Look who's talking: the evolution of viral communication systems

Supervisory team:
Main supervisor: Prof Edze Westra (University of Exeter)
Second supervisor: Dr Tiffany Taylor (University of Bath)
Prof Stineke van Houte (University of Exeter)

Collaborators: Prof Susanne Gebhard (University of Bath), Prof Sylvain Gandon (CNRS, France)

Host institution: University of Exeter (Penryn)

Project description:
The rise of multi-resistant bacterial pathogens is a serious and urgent health threat in the UK and throughout the world. Viruses that infect bacteria (phages) have been suggested as a potent antibacterial therapeutic strategy. Many phages can employ two lifestyles: lytic, where they replicate in infected cells to generate new virions, and lysogenic, where they remain dormant following an infection and wait for a future opportunity to become lytic. Every infection, phages must 'decide' whether to employ the lytic or the lysogenic cycle, but the principles governing this decision are largely unknown. It was recently demonstrated that some phages use molecular communication to coordinate their infection dynamics (Erez et al Nature 2017). These phages produce communication molecules that determine whether phage will lyse their bacterial host or whether the phage instead enter into lysogeny. It was found that different phages use different communication molecules, effectively causing them to speak different languages.

The discovery that viruses can communicate to make group decisions about their infection strategy has opened an entirely novel paradigm in virology, and raises many pressing questions. How widespread is the ability of viruses to communicate? Why do not all viruses communicate? What drives the diversification of viral communication systems?

In this project, you will combine experimental evolution, molecular microbiology and theoretical approaches to address these important questions, using Bacillus species in which these phages were identified as a model. This project will be the first to address the evolutionary ecology of viral communication systems. Understanding how phage communication systems work and how they evolve will pave the way for manipulating phage-mediated lysis of bacteria in clinical, agricultural and natural environments.

The project will be based at the Penryn campus of the University of Exeter, which has state-of-the-art facilities for Microbiology research. You will be part of a thriving community of microbiologists who are studying various aspects of bacteria-phage interactions and microbial evolution and ecology. Moreover, you will benefit from co-supervision by Prof van Houte, a leading phage biologist, Dr Tiffany Taylor, who is an expert in the evolution of gene regulation, and close collaborations with the Gebhard lab, who bring expertise in Bacillus genetics, and the Gandon lab (CNRS, France), who has developed mathematical models that predict how viral communication systems evolve (Bruce et al, Current Biology 2021).

For more information on the team, see https://westralab.wordpress.com.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.