

Adventures in the Wild

Tales from Biologists of the Natural State



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Cave Biology: It's Not a Job, It's an Adventure

ALDEMARO ROMERO

 A GOOD PORTION OF MY scholarly work has dealt with cave fauna—cave fishes, to be more precise. In fact, cave fishes were the central theme of my doctoral dissertation in 1984, and to this day I continue to do work in that area. That is not to say that I am a scientist whose cave work has been an uneventful quest for data, nor am I an avid spelunker (cave explorer) who also happens to do science. Actually, many of my experiences in caves have been rather unusual, spanning many countries and dating back to the time before I was even a teenager. I will present my cave stories in chronological order as I moved from one country to another, from one circumstance to another.

Venezuela

When I was seven, my father bought a house in a suburban area on the fringes of the city where I was born: Caracas, Venezuela. Having always been a person interested in nature, I was delighted by the move. The fact that we had moved to a hilly area of the mountains that surround the capital of the country meant that I had the opportunity to wander around, explore new territories, and have childhood adventures in natural areas. In fact, my bedroom on the second story of my house faced one of those hills, so to me, walking and exploring was as easy as visiting a neighbor.

From my family's vantage point in the suburban hills, I was also able to witness some interesting political events from a unique viewpoint. Being able to overlook the city of Caracas from the surrounding hills

meant that I could observe the planes flying all around during the coup d'état that in 1958 restored democracy in Venezuela. Those were turbulent years because shortly after that political shake-up, Fidel Castro took over the government in Cuba, and for some reason he put a great deal of effort into supporting the leftist guerrillas in Venezuela.

One day in 1961, when I was about ten years old, some of the new friends I had made in the neighborhood told me about a cave known as *La Cueva del Zamuro* (the Vulture's Cave) in one of the hills nearby. They asked me if I would like to walk there with them and I did not think twice. The cave lay at the heart of a large, pyramidal hill facing Caracas and was about a forty-five-minute walk from my home.

My friends and I strolled toward the cave while chattering like any other group of kids involved in a similar activity. As soon as we arrived at the cave, we could see it was not a natural cave. It looked more like an abandoned mine in which you could barely walk standing up without bumping your head against the ceiling. We were all carrying flashlights.

We had not walked more than ten feet into the cavern when we observed a couple of large bags. We opened them and saw that they were full of food, lots of canned food. We had just begun to sort out the cans while asking ourselves why someone would leave so much food in a remote area when someone with a deep voice and from well inside the cave yelled, "What do you want?"

Needless to say, we all ran out of the cave for miles without even looking back. As soon as we all got home, we told the story to our parents and some of them alerted the police. Two days later we learned through the TV news that the cave was being used by a guerilla group and that a group of "courageous kids" had discovered some kind of hideout for "subversives." So much for my first visit to the underground, geological or otherwise. Another less than pleasant experience in caves happened to me when I was just trying to visit one.

In 1979 my wife, Ana (also a biologist), and I had been hired to our first faculty positions at a new university in Venezuela. In fact, the university was so new that it had no students, so we had plenty of time on our hands.

The university was located in Coro, a state capital in western Venezuela. The town was between the sea and a mountainous region. That part of the country is known for being very, very hot, with regional temperature records well above 110 degrees F.

One day we heard about a rather cool area in the nearby mountains where there was a yet unexplored cave. My wife and I were intrigued, of

course, and decided to visit the place. We were given detailed driving instructions and headed there at mid-morning. Once we arrived at the location, we realized that the trail to the cave went through a pasture where there were some cattle. We started walking and not even a minute had passed before my wife and I realized that each of us was covered with ticks—literally hundreds if not thousands of small, black ticks!

The ticks were everywhere, on our skin, scalps, clothing, underneath our fingernails. We rushed back toward our jeep and headed home, where we disposed of our clothing, got into swimsuits, and headed to the beach armed with eyebrow tweezers. Once we got to the beach, we sat at neck level in the water trying to kill by asphyxiation as many ticks as possible, while removing the rest from each other's faces and scalps and from under our fingernails using the tweezers. We looked like monkeys deparasitizing each other. It took us about two hours to get rid of every single little, black creature from our bodies.

We never tried to visit that cave again.

Coral Gables, Florida

After these failed attempts to visit caves early in my life, the next opportunity came, of all places, in Miami—where there are no caves.

