

CONVERSATION

JEB@100: an interview with Monitoring Editor Sanjay Sane

Journal of Experimental Biology is celebrating 100 years of discovery in 2023 and, as part of our reflections, we are inviting Journal Editors to tell us their thoughts about the journal and to look to the future. In this Conversation, Sanjay Sane, one of JEB's Monitoring Editors, tells us about his first experience of publishing with the journal and why he thinks JEB is going to play a key role in our understanding of the current climate crisis and its implications for biodiversity.

What is your area of scientific expertise and how did that introduce you to JEB?

I study the biomechanics and neuroethology of insect flight and, more recently, insect architecture and how insects build nests collectively. My interest in insect flight started as a physics Master's student at the University of Poona, India. At the time, I was very interested in fluid mechanics and how vortices are generated and localized, and how we can draw energy out of them. Then I joined Michael Dickinson's lab as a graduate student at the University of Chicago, USA, just around the time that the field took off. We studied how insects generate sufficient aerodynamic forces to fly using a scaled-up robotic insect and found some aerodynamic mechanisms that turned out to be very different to what had previously been thought. This resulted in a series of papers that we published in JEB and other journals during my time as a graduate student. The first manuscript that I wrote was sent to JEB. It was also among the first journals I started reading when I moved into biology from physics. It naturally attracted me, because that was the kind of biology I liked. A lot of the key papers in insect flight, including Charlie Ellington's, Mike Dickinson's, Robert Dudley's and Torkel Weis-Fogh's papers, were published in JEB. I vividly remember the experience of submitting my first paper. I made three hard copies and mailed them off to the JEB office in the UK. I was lucky that the paper got really good reviews, so it just went through. Michael and I had gone through many drafts of the manuscript before submission and I thought we couldn't improve it anymore, but the copyeditors at JEB made it read even better. I was really impressed by how good they were, and I still think that is one of the standout features of the journal – how the copyediting makes your paper better. The whole experience was just so pleasant. I have warm and fuzzy memories about the time.

What do you think is the secret of JEB's longevity and success?

I think the science published in JEB is consistently solid and interesting. We have all heard the saying that nothing in biology makes sense except in light of evolution, but I'd like to add that nothing in evolution makes sense except in light of diversity. I think JEB exemplifies this more than any journal I know. For me, it's a go-to place whenever I require an energy boost. I can read random papers about anything. Animal biodiversity is so vast and JEB is where you get to read about it. Over the years, we've seen a decline in the funding for comparative research. There was a very healthy



tradition even until the mid-1990s of people who worked with diverse animals, which has reduced with the rise of the 'model systems' approach. For me, this is disappointing because most journals now focus on model systems, but JEB continues to focus on animal biodiversity, so it is a happy place for me.

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What are the big current outstanding questions in your field?

That depends on the discipline that I am talking about because I work across several. In biomechanics, the big challenge is to take experiments into the field. For the longest time, we've conducted experiments in our labs, but it's now time for this area of research to step out into the wild and start to experiment on animals in their natural habitats using accelerometers, telemetry, GPS systems and other instruments. It would also be interesting to look at how the tissues of diverse animals are constructed; what is their architecture, how do they adapt to the specific challenges that nature poses for them and what does selection do to their morphology?

As a neuroethologist, there are a lot of really interesting papers on what's happening in the brain during navigation, what part of the brain is involved in determining the direction in which an animal is moving. It would be interesting to understand how sensors encode environmental information. The brain and sensory systems do not encode everything they see or sense. In fact, they throw away a large part of it and only encode a very small part. If I show you a picture that is high definition, then compress the picture from, say, 10 MB to

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100 kB, you won't see much of a difference between the two because you don't need to encode all that resolution. Now, imagine that I just flash the picture in front of you. This is what animals really deal with – they need to sense the key features of an object very quickly. It would be interesting to know which sensory features are important for animals in the wild, how they are encoded and how animals put all this information from different sensory modalities together and process it.

