variations in the population at any given time. This brings faster evolutionary responses. Also, in ecology, we need a more complex system than *E. coli*. Understanding of adaptation to crowding, competition and evolution of competitive ability has played a great role in forming ecological theories. Competition in *E. coli* does not relate well to the theory as it was made keeping in mind plants and animals. Fruit flies are therefore convenient and it is inexpensive to handle even large populations. It is labour-intensive work and does not require any fancy, expensive equipment. All you will find in my laboratory are vials, dissection microscopes and a couple of incubators. The only high-tech instrument we use is our brains.

Why is that there are very few people in India who are pursuing research in ecology and evolutionary biology?

Ecology and evolution are not properly taught in schools and colleges, and are also not properly represented in the curriculum. The textbooks used today are completely outdated. If you take a look at the ecology and evolution topics in our university curricula, it is almost as if nothing happened after Darwin or, at best after the Neo-Darwinian synthesis of the 1930s–40s. Can you imagine physics curricula ignoring Einstein's work and quantum mechanics? It sounds ludicrous, but that is what the state of affairs is with regard to ecology and evolution in our universities. Also, biology in India is increasingly being dominated by a reductionist viewpoint coming from the perceived importance of molecular biology. However, molecular biology and what one might call organismal biology are fairly different kinds of subjects. The epistemology of ecology and evolutionary biology is different from that of sub-organismal biology in being model-based rather than description-based. As a consequence, much like physics, ecology and evolutionary biology rest upon a solid theoretical foundation of formal mathematical theory. In India, that itself guarantees that many biologists will shy away from the field, shunning the dizzyingly attractive but also scary heights of concepts for the more mundane but reassuring solidity of a more descriptive and concrete world of facts.

Another problem is that in India science is viewed in a very utilitarian perspective, and ecology and evolution are (wrongly) believed to not have much applied significance. Science is ultimately about conceptualizations, not facts. It is about ideas, questions, curiosity and concepts and along these axes, ecology and evolution are perhaps the richest areas of biology. To my mind, the ultimate irony of our neglect of ecology and evolution in India is that these are the fields of biology in which we can excel internationally and to some extent already have, despite the small number of research groups studying these areas in India. This is because fields like ecology and evolutionary biology are not expensive or technology-driven, they are concept-driven. Therefore, even if you work in a university in some small town in India, it is much easier to do cutting-edge research in ecology and evolution than in molecular biology. Fields like molecular biology are technology-driven with research being hampered by technology gaps. So if one cannot afford it, he/she falls behind the competitors who are able to do so. In ecology and evolution you can compete with the best in the world on a level playing field because it is your brain against theirs, not your budget against theirs.

Ipsita Herlekar

Milind Watve

Milind Watve is an evolutionary biologist at IISER, Pune. He is the author of the book *Doves, Diplomats and Diabetes*, where he puts across an alternative model for understanding the cause of diabetes. In an interview with *Current Science*, Watve speaks about his research and the need for communication between scientists and the general public.

What inspired you to pursue research in the field of evolutionary biology?

My interest in evolutionary biology goes way back to my undergraduate college days. One of my teachers, M. T. Chauhan, was very enthusiastic about the subject. I pursued Masters in microbiology and later began a career in teaching. After 10 years of teaching, I had the opportunity of meeting Madhav Gadgil, who convinced me to pursue a Ph D, in order to equip me to teach better. While pursuing my Ph D at the Indian Institute of Science, Bengaluru, I was mentored by Nanjundiah, Gadagkar, Sukumar and Joshi. This rekindled my interest in evolutionary biology and behavioural ecology. On returning to Pune, I began teaching evolutionary biology at the undergraduate level, engaging the students in my research projects. Involving undergraduate students in projects that need data-intensive or technique-intensive work is difficult. However, as evolutionary biology is a conceptually rich discipline, it is possible for undergraduate students to take part in research projects.

What does your research currently focus on?

