**Ph-D position - Finding a better way to design domestication programs: development of multi-function selective breeding programs as an asset for aquaculture development**

**General information**

Type: Ph-D Position

Keywords: Aquaculture, Bioassays, Domestication, Integrative approach

Research units: **France**: Research Unit Animal and Animal Product Functionality (UR AFPA), Team Domestication in Inland Aquaculture (DAC), University of Lorraine, Faculté des Sciences et Technologies, Boulevard des Aiguillettes BP 70239, F-54506 Vandœuvre-lès-Nancy, France

**Belgium:** Research Unit in Environmental and Evolutionary Biology (URBE), Institute of Life, Earth & Environment (ILEE), University of Namur, Rue de Bruxelles 61, B-5000 Namur, Belgium

Directors: Pascal FONTAINE (UR AFPA; Professor); Thomas LECOCQ (UR AFPA; Associate Professor); Patrick KESTEMONT (URBE; Professor)

**Application deadline: 15th July 2021**

Duration: 36 months from the 01st October 2021

Fund category: Public Funding - **Funding has already been secured**

Doctoral School: SIReNa - Sciences et Ingénierie des Ressources Naturelles

Application must include (i) a cover letter, (ii) curriculum vitae, and (iii) the contact details of three reference persons. This should be sent as a single pdf at [thomas.lecocq@univ-lorraine.fr](mailto:thomas.lecocq@univ-lorraine.fr).

**Applicants are invited to contact Thomas Lecocq for further details.**

**Ph-D student position and working environments**

**In the context of an International Research Partnership** (2020-2024) between UR AFPA (University of Lorraine, France) and URBE (University of Namur, Belgium), a **Ph-D position** (a 3-year contract) funded by the French Minister of National Education, Higher School and Research is available at the UR AFPA (Vandœuvre-lès-Nancy, France).

**Main team:** The DAC team (UR AFPA) works on the sustainable development of aquaculture through agroecology and new species domestication. We study (i) the domestication consequences on fish biology and (ii) the domestication process through interspecific and intraspecific comparative approaches. We have facilities for molecular, behavioral, and physiological analyses as well as fish bioassays (i.e. experimental platform in aquaculture, a part of the European network AQUAEXCEL and labelling LUE Infra+).

**Belgian partner:** The URBE studies aquatic organisms and environments, at all integration levels, from molecules to ecosystems. Rather than focusing on specific molecular and cellular approaches of life, URBE investigates of biochemistry, physiology, evolution, and ecology.

**Ph-D student profile**

We are looking for **highly motivated person** with a MSc in a related discipline (e.g. zoology, evolutionary biology, ecology) **a particular interest for transdisciplinary dialogue**. Skills in or willingness to learn molecular, physiological, and behavioral analyses and R-language are required. Although fish breeding will take place at the University of Lorraine, several stays in the University of Namur and other foreign institutions will be necessary. Therefore, the Ph-D student will **have to accept international mobility** to achieve her/his project (grant by the DrEAM program).

**Benefits for the candidate**

The candidate will have the **opportunity to integrate an international consortium** and to **acquire strong skills in genetic, physiological, and behavioral analyses as well as in scientific writing**. She/he will **develop an international research network** that facilitate obtaining post-doc or permanent positions in scientific institutions. Overall, the supervisors aim at providing the best training and the best possible curriculum vitae for the future steps of the Ph-D student researcher career.

**Research background**

Domestication is one of the most important developments in human history1. Around 13,000 years ago, a first wave of domestication happened. It concerned mainly terrestrial vertebrate and plant species that are those dominating the agricultural world today1. Over the past decades, new human needs/demands, population decline of wild exploited species, and global change impacts have triggered a **new wave of domestication to ensure humankind’s future food security as well as raw material supply in a sustainable way** (e.g.2,3). However, **domestication is still a challenging process**. It often (i) fails because of zootechnical limitations, socio-economic restrains, design error, or intrinsic species/population features, (ii) leads to animal welfare issue, or (ii) results in poorly sustainable productions with a low adaptive potential to face changes in human expectations and global changes. **This raises the need to improve domestication approaches to shape the tomorrow’s species production**.

