. There are many unanswered questions, not just about why the lizards nest together, but also about how they communicate with each other, and especially how they avoid leaving clues for the many predators of lizard eggs. It wasn't earth shattering as scientific discoveries go, but it made me look much more closely when I saw lizards foraging or interacting with each other.



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**Photo 8.3** The red worm lizard, Amphisbaena alba, is one of the commonest lizards near Manaus, but it is only seen occasionally because it spends most of its time underground. Photo by Bill Magnusson.

The INPA grounds had many species of lizards. Some had bodies shorter than my little finger and were only as thick as a knitting needle. They reminded me of the weasel skinks in Australia, but these were in the family Gymnophthalmidae, which is related to the teiids. Always on the move, they scuttled under and over the leaf litter and never ventured into the sun. There were probably several species, but I didn't know how to tell them apart back then.

After heavy rain, I would often find species of *Bachia*, elongate lizards with tiny legs that were just like the Australian burrowing skinks, except that their scales were keeled rather than smooth. However, these were also gymnophthalmids. They slithered across the road looking for soft earth to dig into. Much bigger lizards often came to the surface after heavy rain. These were species of *Amphisbaena*, as thick as my index finger and several hand spans



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long. The scientific name for the genus and the family comes from Greek legends about a two-headed serpent. I had never seen one before, though the family occurs in most parts of the World except Australia, and they are generally called worm lizards. One species was mottled black and white<sup>104</sup> and the other was generally brown with white blotches<sup>105</sup>. Their short rounded tails gave the impression of a head on each end and they were very strong, writhing around and trying to bite with their powerful jaws if picked up.

The amphisbaenas were a bit like snakes in that they seemed to occupy a parallel universe, only appearing in ours for short periods. The two large species were always popping into our world, and I rarely went more than a few months without seeing one. However, the third species from around Manaus was completely different. It was tiny, no thicker than a knitting needle, and transparent pinkish white; a veritable ghost.

We had camped beside a stream in the forest near Manaus and I was annoyed when heavy rain caused the stream to overflow its banks and flood our campsite. All our equipment had to be suspended in hammocks or shifted to higher ground, and I had just dropped a load of gear near the edge of the water when I noticed what looked like two white worms wriggling in the sand. I picked them up and was surprised to find that they were Slevin's worm lizards<sup>106</sup>. They were the only specimens that I have seen in the wild of that species in 40 years in the Amazon. A few others have been collected by researchers following earth-moving equipment. Apart from the fact that they live underground and never voluntarily come to the surface, we know virtually nothing about them.





*Photo 8.4* Said to be called the smooth tegu, Tretioscincus agilis is a small agile, lizard that forages rapidly on the ground and in the undergrowth in Neotropical forests. Photo by Bill Magnusson.

The variety of ground lizards was surprising, but most of the lizards I found were on bushes or tree trunks. Some used both the ground and branches in the undergrowth. One gymnophthalmid with a bright blue tail is said to be called the smooth tegu, though I have never heard anyone use that name. Its scientific name is *Tretioscincus agilis*, which makes sense because it looks like a skink and it is very agile. Except for the blue tail, it looked like the little fence lizards I had watched as a child. I was kneeling down trying to creep up on one of the blue-tailed lizards when I heard someone behind me say "Give up, you don't have a chance."

I ignored the voice and continued to edge closer to the lizard, which was jumping agilely from leaf to leaf in a small bush. When I finally grabbed the lizard, I turned and showed it to the person who had made the comment. They said "Oh, it's a lizard. I thought it was a blue butterfly flitting around the bush and that's why I thought you'd never catch it!"

There were other lizards with blue tails. These were specimens of the black-spotted skink<sup>107</sup>, which is included in one of the few genera of skinks in the Americas. Being somewhat out of place is not their only claim to fame. Most tropical lizards lay eggs, but members of the genus *Copeoglossum* have live young and the placenta described from another species of South American skink is the most complex for any reptile, with similarities to the placenta of mammals<sup>108</sup>. The skinks I saw at INPA grew to be as wide as my thumb, but they only had blue tails when they were as small as the *Tretioscincus agilis*. I wondered why the little lizards running around had blue tails, but the larger adults, which sat on logs and generally didn't move until I got close, did not. However, I would only start to understand several years later and I'll come back to that story in another chapter.



The most impressive lizards around my office were the green iguanas<sup>109</sup>. The biggest were about a 1.5 m long, though there are reports of individuals more than 2 m long. I had seen goannas climb tree trunks, but I was unused to seeing large lizards scrambling around the leaves on the outer branches of trees. Green iguanas are herbivores and rely on intestinal microbes to digest the cellulose in their leafy diet. They do not have the necessary gut flora when they hatch and the babies have to find an adult and eat their feces so that they can digest leaves<sup>110</sup>.

