



GÖTEBORGS UNIVERSITET

Doctoral student in Natural Science, specialising in Biology

Ref PAR 2022/952

The University of Gothenburg tackles society's challenges with diverse knowledge. 56 000 students and 6 600 employees make the university a large and inspiring place to work and study. Strong research and attractive study programmes attract scientists and students from around the world. With new knowledge and new perspectives, the University contributes to a better future.

Doctoral position in Natural Science, specialising in Biology

At the Department of Biological and Environmental Sciences (BioEnv) we have teaching and research activities that stretch from the alpine ecosystem, through forests, cultivated land and streams, all the way into the marine environment. In these environments we study different levels of biological organisation from genes, individuals and populations to communities and ecosystems. We work within ecology, evolution, physiology, systematics, and combinations of these fields to understand the impact of natural and anthropogenic changes of the environment.

The department is placed at three different localities: in Gothenburg Botanical Garden, at Medicinarberget in Gothenburg and Kristineberg Marine Research Station. The current position is placed in the Gothenburg Botanical Garden.

General information about being a doctoral student at the University of Gothenburg can be found on the university's doctoral student pages.

<https://medarbetarportalen.gu.se/doktorand/?languageId=100001&skipSSOCheck=true>

Project description

The quantitative genetic paradox of stasis, and its relevance for sustainable pest control.

Pathogens provide some of the strongest selection pressures in nature, driving continual dynamic coevolutionary interactions with their hosts. While such strong selection might

normally erode genetic variation, genetic variation for resistance to pathogens is typically high, because hosts can usually only resist a subset of pathogens circulating in a population (i.e., pathogens tend to show specificity in their ability to infect hosts). As soon as particular pathogen strains or host genotypes become prevalent, they experience negative frequency-dependent selection that favours other strains or genotypes, and thereby maintains genetic variation in the wider population.

These phenomena are relevant for the sustainable use of biopesticides, a welcome new technology that enlists living organisms in the fight against crop pests. Synthetic chemical pest control can be problematic because it often conflicts with other sustainable development goals by damaging non-target organisms and disrupting natural food webs. Moreover, despite intensive research and development, insects continue to evolve resistance to synthetic pesticides with predictable regularity, eluding even the most ingenious attempts to prevent resistance evolution.

The fact that insect pathogens rarely engender resistance is therefore an alluring aspect on the side of biopesticides. However, unlike natural enemies, industrially produced biopesticides cannot coevolve with pests, and most research and development has focussed intensely on a small number of highly pathogenic strains. We therefore urgently need to find alternative ways to prevent pest resistance to biopesticides.

We have recently proposed an innovative and evolutionarily sustainable approach to pest control that harnesses rather than resists the enormous evolutionary potential of pest populations. It relies on the observation that strong pathogen-induced selection in nature does not always produce evolutionary responses, the so-called “paradox of stasis”. The paradox can arise for multiple reasons, including trade-offs between characters or across habitat patches, and it could conceivably allow farmers to vary selection in subtle ways that preserve genetic diversity for susceptibility to biological agents at a landscape scale. However, while we have demonstrated this proof of concept, the very complexity of this approach, which might be the key to sustainability, also makes predicting long term effects on genetic variation and pest population dynamics difficult.

One source of inconsistent selection on pests for biopesticide resistance is pathogen dose. The genotypes that best survive exposure at one dose may not be the same as those that are optimal for survival at other doses. Therefore, if biopesticide application practices introduce variation in pest exposure doses, this might provide a practical solution to reduce the risks of biopesticide resistance evolution. This PhD project will determine how genetic (co-)variation scales with biopesticide dose, and model consequences of variable selection for pest population dynamics and crop damage. Thereby it can play a major role in addressing one of the most wicked problems confronting sustainable development: the trade-off between abolishing hunger and preserving healthy environments. It will help clarify pressing but as-yet unanswered questions about the long-term sustainability of evolutionarily sustainable pest control using biopesticides, while simultaneously shedding light on fundamental questions concerning strong selection and evolutionary constraint.

The successful candidate will use a combination of quantitative genetic experiments and metapopulation modelling to explore how dose-dependent heritability affects biopesticide resistance in heterogeneous environments.

Funding for the research includes expected secondments to the institutions of project partners in the United Kingdom for some components of the research. In addition, we will encourage the student to develop their own questions as the PhD develops, and to collaborate and conduct stakeholder outreach using our existing network in Sweden, the United Kingdom, and Brazil.

Duties

The main task is to conduct the PhD thesis work under supervision, which includes development of the PhD student's methodology experience, analytical skills, and theoretical depth and breadth. Techniques used within the project include systematic research synthesis, quantitative genetic experiments, microbiological infection assays, meta-population modelling, individual-based simulations, and methods associated with transdisciplinary work with stakeholders. The empirical research will be conducted mainly in the laboratory. Depending on the future availability of travel funding, shorter periods may also be spent as field work in South America or Africa, where our research group has active collaborations with international researchers at universities, national research centers, not-for-profit organizations, and industrial partners. Specific research topics potentially associated with later parts of the research project include questions that transcend disciplinary boundaries, such as those concerning the logistics of biopesticide dose variation, heterogeneous landscape management, the economic implications of producing or using diverse biocontrol products, and the social science of sustainable agriculture from farm to fork.

