**PROJECT TITLE:** **Evolutionary and ecological factors shaping genome composition of a social microbe**

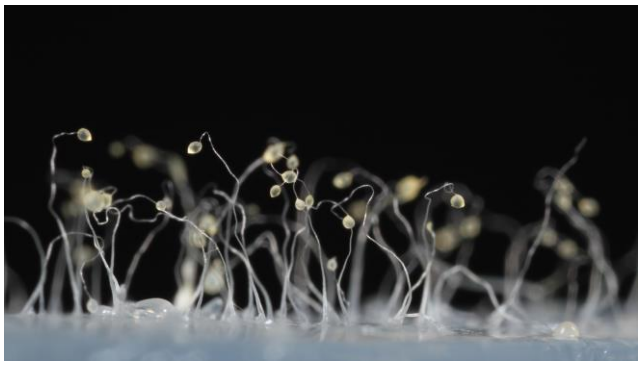
**DTP Research Theme:** **Living World**

**Lead Institution:** **University of Bath**

**Lead Supervisor:** **Prof Jason Wolf, University of Bath, Milner Centre for Evolution**
**Co-Supervisor:** **Dr Alex Hayward, Biosciences, University of Exeter, Penryn Campus**
**Co-Supervisor:** **Prof Sam Sheppard, University of Bath, Milner Centre for Evolution**

**Project Enquiries:** **j.b.wolf@bath.ac.uk**

Late stages of development of the social amoeba, *Dictyostelium discoideum*. (photo by Usman Bashir)



Mature fruiting bodies of the social amoeba, *Dictyostelium discoideum*. (photo by Usman Bashir)

## Project Background

The social amoeba *Dictyostelium discoideum* ('Dicty') lives as single celled individuals in the soil, where they consume bacteria and undergo vegetative growth. However, when food becomes scarce they aggregate to form a multicellular slug that migrates and forms a fruiting body composed of a dead stalk that holds aloft a sorus of viable spores. This process of aggregation and developmental differentiation represents a social stage where cells cooperate to form a functioning fruiting body and compete for space in the sporehead. Consequently, Dicty have been used as an ecological model to study predation and as an evolutionary model to study sociality. We have pursued these areas of research by sequencing large numbers of Dicty strains collected from natural populations. This prior work forms the foundation for this project, which will utilize and build on our existing datasets to analyse a series of questions about the evolutionary and ecological processes that have shaped the composition of the Dicty genome.

## Project Aims and Methods

The project aims are hierarchical and flexible, proving many opportunities for student led avenues of inquiry. The goal is to first characterise patterns of gene gain and loss across lineages sampled from natural populations. For this we will utilise existing sequence, but we will complement our existing data with acquisition of new sequence data as needed. We will then relate these profiles to ecological factors across populations and to patterns of sequence evolution within and among closely related species. This aspect is especially flexible and can allow students to pursue their own directions across a range of factors. Finally, we will apply a number of fine-scale tools that can dissect the independent evolutionary histories of different genes and genome regions to understand the mosaic nature of evolutionary and ecological processes shaping the genome.

## Candidate Requirements

This project will apply modern and cutting-edge approaches from the field population genetics and bioinformatics. Therefore, some familiarity with computer programming, bioinformatics, and statistics (e.g., R) will be beneficial, but not essential.

## Training

The student will be trained in aspects of computer programming (e.g., Matlab, Python) and statistical programming (using R). They will also receive training in statistical theory, bioinformatics, analysis of sequence evolution, and evolutionary mathematical modelling. In addition to these project specific components of training, the student will benefit from the career development, research and transferrable skills training provided by the NERC GW4+ DTP.

## References / Background reading list


Lima de Oliveira J, A Castillo Morales, B Stewart, N Gruenheit, J Engelmoer, S Battom Brown, RA de Brito, LD Hurst, AO Urrutia, CRL Thompson & JB Wolf*. The Red King process explains molecular evolution of social genes in a microbe. in review

Madgwick PG, B Stewart, LJ Belcher, CRL Thompson* & JB Wolf* 2018. Strategic investment explains patterns of cooperation and cheating in a microbe. *PNAS* doi.org/10.1073/pnas.1716087115

Gruenheit N, Parkinson K, Stewart, B, Howie J, Wolf* JB, & CR Thompson*. 2016. A polychromatic 'greenbeard' locus determines patterns of cooperation in a social amoeba. *Nature Communications*, DOI: 10.1038/ncomms14171

Wolf* JB, JA Howie, K Parkinson, N Gruenheit, D Melo, D Rozen, & CRL Thompson*. 2015. Fitness trade-offs result in the illusion of social success. *Current Biology*, 25:1086-1090


## Useful links

Enquiries relating to the project should be directed to the lead supervisor (see email address above for Project Enquiries). Enquiries relating to the application process should be directed to doctoraladmissions@bath.ac.uk

In order to apply, you should select the relevant University of Bath PhD online application form found here: https://www.bath.ac.uk/study/pg/applications.pl. When completing the form, please state in the 'Finance' section that you wish to be considered for GW4+ DTP funding and quote the project title and lead supervisor's name in the 'Your research interests' section.

Further information about the application process may be found here: http://www.bath.ac.uk/topics/postgraduate-research/

**The application deadline is 1600 hours GMT Monday 7 January 2019 and interviews will take place between 4 and 15 February 2019. For more information about the NERC GW4+ DTP, please visit https://nercgw4plus.ac.uk.**