**PhD studentship Project information**

**Funding Source:** CENTA DTP

**Proposed start date:** 25th September 2023

**Closing date for applications:** 11th January 2023

**Eligibility:** UK/International

**Department/School:** Genetics

**Supervisors:** PI: Prof. Eamonn Mallon, University of Leicester, ebm3@le.ac.uk

Co-I: Prof. Bambos Kyriacou, University of Leicester, cpk@leicester.ac.uk

**Project Title:** Does diapause alter epigenetic ageing trajectory in insects?

**Project Description :**

**Project Highlights:**

* Why individuals and species age so differently is an unanswered question in evolutionary biology.
* Diapause is an example of senescence plasticity, where the same genetics produces different ageing patterns in an organism
* Using next-gen sequencing the project will measure DNA methylation across the genome of Nasonia and build the first insect epigenetic clock

**Overview :**

Why individuals and species age so differently is an unanswered question in evolutionary biology. Ageing is the combination of DNA, cellular and organ damage leading to a decline in function and increased chance of dying. This project will combine two major themes in the study of ageing; epigenetic clocks and senescence plasticity.

An epigenetic clock is an emergent property of the epigenome which is a better measure of true biological age than chronological age. Epigenetic clocks are used widely through-out biogerontology. Epigenetic clocks are calculated by combining chronological age and epigenetic marks (methylation) on genes to give a better representation of biological age.

Diapause is an overwintering stage in some insects where development is arrested. There are many differences between diapaused insects and non-diapaused members of the same species, including a decrease in ageing during and after diapause. Diapause is an example of senescence plasticity, where the same genetics produces different ageing patterns in an organism.

Nasonia (a small hymenopteran) exposed to short photoperiod and 20 degrees C initially produce offspring which do not go through diapause but then switch to producing diapause bound offspring by day eight of laying. When they are seven days old, the nondiapaused larvae will begin to pupate and continue their normal development. The diapaused offspring remain suspended as larvae for up to eighteen months. DNA methylation is involved in Nasonia diapause.

Using next-gen sequencing the project will measure DNA methylation across the genome of Nasonia. We will then build the first insect epigenetic clock. We can then compare ageing in diapaused/normal larvae and diapaused/normal adults to see does diapause affect this epigenetic ageing.

This project, by developing an insect model of epigenetic ageing, is ambitious, adventurous and beyond the state-of-the- art. Current invertebrate models of ageing (Drosophila and C. elegans) do not possess DNA methylation, reducing their generality. Future study into diapause as an example of senescense plasticity could allow us to differentiate between various similar theories for the evolution of ageing. If adult ageing is affected by early life experiences this could have wide consequences for understanding life history traits in insects.

**Methodology:**

This project combines whole genome bisulfite sequencing of age controlled larval and adult *Na- sonia vitripennis* and penalised regression analysis to analyse epigenetic ageing in diapaused and non-diapaused *Nasonia*.

**Training and skills:**

The student will be provided with training, as required, in R, a powerful and increasing popular statistical programming language, Python, a general-purpose, high-level programming language widely used in bioinformatics, molecular biology and Nasonia husbandry.

Training will also be provided in the preparation of NGS libraries. The student will also become conversant with general molecular biology techniques such as PCR, qPCR and cloning.

**References:**

Horvath, S. DNA methylation age of human tissues and cell types. *Genome Biol* **14**, 3156 (2013). <https://doi.org/10.1186/gb-2013-14-10-r115>. The original paper that discovered epigenetic clocks in humans.

Pinho, G.M., Martin, J.G.A., Farrell, C. *et al.* Hibernation slows epigenetic ageing in yellow-bellied marmots. *Nat Ecol Evol* **6**, 418–426 (2022). <https://doi.org/10.1038/s41559-022-01679-1>. A paper showing a very clear effect of mammalian hibernation on epigenetic ageing.

**Funding details:**

NERC CENTA studentships are for 3.5 years and are funded by NERC. In addition to the full payment of your tuition fees, you will receive the following financial support:

* Annual stipend, currently set at £17,668 (2022/3 – new figures to be confirmed spring 2023)
* Research training support grant £8,000 (RTSG)

\* If you do not meet the criteria for UK Fees you will need to fund the difference between UK and International fees for the duration of your studies.

\* A limited number of top up studentships to fund the difference between UK and International fees may become available but are not guaranteed.

For more details of the CENTA consortium please see the CENTA website: [www.centa.org.uk](http://www.centa.org.uk) .

**Entry requirements:**

Applicants are required to hold/or expect to obtain a UK Bachelor Degree 2:1 or better in a relevant subject or overseas equivalent.

The University of Leicester [English language](https://le.ac.uk/study/research-degrees/entry-reqs/eng-lang-reqs) requirements apply where applicable.

**Application advice:**

To apply please refer to

<https://le.ac.uk/study/research-degrees/funded-opportunities/centa-phd-studentships>

With your application, please include:

* CENTA Application form - available to download on the How to Apply section of the above link
* CV
* Personal statement explaining your interest in the project, your experience and why we should consider you
* Degree Certificates and Transcripts of study already completed and if possible transcript to date of study currently being undertaken
* Evidence of English language proficiency if applicable
* In the reference section please enter the contact details of your two academic referees in the boxes provided or upload letters of reference if already available.

In the funding section please specify that you wish to be considered for Ref CENTA2-GENE1-MALL

In the proposal section please provide the name of the supervisors and project title (a proposal is not required)

**Project / Funding Enquiries to:** **CENTA@le.ac.uk** **or** Eamonn Mallon ebm3@le.ac.uk

**Application enquiries to** **pgradmissions@le.ac.uk**

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