SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Herpetology

has the honor to invite you to the public defense of the PhD thesis of

Constantijn RAAYMAKERS

to obtain the degree of Doctor of Sciences

Joint PhD with Universiteit Gent

Title of the PhD thesis:

Poison from a frog's perspective: Elucidating the adaptive role of skin-secreted peptides in anti-predator defence

Promotor:

Prof. dr. Kim Roelants

The defence will take place on

Friday March 15 2019 at 16:00h

in Auditorium D.0.07 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. dr. Franky Bossuyt (chairman)
Prof. dr. Bram Van Schoenwinkel (secretary)
Prof. dr. Frank Pasmans (co-promotor, UGent)
Prof. dr. An Martel (co-promotor, UGent)
Prof. dr. Siska Croubels (UGent)
Prof. dr. Filip Immerseel (Univ. Gent)
Prof. dr. Raoul Van Dammen (Univ. Antwerpen)
Prof. dr. Nicholas Casewell (Univ. Liverpool, UK)

Curriculum vitae

Constantijn (Tijn) Raaymakers graduated the Master program in Herpetology at the Vrije Universiteit Brussel in 2014, after which he started his PhD research at the Amphibian Evolution Lab, as a continuation of this Master thesis project. The main focus of his research was the role of skin-secreted peptides found in frog poison, and their role in protecting a frog during predator attacks. This interdisciplinary research was conducted in close collaboration with the university of Gent, and has resulted in the publication of several articles in peer-reviewed scientific journals. In addition, he presented his work at various international scientific conferences.

Abstract of the PhD research

The skin secretions of many amphibians are rich mixtures of peptides and proteins that are thought to play a role in host defence (i.e. deterring predators and killing pathogens). After five decades of research, hundreds of peptides and proteins with diverse bioactivities have been discovered, fuelling the perception that the amphibian skin provides a natural source of new pharmaceuticals. Skin-secreted peptides have therefore been predominantly studied from a pharmacological perspective focussing on medical potential, leaving the adaptive role of these molecules (i.e. how they enhance an amphibian's survival chances) poorly understood. In this thesis, I studied the adaptive role of skin-secreted peptides in antipredator defence, with a strong focus on the overlooked function that immune components like antimicrobial peptides (AMPs) might play.

Using a combination of cell physiological and pharmacokinetic techniques we show that antimicrobial peptides, besides killing microbes, can permeabilize oral epithelial tissue to enable fast access of co-secreted toxins to the predator's bloodstream. This absorption enhancing system exists in at least three distantly related frog lineages, and is likely to be a widespread adaptation. We additionally provide evidence that a widespread peptide toxin in frogs named bradykinin, can pass through epithelial barriers independently of this delivery system. Besides aiding in the uptake of other toxins, we reveal that antimicrobial peptides additionally have a fast acting adverse effect on snake predators on their own. We show that stressed frogs secrete such high quantities of cytotoxic AMPs, that these peptides can make a snake release its meal, thereby providing a crucial opportunity for a frog to escape. In the last study, we use a combination of transcriptomic and peptidomic techniques to study the skin secretions of a poorly studied frog species, and identify five new peptides that form a new family of amphibian skin peptides. By looking at a frog's poison from the animal's perspective, we discovered previously overlooked functions of amphibian skin peptides, that suggest that a frog's poison is more a complex adaptation than previously assumed.