My scientific career as a biospeleologist began at the University of Miami, Florida. My original intention was to study marine biology for my PhD, and the University of Miami had one of the best marine schools in the United States. So I went there and registered first to study English since at that time my proficiency in that language was little better than the ability to do some technical reading.

However, shortly after I arrived there, I was told that the marine school had many problems and that I would be better off if I stayed on the main campus and found a potential adviser in any area of interest for me. Since I was interested in both fish and behavior, I visited the office of Dr. Brian Partridge. Brian was a recently hired assistant professor who had worked on fish behavior at Oxford University, and one of the most interesting results of his experiments was that after artificially blinding some fish, he had shown that they were still capable of swimming and forming schools. That was interesting to me because at that time it was not clear how much vision and how much pressure sensing through their lateral line (a sensory system on the sides of most fishes, capable of detecting changes in pressure) was necessary to form schools. His experiments had shown that, at least in some cases, eyes were not necessary.

He was just turning his attention toward blind cave fishes when I visited him. I was just a candidate for graduate school speaking broken English. He was courteous but not particularly enthusiastic about my visit. I told him that I was at the university studying English and planned to enter graduate school in biology, and that in the meantime I wanted to keep my hands "wet" by doing some science. He wrote on a piece of paper the scientific name of a blind cave fish he intended to study, *Anoptichthys jordani*, and told me that if I wanted, I could come back on Monday and help him. That was on a Friday.

The existence of blind cave fishes was news to me, but I felt fascinated about those creatures. So I spent Saturday and Sunday at the library at the University of Miami trying to find everything that had been published about that species: I scanned all the volumes of the *Biological Abstracts*, a collection of references to most of the papers in biology since 1927. In those two days I was able to generate on note cards more than a hundred references of published papers about that species, and by reading the abstracts I learned that the species name that he had given me was probably incorrect and that most likely his intended study organism was a blind cave form of a surface fish known as the Mexican tetra, *Astyanax fasciatus*.

On Monday I showed up at Brian's office with a full set of note cards. As soon as I showed them to him, he was really impressed; and as I was telling him what I had learned (including about the correct name), his eyes kept widening larger and larger. He noticed my enthusiasm for the subject and he was caught up with it as well. He quickly showed me his lab, talked to me about his ideas . . . and offered to become my graduate adviser. I did not think twice, and a few months later I was a graduate student at the University of Miami and would dedicate many future years to the study of cave biology.

Costa Rica

My plan once I became a graduate student was to finish my coursework as quickly as possible so I could dedicate all of my time to studying blind cave fishes. I still remember that once I was admitted to the graduate school, Brian asked me what question I wanted to answer for my dissertation. My answer surprised him: I wanted to know how these fishes became blind and depigmented? The surprise was two-fold: I was proposing a rather BIG question that could have required years if not decades of work; the other reason was that this was not a typical answer to the ques-

tion, "What is your hypothesis?" How I was going to answer it, I had no idea, nor did he, but that did not mean that I was afraid of tackling the problem.

In the meantime I had decided to take as many courses as possible, and I saw an opportunity that summer: a two-month course on tropical ecology organized by the Organization for Tropical Studies in Costa Rica. At the end I would receive eight graduate credits. Thus, the combination of credits and the incredible experience that I would gain spending two months doing field work made this a very tempting opportunity. In addition, I knew that the surface form of the fish *Astyanax fasciatus* is also found in Costa Rica, which meant that I would have the chance to see this species in its natural environment, although no blind cave fishes had been reported at that time for that Central American country.

In this course all students participated in group projects at many different field stations, and one of those stations was Palo Verde in a semi-dry forest in western Costa Rica. It happened that on the second day at that station as I was walking around looking for bodies of water where I might find "my" fish, I encountered a spring, and in the small pond next to it, there it was: my fish. Could it be that this tetra (as it is known in the aquarium fish trade) was entering a subterranean source of water and, if so, could this be a living example of cave colonization?

Given the short time of the course and our stay at that station, I had no time to conduct serious research; but as soon as I got back to Miami, I wrote a grant proposal in order to return to Costa Rica and do some field work in that area. After securing the funding, I went back with a portable video-recording system in order to record any possible behavior of the fish entering and exiting this subterranean source of water. At that time "portable video" meant a rather large black-and-white camera with a separate, bulky video recorder, using Betamax tapes.

