Master's-Level Final-Year Internship Offer

INTERNSHIP TITLE: Climate change and poultry breeding schemes: impact of partial flock losses and value of selecting for stress tolerance

Host organisations:

The French National Research Institute for Agriculture, Food and Environment (INRAE) is a major player in agricultural and animal sciences in Europe. Within the joint research unit UMR PEGASE (Physiology, Environment and Genetics for Animals and Livestock Systems), located in Saint-Gilles (near Rennes, Brittany), the GGA team (Poultry Genetics and Genomics) studies the genetic mechanisms underlying the adaptation of laying hens to innovative and sustainable farming environments.

The French Poultry and Aquaculture Breeders Association (SYSAAF, Syndicat des Sélectionneurs Avicoles et Aquacoles Français) is a professional organisation specialising in technical support for genetic selection and biotechnologies applied to the poultry, aquaculture and insect-farming sectors (https://www.sysaaf.fr/). With a staff of 28, including 21 geneticists, SYSAAF supports some forty organisations, mostly based in France, in the genetic monitoring and/or selection of around thirty species. SYSAAF teams are mainly based at the INRAE sites in Rennes and Nouzilly, where they work alongside partners from public research and industry.

Background and research question:

Global warming is increasing the frequency and intensity of the hazards to which poultry farms are exposed. Livestock are increasingly confronted with thermal stress, such as that caused by heatwaves (Masson-Delmotte & Zhai, 2022), while also being more exposed to biotic stressors, owing to the lengthening activity period of certain pathogens and parasites (Sparagano & Ho, 2020) and to shifts in the distribution ranges of their vectors and reservoirs (Brown & Rohani, 2012; Collin et al., 2024). Depending on their intensity, these repeated stresses can impair animal welfare, reduce production performance or cause mortality (Wolc et al., 2019), which in most cases remains partial, affecting only part of a given batch of animals.

In breeding flocks, these episodes of partial mortality raise specific problems. They disrupt phenotypic recording and reduce the number of candidates available for breeding, which lowers selection intensity and hence the overall efficiency of the breeding scheme (Falconer & Mackay, 1996). In the longer term, the smaller number of available breeders also leads to increased relatedness within populations, with the associated risk of inbreeding depression (Leroy, 2014).

Several levers exist to limit partial losses that affect the efficiency of selection in poultry lines, such as adapting housing systems or feeding strategies (Collin et al., 2024), as well as breeding more tolerant lines (Doeschl-Wilson et al., 2012). The latter option, however, faces two main limitations: the often low heritability of traits related to stress tolerance, whether abiotic or biotic (Van Goor et al., 2015), and a genetic correlation with production traits (growth, feed efficiency, etc.) that is sometimes unfavourable.

Internship objectives:

This internship aims to assess, through stochastic simulation, the impact of partial flock losses resulting from the expected increase in the frequency and intensity of stressors on the efficiency of selection in poultry lines. More specifically, the internship seeks (1) to quantify the effect of partial flock losses caused by various abiotic and/or biotic stressors in nucleus flocks on selection efficiency and genetic

diversity, and (2) to evaluate the expected genetic gain in tolerance to these stresses depending on whether or not the tolerance traits are included in the breeding goal (directional selection vs. natural selection).

Main activities:

The intern will have access to the breeding scheme simulators for commercial lines developed and already validated by SYSAAF, as well as real mortality data recorded in these lines during stress episodes.

First, the intern will define a model simulating partial flock losses (i.e., an uncontrolled loss of selection candidates whose frequency, timing within the selection cycle and intensity vary across generations) and integrate it into the breeding scheme simulator. They will then be able to assess the impact of these partial losses on selection efficiency (objective 1).

Next, the intern will focus on a small number of stressors. They will estimate the parameters of tolerance to these stresses in order to develop an individual stress-response model based on the simulation of a tolerance trait. This model will be integrated into the breeding scheme simulator to accurately estimate the impact of stress-induced partial flock losses on genetic diversity and on production traits potentially correlated with these tolerance traits. Genetic gain in the tolerance trait will also be estimated, both under directional selection (trait weighted in the selection index) and under natural selection (trait not weighted in the selection index; objective 2). Finally, time permitting, an optimised trade-off between selection for production traits and selection for tolerance traits may be defined.

Desired profile and skills:

Education: second-year Master's student or final-year engineering student (agricultural sciences, genetics, biostatistics), specialising in quantitative genetics or animal breeding.

Required skills:

- Grounding in quantitative genetics
- R for programming and data analysis
- Strong interest in modelling and stochastic simulation
- Scientific writing skills
- Scientific English

Additional assets:

- Knowledge of a breeding scheme simulation tool (AlphaSimR or other)
- Linux environment and cluster computing
- Version control (Git)
- Thoughtful and critical use of generative AI tools

Personal qualities:

- Good interpersonal skills
- Initiative and ability to propose ideas
- Scientific rigour

Practical information:

Scientific supervisor contact:

- **Name and position:** Sophie Allais, Associate Professor
- **Address:** UMR PEGASE, INRAE – L'Institut Agro Rennes-Angers, 16 Le Clos, 35590 Saint-Gilles, France
- **Phone:** +33 2 23 48 54 68
- **Email:** sophie.allais@agrocampus-ouest.fr
- **GGA team website:** https://pegase.rennes.hub.inrae.fr/recherche/equipes-de-recherche/genetique-et-genomique-avicole

Scientific and technical co-supervision:

- Clovis Pawula, SYSAAF, Centre INRAE Val de Loire, UMR BOA, 37380 Nouzilly, France
- Sophie Brard-Fudulea, SYSAAF, Centre INRAE Val de Loire, UMR BOA, 37380 Nouzilly, France

Duration and dates:

Start between 4 January 2027 and 1 March 2027; end between 4 July 2027 and 31 August 2027, for a duration of 6 months.

Location:

Preferably at SYSAAF (UMR BOA, 37380 Nouzilly). Also possible at UMR PEGASE (16 Le Clos, 35590 Saint-Gilles, or 65 rue de Saint-Brieuc, 35042 Rennes).

Benefits:

- **Catering:** subsidised staff canteen
- **Transport:** free INRAE shuttle bus from Tours (if the intern is based at SYSAAF, at the INRAE Nouzilly centre); public transport access from Rennes (if the intern is based at UMR PEGASE).
- **Stipend:** approximately €656/month (depending on the number of days worked per month, €31.50 per day worked)

Funding: GIS Avenir Elevages

How to apply:

Applications (CV and cover letter) should be sent to Sophie Allais **(**sophie.allais@agrocampus-ouest.fr), Clovis Pawula (clovis.pawula@sysaaf.fr) and Sophie Brard-Fudulea (sophie.brard-fudulea@sysaaf.fr) by 12 November 2026.