Popular science summary of the PhD thesis

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Title of the PhD thesis	European eel larval quality and feeding regime: Establishing first-feeding culture
PhD school/Department	DTU Aqua

Science summary

European eel is a high-value species for aquaculture, however production relies on wild-caught glass eels that are farmed to marketable size. During the last 50 years, the natural stock has declined to a critical level rendering capture-based farming unsustainable. Therefore, efforts are made to replace this practice by production of offspring from captive-bred broodstock. Research-based technology has recently enabled a stable production of viable offspring. Thus, current focus is on establishing feeding larval culture. Here, a gap of knowledge about early larval stages and their requirements is a new challenge, especially in relation to their nutrition. Experimental work is therefore needed to develop feeds and feeding regimes that can sustain larval development and growth after the exhaustion of the yolk-sac.

This PhD project aims at filling gaps in knowledge about factors affecting the quality of offspring, digestive physiology and feeding capacity of European eel larvae under hatchery conditions. If eel larvae, as other fish larvae, do not start feeding within a certain window of opportunity, they will enter irreversible starvation where their body is not able to develop and grow and, on the contrary, it starts to decompose leading to death of the organism. To help filling gaps in knowledge, this PhD project is divided in three parts. The first part, corresponding to the Study 1, focuses on the influence of hormonal induction of reproduction on offspring quality. The second part, corresponding to Study 2 and 3, investigates the possibility of "promoting" the maturation of the gut by either adding gut-priming agents such as probiotic, prebiotic and synbiotics or by introduction of feed earlier than the first feeding stage and full digestive capacity. Finally, the last part, Study 4, explores the suitability of different diets and feeding regimes for first-feeding eel larvae.

Study 1 focuses on larval quality in terms of maternally derived biochemical quality and fate of the offspring. Due to hormonal inhibition of sexual maturation, female eel need to be stimulated by external hormone therapies, which includes weekly injection of carp (CPE) or salmon pituitary extract (SPE). A recent study documented that embryonic survival was higher for offspring from SPE treated females than for CPE treated. The present study follow-up these findings by investigating effects of these treatments on the biochemical composition of the eggs and of the larvae during the yolk sac stage, when they rely on the resources present in the yolk. The results showed that the hormonal therapy influenced the composition of the egg and newly hatched larvae, where CPE female produced eggs with higher lipids and free amino acids content. However, SPE female produced more buoyant eggs with higher fertilization rate and larvae with more energy reserves. Nevertheless, larvae reaching first-feeding stage have similar composition and quality no matter which type of hormone has been used on the females. Further investigations are encouraged to link biochemical composition and survival rates of the offspring. The successful maturation of the gut tract is important for eel larvae to digest and absorb food but also to protect from bacteria associated with the rearing water and with the feed. Therefore, to help the development of the gut functionalities, different approaches has been tested.

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As such, the focus of **Study 2** is on gut maturation by using commercially available prebiotic (substrate for bacteria grow), probiotic (bacteria) and their combination to “prime” the digestive system of eel larvae. Results showed that none of the applied gut-priming agents improved the growth and survival of the larvae, possibly due to the very immature immune system of the larvae. Another cause might be effects of increased nutrient load on culture water quality. In this regard, we evidenced that eel larvae need high water quality and low bacteria load to grow and develop. Further research to identify specie-specific bacteria strains to promote the development of a healthy gut microbiota are encouraged.

The aim of **Study 3** was to stimulate the larval feeding behavior and maturation of the gut by introducing different types of feed, while the larvae were still in the yolk sac stage in order to facilitate the transition between endogenous to exogenous feeding. Since no suitable diet is yet available for European eel larvae, different diets and feeding regimes were tested. The results showed that introducing feed earlier than exhaustion of yolk-sac reserves showed that physiological traits related to the growth and digestive capacity were stimulated but also here microbial interference needs attention.

Therefore, the last study, **Study 4** focused on testing the potential of three custom made diets on the digestive capacity, growth and survival of eel larvae. The results showed that only one of the dietary regimes/diets tested promoted larval survival and growth showing regulation of physiological processes related to growth and development. Although growth was not demonstrated within the was short experimental period, the larvae sustained and maintained their body size of larvae after the first feeding window (probably finishing around 20-22 day after hatching). These results will be important for further work on first feeding culture and the nutritional requirement of European larvae, while at the same time drawing attention to the rearing conditions that needs to be further developed to manage the bacterial load in feeding larval culture.

Please email the summary to the PhD secretary at the department