Dr Catherine Labbé
Research Director at INRAE
Fish Physiology and Genomics Department (LPGP)
INRAE
Campus de Beaulieu
F-35000 Rennes
Tel. : + 33 2 23 48 50 02
catherine.labbe@inrae.fr
https://www6.rennes.inra.fr/lpgp_eng/People/Catherine-Labbe

Rennes December 24th 2025

Review of the doctoral dissertation of Rossella DEBERNARDIS entitled:

The transcriptome of newly hatched larvae as a window into the exploration of parental legacy and early life performance in Eurasian perch.

The doctoral dissertation of Rossella DEBERNARDIS recapitulates the work that she developed at the Polish Academy of Science in Olsztyn during her PhD internship, under the supervision of Dr Daniel Żarski. The thesis was carried out under the project SONOTA BIS funded by the National Science Centre, Poland.

The thesis is introduced by a general presentation of the model species, the Eurasian perch (*Perca fluviatilis*). Its interest for aquaculture, the physiological and molecular specificities of the larval stages, the developmental challenges, the mechanisms of non-genetic inheritance, and the input of the parental history, are summarized in an efficient introductive section. This deftly points out where research is needed, and what are the key developmental stages that should be explored further. This logically sets the ground for the objectives and hypothesis section where all 4 chapters of the research work are enumerated. The main body of the thesis is then developed in four research chapters written in an article format. Rossella Debernardis signs all four chapters as first author. Despite numerous co-authors of the whole work, the major contribution of Rosella Debernardis is clearly stated. She notably undertook the conceptualization, experiments/ investigation and formal analyses of the work, and she wrote the original drafts of the chapters.

The first chapter was published in Aquaculture this year. Rosella Debernardis aimed to decipher whether some early transcriptomic signature of the larvae could be associated with (or even predict) their developmental trajectories. To answer this very important question, she created 16 families from different parents in order to induce the required genetic variability. This ambitious work produced a huge dataset that Rosella Debernardis organized into significant descriptive information. She showed that each family was detectable from the others, and that some families had lessened and more variable zootechnical traits than others. At the transcriptomic level, Rosella Debernardis focused her analysis on the 500 most variable genes between families (no intra-families replicate). She then carried out a weighted gene co-expression network analysis in order to identify different gene modules that could be used to test correlations with the zootechnical traits. At this point, some candidate genes were identified in relation to important larvae's functions. **In all, this work produced a huge amount of data that can still be further investigated by the scientific community in order to validate, if so, predictive markers of both the parental contributions and the future performance of the larvae.**

The second research paper, submitted to BMC Biology, aims to study parental effect on the progeny fitness. Contribution to this paper was shared between Rosella Debernardis and another author, Abhipsa Panda. Rosella Debernardis contributed to experiment, laboratory works and data analysis related to maternal effect, while the paternal effect was studied by the other author. The experimental set up cleverly used reciprocal crosses between wild and domesticated parents, in order to assess both genetic and non-genetic influences, and to separate paternal and maternal influence on progeny phenotypic variation. The quality of this work deserves being highlighted. Some experimental choices made to answer better the scientific question are clearly outlined. The replicate number, the chosen zootechnical traits, and the mRNA filtering cascade are all especially relevant. Both zootechnical traits and transcriptomic profiles appear more sensitive to maternal than to paternal input, which was to be expected. Interestingly, a wide set of mRNAs were parental origin-independent, and deemed to be instrumental to larvae's development (80 % of the expressed ones). **The discussion of this set of data regarding parental influence is very interesting, especially regarding how paternal input would be involved in gene expression refining and adjustments later in ontogeny, contrarily to the obvious and widespread role of the maternal input during early development.**

The third research chapter addresses a very important question regarding how the initial egg quality will affect larval gene expression and development. Importantly, Rosella Debernardis selected spawns with good fertilization rates for this study, a fine choice as this will exclude the most obviously impaired spawns. The quality groups were designed later on, from the embryonic development ability. This allowed a more astute analysis of the question. Another wise strategy was to add an experiment where the offspring from various quality origin were mixed, to investigate the interactions between quality groups. The lowest quality group could not be analyzed after hatching, for lack of live larvae, but it is interesting to see that both high quality and medium quality eggs yielded the same larval developmental ability. Another interesting pattern is that medium quality group had a more variable transcriptomic signature than the high- and low-quality groups. The gene ontology analysis between egg quality groups was partially enriched by the identification of the genes behind the terms. Interestingly, the hatched larvae had the same transcriptomic profile whatever their group. **Again, the whole study provided a very interesting set of experimental and molecular data that will be very useful for further research on prediction and validation of candidate markers.**

