

CONSERVATION

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PERSPECTIVES IN CONSERVATION

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Your name is synonymous with amphibians, but let's start from the beginning. What sparked your interest in herpetology?

This goes back to when I was a kid growing up in South Florida (Jensen Beach) and I remember snorkeling in the warm water and exploring the reefs. Basically, I was a naturalist; I would spend my days in the water or walking through the woods and in the rivers fishing. Thinking back to my childhood, I always knew I loved animals, I wanted to be a vet at that time, and from a very young age my mom would go to the library and check out all the books on animals for me. I didn't know about being a scientist, I didn't know that was even a job until I was in college. Once I realized I could be a biologist, getting paid to study animals, I knew that was the perfect job for me.

I understand you are a first-generation college graduate in your family. Tell us about that experience.

Honestly, I felt completely clueless much of the time. I did well in my classes, but I did not always understand the process or how to move forward. I knew that I loved to work with animals, and I was going to be a biologist of some sort. I don't think I fully appreciated at the time that I was the first in my family. It's interesting, I now work at a university with students who are in a similar situation, and I think that my experience has enabled me to be a better mentor to them. I try to identify those kids who show a real interest and aptitude for biology and perhaps need some guidance.

I actually started at Cornell and spent a year there, but I did not have the finances available to me to stay, so I transferred to the University of South Florida to finish my bachelor's degree. I was lucky, I just so happened to end up in a herpetology class taught by Henry Mushinsky. He wanted to know if I had considered going to graduate school. I did not really know what grad school even was, but he offered me a position as a work study student. At that time I was working at the mall in a drugstore making minimum wage, which was \$3.15 an hour, and Henry was going to pay me twice that amount to catch gopher tortoises. It was like winning the lottery.

Sounds like it! Would you consider Henry your first mentor? Did you have others during graduate school?

Henry was the first to get me on the right track. He told me about a field station by the name of Archbold, and suggested I intern there to gain more experience. So, I applied, and I spent an entire year there (Fig. 1). To this day I consider Archbold to be one of those key experiences in my life. I worked for an amazing

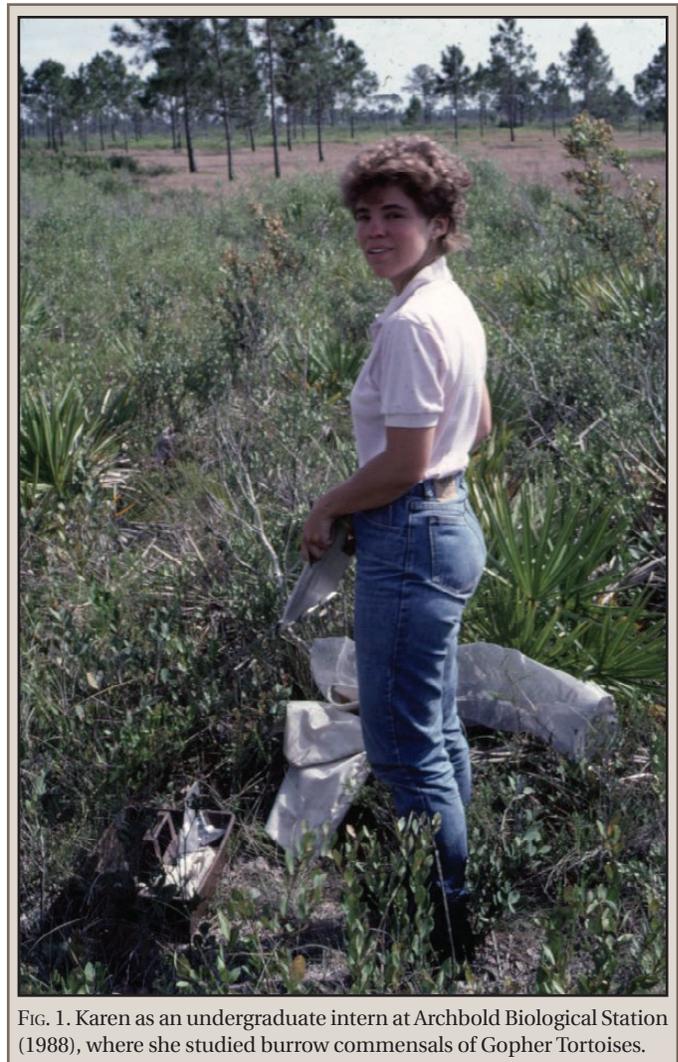


PHOTO BY NANCY DEYRUP

FIG. 1. Karen as an undergraduate intern at Archbold Biological Station (1988), where she studied burrow commensals of Gopher Tortoises.

