MASTS PECRE final report

Dr Tommy Norin
University of Glasgow

Period of exchange: 1 May 2018 to 31 August 2018
Exchange host: Dr Ben Speers-Roesch
Exchange organisation: University of New Brunswick (UNB), Saint John, NB, Canada

Background

Individual animals of the same species and body size differ consistently in their physiology and behaviour. This among-individual variation has important functional, ecological, and evolutionary consequences because it is associated with variation in growth, dispersal, life history, and survival. My previous work (Norin *et al*. 2016) has shown for the first time that individual fish not only differ consistently in their overall metabolic rate (a key physiological trait) but also in their capacity to adjust metabolic rate when exposed to fluctuating temperatures. Consequently, the capacity of fish to respond to changing environments differs among individuals because some are more capable of dealing with new conditions than others; the fish are said to differ in their phenotypic plasticity. However, it is unknown if plasticity of metabolic rate co-varies with plasticity of behaviour in response to changing conditions, or if plasticity in one trait is traded off against plasticity in the other. The latter could be detrimental if it results in reduced performance and survival in a new environment.

At UNB, Dr Ben Speers-Roesch works on a unique marine fish species (cunner, *Tautogolabrus adspersus*) that enter dormancy when environmental temperatures drop below a threshold (~8°C) as when winter is coming. This abrupt change in both physiology and behaviour as the animal goes from an active to a dormant state with reduced metabolic rate provides an excellent opportunity to study among-individual co-variation in physiology and behaviour across critical environmental thresholds in the marine environment.

Acheivements during exchange

During my research exchange to Dr Speers-Roesch's lab at UNB, I performed a series of laboratory experiments to investigate if individual cunner, which were hypothesised to differ in the thermal sensitivity of their metabolic rates (cf. Norin *et al*. 2016), enter dormancy at different temperatures (corresponding to different times of the year), or if some individuals stay active in the cold. To do this, I measured the metabolic rate and behaviour (activity and time spent sheltering) of 75 individual cunner across a broad range of temperatures (2, 5, 8, 11, and 14°C). This allows me to create so-called reaction norms for metabolic rate and behaviour, from which I can test whether metabolic and behavioural plasticity co-vary or trade off against each other. These are very interesting experiments as they can elucidate how individual fish exploit different physiological or behavioural strategies to conserve energy during extended periods of low food availability. The research has clear applied aspects relevant to MASTS since hatchery-reared cunner and their relatives (i.e. other species of temperate wrasses) are used as "cleaner fish" in programs aimed at combatting sea lice in farmed Atlantic salmon reared in sea cages (cunner eat the sea lice), in both North America and Scotland. If specific phenotypes (i.e. individuals with certain combinations of traits) within cleaner fish populations are better adapted to the environmental conditions at the sea cage sites, the selective potential for such individuals could create a more efficient way of naturally combatting a major problem in fish farming (i.e. sea lice infestation).

Interactions with faculty at UNB

During my exchange at UNB, I interacted primarily with Dr Speers-Roesch, who provided experimental fish, assisted with logistics surrounding experimental setups, and with whom I discussed experimental protocols and procedures. I also worked with and mentored the two MSc students in Speers-Roesch's lab who were working on projects related to mine. In addition to Dr Speers-Roesch and his research group, I discussed my work with Prof James Kiefer, who is a fish ecological physiologist working primarily with sturgeon. I also interacted with the majority of the remaining faculty through faculty meetings and departmental seminars.

Expected outputs

The experiments all went according to plan and, at the time of writing this, I am in the process of analysing the data. The results from my experiments will be published as a research article in a peer-reviewed journal such as *Functional Ecology*, *Journal of Experimental Biology*, *Journal of Fish Biology*, or *Aquaculture*.

Future plans for building on the PECRE

My collaboration with Dr Speers-Roesch will continue into the future, and we are already working on other projects and papers together, including work on wrasses (e.g. Roche *et al*., in review). Moreover, we are currently planning a writing retreat together before attending the Society for Experimental Biology's Annual Main Meeting (Seville, Spain, July 2019), where I expect to present the work from my PECRE.

References

Norin T, Malte H & Clark TD (2016) Differential plasticity of metabolic rate phenotypes in a tropical fish facing environmental change. *Funct. Ecol.* 30, 369-378.

Roche DG, Amcoff M, Morgan R, Sundin J, Andreassen AH, Finnøen M, Lawrence MJ, Henderson E, Norin T, Speers-Roesch B, Brown C, Clark TD, Bshary R, Jutfelt F & Binning SA (in review) Replication alert: behavioural lateralization in a detour test is non-repeatable in fishes. *Proc. R. Soc. B* [research article initially submitted on 27 August 2018].