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ECR SPOTLIGHT

ECR Spotlight – Jeffrey Hainer

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 during our centenary year but also the huge variety of animals and physiological systems that are essential for the 'comparative' approach. Jeffrey Hainer is an author on 'Sensorimotor control of swimming *Polypterus senegalus* is preserved during sensory deprivation conditions across altered environments', published in JEB. Jeffrey is a PhD student in the lab of Emily Standen at University of Ottawa, Canada, investigating how sensory information is used to control locomotion in fish.

Jeffrey Hainer

Describe your scientific journey and your current research focus

As a child, I wanted to be a marine biologist. As I grew up, however, I had a change of heart and began planning to become something else. It was not until recently that I realized I accidentally became a marine biologist after all. My undergraduate journey began with a roadmap towards a graduate degree in chemistry or medicine. But when one of my biology professors put a call out for volunteers to help feed fish in her lab, I jumped at the opportunity to both gain lab experience and integrate my affinity for animals into my education. I soon became fascinated with the research being conducted in Dr Emily Standen's lab. What started out as volunteering led to an Honours project concerning locomotor control in novel aquatic environments. This research paved the way for my graduate research, which broadly focuses on locomotor control of different fishes and how higher order commands, sensory information and the mechanics of muscle tissue all contribute to fish movement.

How would you explain the main finding of your paper to a member of the public?

By changing the environment that a fish swims in, you can learn about how they control their movement. When you put the fish *Polypterus senegalus* in a viscous syrup-like fluid instead of normal water, they change their swimming form. We wanted to know what senses they were using to respond to this environmental change. To do this, we turned off the different systems (the lateral line and vision) that *P. senegalus* could be using to sense changes in their environment. Our findings show that *Polypterus* still change their swimming form in viscous water after removing lateral line and visual information. This suggests they do not need lateral line or visual sensory information to respond to increased viscosity, and that one or more other senses (possibly stretch receptors in the spinal cord) are being used by these fish to respond to these environmental changes.

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What are the potential implications of this finding for your field of research, and is there anything that you learned during this study that you wish you had known sooner?

Our research provides clear experimental testing of the effect of lateral line and visual sensory feedback on a motor output, as well as providing an exciting avenue for investigating proprioceptive control in *Polypterus senegalus*, a member of the basal-most group of ray-finned fish. As a member of this group, *P. senegalus* represent a valuable evolutionary model for studying locomotor control.

Which part of this research project was the most rewarding/challenging?

The most challenging part of this research by far was the actual recording of *Polypterus* kinematics. Fish tend to do the exact opposite of what you want them to do in any given moment. Whenever you need them to swim in the middle of the tank, they will swim along the edges or not at all. It is almost a guarantee that as soon as the cameras stop rolling, the fish will swim beautifully all the way across the tank. While this research has led to many victories both great and small, the most rewarding part of the process for me has been finally sharing my completed research with others.

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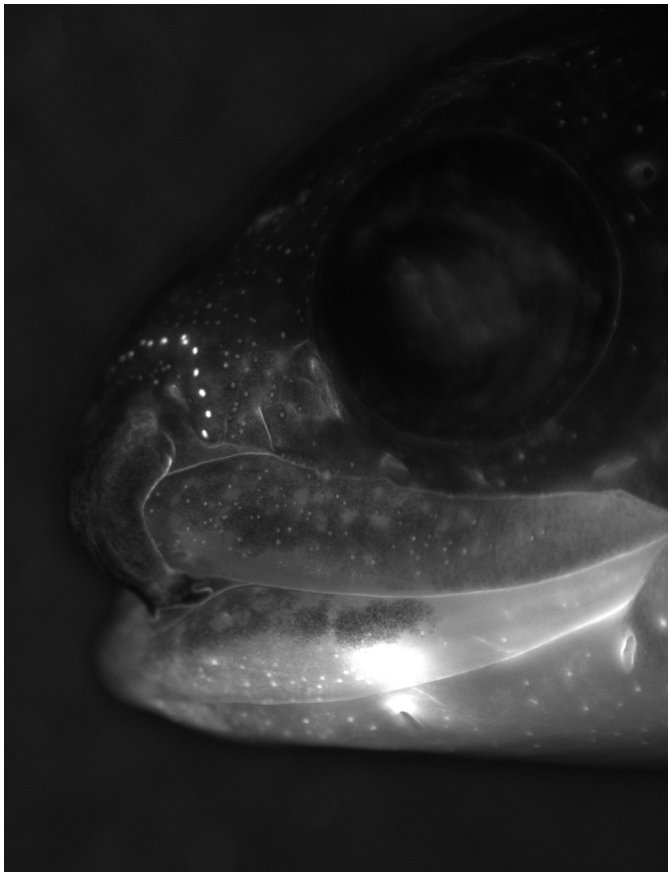

***Polypterus senegalus* head with illuminated pit neuromasts.**

Why did you choose JEB to publish your paper?

It is vital for research to reach a broad audience and JEB provides an excellent platform to do so. The rigorous peer review process and high standards of JEB help ensure that my research is as rigorously performed and effectively presented as possible. Moreover, the publication model used by JEB aligns with my personal view on publication and access rights standards for scientific articles and I am thrilled to be published in a journal that believes in making science accessible to as many readers as possible.

Are there any important historical papers from your field that have been published in JEB?

There are so many excellent papers to choose from! One that paved the way for my research specifically is 'Selective and reversible blocking of the lateral line in freshwater fish' by Karlsen and Sand (1987; doi:10.1242/jeb.133.1.249). This paper provides instructions for the selective and reversible blocking of fish lateral line neuromasts. Selectively removing different sensory systems is a valuable tool for exploring control of locomotion. Karlsen and Sand's work in this paper has been used extensively to study the role of lateral line feedback in different behaviours, including in my research.

What do you think experimental biology will look like 50 years from now?

It is incredibly difficult to predict how experimental biology will look in the future as technology, global ecosystems and research priorities change so quickly. In my short career as a researcher, the introduction of tools such as machine learning has drastically reduced the hours upon hours of hand-digitizing data that was previously required. I would predict that tools such as these will become more prevalent, allowing for the automation of many scientific analysis processes. In terms of my specific field of animal kinematics, I would predict that there will be a shift from using live animals to a heavier reliance on computer simulations.

If you had unlimited funding, what question in your research field would you most like to address?

If I had unlimited funding, I would attempt to locate stretch-sensitive cells within *Polypterus senegalus*. Stretch-sensitive cells and organs have been found in other fishes but are yet to be discovered in *Polypterus*. Furthermore, investigating how feedback from these cells is used locally compared with in higher brain centres would fill in important knowledge gaps currently present in studies on *Polypterus* sensorimotor control.

What's next for you?

There is so much to do! I am currently in the middle of data analysis of one of my other projects, this one involving central pattern generators in the American eel. The nature of kinematic analysis means that extensive data processing is required. As such, this will be keeping me busy for quite some time. I have another project on the horizon involving *in vitro* muscle physiology of pectoral fins. This is a subject that I am not as familiar with, but I am excited to expand my knowledge in areas outside of sensory control and kinematics to give a more complete understanding of fish locomotion.

Reference

Hainer, J., Lutek, K., Maki, H. and Standen, E. M. (2023). Sensorimotor control of swimming *Polypterus senegalus* is preserved during sensory deprivation conditions across altered environments. *J. Exp. Biol.* **226**, jeb245192. doi:10.1242/jeb.245192