The pond was surrounded by forest, and in my first day as I was setting up the camera, I heard a troop of howler monkeys (*Alouatta palliata*) roaming through the canopy of the forest. As they got closer and closer to me, they became noisier and noisier. Since I had work to do, I did not pay much attention to them. But they became really agitated and started to throw branches of trees at me. I realized that I was probably in their drinking pond and they wanted me to go away, but I figured that if I ignored them, they would go away. So I continued to do my work, although I became concerned that if they kept throwing branches at me, some of those branches would fall onto the water and would disturb the fish whose behavior I was trying to record. When I was finally focusing my

camera, I started feeling a warm fluid on my back: the monkeys were peeing on me!

Since no monkey was going to deter me from doing my observations, I set up all my equipment in a tent (a dangerous proposition when you are working with electronic equipment in the middle of the summer in tropical Costa Rica). Well, I was able to record the behavior; the monkeys relented and probably moved on to another pond, and I could videotape the fish entering and exiting the spring. (I would later discover that they used the cave as a refuge from predators, mostly fishing bats.)



Aldemaro Romero filming blind cave fish
at a spring in Palo Verde, Costa Rica.

PHOTOGRAPH BY ANA ROMERO.

Once I had the data and tapes that I worked so hard for several weeks to obtain, it was time to return to San José, the capital of Costa Rica. I went to the nearest port by horse to be transported with my equipment to the other side of the river. The boatman approached me and I passed on to him all the paraphernalia I was carrying. Then I boarded the boat and went to the other side of the river. We both disembarked at the same time once we arrived at the other shore. The problem was that the boatman had not anchored the boat to any pole, so as soon as our feet were on shore, the boat started to drift downstream. "The boat!" I screamed, and at that point the boatman replied, "I do not know how to swim." Well, there it was, a boat carrying all my possessions going down the river, probably heading to the ocean with all the tapes and data in it. I did not think twice and jumped into the water, swimming as fast as I could. I clung to the boat and pushed it toward the shore. Once there, I made sure that the rope was tied to a tree, and then the boatman caught up with me. Soaking wet, I went to get the jeep I had rented, drove to where the boat was, and put all the equipment and tapes in the jeep.

It had been quite an adventure. But weeks of work had not been lost. My work in Costa Rica resulted in a couple of papers and became an important part of my doctoral dissertation. But, I had had no real cave experiences yet.

Mexico

To really study the cave fish, I had to go to Mexico to the caves in La Sierra del Abra in the San Luis de Potosí region, where nearly thirty cave fish populations of the Mexican cave tetra had been found. The caves had been well mapped by Robert Mitchell and his colleagues in the 1970s. So the question was not so much whether we could find the caves, but whether we could get the collecting permits to be able to explore them, find and collect the fish, and study them for as long as needed. One thing I was interested in seeing was how they responded to light. Yes, it sounds strange to study the responses to light among fishes that are blind, but it happens that the American ichthyologist Charles Breder had noticed in the 1940s that some of the individuals he had collected in Mexico did respond to light, probably through their pineal gland, a hormone-producing, light-sensitive organ located near the brain. So the issue was an intriguing one to me.

I first made an exploratory trip to Mexico in order to deal with the paperwork for the collecting permit, meet a local caver who could accompany me in my explorations (it is never a good idea to adventure alone

into caves), and get a "feeling" for the area. For example, what kind of transportation was needed to get to the caves? What kind of gear did I need? Could I find a good hotel for me and my family where I could conduct some of the experiments with the fish? Once I had answered all those questions, I got my rabies shots (many of the caves are inhabited by bats), got my gear (some of the caves were vertical ones up to 240 feet deep), and then headed down to Mexico.

Once I got to the study area, I settled with my family in a cabin at a local hotel and then got ready for my first cave exploration. The first caves I visited had easy access: horizontal and wide enough. Then came the vertical ones and they were really challenging: to descend and (especially) ascend vertically for about 240 feet carrying a lot of gear—including old-fashion video cameras, recorders, and buckets with fish—is not fun. But everything went well.

Then the local caver I had hired to accompany me on my visits to the caves had to leave, but I still had a few caves to visit. Fortunately, they were all horizontal ones, so they did not look particularly risky. In any case, every morning before leaving for the cave, I told my wife where I was going and at what time I should be expected back. In an era with no cell phones and in the middle of nowhere in Mexico, that was the best I could do.

