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CONVERSATION

In the field: an interview with Rohini Balakrishnan

Rohini Balakrishnan is a Professor at the Indian Institute of Science, where she investigates animal communication and bioacoustics. After her undergraduate degree in Biology at Mount Carmel College, Bangalore, she completed a Master's degree in Zoology at the University of Pune, India, and a PhD in neurogenetics at the Tata Institute of Fundamental Research, Mumbai, before undertaking postdoctoral research at McGill University, Canada, and the University of Erlangen, Germany. Telling us about her research experiences in the Kudremukh National Park, India, Rohini Balakrishnan reflects on working with crickets, bushcrickets, bats and elephants, explaining how these animals communicate against loud background noise and why silent female bushcrickets are more vulnerable to bat predation than noisy males.

Where did you grow up? How did you become interested in animals?

I moved all over India when I was growing up, because my father was a geophysicist working in oil exploration. That affected my education and I didn't go to school much when I was younger. I even spent a couple of years in Baghdad, Iraq, when I was 9 to 11 and I didn't go to school at all there. It's hard to tell where my interest in animals came from. I think it was always there. My earliest passion was fireflies. I also used to bring moth and butterfly caterpillars home and wait for them to pupate and emerge. My greatest encouragement came during high school in Cambrian Hall, Dehra Dun, between the ages of 12 and 16. We had many extracurricular activities, including a wildlife club. That's where I started doing my first natural history outings and treks. My very first field trip was when I was 12: we went to Jim Corbett National Park looking for tigers and elephants. We camped and had some pretty hair-raising experiences. One time, a wild boar got into our tent and he charged, but luckily not in my direction. He had ripped up many of the sleeping bags, mine included, because I had a packet of biscuits inside!

How did you transition from high school to university?

In those days in India, high school was all about becoming an engineer, a doctor or a lawyer. People assumed that I would go into medicine, but I always knew I wouldn't and I pursued an undergraduate degree in biology in Bangalore. I did chemistry, botany and zoology. It was probably the most soul-killing three years of my life, it was so boring! Then I moved on to a Master's degree in Pune, India, with a mix of zoology and molecular and developmental biology. But I contracted hepatitis at the end of my Master's so I couldn't go abroad for a PhD. I ended up applying for a PhD in genetics in the Tata Institute of Fundamental Research. After that I decided that there was no way I was going to continue with genetics, so I eventually found a job advert from Jerry Pollack at McGill University, Canada, for a lab-based postdoc working on cricket acoustic communication. He offered me the position and that's how I moved into bioacoustics. Then, I went to the University of Erlangen, Germany, where I did a second postdoc on grasshoppers in the lab of Otto and Dagmar von Helversen. I picked up some field skills there. After that, I applied to the Centre for Ecological Sciences here in Bangalore and I got the offer for an Assistant Professor's position. I think they had the feeling that I had the passion and the ability to do some good work in animal behaviour.

What scientific questions were you wanting to answer when you arrived in Bangalore?

When I arrived here, next to nothing was known about insect acoustic communication in the field. A lot of that research was done indoors. At that time, there were very few studies where individually marked crickets were followed for weeks in the field; people often believed it was impossible and even today, few people do it. But you need that kind of information if you want to make sense of what's going on out there. My lab regularly goes out into the field, tracks down insects and paints dots on them – so we can uniquely identify them – and releases them back into the wild. We get back some 50–60% of the animals that we mark, which is more than enough to tell us many important things.

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Journal of Experimental Biology (2021) 224, jeb242697. doi:10.1242/jeb.242697

Rohini Balakrishnan searching for crickets at night. Photo credit: Mohammed Aamir Sadiq. Inset: Kudremukh National Park by day. Photo credit: Manjari Jain.

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How did you learn to track insects in the field?

We started with the field crickets and tree crickets here on campus. We have a large, wooded campus and they are everywhere, so I started honing my tracking skills to find those creatures. I would go out at night with a couple of students from the animal behaviour course that I was teaching – as part of their practical training – and we'd listen. We would try to track each sound we heard; easier said than done! When you start, there's a world of sound, you're just hearing all these different noises. Then you painstakingly listen in, you focus your attention on one singer and retreat from the cacophony. Once you pin your attention on that one sound, you then try to use your ears and move very slowly without causing any vibration, otherwise the animal will immediately stop singing. You move very slowly, moving your head from side to side, and you try to locate it. You cannot shine white light on them, it disturbs them, so we usually have headlamps with red light, or, in the old days, we used to put red cellophane over our torches. As you gain experience, you get better. Once we find the animal, we start our recorders. Then, in the early days, we had to catch the animal, because we needed to identify the species that were producing those calls. Our success rate performing all of these steps was 30–40%. Once we'd perfected the technique, we moved to an area outside Bangalore, which was more agricultural, and also to the rainforests of Kudremukh.

