Will climate change worsen the problem of antibiotic resistance?

Supervisory team:
Main supervisor: Dr Daniel Padfield (University of Exeter)
Second supervisor: Prof Angus Buckling (University of Exeter)
Dr Anne Leonard (University of Exeter), Prof Edward Feil (University of Bath)

Collaborators: Dr Bram Kuijper (University of Exeter)

Host institution: University of Exeter (Penryn)

Project description:
Recent studies have shown that levels of antimicrobial resistance (AMR) increase at higher environmental temperatures, but we have very little idea about the mechanisms causing this pattern. Mobile genetic elements, such as plasmids, play a key role in spreading AMR, by allowing bacteria to acquire DNA through horizontal gene transfer (HGT). So to improve our ability to control AMR, we need to know much more about how temperature alters the selection and spread of plasmids. This interdisciplinary project will combine lab-based experiments, theory, and genome sequencing to achieve this.

We outline possible components of this project, but we will encourage you to lead the design of your own project to align closest to your interests. We will take advantage of a set of >3000 isolates of Klebsiella spp. collected from the environment and from humans. These isolates cover 15 species, including the human pathogen K. pneumoniae, have variation in their resistance to antibiotics, and have high quality genomes from previous work. Using controlled experiments on these isolates, we will uncover how plasmid transfer rate, the cost of plasmid carriage, and the effect of antibiotics on susceptible bacteria change with temperature. Finally, we will use novel sequencing and bioinformatics methodologies that link plasmids to their host bacteria to investigate whether AMR spreads more at higher environmental temperatures in natural communities, and look at whether pathogenic bacteria become more prevalent in a warmer world. All aspects of the work can be complemented by mathematical modelling to generate testable predictions.

The work will result in a step-change in our understanding of how climate warming will alter the selection and spread of AMR. You will be primarily based in the lab of Dr Daniel Padfield at Exeter's Cornwall campus, who is a NERC Independent Research Fellow with an inclusive and expanding team working on microbial ecology and evolution, AMR, and climate change. The lab is passionate about open and reproducible science and you will receive encouragement and support to learn programming, bioinformatics, and mathematical and statistical modelling as desired. Throughout the project, we will work closely with the groups of Buckling, Leonard, and Kuijper, in Cornwall, and Prof Feil's lab in Bath.

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.