I found one of the caves. As I always am, I was very careful making sure that all of my gear was in order, with the headlamp and flashlights working properly, as well as all of the videotape equipment. I started to walk into the cave, but from the beginning I got the sense that something was wrong. I could not see as well as usual. I tried to adjust the headlamp but yet things did not seem right. Then I realized that I had made a very stupid mistake. I had walked into the cave still wearing my sunglasses! So much for careful preparation. Well, I then took the sunglasses off and at that very moment I heard something strange. I looked down, and there just three feet away from me were several small rattlesnakes, which started to rattle intensely as soon as I pointed the light from the headlamp toward them. Despite the fact that I always wear boots when doing field work, I am sure it would not have been a nice experience to step on half a dozen or so rattlesnakes.

After exploring the cave and avoiding any direct contact with the snakes on my way out, I stopped by a nearby *caserío* or small town. I mentioned what had happened to me with the snakes while drinking a soda in the only local establishment that sold food. The locals told me that those snakes had been "placed" there by the gods to protect an alleged

Aztec treasure. In the beginning I was amused by the story, but then they started to ask me more and more questions and I realized that they took me for a treasure hunter.

As the questioning became more and more aggressive, I decided to leave, but I was surrounded by a crowd, which kept looking at my bags while asking all kinds of questions. Then I remembered that I was carrying with me some live fish, and I showed them to the locals, who were quite intrigued by the jars of fish. Then I started to speak like a real nerd, using all kinds of scientific jargon. I said things such as "I am studying the photoresponses of *Astyanax fasciatus* in order to see how scotophilia works as a behavioral response from their pineal organ" and other things along those lines. People started looking at me as if I needed a straight jacket. At that very moment I got my stuff in the car and left.

Other experiences were also frightening, although for different reasons. Another horizontal cave I visited was in a mining area. The cave looked easy enough, but as I walked into it, the passages became narrower and narrower to the point that I had to crawl to get to the hall where the pond with the blind fish was. While I was crawling along thirty feet of passages, I started to think what would happen if at that very moment an earthquake occurred. As though having brought the earthquake with my mind, the earth started to shake with a deep, low-frequency sound. I thought that was my end. I stopped crawling and waited for the worst, but having previously lived through a couple of earthquakes, I thought this one seemed different. The shaking was very regular with a combination of noises that were almost rhythmic. But, of course, I had never before been underground while an earthquake was taking place. Then I realized that there was no such earthquake: all the noise and trembling of the ground was a cargo train, just passing above me.

Once it was time to go back to Miami, I put my live fish in a bucket and prepared all the permits that were required in order to carry my fish on the plane. In order to keep the fish alive, I was carrying with me a portable air pump, which I used while I was at the airport, and a few "oxygen pills," the type of effervescent pills that you put in the water that can provide oxygen to the fish for a few hours. These pills were small and black.

When I arrived at the Miami International Airport and was asked at customs if I had anything to declare, I said "yes," explained about the fish, and was directed to the agriculture inspector. As soon as I had placed the bucket with the fish on his counter, I showed him the paperwork. He looked at it like he was not really sure what he was supposed to look for and then he looked into the bucket with curiosity. After glancing at it for

about twenty seconds, he asked me, "Do you have a permit for the snails too?" I looked at him and asked, "What snails?" He replied, "Those at the bottom of the bucket." Thinking that the water might have been contaminated with snails, I looked into the bucket and then realized that the agriculture inspector thought that the black oxygen pills were snails. I laughed. However one wonders about the effectiveness of government officials who cannot distinguish between a pill and a snail.