How did you discover the field site where you do most of your research?

When I started, I was looking for a site where I could study an entire forest community. I would join students from other labs that were doing other kinds of biodiversity work on their trips. We worked by day, but I was more interested in working by night because I was interested in crickets. Over 2 years, I walked up and down the Western Ghats, listening for the right acoustic community, and that was when I honed my forest skills. Eventually I found it near the Kudremukh National Park. I heard all these crazy sounds (Audio 1)! I needed to know what these animals were, how they manage to communicate in this din. There were also two other important logistical constraints. South India is full of elephants and they're mighty dangerous; you can't work at night in elephant-infested forests, but Kudremukh National Park has very few. However, it has a lot of snakes – including king cobras and pit vipers – it is snake heaven, so you have to be careful.

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What made the sounds in this location stand out for you?

The patterns were crazy, unlike anything I had heard before. There were these beautiful bell-like calls that could have been frogs, birds, or crickets. Apart from your typical cricket calls, there were a lot of things which I would call atypical, which were lower in frequency than I would have imagined crickets to be. In this community we have the second lowest-frequency katydid caller in the world. We have probably the most noisy or broadband caller ever, the *Mecopoda* genus; their calls have energy ranging from 2 kHz to over 100 kHz with fantastic rhythm patterns (Audio 2). There were also very low frequency, frog-like calls, which we later discovered to be the calls of tree weta (Audio 3). The community struck me as very diverse and I knew that this was where I would like to study how animals communicate in a din; but it was going to be a huge challenge.

What precautions do you take to protect yourself from snakes?

Having very good shoes is important; you need good ankle-high boots that can't be bitten through. Keeping your eyes and ears open is also most important. When you're walking, you must scan the ground with your light before putting your foot anywhere. If you reach out for anything, make sure there's nothing around that can bite you. If you're walking on a path you can use white light. The biggest difficulties come when you're trying to track a cricket and you go off the path; your attention is focused, so it's difficult to look around you. That's when it gets most dangerous. You walk very slowly, so that you don't disturb the cricket, but you don't disturb the snakes either.

One of my first students, Swati Diwakar, got bitten. She was climbing a steep slope with a guide. She put her hand on a rock to get purchase and a small viper bit her. I was back in Bangalore and it was quite a horror story. She then walked a few kilometres back to the village with a swollen arm. It was before cell phones, so it was only when she got back to the village that somebody called me. Then I was in a total panic. They took her to a hospital about an hour away and I took the night bus to get there. I was with her in the intensive care unit for 3 days. It happened during her first 6 months of fieldwork. At that point, I wanted to close the project, it didn't seem worth it, but she said she was going to come back to finish the PhD. Swati is one of the bravest people I know and that's why I am where I am today with this research. She's currently an Assistant Professor at the University of Delhi, India.

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Where is your base during an extended period of fieldwork?
We worked within Kudremukh National Park, but we're not allowed to camp inside, so we set up a permanent establishment that we've had for 20 years in Kadari village, just outside the gates. It's relatively comfortable; there is electricity and water and there are even places to eat. We take a jeep and go into the forest every evening. Work starts at about 5 or 6 p.m. and finishes maybe around 11 p.m. to midnight, allowing us to get back relatively early for a comfortable night's sleep.

Can you tell us about your work with bats?
I had been working for 15 years on communication in a cacophony and I had done a lot of good work, but I hadn't entirely understood what was driving the way these signals look. In the early days I liked to track in the dark. One night, I switched off the light and, as I was going to turn my headlamp back on, something brushed my cheek. I switched on the lamp and saw a bat swoop down and pick up the bushcricket that I was tracking. That triggered a thought; why were bushcrickets calling so loudly when they're perfect bat food? That's when I got interested in bats.

We started out mist-netting to catch the bats to get a feel for what species of bat we have in the area and what their calls are like. Then I was interested to find out which of these bats may be eating my crickets, so we spent a lot of time trying to find the bat roosts. We had four or five candidates, but it was difficult to find the roosts in the national park. One day, on our way back from fieldwork, we stopped at a small, abandoned building in the forest not far from the village. Whenever we see abandoned buildings, I look inside. There was a broken window, so I looked through it and saw bushcricket wings on the floor; we'd found the roost of a cricket-hunting bat, the Indian lesser false vampire, which isn't a vampire but an insect-eating bat! Looking at the insect remains in multiple bat roosts, we could figure out what the bats were eating and we found they were eating far more female bushcrickets than males; but females don't call. I thought this was crazy; why were the females being caught when they didn't make a sound? We built a large outdoor bat enclosure so we could run behavioural experiments, playing back the calls of different bushcricket species and putting live prey in with the bat. After 2 or 3 years, we got a rock-solid result; the bats are 2 to 3 times more likely to approach and capture flying females than they are to approach male calls. Flying is riskier than calling, which turned the whole narrative on its head. You read in all the textbooks that males are taking all the risks by calling out loud, but nobody had ever tested it!