Recently, domestication programs have reaped the benefits of advances in genetics, genomics, and physiology to design **selective breeding programs (SBP)** (e.g.4,5). These SBP aim at intentionally modifying some traits or biological functions of the human-controlled populations to improve performances of farmed organisms6,7. **Most SBP focus one or very few particular biological functions** (i.e. single-function SBP), but disregarding the evolution of other biological functions over the domesticated generations8. **Yet, a successful domestication requires the favorable expression of several traits involved in various biological functions** as well as maintaining adaptive potential of domesticated populations9. Moreover, single-function SBP can result in co-selection of deleterious trait expressions, which can doomed animal production (e.g.10,11).

Developing selective breeding programs that consider all, or at least most, important biological functions (i.e. **multi-function SBP**) **could overcome single-function SBP pitfalls** and shape improved species productions8. However, development of multi-function SBP is challenging since they require (i) performing integrative assessment of various traits (from gene to phenotypes of all biological functions), (ii) defining sought optimal trait expressions which can vary according to domestication objectives, and (iii) making consensus between sometimes discordant results obtained for different functions (for aquaculture see 8,9,12). **In aquaculture,** these challenges are being the focus of an increasing research, but **previous studies have only scratched the surface of multi-function SBP.** The lack of conceptual approaches to guide the design of efficient and pragmatic multi-function SBP still limit its potential to foster a more efficient and sustainable aquaculture.

**Ph-D objectives**

**The Ph-D project will aim at proposing multi-function selective breeding approach to facilitate future aquaculture developments**. The project will (i) assess the potential of multi-function SBP *versus* single-function SBP and (ii) develop a conceptual approach to guide the design of efficient and pragmatic multi-function SBP for aquaculture. **The developed multi-function SBP framework will integrate sustainability and welfare concerns.**

The Ph-D student will develop multi-function SBP jointly with the project consortium. Together, we will define (i) which traits and functions (e.g. reproduction, growth, welfare, immunity, behavior) must be integrated in multi-function SBP, (ii) which trait expressions are sought through investigative work on aquaculture stakeholders (e.g. farmers, researchers, regulation organizations), and (iii) how making consensus among traits involved in different biological functions (e.g. integrative index development). Based on this new conceptual approach, the Ph-D student will develop a multi-function SBP and a single-function SBP (as a comparison point) on a model species, the zebrafish (*Danio rerio*). She/he will develop **genetic, genomic, physiological, and behavioral analyses** to study the consequences of the two SBP over several generations to highlight benefits and pitfalls of multi-function SBP compared to traditional approach.

**References**

1. Diamond, J. Nature 418, 700–707 (2002).

2. Duarte, C. M., Marba, N. & Holmer, M. Science. 316, 382–383 (2007).

3. Lecocq, T. & Toomey, L. Anim. Front. 11, 69–77 (2021).

4. Zhou, Z., Yang, H. & Zhong, B. Acta Biochim. Biophys. Sin. 40, 601–611 (2008).

5. Larson, G. & Fuller, D. Q. Annu. Rev. Ecol. Evol. Syst. 45, 115–136 (2014).

6. Gjedrem, T., Robinson, N. & Rye, M. Aquaculture 350–353, 117–129 (2012).

7. Vaughan, D. A., Balázs, E. & Heslop-Harrison, J. S. Ann. Bot. 100, 893–901 (2007).

8. Toomey, L. et al. Sci. Rep. 10, 11564 (2020).

9. Toomey, L., Fontaine, P. & Lecocq, T. Rev. Aquac. 12, 2212–2227 (2020).

10. Pryce, J., Royal, M., Garnsworthy, P. & Mao, I. Livest. Prod. Sci. 86, 125–135 (2004).

11. Rauw, W. M., Kanis, E., Noordhuizen-Stassen, E. N. & Grommers, F. J. Livest. Prod. Sci. 56, 15–33 (1998).

12. Toomey, L., Lecocq, T., Pasquet, A. & Fontaine, P. Aquaculture 530, 735807 (2021).