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ECR Spotlight – J. Lisa Hoogenboom

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. Lisa Hoogenboom is an author on 'Using ^{15}N to determine the metabolic fate of dietary nitrogen in North Pacific spiny dogfish (*Squalus acanthias suckleyi*)', published in JEB. Lisa conducted the research described in this article while a PhD Candidate in W. Gary Anderson's lab at University of Manitoba, Canada. She is now a Biological Laboratory Technician at the University of Manitoba, Canada, investigating the gut physiology of marine elasmobranchs – specifically how nitrogen is transported across the intestinal tissues.

J. Lisa Hoogenboom

Describe your scientific journey and your current research focus

My research journey began with cetacean ecology in Dr Hal Whitehead's lab at Dalhousie University, Halifax, Canada. My focus was photographic identification of various whale species, including sperm whales, long-finned pilot whales and Northern bottlenose whales. This research focused on population dynamics of individuals residing both in the North Atlantic ocean and around the Galápagos islands.

My love and fascination of sharks turned my research focus from whales to basking sharks. I began looking at predictors of basking shark occurrence in the Bay of Fundy, Canada, and used photographic identification to determine the site fidelity of individuals. My work demonstrated the longevity and persistence of marks and scars on the basking shark dorsal fin, as well as highlighted the role that photo-ID could play as a non-invasive tool for the regional-scale monitoring of a vulnerable species.

In an effort to better understand sharks, I switched my research focus from an ecological one to a physiological one. My current research focuses on the gut physiology of marine elasmobranchs. These animals are reliant on nitrogen for both somatic and osmoregulatory processes. As such, the acquisition of nitrogen, primarily through the ingestion and digestion of food, is of utmost importance. However, there is a lot we do not yet know about the movement of nitrogen from the gut to the blood, or how and where it is moved to and used. My research seeks to highlight the role of the gut in marine elasmobranch osmoregulation.

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

In order to survive in a salt water environment, marine elasmobranchs need to actively balance their internal water and salt concentrations to avoid dehydration. One way they do this is through the synthesis and retention of large concentrations of urea, which requires nitrogen. In marine elasmobranchs, the main source of acquired nitrogen is from the ingestion and digestion of food. In our study, we show that ingested nitrogen is very important for the synthesis of urea, as nitrogen from the gut is moved through the urea-synthesizing process (the ornithine urea cycle), within 20 h of ingesting a meal. We also show that this newly synthesized urea is retained within the body of the animal for at least one week after feeding. Additionally, the ingested nitrogen is used to synthesize amino acids and proteins, which are necessary for various somatic processes, including the growth of the animal.

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

The most rewarding and challenging aspect was figuring out how to separate the nitrogenous components from the tissue samples. I had one previous publication from 20 years ago – Rodicio and colleagues' 2003 article 'Metabolic fate of exogenous $^{15}NH_4Cl$ in the gulf toadfish (*Opsanus beta*)' (doi:10.1016/s1532-0456(03)00196-0) – to use as a starting point for the methods, but our lab did not have any of the same equipment that they used. It was

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Lisa performing the dissection of a spiny dogfish (*Squalus acanthias suckleyi*) at Bamfield Marine Science Centre, BC, Canada.

a lot of trial and error, and it was such a relief to get the data back from the first set of analysed samples and realize that the new methods worked and we had some great data to tell a story with.

Why did you choose JEB to publish your paper? Are there any important historical papers from your field that have been published in JEB?

This study builds upon previous research from our colleagues that has focused on the unique osmoregulatory strategy of marine elasmobranchs and their retention of high concentrations of urea. A lot of their research is published in JEB, making this an excellent journal to add our research to the foundation they laid. For example: Liew and colleagues' 2013 paper 'An *in vitro* study of urea, water, ion and CO/HCO^- transport in the gastrointestinal tract of the dogfish shark (*Squalus acanthias*): the influence of feeding' (doi:10.1242/jeb.082313); Wood and colleagues' 2005 paper 'Alkaline tide and nitrogen conservation after feeding in an elasmobranch (*Squalus acanthias*)' (doi:10.1242/jeb.01678); Wood and colleagues' 2007 paper 'Osmoregulation, ionoregulation and acid–base regulation by the gastrointestinal tract after feeding in the elasmobranch (*Squalus acanthias*)' (doi:10.1242/jeb.02736); and Wood and colleagues' 2019 paper 'Nitrogen handling in the elasmobranch gut: a role for microbial urease' (doi:10.1242/jeb.194787).

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

Hopefully, technology and innovation will improve our ability to conduct research in extreme environments, such as the very depths of the ocean, and allow us to explore more of the ocean and better understand the organisms that reside within it. Or perhaps nanotechnology will have progressed to the state where we can conduct digestion studies in real time on living animals in their natural habitats, without the need for terminal endpoints. Then, we could conduct studies on animals that are too large to bring into a laboratory setting, or those that are threatened or vulnerable.

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

Given unlimited funding, I would sequence the gut microbiome from as many shark species as possible, across all age classes, in all the oceans, and across the various latitudes and ecosystems. I want to understand the role that the gut microbes play in the overall nitrogen balance of marine elasmobranchs. I would also compare the gut microbiome of the marine elasmobranchs with that of the obligate freshwater and euryhaline species.

What changes do you think could improve the lives of early-career researchers, and what would make you want to continue in a research career?

Improve funding. It is no longer attainable to expect students to live below the poverty line in pursuit of research and education. The financial burden that graduate students are put under is staggering, but it's a topic that people do not want to talk about. The financial hardships and pressures that students face need to be brought to the forefront of discussion within institutions, rather than brushed aside and ignored while tuition rates and the cost of living continually increase.

Reference

Hoogenboom, J. L. and Anderson, W. G. (2023). Using ^{15}N to determine the metabolic fate of dietary nitrogen in North Pacific spiny dogfish (*Squalus acanthias suckleyi*). *J. Exp. Biol.* **226**, jeb244921. doi:10.1242/jeb.244921