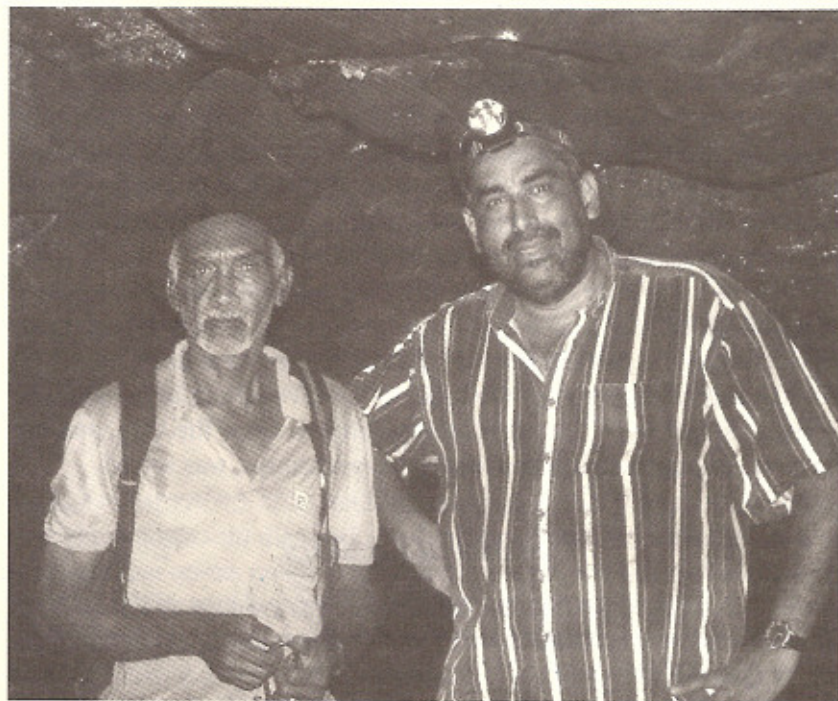
Trinidad

Trinidad is an island country northeast of Venezuela. Its fauna and flora are more related to those in South America than those of the other large island of that country, Tobago. Trinidad has a cave, the Cumaca Cave, known for having a blind cave catfish; and while I was still a graduate student, I decided to visit it in order to know more about it. After all, since the time this catfish had been discovered, there had been very little published information about it.

In 1983 I contacted the Selma Biological Station, a field laboratory where I could stay and from where I could go to explore the cave in question. I had made arrangements to be picked up by a local driver, who was to take me to the cave, but that morning beginning at about 4:00 AM, I woke up with a discomfort in my belly. In the beginning I did not think too much about it. I went to the restroom and back to my bed, but the pain became more and more acute. Because of the location of the pain, I started to think that I had appendicitis; however, I had no fever and when I lifted my leg while pressing the area of pain, I felt no difference. "It must be something else," I said to myself. So I woke up the field station manager, who took me to a local doctor who as soon as he saw me said, "You have a kidney stone." And his diagnosis was right on the mark. I had to leave the country but returned years later to study the blind catfish there.

In the year 2000 I returned with a student of mine, Joel Creswell, in order to observe the fish. By now I was more intrigued than ever. Based on what I had read, this blind cave catfish had been elusive at best. Since first described by the British ichthyologist John Richardson Norman in 1926 as a new genus and species, *Caecorhamdia urichi*, the fish had been seen by very few people. In fact, some of the few who had tried to collect it since then claimed that the fish could not be found.

When I finally visited the cave, I felt frustrated. This cavern is famous for hosting a colony of noisy oil birds (*Steatornis caripensis*) as well as a colony of bats and some other cave creatures. The cave is not particularly



Aldemaro Romero (*right*) with guide in Cumaca Cave in Trinidad.

PHOTOGRAPH BY JOEL CRESSWELL.

long (about three hundred feet) and is horizontal. The water is not deep, and although two divers died trying to explore the origin of its water at a pool at the end of the cave, it is actually a very safe and easy cave to explore. After spending one hour looking for the fish, I and my companions had not found even one. Was it possible that the fish in question had become extinct? After all, it had only been reported from that cave.

Tired of looking, I had almost decided to leave when I suddenly saw a quick reflection in the water. I asked my companions to turn off their flashlights while I turned on a portable video camera with infrared capabilities. Once I did so, I started to scan the waters with the camera, and then, surprise: dozens of fish started to appear from underneath the rocks, while reflecting the infrared source of light from their tapetum lucidum, a layer of tissue in their eyes that quite easily reflects *low-intensity light* ("cat's eyes").

But wasn't this catfish supposed to be blind and depigmented? After collecting a few specimens and studying all specimens of this species

available from around the world, I came up with the conclusion that the blind cave catfish was just a form of the catfish *Rhamdia quelen*, quite common in that part of the world. The blind form was the product of isolation when the waters of the cave were disconnected from the nearby rivulet at the end of the nineteenth century and beginning of the twentieth. But beginning in the 1930s, rain precipitation had increased considerably in that part of the world, allowing the normal catfish to invade the cave and ecologically replace its blind derivative.

The fish was only observable by using infrared cameras because it was scotophilic, that is, stayed away from the light. That is why so many researchers in the past could not find the fish: they were using flashlights and the fish hid underneath the rocks in the cave stream in the presence of light. Somehow by turning off the flashlights, I saw the light, and one mystery, among the many concerning cave creatures, was solved.

Additional Readings

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