ECR Spotlight – Yangfan Zhang

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. Yangfan Zhang is an author on ‘Energetics of collective movement in vertebrates’, published in JEB. Yangfan is a Natural Sciences and Engineering Research Council of Canada (NSERC) post-doctoral research fellow in the lab of George V. Lauder at Harvard University, USA, investigating environmental effects on respiratory phenotype and the bioenergetics of specific locomotion gaits, to ultimately expand the potential of tracking field metabolic rate in fish in the light of ecology and evolution.

Describe your scientific journey and your current research focus
My scientific journey started with my BSc (honours) degree at Dalhousie University (Canada), where the experience sparked my interest in physiology. I then studied comparative physiology with a specialization in cardiorespiratory physiology under the tutelage of Tony Farrell at the Department of Zoology, University of British Columbia (UBC), Canada. Trish Schulte was on my MSc thesis committee and I have been working with her ever since on integrative physiology.

My research at UBC was comparative physiology and focused on how the respiratory system links to whole-animal metabolic rates under different environmental conditions and across broader biological disciplines: ecology, aquaculture, virology and toxicology. I have been fascinated by the ‘fire of life’ and its interactions with the environment.


My current work at the Lauder Laboratory aims to understand the energetics costs of underwater propulsions using fish and underwater robotics as model systems. George and I have great interactions and have been thinking a lot about the interface of bioenergetics and biomechanics of collective movement. We shared our insights with the JEB readership in this Commentary.

Besides my appointment at Harvard, I also collaborate with Kristin O’Brien at the University of Alaska, USA, to understand the limits of the physiology of Antarctic icefish in a changing climate. This avenue of research is deeply rooted in my comparative physiology training back in the UBC days.

Although I might still be too young to say this, when I reflect on my scientific journey, I can see the dots are connecting. The thread is the research question.

How would you explain the main message of your Commentary to a member of the public, and how would you explain the broader impact of research in this area?
Collective movement is a ubiquitous behaviour among vertebrates and yet we understand little about the energetic cost of moving as a group compared with that of solitary locomotion. Although the collective movement has some proposed behavioural and ecological benefits (e.g. safety in numbers and reproductive advantage of aggregation), our Commentary aimed to inspire the field to think about some more tangible mechanisms. Hence, the Commentary focuses on the first principles of physics and physiology. These principles enable researchers to think about collective movement using a framework of physiological performance curves and to study several testable predictions.

Is there anything that you learned while writing this Commentary that surprised you?
We know very little about ‘common phenomenon’. Often, when we see a common phenomenon, the first place our minds perhaps go to is ‘someone must have figured this out’. However, often when examining the literature carefully, one might find there is virtually no direct measurement to actually explain a seemingly common phenomenon. Sometimes, to make a discovery, we need to observe a subject carefully. Sometimes, the outcome can be quite rewarding.
What I learned from the ‘surprise’ when writing the Commentary is that understanding the inner workings of seemingly common phenomena can greatly advance the frontiers of human knowledge.

What do you see as the main value of Review/Commentary-type articles?
The most valuable aspect of the Review/Commentary-type article is to synthesize literature across disciplines and provide some novel insights. This is often achieved by identifying gaps in the knowledge. The hope is to inspire like-minded individuals to get on an exciting scientific journey and chart a path forward in the scientific field. There are so many questions out there that we can answer. Therefore, a collective research effort in our community is often the way to explore the research topics we are passionate about.

Are there any important historical papers from your field that have been published in JEB?
There are a lot of important historical JEB papers published in my field. JEB is one of the most important forums for comparative physiologists to share ideas and establish collaborations. I want to name three JEB research papers that directly inspired my current research of animal locomotion at the interface of cardiorespiratory physiology, biomechanics and whole-animal metabolic rate: Richard Bainbridge’s 1958 paper, ‘The speed of swimming of fish as related to size and to the frequency and amplitude of the tail beat’ (doi:10.1242/jeb.35.1.109); E. Don Stevens and D. J. Randall’s 1967 paper, ‘Changes in blood pressure, heart rate and breathing rate during moderate swimming activity in rainbow trout’ (doi:10.1242/jeb.46.2.307); and C. R. Taylor, N. C. Heglund and G. M. O. Maloiy’s 1982 paper, ‘Energetics and mechanics of terrestrial locomotion. I. Metabolic energy consumption as a function of speed and body size in birds and mammals (doi:10.1242/jeb.97.1.1). As I am writing this, I notice that I studied and am working in the same departments as the authors in 2 out of the 3 papers. This really showcases that scientific endeavour is standing on the shoulders of giants. Without the foundations laid down by the historical papers, I would not have been able to conduct my current research.

What do you think experimental biology will look like 50 years from now?
Experimental biology in 50 years will likely be more integrative and interdisciplinary, but still will be based on the first principles. Like many aspects of our society, artificial intelligence will likely be more entrenched in the analytic pipelines. However, I believe the human brain will still be the central pillar of the research. The miniaturization of electronics and the advances in battery technology will help bridge the gap in understanding how biology works in the lab to how biology works in the complex nature. JEB will, as in the past 100 years, be a community for experimental biologists across the world to communicate their research ideas.

Reference