PHOTO BY KAREN LIPS



FIG. 2. La Casita, Zona Protectora Las Tablas, Costa Rica. This was Karen's home for two years in the old growth oak forest of the Amistad Biosphere Reserve.

mammologist by the name of Dr. Jim Layne. It was an immersive ecology experience, I learned how to set up herp arrays and drift fences, and monitor frog calls as well as study the rodents and other local species. That intensive year at Archbold was critical in my becoming a biologist. For mentors, Henry and Dr. Layne were important people in my life early on.

From there I went on to graduate school at the University of Miami to work with Jay Savage, who was a very important mentor during my PhD studies. I had this crazy idea that I wanted to be a tropical biologist, and Jay was key in getting me into the rainforest. Right around this time Mo Donnelly was working as a postdoc in the Savage lab and both she and Craig Guyer were influential at this stage; they reviewed proposals I was working on and really helped me become an ecologist. Post PhD there were some other important people; I would especially like to mention George Rabb. He was one of these wonderful people who, behind the scenes, was instrumental for many of us in the amphibian conservation world. When we were young and inexperienced, George got us a seat at the table and really helped get our information out to the rest of the world.

I've heard George Rabb orchestrated multiple movements in amphibian conservation.

He was omnipresent in the background, he put the people with the information in the forefront. Without him as an advocate, I don't know what would have happened. Now that I am in a similar position, I like to think about what I can do to be like George Rabb and help other biologists.

Let's discuss your time in the Savage Lab, working in the rainforests of Costa Rica.

Well, at first, I wanted to work with varanid lizards in Australia. I had no experience doing this, and ultimately did not get the funding. Jay suggested I head down to Costa Rica to do some surveys of the amphibians and reptiles along the Panamanian border. This was an amazing opportunity to spend an entire summer at the remote site in the Amistad Biosphere Reserve. I had the opportunity to learn herpetological field methods from Craig Guyer, Steve Werman, and Dave Wake. I found a field site right on the border run by a family who lived within the Zona Protectora (protected area) and I happened to find this beautiful little frog (originally called *Hyla lancasteri*, now *Isthmohyla calypsa*), and I came up with a project on the clinal variation of the species. I spoke to this local family with my poor Spanish and asked if I could live in their little shack in the pasture and study this frog. They nodded their heads and said yeah, sure. I actually don't think they believed me at first, but I rented the shack from them which was about an hour hike up the mountain from their house (which was a ~2-hour drive from San Vito). It was an adventure—no electricity and no running water—I spent two years by myself living in the middle of a cow pasture (Fig. 2). I ran transects, counted frogs, documented eggs, measured tadpoles, and even discovered several new species. It was an amazing experience. Then I came back and had to sit in an office and write it all up.

What an adventure! This is the early 1990s, (1991–1993), you are a young female biologist living alone in a remote area of Costa Rica, what was that like?

To be honest I certainly did not tell my parents! I would probably never allow one of my students to do that, but it was great experience. The family was very protective of me, it was their property. The agreement was that I would show up twice a week to get materials and supplies, and if I did not show they would come look for me. There were jaguars and mountain lions up on the mountain, and actually a jaguar was killing off some of the cattle. Lucky for me people are generally more dangerous than animals, and since it was so remote, there weren't many people there. One year when I came back, the family handed me an old rusty revolver to carry around in case I was threatened by the jaguar, but I declined. Thirty years in the jungle, and I have still never seen a jaguar.

When did you begin to notice the frogs were in decline at your field sites?

It was at the Las Tablas site in Costa Rica. I was mostly finished with my project, and I had been writing back at University of Miami for a few months. I went back to my field sites to wrap up some data and there just weren't any frogs. This was at the beginning of the rainy season, and I was specifically hoping to get a second year of reproductive biology on *Incilius fastidiosus*, a species that was related to the Golden Toad (*Incilius periglenes*). At first, I thought it was the lack of rain. I stayed through June, and the frogs I had been studying for years never showed up.