Education at third-cycle level comprises four years of full-time study, and leads to a doctoral degree.

As part of your employment as a doctoral student, you may have departmental duties corresponding to up to 20 % of full-time employment, distributed throughout your study period. Departmental duties usually consist of teaching at first- and second-cycle levels, but may also include research and administration.

Eligibility

Education at third-cycle level requires general eligibility and, where appropriate, specific eligibility as set out in the general syllabus for the subject.

The general eligibility requirements for education at third-cycle level are:

1. having completed a degree at second-cycle level, or
2. the fulfilment of course requirements totalling at least 240 credits, of which at least 60 credits must be at second-cycle level, or
2. the acquisition of equivalent knowledge in some other way, either in Sweden or abroad.

To meet the specific entry requirements for third-cycle studies, applicants must:

1. have a second-cycle (advanced-level) degree in a relevant* subject area in the natural sciences, or

2. have completed studies for at least 60 higher education credits at a second-cycle level in relevant subject areas in the natural sciences, or
3. have completed a corresponding programme of relevance to the planned third-cycle programme, in Sweden or in another country, or have equivalent qualifications.

*Relevant subjects for the planned third-cycle education are evolutionary biology, ecology, quantitative or evolutionary genetics, population dynamics, metapopulation or individual-based modelling entomology or biological control.

Assessment criteria

The selection of applicants who meet the basic and specific eligibility requirements will be based on the ability to assimilate the education at third-cycle level.

We are seeking a motivated person for PhD studies in evolutionary biology with emphasis on evolutionary genetics, metapopulation modelling, or sustainable pest control.

Required characteristics:

A degree including training in one or more of: evolutionary biology, quantitative genetics, meta-population dynamics or individual based modelling, biological control or a related biological or agricultural discipline.

Excellent organizational and data management skills that will allow the coordination of large laboratory experiments including thousands of insects.

Strong quantitative skills or a demonstrable interest in developing these in order to learn and implement the advanced statistical models needed to estimate genetic variance and covariance parameters.

Strong computer coding skills or a demonstrable interest in developing these in order to learn and implement the metapopulation dynamics and individual-based models of how variable environments produce evolutionary change at a landscape scale

Excellent communication skills, both written and spoken, in English are necessary since we work in an international environment.

Desired characteristics:

A demonstrable ability to coordinate and integrate with a large team of researchers will facilitate working on ambitious experiments.

Experience with laboratory sterile microbiological techniques.

An ability to work flexible hours (e.g., including on weekends in a coordinated rota with other members of the research group) to facilitate coordination of research during labor-intensive experiments.

Advanced coding skills using R, possibly including mixed models, metapopulation models or individual-based simulations.

The application should preferably be written in English and must include:

- A cover letter with the applicant's justification for the application, i.e., that describes how the applicant meets the selection criteria
- An attested list of qualifications (CV)
- Examination certificates and a transcript of courses with grades
- A copy of the Master thesis (or equivalent)
- Employments certificates and other documents deemed important by the applicant

The top ranked candidates will be selected for an interview, which might be held in English and could also be performed by phone/Zoom.

Employment

Once you have been admitted for education at third-cycle level, you will be employed as a doctoral student at the University of Gothenburg.

The provisions for employment as a doctoral student can be found in ordinance SFS 1993:100.

Initial employment as a doctoral student may apply for a maximum of one year, and may be renewed by a maximum of two years at a time.

A doctoral student may be employed as a doctoral student for a maximum of eight years, but the total period of employment may not be longer than the equivalent of full-time education at third-cycle level for four years.

First day of employment is upon agreement.

The University applies a local agreement on salaries for doctoral students.

Contact information

Luc Bussière, Senior Lecturer, supervisor

Phone: +46 73 048 02 33

Email: luc.bussiere@bioenv.gu.se

Webpage: www.lucbussiere.com

Åsa Arrhenius, Head of Department

Phone: +46 31-786 26 25

Email: asa.arrhenius@bioenv.gu.se

Unions

Union representatives at the University of Gothenburg can be found here:

<https://www.gu.se/om-universitetet/jobba-hos-oss/hjalp-for-sokande>

Application

You can apply to be admitted for education at third-cycle level via the University of Gothenburg's recruitment portal.

It is your responsibility to ensure that the application is complete as per the vacancy notice, and that the University receives it by the final application deadline.

Applications must be received by: July 4th 2022.

Information for International Applicants

Choosing a career in a foreign country is a big step. Thus, to give you a general idea of what we and Gothenburg have to offer in terms of benefits and life in general for you and your family/spouse/partner please visit:

<https://www.gu.se/en/about-the-university/welcome-services>
<https://www.movetogothenburg.com/>

The University works actively to achieve a working environment with equal conditions, and values the qualities that diversity brings to its operations.

Salaries are set individually at the University.

In accordance with the National Archives of Sweden's regulations, the University must archive application documents for two years after the appointment is filled. If you request that your documents are returned, they will be returned to you once the two years have passed. Otherwise, they will be destroyed.

In connection to this recruitment, we have already decided which recruitment channels we should use. We therefore decline further contact with vendors, recruitment and staffing companies.

Apply