

Faculty of Science and Engineering

Profile report: Molecular Genetics of Adaptation

- **Discipline:** Molecular Genetics
- **Level:** Tenure-track assistant/associate professor with research profile
- **Fte:** 0.8 - 1.0 fte

1. Scientific discipline

Molecular genetics is a fundamental discipline in the Life Sciences. It develops and deploys methods to study the function of genes, gene networks and genomes in shaping phenotypes, and has become indispensable for understanding how organismal traits are shaped and inherited. This includes the roles of epigenetics, coding and non-coding DNA and RNA sequences, and gene regulatory pathways in determining and modulating traits. The enormous recent advances in genetic and genomic techniques makes it now attainable to study the genotype-to-phenotype map beyond model organisms.

2. Vacancy

This position is opened by the Board of the Faculty of Science and Engineering (PT/gl/22/00156) and will be embedded in the Groningen Institute of Evolutionary Life Sciences (GELIFES). The position falls within the framework of 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see link for [criteria and conditions](#).

3. Selection committee (BAC)

- Prof. dr. Rampal Etienne (Scientific director GELIFES)
- Prof. dr. Theo Elzenga (Education director GELIFES)
- Prof. dr. Leo Beukeboom (Evolutionary Genetics, GELIFES)
- Prof. dr. Bregje Wertheim (Evolutionary Genomics, GELIFES)
- Prof. dr. Jean-Christophe Billeter (Behavioural Genetics, GELIFES)
- Prof. dr. Dineke Verbeek (UMCG)
- student

Advisors: Marlies Beuving (HR), dr. Elzemiek Geuverink, Prof. dr. Martine Maan, Prof. Arnold Driessen (GBB)

4. Research area

Genetics is a fundamental field of Biology, as well as an essential discipline in the Medical and Life Sciences. Knowledge of genetics is indispensable for many societal aspects, including health and diseases, food supply (plant and animal breeding) and nature conservation (e.g. adaptation to climate change). Mendelian genetic principles are central to our understanding of how single genes shaping organismal traits can be altered by selective and non-selective processes, and how (mal)adaptations and diseases come about. Quantitative genetics focuses on the organismal and population level and studies complex traits with a polygenic basis, which includes most traits that are important for

fitness. Population genetics has been central in the study of allele frequencies at the population level and forms the basis of evolutionary biology. These three fields of genetics have seen enormous advances since the discovery of DNA and the subsequent development of molecular genetic techniques, such as gene cloning, DNA sequencing, transgenesis and functional genetics (e.g. RNA interference and CRISPR/Cas-9) supported by bioinformatics. This has led to an important fourth field of genetics that aims to elucidate the molecular genetic mechanisms underlying traits and adaptations. This includes forward and reverse genetics to home in on the functioning of individual genes and chromatin structure, molecular cell biology to uncover protein or DNA/RNA based processes, how new genes arise and can change cell differentiation processes, how gene regulatory mechanisms can evolve, or how alternative splicing can lead to novel gene products.

A central challenge in biology is the reconstruction of the genotype to phenotype map. This requires the elucidation of single gene functions and their interactions with other genes at the genomic, transcriptomic and proteomic level. Novel techniques for discovery of genes and testing their function (e.g. RNA interference, CRISPR-Cas gene-editing) now enables the study of the causal impact of genetic pathways on phenotypic traits in both model and non-model organisms. The genomics revolution expands this towards uncovering the genetic architecture of multiple and complex traits. The focus for this position is on the molecular genetics of adaptation, including molecular structure and function of biomolecules (e.g., DNA, RNA, proteins), cell physiology and the processes of transcription and translation, to understand the adaptive biological function at the cellular level. There are also important applied aspects of functional molecular genetics, such as elucidating the genetic basis of economically important traits for breeding (e.g. seed yield, milk production) and genome editing for pest control (e.g. gene drives).

This position will represent state-of-the-art expertise in functional Eukaryotic molecular genetics. In line with the GELIFES' mission, the position will have an evolutionary perspective towards understanding the molecular genetic basis of adaptive processes. Phenotypic traits are shaped by evolutionary processes (which are to large extent driven by genetics and development) to maximize fitness, but may also become maladaptive, such as in rapidly changing environments. The appointed candidate's research should be complementary to the current research interests in the Groningen Institute for Evolutionary Life Sciences. There are many possible focus fields, including the molecular genetics of: the evolution of development (evo-devo), behaviour, speciation, chronobiology, or adaptation to climate change. The aim of this position is to establish an independent research line for fundamental and/or applied research on molecular genetics of adaptations, and to contribute to education in molecular genetics of eukaryotes as part of our educational programmes in biology and life sciences.