Green iguanas are in the family Iguanidae. It and related families, such as the Tropiduridae, have many species that are ecological equivalents to the Agamids of the old World. Dusky green blue-lipped tree lizards<sup>111</sup>, about the size of the jacky lizards I had seen in Australia, scampered up tree trunks that were generally less than my waist in diameter. Slightly larger collared tree lizards<sup>112</sup>, which were flattened, spiny and colored like green lichens, generally occurred on the biggest trees. Both species subsisted mainly on ants that they licked off the bark.



*Photo 8.5* Adult male green iguanas are often grey rather than green, like the females and the juvenile that can be seen in the background. They eat only vegetable matter, mainly in the form of leaves. Photo by Albertina Lima.

High in the canopy of the trees, I could make out green thorny-tail iguanas<sup>113</sup> the thickness of my forefinger that had bight green and black bands and short spiky tails. They would have been well camouflaged amongst leaves, but stood out on the grey branches. Each seemed to have several hollows to hide in, but they were very active, jumping over a meter from branch to branch, even though they were no longer than my finger. Someone gave me one that had



been captured when the tree it lived in was felled by foresters and I offered it all sorts of juicy insects, but it would only eat ants.

The largest genus of lizards in the World is *Anolis*, which holds the New World anoles, though some authors now place many of the species in other genera. There were several other species around the INPA grounds, but the most common were the slender anole<sup>114</sup> and the goldenscale anole<sup>115</sup>. The slender anoles lived in the undergrowth, and their slim form and long tails allowed them to balance on twigs not much thicker than match sticks. The goldenscale anoles mainly lived on the ground. Although a little thicker than the slender anoles, they were less than a hand span long, with triangular markings on their backs that made them inconspicuous among the fallen leaves.



The large number of species of lizards I found in a small area started me thinking about how they managed to eke out an existence with so many potential competitors. Ecological theory says that if two species do exactly the same thing, then one will end up eliminating the other through competition. This is hard to test because you would not expect two species to evolve to do exactly the same thing by chance. However, ecologists have spent a lot of time trying to work out how similar two species can be without spiraling into competition so intense that one will be eliminated.

Like many other field biologists, I became interested in the theoretical questions because of the insights derived from observations of lizards. However, my first studies just related to simple natural-history questions, such as "where do lizards sleep?" All Australian geckos are nocturnal, but there is only one common nocturnal gecko in most parts of the Amazon, the turnip-tailed

gecko<sup>116</sup>. It can get almost as big as the leaf-tailed geckos in Australia. In color, it resembles the greyish bark of the trees on which it lives and its original tail can be strikingly banded in black and white. However, it is rare to find one with an intact tail and a regenerated tail is dull brownish grey, thickened near the base, which is presumably the reason for its common name.



**Photo 8.6** The tiny Chatogekko amazonicus is small enough for several to fit on a human thumb, as shown by the female with an egg showing through the abdominal wall (inset). Photos by Bill Magnusson.

Most of the Amazonian geckos belong to another family, and all are active during the day. Some, such as the Amazon pigmy gecko<sup>117</sup> and *Chatogekko amazonicus*, another tiny gecko that does not appear to have a common name, can be common in undisturbed forest. These geckos are so small that I could fit six side by side on my thumb, and so delicate that it is difficult to catch one without rubbing off patches of skin. They live in the leaf litter and most people



don't realize that they are lizards when they see a tiny movement on the ground. The pigmy gekkos are difficult to follow when foraging, but another species, the Trinidad gecko<sup>118</sup>, is a bit bigger and sits low on the trunks of small trees where its behavior can be studied easily.

I had frequently seen the little geckos on trunks of trees and even saw one disappearing down the throat of a brown vine  $\text{snake}^{119}$ , but I hadn't looked at them particularly closely. When a student from the University of São Paulo, V ânia Nunes, asked if she could collect data for her undergraduate thesis while she was in Manaus, I suggested that she study the behavior of the Trinidad geckos.

Helping V ânia set up her study required that I spend time watching the little lizards. I had thought that they were rather dull colored, but I discovered that the males had bright yellow markings on their head and bright red lines and blotches scattered over the body. They could apparently control their colors and sometimes returned to a general mottled brown like the females if you caught them. Watching them without disturbing them changed my appreciation of their colors from nondescript to spectacular!

I had also thought that they did not move much, and it is true that they spend several minutes in the same position, but we often saw them jumping an arm length from one tree to another, which would be the equivalent of a human jumping 20 m. As soon as the lizards stopped after running or jumping, they sat with their heads held high and waved their tails sinuously for a few seconds. They then generally remained motionless until their next move to a new perching site or to catch an insect.





Photo 8.7 Trinidad geckos, Gonatodes humeralis, sometimes eat things that are almost too big for them. This species, like most Amazonian geckos, is active during the day. Background photo by Albertina Lima; inset by Bill Magnusson.

We had expected them to take refuge at night under loose bark near the base of the tree or on leaves in the undergrowth, as had been described for the species in other areas. However, just before sunset they climbed up into the canopy of the trees and spent the night seven to ten meters above their daytime perches. This had never been described before and we climbed into neighboring trees to try to see what they did up there, but it was too dark and we lost sight of them<sup>120</sup>.