The work done in our laboratory focuses mainly on theoretical development in the field of behavioural physiology and medicine, supplemented by a few simple experiments. We mainly use secondary data from studies on rodents, primates and humans to conduct meta-analysis. The differences in the behavioural

strategies adopted by different species and populations are supported by alterations in the physiological state. In our laboratory we examine physiological states that accompany different behavioural strategies.

The cause behind a large number of disorders prevalent in humans today is more likely due to behavioural changes rather than factors like diet. Humans evolved with a different set of behaviour from the ones they exhibit today. These behavioural deficiencies work much like nutritional deficiencies. For example, physical aggression is missing in the life of an adult human and is substantially reduced in childhood too. Previously, children engaging in playful physical fights were accepted, but this perception has changed today. Humans originally evolved to be hunter-gatherers. Though physical fights among individuals were not frequent, a number of physically aggressive actions like hunting, chasing, etc. existed. As humans turned into agriculturists and began to lead a more settled life, these behaviours disappeared. Today, we humans lack many physically aggressive neuro-motor actions which have proven to be linked to several neuro-endocrine pathways. There are several important molecular links between behaviour and metabolism. Empirical data and computational models have shown that when a behaviour is altered for a prolonged period, the entire system changes. Eventually, physiological changes that evolved as adaptive responses turn pathologic when taken to extreme levels.

What does evolutionary biology help understand?

I will answer this question with an example. The theory of life history strategies was developed without thinking about its applications. Subsequently, it was discovered that insulin is a life history determining molecule. Therefore, unless one has the understanding of life history strategies, it becomes difficult to understand insulin signalling and in turn diabetes itself. Understanding the evolution of a disorder helps us find ways of countering it. This is also true in the case of many other disorders and diseases like cancer. Cancer is highly improbable unless there is selection of intermediate stages within a tissue. The concepts and mechanisms of selection that were originally developed at organism level can now be applied at sub-organism levels, leading to better understanding of the disease. It is similar in the case of some mitochondrial and neurological disorders as well. A new but prospering branch of medicine termed Darwinian medicine which is based on evolutionary concepts is now gaining importance.

What are the current research trends pertaining to evolutionary biology in India?

Contrary to the popular belief, research on evolutionary biology in India is not at a nascent stage. Though in terms of number the people involved are few, their contributions are of a pioneering quality. It will take a few generations to build and spread this culture. Many scientists in India presume that funding opportunities for research with no direct or immediate applications are limited and therefore hesitate in pursuing research on fundamental topics. This is not entirely true. Many agencies are keen to fund investigations of fundamental and basic research topics. Every piece of knowledge is important and is of some relevance in one way or another. They will prove to be important in the long run.

What are the caveats of doing research in India?

Getting your work published in top-tier journals is tough for a scientist working in India. But nothing prevents you from doing path-breaking research. We need to publish some of our best quality work in Indian journals to make Indian research more visible in the long run.

In your opinion, is evolutionary biology well represented in the syllabus of schools and colleges?

Absolutely not. If anything is taught on evolution in schools, it is only something about dinosaurs and our ape ancestry. The principles of evolution have not percolated enough. Over the years, the syllabus followed by schools and colleges has not undergone much change. IISER, Pune is one of the few institutions which has a rigorous module on evolutionary biology as a part of its undergraduate course. The student community today is enthusiastic and receptive, and it is necessary to teach them theories on modern synthesis, behavioural and social evolution.

You have been active in popularizing science. What is your opinion on researchers engaging themselves in science outreach programmes?

Researchers should definitely engage themselves in more outreach programmes. This not only helps the general public, but also the scientists themselves. While interacting with a naïve audience, scientists come across the most unexpected questions which are unlikely if they interact only with their peers. When interacting with a general audience, one comes across very basic and fundamental questions; questions that often make you think.

Ipsita Herlekar, S. Ramaseshan Fellow.
e-mail: iherlekar@gmail.com