To eat or not to eat? Zootechnical and transcriptomic exploration of foraging performance in Eurasian perch larvae

The life cycle of numerous fish species includes distinct stages: egg, larva, juvenile and adult. Each stage plays a crucial role in shaping their growth and survival. However, the larval stage stands out as one of the most critical phase in fish life. In fact, fish larvae have to overcome many challenges in order to develop into healthy adult fish. Among others, one of the most important step is the beginning of exogenous feeding. After hatching, fish larvae initially rely on nutrients from yolk reserves to gain energy. As larvae grow, those nutrients will decrease, encouraging them to start searching and eating external food sources present in the environment. Interestingly, not all the fish larvae will start eat efficiently from day one. In fact, some will start later, and this variation in initiation will cause differences in larval sizes: early eaters will probably be larger than the later ones. In addition, an high percentage of larvae will never start ingest external food and they will eventually die due to starvation. This results in high mortality rate occurring during the first days of larvae life (even up to 40%) representing a significant challenge in the aquaculture sector.

Foraging variability can be influenced by environmental factors like temperature, food availability or light, or can be related to genetic factors and physiological traits (e.g., problem in nervous or digestive system). However, in controlled conditions (i.e., fish farms) with stable temperature and light, and with abundant food, many larvae still fail to start eating. This suggest that there may be problems at biological level contributing to innate foraging incapability (IFI) in fish larvae. Indeed, foraging activity involves a complex interaction of biological systems which influence its success. Briefly, the journey begins with the larvae's visual system detecting prey, followed by the brain regulating hunger and satiety through specific hormones, determining when to eat and stop. Once the prey is ingested, digestive enzymes work to process and digest the food. Therefore, non-eating larvae may have a malfunction at any stage of this process. However, the reasons and the specific stage responsible for this phenomenon remains unexplored. Thus, the present project wants to explore the causes of IFI in Eurasian perch (*Perca fluviatilis*) larvae by using advanced molecular analysis (i.e., transcriptomic, qPCR) together with classic zootechnical data (e.g., weight, length) and also supported by histological analysis. For this purpose, larvae will be reared in controlled conditions, where abundant food is provided. This will allow us to differentiate larvae that successfully eat, named “eaters”, with larvae incapable of eating, referred to as ”non-eaters”. Furthermore, this project will allow a morphological comparison (e.g. length and weight) between individuals that start foraging from day one (early eaters) and those that start days later (late eaters). This could reveal that the day of beginning foraging is the main cause of size differences in Eurasian perch larvae.

In conclusion, the expected results of this project could bring us closer to understanding the fundamental biological processes controlling foraging activity in fish larvae and, in particular, the causes of IFI. Besides, in a long-term perspective, the key information could significantly contribute to the improvement of the aquaculture industry, enabling the application of more effective strategies in larval rearing, both for commercial aquaculture purposes and for restocking operations, not only of Eurasian perch, but also of other percids and freshwater fish species.