V ânia's study was just simple natural history, but it set me thinking about sex, color, movement, foraging and predation; seemingly independent aspects of the biology of the lizards that were coming together as an integrated story.





Some of the snakes I found around the office were similar to those I was familiar with in Australia. The first one I came across in a small bush was a parrot snake<sup>121</sup> about the thickness of a pencil and very long. It looked a bit like an Australian green-tree snake, but it had golden brown along its side and white lips. When I got close, it opened its mouth to show the inner white lining and waved its head in what I assumed was a threat display. However, it didn't bite until I grabbed it. The species is supposed to be mildly venomous, but I felt nothing except tiny pinpricks. Brown vine snakes<sup>122</sup> also opened their mouths in a similar threat display, but the inside of their mouths was black rather than white.

Another slender species, the green vine snake<sup>123</sup>, was only the thickness of my finger, but as long as I was tall. Unlike the parrot snake and the brown vine snake, the first green vine snake I found gave no warning before it bit me. As a result, my hand swelled up for several hours and throbbed as though I had a deep infection.

All the vine snakes are in the family Colubridae, which has few species in Australia. In fact, most of the snakes I found were colubrids, even the tropical racers<sup>124</sup> and the many species if *Chironius*, *Atractus* and *Liophis*, which bore striking resemblance to the highly venomous Australian elapids, but which were generally harmless. There were so many species and the identification guides were so poor that I usually didn't bother trying to classify them to species.

I found blind snakes crossing the road. They all had much the same shape as the blind snakes I had seen in Australia, but as with most aspects of the snake fauna, the diversity was much higher in Brazil. There is only one family and genus of blind snakes in Australia, but I found species of blind snakes from three different families<sup>125</sup> close to my office in Manaus. One, the Guyana blind

snake<sup>126</sup> was much more colorful than other blind snakes I had seen and was quite beautiful, with yellow spots on the head and tail tip, and yellow lines along its body.



*Photo 8.8* The American pipe snake, Anilius scytale, is brightly colored, but unlike the coral snakes, it has only two colors on the back, is not venomous, has tiny belly scales and is in a family all its own. Photo by Bill Magnusson.

Another family of burrowing snakes that doesn't occur in Australia is the Aniliidae. There is only one species, the American pipe snake, *Anilius scytale*, but what the family lacks in number of species it makes up for in color. I found snakes nearly a meter long and as thick as my thumb that had bright red and black bands on the back and bright black and yellow bands on the belly. Unlike the blind snakes, which only eat insects and their larvae, the pipe snakes eat other long animals, such as snakes, amphisbaenas and eels.



I knew that the only elapids in South America are coral snakes of the genus *Micrurus*, and I mistakenly thought that all were brightly colored. I now know that there are a few species of nondescript coral snakes, but they are uncommon. I had read a popular account on North American coral snakes which gave rhymes to distinguish coral snakes from coral-snake mimics in the colubrid family. The rhymes were very simple, such as "Yellow touch red: You're dead" and "Red touching black: Safe for Jack".

I had found a snake with brilliant red, black and yellow bands that the rhyme identified as a coral-snake mimic and I was watching it wind its way between my fingers when another researcher came up and asked how I knew that it wasn't poisonous. I recited the rhyme, then said "But if you really want to be sure, you should hold it behind the head and make it open its mouth." When I did exactly that, I saw the tiny fangs wrapped in their white sheaths and realized my mistake. The rhymes only work in North America!

The first viper I caught also surprised me. It was a lance-head viper<sup>127</sup> and I identified it immediately, even though I had never seen one before. It was blotched brown with markings that made it look like a bunch of dead leaves when curled up, and its big triangular head had small pits behind the nostrils that I knew were heat sensors it could use to locate prey in total darkness.

I pinned it with a stick and grabbed it around the back of the neck, imagining that it would be strong like the death-adder, the closest thing to a viper shape and behavior among the Australian elapids. It is not wise to hold death adders behind the head because they are so strong they are likely to be able to twist out of your grip. The lance-head viper was weak and its ineffectual thrashing did not bother me. However, when it opened its mouth I realized that its fangs were so long that they reached almost to its throat when folded back. The snake twisted one side of its upper jaw around and poked the the two-centimeter long fang, towards my fingers, which were around its neck.



*Photo 8.9 I was shocked by the size of the fangs of the first lance-head viper,* Bothrops atrox, *that I picked up, and I was lucky that the snake didn't bite me as I took the photo. Photo by Bill Magnusson.* 

I very carefully rearranged my grip on its neck and took a photo of the exposed fang. I then gingerly put the snake on the ground, pinned its head momentarily with a stick and jumped back, deciding that would be the last viper I picked up by holding around the neck. It was a promise I didn't keep.

Encounters with lizards and snakes in my first months in Brazil deepened my fascination for them, but I realized that I would have to learn much more about this diverse and complex fauna if I was to contribute to scientific knowledge and survive.