5. Embedding: institute and expertise group

The integration of mechanistic and evolutionary approaches is one of the core aims of the Faculty's strategic theme Adaptive Life. The Groningen Institute for Evolutionary Life Sciences (GELIFES) in which the position will be embedded, is the home base for this theme. GELIFES aims to enhance the understanding of adaptive processes and the maladaptive consequences of their limitations, across all levels of biological organization (from molecules and genes to individuals and ecosystems), to inform society and contribute solutions to societal problems. The institute has close connections with the Faculty of Medical Sciences (FMS) and the University Medical Centre Groningen (UMCG). It coordinates master programs in biology, evolution and ecology, marine biology, biomedical sciences, and behavioural and cognitive neuroscience, all of which are integrating genetic and genomic knowledge, and providing an exciting environment for teaching molecular genetics in a variety of contexts. The position has clear links to molecular genetic groups in the Groningen Biomolecular Sciences and Biotechnology Institute, but is distinctive in having a main focus on eukaryotic organisms and an evolutionary perspective.

GELIFES is organized in a non-hierarchical manner, and staff associate with one (or more) informal expertise groups. The tenure-track assistant professor is free to choose its expertise group. GELIFES currently has six expertise groups, each consisting of several principal investigators with their groups: *Theoretical Research in Evolutionary Life Sciences (TRES)*, *Genomics Research in Ecology & Evolution in Nature (GREEN)*, *Evolutionary Genetics, Development and Behaviour (EGDB)*, *Behavioural and Physiological Ecology (BPE)*, *Neurobiology, and Conservation Ecology (CONSECO)*.

The candidate will have access to GELIFES' excellent facilities for experimental research, including well-equipped molecular (and safety) laboratories, indoor and outdoor animal facilities and laboratories, climate rooms, microscopy facilities, as well as IT facilities for large data processing.

6. Local and (inter)national position

Local:

GELIFES has strong links with the medical sciences at the UMCG and through the GELIFES graduate school. Within the FSE collaboration exists with the Groningen Biomolecular Sciences and Biotechnological Institute (GBB; genetics and evolution of microbial systems). GELIFES coordinates the renowned international selective Erasmus Mundus Master in Evolutionary Biology (MEME), the top master in Behavioural and Cognitive Neurosciences, and the selective Master Ecology & Evolution. GELIFES is the main driver of the research program Adaptive Life, a focus theme of the faculty. A key element is the integration of mechanistic (e.g. genetic and genomic) approaches with evolutionary approaches to understand adaptation. As molecular genetics is a key discipline for these research and educational programs, the Molecular Genetics of Adaptation position is a crucial component for maintaining and strengthening these fields.

National:

GELIFES has a strong reputation in research and education in ecology, evolution, behaviour and neurobiology. GELIFES is the only life science institute in the Netherlands that specifically aims at integrating the study of physiological mechanisms with those of ecology and evolution. Many collaborations exist with other universities and research institutes in The Netherlands on a wide variety of topics, including the universities of Wageningen, Utrecht and Amsterdam and the Royal Dutch Academy Institutes Netherlands Institute for Ecological Research and the Netherlands Institute for Sea Research.

International:

GELIFES, unlike many other institutes in the world, specifically aims at the integration of ecological and evolutionary approaches with neurobiology and physiology in the Life Sciences. Research topics that are internationally recognized and relevant for the new staff member are, among others, the evolution and physiology of animal personalities and ageing, the mechanisms and function of social interactions, neurobiology of neuropsychiatric disorders, biological and seasonal clocks, microbial genetics and ecology, maternal effects, avian flyways & population dynamics, adaptation to climate change, facilitation in plant communities, ecological community resilience, genetics and evolution of life histories, both from empirical and theoretical perspectives.

7. Expected contributions to teaching

The candidate is expected to contribute to the BSc programmes in Biology and Life Science & Technology, and (depending on biological expertise) to the MSc programmes in Biology, Behaviour, Cognition and Neuroscience, Ecology and Evolution, Marine Biology, Biomolecular Sciences or Biomedical Sciences. The candidate will also supervise Master Research projects that include advanced principles of Molecular Genetics. The candidate will lead a number of courses in these areas and coordinate with colleagues that teach related fields such as evolutionary genetics, behavioural genetics/neurogenetics, evolutionary medicine and chronobiology.

8. Expected contributions to research

The new staff member is expected to implement an independent research line of molecular and functional genetics applied to multicellular eukaryotic organisms. The research should lead to high-quality publications and presentations at scientific conferences. The candidate is expected to obtain substantial external funding (e.g. NWO and EU grants agencies) and successfully supervise PhD students. He/She will have core expertise in molecular genetics within an ecological and/or evolutionary framework and should be complementary to that of the tenured staff at the institute.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. At the level of FSE, the candidate will contribute to the organization of the faculty, for example by

participating in working groups and committees, in the fields of teaching, research and management. The candidate will participate in relevant national and international organizations.