**Ref:** 2024/04
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**Project Title: Identification of viral determinants influencing bluetongue virus infection dynamics in *Culicoides* biting midges**

**Supervisors:** Dr Marc Guimera, Dr Simon King & Dr Christopher Sanders
**Research group:** Entomology, Vector Ecology & Non-Vesicular Reference Laboratory

***About The Pirbright Institute***

The Pirbright Institute delivers world-leading research to understand, predict, detect and respond to viral disease outbreaks. We study viruses of livestock that are endemic and exotic to the UK, including zoonotic viruses, by using the most advanced tools and technologies to understand host-pathogen interactions in animals and arthropod vectors. Our Institute is made up of a dynamic and vibrant community of employees covering a diverse set of chosen fields, backgrounds and experience. Our outlook is always balanced by our strong sense of purpose, values and behaviours, and an unwavering commitment to a 'one Institute' approach.

**Project Summary:**

Bluetongue virus (BTV) is an arthropod-borne virus (arbovirus) that causes a severe haemorrhagic disease in domestic and wild ruminants (sheep, cattle, goats, deer, etc.). Bluetongue disease is of significant economic importance in livestock in both intensive agricultural settings and subsistence farming worldwide. The UK is currently facing the threat of BTV incursion due to an outbreak of BTV-3 in the Netherlands in 2023. BTV is transmitted between susceptible animals through the saliva of midges of the genus *Culicoides* during blood feeding on the animal. Interestingly, different BTV strains display different abilities to infect, replicate and disseminate through the insect, with some viruses reaching the vector's saliva more efficiently than others. In addition, the capsid shell of the BTV viral particle, which plays a role in initiating infection in target cells, can be partially digested by enzymes found in the gut and saliva of *Culicoides*. Such modified viral particles can be 100 times more infectious in the midge compared to their respective unmodified particles. Why and how these differences between viral strains and particles influence infection rates and dynamics in the insect vector is currently unknown.

This project aims to identify specific genetic and structural characteristics of BTV that influence the ability and efficiency of the virus to infect *Culicoides* midges, and consequently, its ability to be transmitted to an animal. To achieve this, the student will:

1. Generate different viral particles from several strains of BTV.
2. Infect adult *Culicoides* midges.
3. Characterise viral infection in the insect using a range of molecular biology techniques such as confocal microscopy, real time PCR and genome sequencing.

**Further Details:**

Survival of arboviruses depend on their ability to replicate in both the vertebrate host and the invertebrate vector. To increase their chances of survival in such different systems, arboviruses, including BTV, have developed different strategies. Identifying and understanding how such viral strategies work, will enhance our knowledge of how arboviruses (and the diseases they cause) are transmitted by insects. The student will join the Entomology, Vector Ecology and Non-Vesicular Reference Laboratory groups at The Pirbright Institute (TPI), in this collaborative and multidisciplinary project that provides an excellent opportunity to learn and be trained on a broad range of virology, entomology and molecular biology techniques. Furthermore, the student will develop competency to work in the unique, state-of-the-art high biological containment laboratories at TPI. The expertise of the supervisory panel and their teams ensures strong technical support across all project aspects.

**References for Suggested Reading:**

Guimerà Busquets, M. *et al*. (2023). Visualisation of Bluetongue Virus in the Salivary Apparatus of Culicoides Biting Midges Highlights the Accessory Glands as a Primary Arboviral Infection Site. ***Biological procedures online***, *25*(1), 27. https://doi.org/10.1186/s12575-023-00221-2

Darpel, K. E. *et al*. (2011). Saliva proteins of vector *Culicoides* modify structure and infectivity of bluetongue virus particles. ***PloS one***, 6(3), e17545. https://doi.org/10.1371/journal.pone.0017545

Mills, M. K. *et al*. (2017). *Culicoides*-virus interactions: infection barriers and possible factors underlying vector competence. ***Current opinion in insect science***, *22*, 7–15. https://doi.org/10.1016/j.cois.2017.05.003

Carpenter, S. *et al*. (2015). Vector competence of *Culicoides* for arboviruses: three major periods of research, their influence on current studies and future directions. ***Revue scientifique et technique (International Office of Epizootics)***, *34*(1), 97–112. https://doi.org/10.20506/rst.34.1.2347

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