SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Ecology, Evolution & Genetics

has the honour to invite you to the public defence of the PhD thesis of

# Shabnam Zaman

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

**Contingency and convergence in the evolution of anuran host defence systems: a structural and functional perspective**

**Supervisor:**
Prof. dr. Kim Roelants

The defence will take place on

**Wednesday, May 21, 2025 at 4 p.m. in Auditorium I.0.02**

The defence can also be followed through a live stream:
https://teams.microsoft.com/meet/3253193307818?p=Dt68EKEj0rZWSR1lyY

### Members of the jury

Prof. dr. Franky Bossuyt (VUB, chair)
Prof. dr. Wen-Juan Ma (VUB, secretary)
Prof. dr. Peter Tompa (VUB)
Prof. dr. Patrick Flammang (UMons)
Prof. dr. Karen Siu Ting (Queen's University Belfast, UK)

### Curriculum vitae

Shabnam Zaman graduated with a BSc in Biotechnology from Monash University (Malaysia). After working for several years as a molecular biologist in Bangladesh, she obtained an MSc in Human Ecology at Vrije Universiteit Brussel. In 2018, she was awarded an FWO fellowship to pursue a PhD in the research group of Prof dr. Kim Roelants on the evolution of amphibian host defence systems.
Aside from having 10+ years of research experience and multiple peer-reviewed publications, Shabnam has also contributed to several popular science media outlets to promote science communication.

### Abstract of the PhD research


Anurans (frogs and toads) make up an important component of terrestrial faunal communities worldwide and in most ecosystems, they are on the menu of a broad range of predators. As a result, the skin of many taxa has evolved to become a defence weapon against aggressors. Skin-secreted poisons arguably constitute the most widespread anuran antipredator adaptation, and typically represent cocktails of diverse toxic molecules, including alkaloids, steroids, and/or peptides and proteins. As some of these molecules additionally provide protection against microbial infections, anuran skin defence systems represent extraordinary examples of evolutionary adaptation at the molecular scale.

One notable component of anuran poisons are cytolytic peptides, gene-encoded molecules capable of disrupting cell membranes. Frogs share these molecules - specifically, linear α-helical peptides - with several distantly related animal clades, where they are either used as effectors of the innate immune response (e.g., in many insects and fish) or as constituents of venom (e.g., in arachnids, bees and wasps). By integrating phylogenomic and structural analyses, we explore the peptides' underlying "structural landscape," highlighting the degree of evolutionary convergence that can be expected in peptides with a relatively simple structure. In addition, this research elucidates the multiple origins of α-helical cytolytic peptides in the metazoan phylogeny, thereby providing a guidance tool for examining the utility of these peptides as possible therapeutic agents.

To investigate convergent evolution in host defence molecules with a complex (multidomain) structure, we turned to frog species whose skin secretions support a very different defence mechanism: when attacked by a predator, a small number of species discharge a milky skin fluid that rapidly solidifies into an extremely sticky adhesive: in other words, glue. This glue makes it almost impossible for a predator to ingest the frog, proving its adaptive value as a highly efficient antipredator defence system. Because, glue secretion is shared by distantly related species and often absent in their close relatives, it raises questions regarding the genetic mechanisms underlying its recurrent evolution. Using a combination of molecular techniques, we identified the proteins underlying the action of frog glue and propose functional and evolutionary models that may be relevant to adhesive secretions in other animals as well. Our findings highlight how the recruitment of ancient molecular templates may facilitate the recurrent evolution of functional innovations throughout the Animal Kingdom.