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Finally, if my field is insect architecture, the issue is how insects collectively build nests without having a blueprint, how effort is guided and controlled at the level of a single organism to generate a large meaningful solid structure that can protect the colony, which is also air-conditioned, thermally regulated and kept free of CO₂ build-up and infection. How insects and animals in general, humans included, put together large structures collectively is a very interesting topic.

What impact do you think current research will have in 50 years' time?

Comparative research is going in many different directions at the moment. I think in the next 50 years the emphasis will be on how animals deal with the effects of climate change and habitat alteration in general. I'm really worried about the decline of insect populations across the world. To make sense of it, I think we will need to look closely at the comparative physiology literature because we need to know how animals deal with these conditions. That information exists in JEB and similar journals, so we will need to look closely at those papers to understand and predict how animals will be affected by climate change. If we care about conserving animals, then understanding their physiology is important and JEB is central to that.

What do you think the field of comparative physiology will be like in 100 years?

The resolution of our current understanding of biology – how genes determine structures, pathologies, physiology – is getting better, as is our ability to make very specific manipulations, so I see comparative physiology using these approaches to manipulate genes. Over the past 50 years, Cellular and Molecular Biology departments have separated from Organismal Biology, but, going forward, I hope to see a reunification. Being able to have finer control over neural circuits – to fluorescently mark a circuit or optogenetically activate it – is going to be important, because those kinds of manipulations tell us what's happening 'under the hood'.

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If you could time travel, what piece of future equipment would you bring back with you?

I would like better tools to explore life on ocean floors, especially marine invertebrates. The ecology of animals on ocean floors is

completely under-studied, because these places have been so inaccessible; equipment that allows us to study animals in those habitats would be essential. For that matter, life in the forest canopies is also completely different than on the ground, and life in the intertidal zone, although that is somewhat better studied. There's still so much left to do, even in places that are more accessible than the ocean floor. Occasionally, you hear about new deep-sea species being discovered and wonder how animals see in those environments, withstand the really high pressures, or interact with their own kind, find mates and so on. It's all a big mystery that I would really like to learn more about.

If you had one piece of advice for your younger self, what would it be?

I would tell myself to take field studies more seriously. For the longest time, I assumed that the best place to do experiments was in the lab, because you could control all the conditions there, but then I had my first experience of working in the field in 2006. At the time, I was studying nocturnal hawkmoths and how they derive vestibular feedback – sense of balance – by doing experiments in the lab. I had a conversation with Robert Dudley, a Professor at University of California, Berkeley, USA, who suggested that it would be interesting to see how insects use vision and their antennal mechanosensors to navigate in daylight. Very quickly, I realized that this was an essential piece of the puzzle and my experiments would be more rigorous if I took into consideration what animals do out in the wild. Robert told me about a really wonderful moth, *Urania fulgens*, that migrates across the Panama Canal and said, 'Maybe that's the one we should study, if it is there'. He went off to Panama and sent me an email in May that the moths were out and about and we could study them if I could go. But at the time I was commuting between Seattle and Berkeley and I was a poor postdoc, so I told Robert I could come but we would have to find funding. He said, 'Apply for a JEB Travelling Fellowship'. I sent an application and in early June 2006 I was awarded a fellowship. That trip, funded by JEB, changed my life. It altered the way I thought about animals from a research perspective, because that was the first time I'd seen them in their natural habitats. When I went back to India, I made every effort to make field biology accessible to researchers. I helped set up a field station in Central India for students and researchers, but it all started with the JEB Travelling Fellowship.

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What does JEB mean to you as an author and researcher?

For me, JEB is a sanctuary. I read it to refresh my mind, to learn about crazy things. I urge my students to read it and, as an author, it's my bread-and-butter journal, where I most like to publish. I guess that 80% of the time the papers we discuss are from JEB, so for us it's an immensely important journal.

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