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How do you keep track of the animals that you are studying?
We mainly used VHF transmitters, which are old fashioned, but GPS transmitters were too heavy – our bats are small – so now we know how bats move across the landscape. I also teamed up with Yossi Yovel from Tel Aviv University, Israel, a couple of years ago to get more high-resolution data. He came here and we managed to put GPS tags on our bats. Now we know when the bat is flying, we know when it has captured prey, but we don't know what it is eating. VHF transmitter weights are now down to 0.1 g so we can follow the insect prey too. It's an exciting time! Recently, in February 2021, we did our first insect tagging experiments on bushcricket prey to begin to figure out how insects are moving in the landscape. On one occasion, one of the transmitters dropped off the insect and, when my student found it, it had teeth marks on it. Something ate the insect and there were teeth marks on the transmitter, but it was still working, so we could re-use it! Another time we saw a female with a transmitter on her back mating and a female laying eggs. If they can mate and lay eggs, it's a good thing: it means they can still behave naturally while carrying transmitters.

Do you have any local support in the field?
Our local field assistants have been with us almost 20 years. We don't go into the forest on our own because we couldn't find our way at night. Also, my students come from all over India, they may not speak the local language, so it's good to go with a member of the community. However, all of my students have ended up learning the local language (Kannada). The assistants know the forest, they live right next door to the park and go into it often, so their knowledge of the trails is invaluable. I met my field assistant, Sudhakar Gowda, when I went on one of my first field trips to Kudremukh with my student. Somebody had to be with us, so we asked around the village and they recommended a couple of people. We really clicked with Sudhakar when he guided us. Now, I hire him as a full-time field assistant, but he also lives on his plantation and he farms cashews. The field assistants know where to go, which trails to take and they go ahead with a machete to cut a way through when we go off the trails tracking insects. We also need their navigational ability; they are like a GPS combined with tree-climbing and insect-capture skills, and they keep us safe. We always go into the park in pairs so that somebody is there to help if something goes wrong. Now we have a lot of young boys in the village who help us. It's nice to know that there are youngsters who are still enthusiastic and good at helping us to track insects, shinning into the trees to bring them down.

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Can you tell us about your experiences of working with elephants in the wild?
I got into elephants, because I have a colleague in the department, Professor Raman Sukumar, who has worked on them for a long time. He had a student who wanted to look at elephant communication, so I teamed up with her. The elephant work was done in the Mudumalai Tiger Reserve. These are forest elephants, they walk in dense undergrowth, so most of the time you don't see them until they're closer than you'd like; it's really dangerous. Again, we had very good tribal trackers who were our early warning system; they know when an elephant is nearby. We walked along the paths listening and our guides also used their sense of smell to try to figure out where the elephants were. You hope to get to a point where you get a good view, but you're at least 50–100 m away from the elephant. The important thing is to see what the animal is doing, to get the visual and audio data together. I'll be frank, I don't like elephants – they're way too temperamental. You never know when they might charge or when you might be in the middle of a herd without realizing it. Often, they separate out to eat, so you may be between them and that's not a nice place to be!

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What do you do to get out of a situation like that?

It's tricky. You try to stand as still as possible behind a tree, not draw too much attention to yourself, but their sense of smell is very good, so that doesn't work very well. We try not to alarm them very much and hope that they'll slowly walk away. You can't make sudden movements. If you're slightly further away, it's easier, because you can walk or run. We were charged once; I could not believe how fast elephants can move. We thought we were quite safe, away across a valley, but they charged and we ran as fast as we could. They covered the ground so fast, it was frightening. We've also had elephant encounters working at night in Kudremukh, which were even more hair-raising. I happened to be with Swati; we were sampling insects. Because we work on sound, our ears are very tuned, we can distinguish the sound of a falling leaf from a jumping monkey or a walking mouse deer. The one sound you don't want to hear is a breaking branch because that means elephants. We heard this cracking sound and we didn't know where it was coming from, so we packed up our equipment and ran a kilometre back along the path, hoping that we wouldn't meet any elephants on the way out. Luckily for us, we didn't!

Rohini Balakrishnan was interviewed by Kathryn Knight. The interview has been edited and condensed with the interviewee's approval.