FIG. 3. As a Jefferson Science Fellow, Karen promoted Science and Educational Diplomacy in Latin America. Here she is visiting the U.S. Consulate in Ciudad Juárez, Mexico (2017) to talk about careers in STEM with the Chicas STEM club.

During my previous visit, right before I headed back to the states, I picked up seven dead amphibians (two salamanders and five frogs). Now, seven is no great number, but it did seem a little odd. Jay had me bring them back to his wife, Dr. Rebecca Papendick, who was a pathologist. She looked at them but could not quite figure out what could have been the cause of death, although she did note there was something odd in the skin. So, we put it on the shelf.

After I graduated, I got a job in upstate New York at St. Lawrence University and I was able to bring undergrads down with me to my former field sites. We went back to Las Tablas that year (1995) and the frogs were still missing. This was the first time I realized something had happened. The next year I returned to Fortuna, a site in western Panama, and there were dead frogs everywhere. Due to the large number, we were able to collect enough specimens and get them to pathologists. We got back similar reports, cause of death could not be determined, but they all had this weird thing in the skin.

Is this when you realized there is a connection between the site in Panama and your former field site in Costa Rica?

Looking back on it I realize this was a huge breakthrough but at the time we still knew so little about the causes or patterns of enigmatic amphibian declines even after many years. At no point did we ever say “Eureka! We have found the answer!” You just have to keep building up the evidence and re-assessing all the alternatives.

I would say for us the key moment came after we published the picture of the frog with chytridiomycosis in the *New York Times*. At the time, we did not yet know it was the chytrid fungus. David Green was the pathologist and had sent in the photo that was seen by biologists at the National Zoo and in Australia. Both of these groups had been dealing with chytrid in their frog populations. This is where George Rabb comes in—somehow—he was in touch with all of these biologists. I returned from the field to a phone call from George saying that we all needed to meet in Illinois to discuss this thing that was happening with the frogs. George basically convened us and provided money for us to all get together. This is when we first discovered that it was the same thing, the fungus, that was killing these frogs at these different sites.

This must have been a big shift in research focus for you, as now you are studying amphibian declines and the chytrid fungus.

You know I think that’s correct, we now had a name for this disease, but we did not know anything else. How did it move? What other populations will or could be affected? We published a paper in PNAS and that opened up the door for some opportunities for grants to continue this work. I then got asked to go to lots of meetings and give lots of talks, and quite frankly it’s been like that ever since! Most people had no idea what was happening but we all just kept trying to share what little we did know to look for commonalities among the different places and species to see we could get a step ahead of it. At that point I began working with Jim Collins, who became a really important mentor in the amphibian disease aspect of my career. He convened these annual amphibian disease meetings in Arizona which began in 1998 and have been pretty incredible in terms of bringing people together who are willing to share their data and their techniques—often prior to publication. This has really helped get the information into the hands of those that need it, resulting in greater efficiency of resources.

How did these “boots on the ground” experiences prepare you for working with the U.S. Department of State?

I think that’s part of the natural progression of a scientific career, after you get tenure to expand your areas of interest to larger issues. I started by counting frogs, then moved on to amphibian disease and worked on ecosystem ecology from the impact of amphibian declines. Then *Bsal* entered the picture and we start seeing how amphibian trade was involved with the spread of these pathogens. Around this time (2009), I moved to D.C., which created new opportunities; I now lived in a place where I can hop on the metro and go talk with the people from U.S. Fish and Wildlife Service, or different conservation organizations, or lawmakers. Priya Nanjappa was in D.C. at the time and was really helpful in explaining how the policy side of conservation worked. The truth is, it is very important that science be involved in decision making, and while some scientific societies have a D.C. presence, individual scientists could be doing a lot more to communicate their research with decisionmakers if they had more guidance and support. So, by building these relationships in D.C. with policy makers through my teaching and networking, we were able to contact them later when *Bsal* emerged. Having those connections allowed us to share new scientific information that they were able to use in establishing new policies.