The last research chapter refined even more the analysis of larval development in that it studied the intra-batch variation on the basis of developmental anomalies (heart edema), with the objective to characterize whether this striking anomaly could be embedded in the larvae's transcriptome, as a signature of an altered developmental potential. Five families were created for this purpose. **Rosella Debernardis showed prominent transcriptomic differences between the two groups that were further validated for some heart development genes.**

The last three sections of the doctoral thesis encompass a general discussion, conclusion, and recommendations for further work. The discussion provides additional insight from the merging of all datasets created along this work. This raises a separation based on the conserved genes and the condition-specific genes. This discussion also summarizes the main results and conclusions of the work, especially regarding the predictive status of some candidate genes identified in this work. The conclusion is a masterpiece of integration and interpretation of the whole doctoral work.

This doctoral dissertation clearly shows the **broad theoretical knowledge** acquired by Rosella Debernardis. This is demonstrated by the quality of the experimental set up and its justification regarding the scientific question at stake in each scientific chapter. Rosella Debernardis had to gather the theoretical knowledge necessary to study larval development in Eurasian perch, and to understand the zootechnical constraints of this species. She also learned how to process transcriptomic data, and how to express transcriptomic results. Above all, she showed a striking ability to combine knowledge in fish reproduction, in offspring rearing from embryo to larval stages, in phenotypic traits assessment, and in transcriptomic profiles interpretation. **Rosella Debernardis is clearly bearing a unique background that encompasses fish physiology, genomics, aquaculture, and development**.

Rosella Debernardis also obviously showed a real **ability to conduct independent scientific work**, as her whole project brings new knowledge that had not been conducted previously by other research groups. Besides, the co-authors list of her publications shows that she knew how to gather the skills of other people around her in order to build a sharp and convincing set of experimental results. The huge set of data that she produced did not make her loose the thread of her scientific questions. Instead, she showed a strong ability to organize the results and to extract the most important information, to discuss it, and to show some perspective to the work. At the same time, she was able to keep a perceptive insight into what remains to be done. Although it is obvious that she benefited from a solid scientific and technical environment to develop her research, her dedication to her thesis work and her intellectual involvement is made obvious from the quality of the results and from the quality of the dissertation she so skillfully wrote.

The input of this doctoral dissertation to a scientific and economical problem was outlined in the first part of my reports regarding each research chapter. To summarize my comments, Rosella Debernardis contributed to produce a huge set of valuable transcriptomic and zootechnical data in Eurasian perch at larval stages that are considered to be the main bottleneck for the aquaculture of this species. Transcriptomic analyses at the mouth opening stage allows that no influence of the feed and ingestion interfered with the profiles. At the scientific level, such thorough and judicious transcriptomic data will allow the community to better understand the molecular actors behind the larval quality. The quality of the zootechnical traits records allowed a better understanding of the progeny trajectories in relation with the parental legacy and early live pattern in Eurasian perch.

As **a final recommendation**, I am issuing a **positive review of the doctoral dissertation of Rosella Debernardis**. I strongly recommend that the Scientific Council of Institute of Animal Reproduction and Food Research of Polish Academy of Sciences in Olsztyn, Poland, **admit the dissertation to public defense** and, after a successful defense, award Rosella Debernardis the degree of Doctor in life science.

Additionally, I would like to recommend this dissertation **to be awarded with a distinction**. This heartfelt request is based on the huge quantity of sound results that were produced by Rosella Debernardis during her doctoral internship, on the high quality of the scientific writing of her dissertation, and on her ability to interpret complex data. Besides, of the four experimental chapters in this dissertation, one is already published, and the quality of the second one makes me expect a prompt acceptation by the editor of BMC Biology. The last two chapters bear the same potential for good quality publications. In all, that would make 4 high quality articles from this work. This is quite

exceptional for this type of topic in fish physiology, as the time and manpower required for the experimental work usually delays the data analysis and the article writing.

Dr Catherine LABBE
Research Director at INRAE, France
24/12/2025