ECR Spotlight – Callum McLean

ECR Spotlight is a series of interviews with early-career authors from a selection of papers published in Journal of Experimental Biology and aims to promote not only the diversity of early-career researchers (ECRs) working in experimental biology but also the huge variety of animals and physiological systems that are essential for the ‘comparative’ approach. Callum McLean is an author on ‘The kinematics of amblpygid (Arachnida) pedipalps during predation: extreme elongation in raptorial appendages does not result in a proportionate increase in reach and closing speed’, published in JEB. Callum conducted the research described in this article while a PhD student in Charlotte A. Brassey’s lab at the Ecology and Environment Research Centre, Manchester Metropolitan University, UK. He is now a Postdoctoral Research Assistant in the lab of David N. Fisher at the University of Aberdeen, UK, investigating how and why animals, particularly arthropods, move and behave.

How did you become interested in biology?
I was really interested in palaeontology as a kid. I went to Anglesey often when I was young and spent a lot of my time picking fossils up on the beach. I eventually grew a bit tired of the corals and shells you would typically find in Anglesey, so my parents took me to museums and various fossil shops. One dealer in particular was very good with me and would regularly show me all of the amazing pieces he had recently found from all around the world, which I found fascinating. I still have a collection of fossils, many of which came from his shop. Many years later I studied palaeontology, through a geology degree, during which I realised that I was far more interested in the anatomy and evolution of the ancient animals, as opposed to the geological processes involved. Which eventually led me to study biology for my PhD.

Describe your scientific journey and your current research focus
My research journey started during my master’s at the University of Manchester, UK, where I tried to simulate walking gaits in an extinct arachnid using 3D modelling and computer simulation techniques. Due to technical issues, the whole thing went horribly! I did become very interested in how animals move and how their anatomy informs that though, and I developed a soft spot for invertebrates. My PhD, at Manchester Metropolitan University, looked further into these form versus function questions in amblypygids. Amblypygids have such weird and unique anatomy and very little quantitative work had been conducted on either their anatomy or how they move. I focused on how they captured prey, looking at their prey capture anatomy using statistical shape analysis methods (geometric morphometrics and elliptical Fourier analysis) and by filming and analysing prey capture events in a number of different species; this has just been published in JEB. Next I moved to the University of Aberdeen for a postdoc, where I continued to study invertebrates. This time, I worked on a project that studied changes of social behaviour associated with differing climatic conditions. This has been a bit different to my previous work, but I still got to work on animal behaviour and I have also been using a lot of interesting AI techniques, which I have been waiting to try for a while.

How would you explain the main findings of your paper to a member of the public?
Amblypygids are closely related to spiders, but capture prey in a completely different way. Instead of having venom and silk, they have spined limbs called ‘pedipalps’ which, similar to the forelimbs of praying mantis, snap shut in order to capture prey. These pedipalps vary markedly in size and shape across different species, with some being over three times longer than the animal’s body. Do these long pedipalps have a purpose? Perhaps they aid prey capture? Our study finds that, across multiple amblypygid species, longer pedipalps confer little to no benefit in prey capture. We find that long pedipalps do not close at a faster speed than shorter ones, and though longer pedipalps allow for greater reach, there is a law of diminishing returns, i.e. if pedipalp length doubles, reach will increase by a factor significantly less than 2. These factors combined likely mean it is harder for amblypygids with longer pedipalps to capture prey. Through this
and other studies, we posit that long pedipalps are primarily adapted to perform in display-based territorial contests and courtship, with increased pedipalp length allowing greater success in these two endeavours – a departure from their much more obvious use in prey capture.

**What do you enjoy most about research, and why?**
I feel like biology sets us interesting problems. Not only is the study of animal movement, behaviour and evolution interesting in itself but I feel like my area of study lends itself to being a bit of a jack of all trades. In the morning you can be caring for your study animals, and in the afternoon you are working with computer scientists to adapt the same kind of algorithms used for self-driving cars. Very few days end up being the same; you get to be a part-time coder, 3D computer modeller, camera person, writer, educator – the list goes on. It’s quite difficult to get bored!

**What is the most important piece of equipment for your research, what does it do and what question did it help you address?**
As odd as it might sound, the humble GoPro, or other action camera. They were very useful for the prey capture study because they can film at a decent quality in slow motion, and with a big enough SD card and sufficient charge they can film continuously for 12 h or more. Great for amblypygids, which often do nothing for hours! Of course, they are portable too, which was useful when I went to collect data in Vienna. It was far easier to travel with the camera setup than shipping the animals over to England. I have continued to use them in my research at the University of Aberdeen too. We currently have 16 action cameras taking time-lapse photographs of groups of cockroaches to build social networks. This study is also looking at the effect of different climatic conditions. The action cameras can easily survive high and low temperatures and humidities, and if I drop them they don’t shatter into a million pieces. Ideal!

**What is your favourite animal, and why?**
I have to show some loyalty to my study animal and say amblypygids. Obviously, they helped me get my PhD, but they also seem almost like a deliberate attempt to make an animal that is as unusual as possible. There is actually a CGI amblypygid in the ‘unforgivable curses’ scene of the *Goblet of Fire* movie. When I say that I work on the ‘thing from Harry Potter’, a lot of people have told me that they thought it was a fictional or magical creature. Some are quite shocked to learn that they are real. I can’t say I blame them, because they look totally alien! Having watched them a lot during my research, the way they move and behave is also completely weird and at times almost comical.

**What is one thing about you that others might find surprising?**
I didn’t love Biology in school and I dropped it when I was 16. I only properly studied it again when I started my PhD. I did a geology BSc and got back into biology through my master’s, which combined palaeontology and biomechanics. I had been interested in palaeontology since I was a kid, but in studying it I found out that I wasn’t really too interested in the geological processes involved. I was far more interested in the anatomy and evolution side. I wanted to study these aspects but coming from geology, I wasn’t exactly sure how to make that happen. I asked around about palaeontology master’s at my university and had a bit of a chance encounter with Bill Sellers, who primarily studied dinosaur biomechanics. At the time, I was quite a serious track sprinter [I actually won a British Universities and Colleges Sport (BUCS) medal in the relay during my master’s], which gave me an interest in biomechanics. I had never thought of combining interests in palaeontology and biomechanics until I spoke to Bill, who would become one of my master’s supervisors. My other master’s supervisor, Russell Garwood, convinced me of the worth of invertebrates. I have been happily stuck with them ever since! Biology is such a large field, and there are so many different ways to study it. Unfortunately, schools don’t get enough time to teach students about biology’s many sub-disciplines. I certainly don’t remember being taught much about what I do now. The positive thing is that you can quite easily transfer to biology from another science if you find the right niche.

**What’s next for you?**
I have plans to publish the research I have been conducting at the University of Aberdeen. In particular, we have nearly completed the analysis on a study that looks at how the shape of the social networks of cockroaches changes when they are exposed to increasingly arid conditions. I spent a long time collecting data for the study and amassed nearly 200,000 images of cockroaches in order to construct the social networks, so I am quite excited to see what we learn from it.

**Reference**