The Centre for Fish and Wildlife Health at the University of Bern invites applications of prospective master students starting ~ June 2021 (flexible)

MASTER THESIS

Parental effects on gene regulation in zebrafish

Background:

Organisms are more than the sum of their genes. For example, early-life experiences impact physiology and behaviours from worms to man. Importantly, these effects can span generations. Through so-called parental effects, the experiences of parents can impact physiology and behaviour of offspring. This master’s project will investigate the molecular mechanistic basis of parental effects in zebrafish.

Ecologists have identified two distinct modes of parental effects (Bonduriansky & Crean, 2018). Condition transfer effects occur when the fitness of the offspring directly reflects the condition of the parents. Condition transfer effects can be a consequence of stress, leading to deleterious offspring phenotypes because the parent’s immediate response to the stress is at the expense of resources invested in the next generation. Meanwhile, anticipatory effects occur when a shift in the environment prompts the parents to change the resources they invest in offspring so as to ‘prime’ them towards higher fitness in the new environment. For example, zebrafish exhibit both types of parental effect in response to hypoxia: short-term exposure (1 week) of the parents leads to reduced hypoxia tolerance in the offspring (a seemingly maladaptive, condition transfer effect), while slightly longer exposure (2 weeks) leads to increased offspring tolerance (a seemingly anticipatory effect; Ho & Burggren, 2012). The mechanisms involved in transmitting these different effects are currently unknown, but one hypothesis is that parental RNA is involved and directs embryonic gene expression in a maladaptive or adaptive fashion. Indeed, we have previously shown that both maternal and paternal RNA components do react to the parent’s environment (Adrian-Kalchhauser et al. 2018; Ord et al. 2020).

Project Outline and Techniques:

In this project, we will investigate the expression dynamics of putative hypoxia tolerance genes in zebrafish embryos. By carrying out a literature survey combined with GO term analysis, candidate genes putatively underlying hypoxia tolerance will be identified. Then, the temporal dynamics of their expression will be characterized from existing zebrafish embryo transcriptome data. Specifically, how early are these genes first expressed in the embryo? Are they found in abundance in single-cell embryos?

We will then use an experimental setup to induce parental effects by exposing live adult zebrafish to a mild hypoxia treatment. Measures of hypoxia tolerance (embryo survival and larval swimming behaviour) and expression levels of candidate genes (RT-qPCR) will be taken to capture maladaptive


condition transfer effects and/or adaptive anticipatory effects. Finally, using RT-qPCR, the expression levels of candidate genes will be measured in early embryos from the same broods, preserved at specific timepoints as determined by transcriptome analysis.

Ultimately, the project will determine whether similar genetic pathways can underpin different ecological classes of parental effects. This will shed light on the genetic basis of parental effects which could pave the way to further understanding the evolution and ecological importance of these mechanisms.

Team:
You will join a group of enthusiastic researchers working on diverse aspects of fish health, ecology and evolution. Please email an application package (CV, motivation letter, and certificates) in PDF format to Professor Irene Adrian Kalchhauser (irene.adrian-kalchhauser@vetsuisse.unibe.ch) and Dr James Ord (james.ord@vetsuisse.unibe.ch) with the subject title "Parental effects on gene regulation" by 31.03.2021. For additional information about the project, please contact James Ord via email.

Earning options:
From time to time, student jobs are available at the FIWI. Kindly enquire with Professor Adrian-Kalchhauser for more information.

City of Bern:
The University of Bern is closely associated with the Swiss capital city of Bern. Located on the bend of the River Aare, the city is the country's political center and a popular tourist destination. Academic excellence has earned Bern an international reputation. A large variety of education, sport and cultural opportunities as well as high living and environmental standards make Bern an attractive place for students and researchers.

References:

