

**PROJECT TITLE: Evolution and genomics of mortality and senescence in tetrapods**

**DTP Research Theme(s): Living World**

**Lead Institution: University of Bath**

**CASE Partner: Species360**

**Lead Supervisor: Dr Araxi Urrutia, University of Bath, Milner Centre for Evolution**

**Co-Supervisor: Dr Pablo Orozco-terWengel, Cardiff University, School of Bioscience**

**Co-Supervisor: Prof. Tamas Szekely, University of Bath, Milner Centre for Evolution**

**Project Enquiries: a.urrutia@bath.ac.uk**

**Project Background**

Though death is certain for all, there are marked differences in patterns of ageing and mortality between animal species. Sex specific mortality patterns have been observed in several species but what explains these differences at the molecular level is unknown.

With endothermy, larger brains and high metabolic rates, compared to other tetrapod groups, birds share many of the challenges mammals face in expanding their life expectancy. Although some aspects of the genomic features associated with increased life expectancy in mammals have been explored, genomic mechanisms of mortality patterns in birds have yet to be explored.

**Project Aims and Methods**

We propose to calculate mortality patterns and estimate of life expectancy and analyse fully sequenced genomes 360 species of birds and transcriptomes of 20 bird species. This data will be used to conduct a comparative analyses of gene family size evolution, sequence evolution, gene expression and co-expression network analyses in the first systematic analyses of the forces and genomic mechanisms driving the evolution of senescence. By performing equivalent analyses in over 50 mammalian species and over 15 reptile and amphibian species, we will be able to establish the differences parallelisms in the molecular pathways recruited in the complex adaptations required for the evolution of increased life expectancy in both mammals and birds.

Our study will constitute the most comprehensive study, first in birds and largest in mammals, of genomic mechanisms underlying mortality in animals. The results obtained will increase our understanding of causes mortality and of gender differences in mortality in animals. Importantly, findings will have implications for conservation efforts for improving the health of captive and free-living animals and for improving human health.

This project brings together four top teams with complementary expertise in functional genomics (Dr Urrutia), evolutionary genomics (Dr Orozco-terWengel), demography (Dr Conde) and life history evolution (Prof. Szekely).

**Candidate Requirements**

This project is ideal for those interested in evolution, mortality, ageing and senescence, evolutionary genomics, comparative genomics, functional genomics. Experience in, or interest in gaining expertise in bioinformatics, R and python programming and statistics is highly desirable. A first degree in biosciences, computer science or statistics would be ideal for this project.

## CASE Partner

Importantly, this project benefits from our CASE partner, Species360, a global dataset that holds 7 million records that include demographic information for over 24,000 species. Crucially, Species360 is partnered with a large network of zoos worldwide feeding data on health, morphology and mortality. By having a close relationship and spending time at Species360, the student will get first-hand experience on the work and activities of non-for profit organisations aiming to support conservation. This massive database is an untapped source for studies on life expectancy senescence. Dr Conde is the Chief Director of Species360.

## Training

This project will allow the successful student to gain expertise in evolutionary biology, ageing biology, bioinformatics, R and python programming as well as communication skills, scientific writing. The collaborative nature of this work across institutions and with a non-for-profit organisation will allow the student to build project management and organisational skills. NERC DTP funded students will have access to a wide range of training opportunities relevant to their project as well as transferable skills.

Dr Urrutia has an established research group and has supervised to graduation ten students in the last ten years who have gone on to secure jobs at other top institutions including Oxford and Cambridge Universities, The Sanger Centre and The Roslin Institute. The other two members also have extensive experience in successful supervision of PhD students. Dr Urrutia and Prof. Szekely have successfully co-supervised three students in the past.

## References / Background reading list

Bush SJ, ... Urrutia AO. 2017. Alternative splicing and the evolution of phenotypic novelty. *The Philosophical Transactions of the Royal Society B* 372: 20150474

Biscarini F, Cozzi P, Orozco Ter Wengel P. 2018. Lessons learnt on the analysis of large sequence data in animal genomics. *Animal Blood Groups and Biochemical Genetics* 49(3), pp. 147-158.

Eberhart-Phillips L, ... Székely T, ... Krüger, O. 2018. Demographic causes of adult sex ratio variation and their consequences for parental cooperation. *Nature Communications*.9, 1, 1651

## 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](mailto: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>.**