It was my involvement on the *Bsal*-trade issue that showed me how much more there was to do and how much more I needed to learn. I applied for the Jefferson Science Fellowship; that gave me an opportunity to work for the U.S. Department of State in the Bureau of the Western Hemisphere Affairs in the Office of Public Diplomacy and Public Affairs, which essentially covered Latin America and focused on engagement through science and education. I was the scientist for that office, and they sent me out to talk about environmental issues. They were particularly interested in education, and specifically educating women and young girls in the STEM fields, which was great to hear. Up until then I had no idea the State Department put so much emphasis on science education, specifically concerning women and children. This opportunity allowed me to travel to countries such as Argentina, Mexico, Guyana, and the Bahamas to connect with these audiences over science and the environment (Fig. 3).



FIG. 4. The RANA Network, Puerto Rico, 2001.

What are some of the hurdles conservationists face in today's world?

Where to begin? To start with the positive. I would say that there are so many people who care. For instance, concerning amphibian declines, whether it's government, school kids, university students, the media, or the community at large, everybody cares, and everybody wants to know what they can do. The problem for me has always been, *What do I tell them?* During much of this story we haven't had a silver bullet-type solution that people could support. Sure, there are the usual things: donate money to protect more habitat, call your representatives and encourage them to address invasive wildlife diseases, but no specific action that could be linked to a promising solution. Like most environmental problems the global amphibian threat is big, multidimensional, and complex, and there's really no one thing that we can focus on, but instead this requires international, multidisciplinary research and conservation. From the perspective of a field biologist, things have changed quite a bit. Early on, we had to understand what was happening in the environment, which required immersing yourself in the field; at the time lab work was really just starting up. Now, I think we understand general field patterns related to amphibian declines and chytridiomycosis, and much of the key research is focused on the molecular and genetic responses to infection. Lots of great experiments are going on in labs; including those working to develop reintroduction plans that will be successful in this world where chytrids are globally distributed.

Where do we go from here?

I wish I knew the answer to that. I think the current pressure in academia is that early-career researchers have to focus on projects that will produce multiple papers in a short period of time. I was lucky to have had the opportunity to live in the jungle for a few years counting frogs and be able to use that data to tell a much larger story, but I was not strategic, and things might have turned out very differently for me.

With that in mind, I think an important need is for institutions to generate and curate those types of long term and large-scale data. Universities and field stations have a unique opportunity to contribute and provide that information to the community. I just think back to my time at Archbold where Dr. Layne had 40 years of acorn data and 30 years of mouse trapping data and was able to link them to understand large-scale processes; these long-term baseline data are ever more critical. We need to find a way to accomplish this without relying on linking several short-term grants but finding ways to invest in long-term data

that could be paired with shorter research projects that can investigate mechanisms. Secondly, I would advocate for much more international multidisciplinary collaborations—this has been the most important factor in the progress in understanding global amphibian declines. I would love to find a way to build institutional support for a large team of international researchers from multiple disciplines to collectively amass large amounts of ecosystem data needed to solve some of the environmental issues we are facing.

As an active and effective conservation biologist, what keeps you motivated? Any advice for the next generation of conservationists?

I think everyone needs to stay engaged and curious, explore new things. There are lots of cool opportunities out there you don't even know about yet! I have shifted from counting frogs to working with the State Department on policy, and I have found the diversity of approaches interesting and important in expanding my mind. Get out into the field, be independent, take the initiative. Do not be afraid to talk to other people. Work on multidisciplinary collaborations, team science is really the only way we're going to move forward (Fig. 4). These are the general trends that science is going to have to really embrace.

You have had many fascinating experiences in herpetology, let's close with some of your favorites.

I would say there are two things that I have done so far that I feel have had a big impact on my life. The first was that year at Archbold as an undergraduate intern. Spending a year in the field, no classes, working with other biologists, I just learned so much. The other one was actually that year with the State Department, it was such an eye-opening experience. The people I met there from around the world were incredibly talented, smart, and able to communicate effectively with others from all fields. There, I witnessed the direct application of science and education as a tool for promoting world peace. Those two years afforded opportunities I never knew existed. I'd like to tell all the early career researchers out there that so much of life is random and unpredictable, and much of my success did not have much to do with me specifically, but with luck and serendipity. That said, when things happen you have to be able to recognize the opportunity, take advantage of it, and be persistent. I think it's important to work hard and take advantage of every opportunity that comes along. If it can happen to me, it can happen to you.