Undergraduate Research Experience Placement Scheme with the OneZoo CDT

Funded by The Natural Environment Research Council (NERC)

The NERC Research Experience Placement (REP) scheme is intended to encourage students to consider a career in the environmental sciences through funding to support 6-week summer placements paid at the National Living Wage for undergraduate students. Students will carry out research projects within the environmental sciences and should express an interest in pursuing an environmental sciences career.

We particularly welcome applications from student groups that are typically underrepresented within the Higher Education pathways. These could include (but are not limited to) students from ethnic minorities, those with a disability or from low-income backgrounds.

General Eligibility for undergraduate students

Students are subject to eligibility criteria to be able to apply for NERC REPs and must be:

1. Undertaking their first undergraduate degree studies (or integrated Masters).

Note: students in their final year who have graduated and no longer have student status at the time of the placement start are not eligible.

And

2. Eligible for subsequent NERC PhD funding (see the relevant text in the UKRI Terms and Conditions for Training Grants and associated guidance for further information https://www.ukri.org/publications/terms-and-conditions-for-training-funding/).

Application Process:

Read the full descriptions of each project (from page 2 onwards in this document & at www.onezoo.uk) and contact the supervisory team for any further information.

↓

Choose your project(s) (maximum of 3 separate applications) and complete the form: https://app.onlinesurveys.jisc.ac.uk/s/cardiff/nerc-research-experience-placement-student-application by **Monday 20th May 17:00 pm**

↓

Attend an interview with the OneZoo CDT

Project Title: The new plastic age: assessing the claims of degradability and ecotoxicology of bioplastics in freshwaters.

Supervisor: Dr Numair Masud masudn@cardiff.ac.uk (co-supervised by Professor Jo Cable)

Start Date: 8th July 2024 (flexible)

Project Description: Development of bio-based polymers (commonly termed bioplastics) is a key initiative in tackling petrochemical plastic pollution. Bio-based polymers, notably, polylactic acid (PLA), Polyhydroxyalkanoates (PHAs) and more recently blends constituting seaweed and bamboo have shown promise in being more degradable than traditional petrochemical plastics, with some evidence that they may be less toxic than the latter. However, as the number of bio-based formulations are steadily rising the use of functional additives (e.g., UV stabilisers, flame retardants and antioxidants) within polymers remains largely untested for their effects on the final product degradability and any potential organism toxicity as industries do not release details of such formulations due to patenting concerns. Therefore, for bioplastics to make a sustainable difference in replacing petrochemicals from an ecotoxicological perspective, up and coming bioplastic formulation, especially with additive use must be tested for degradability and toxicity.

This summer project will assess the degradability and ecotoxicity of seaweed-based plastics and their additives using state of the art-weathering chambers and a freshwater invertebrate model, *Daphnia magna*. Specific aims:

1) Assess degradability: exposing seaweed-based plastic to weathering chambers (including freezing/thawing cycles, UV exposure and rain simulations) and assess changes in molecular mass using nuclear magnetic resonance (NMR) spectroscopy.

2) Assess toxicity: exposing seaweed formulations to D. magna for standard ecotoxicology analysing: 21- day fecundity and survival analysis.

Desired skills: The ideal candidate will be passionate about freshwater security, including the state of water quality for humans and animals, particularly in relation to the impact of eco-toxins on freshwater organism welfare. Ideally the student will have expressed interest or have direct experience with interdisciplinary research, specifically bioscience and chemistry.

Project Title: Roadkill as sentinels for zoonotic disease

Supervisor: Dr Sarah Perkins perkinss@cardiff.ac.uk (co-supervised by Sarah Raymond)

Start Date: 24th June 2024 (flexible)

Project Description: Wildlife-vehicle collisions (WVCs) are one of the leading anthropogenic causes of wildlife mortality, globally numbering 100's of millions of animals. Although often under-utilised, these animals can provide insights into species distributions, population trends, animal behaviour, and importantly, wildlife disease (Schwartz et al. 2020). Roadkill can offer a non-invasive and relatively low-cost option for monitoring the spread of pathogens in wildlife and importantly can provide access (with the appropriate licencing) to rare, elusive and otherwise hard to sample species. Species identification and their locations are registered by multiple WVC-monitoring projects across the world (Shilling et al. 2020), providing opportunities for sampling carcasses for disease. These roadkill samples have already been used, for example, to identify an East-West divide in *Toxoplasma gondii* distribution in the UK using European otter, *Lutra lutra* samples (Chadwick et al. 2013); to estimate the distribution of *bovine tuberculosis* (bTB) in European badgers *Meles meles* and other mustelids (Delahay et al. 2007; Schroeder et al. 2020); and to provide insights into a whole range of other wildlife diseases such as chronic wasting disease in mule deer *Odocoileus hemionus* (Krumm et al. 2005) and devil facial tumour disease in Tasmanian devils *Sarcophilus harrisii* (Hawkins et al. 2006; Pye et al. 2016). Many of these diseases are zoonotic: those that 'spillover' from non-human species to humans. Indeed, more than 60% of human pathogens are zoonotic in origin (Rahman et al. 2020), and so using roadkill as sentinels for zoonotic disease could offer a unique surveillance method (Schwartz et al. 2020). The extent to which roadkill is already being used and could be used in future for this purpose has, however, not yet been quantified.

This project will involve carrying out a meta-analysis of previously published work to quantify the diversity of host species and their associated zoonotic community that has been assessed using roadkill animals. We will also identify the most common roadkill species within a given country and these species' potential role as sentinels for specific zoonotic pathogens. The outputs of this research project will provide a valuable first step for assessing how roadkill might contribute to monitoring and surveillance of zoonotic diseases. The successful candidate will learn how to carry out detailed literature searches and collate quantitative data therein and use existing standards for evidence synthesis from the Collaboration for Environmental Evidence (CEE) and established meta-analysis guidelines (PRIMSA). They will also develop their analytical and critical thinking skills and will advance both their written and oral communication skills. The candidate will work within a diverse and inclusive team: The Road Lab team, and will gain experience of general project management (database management, social media monitoring, liaising with the media etc.) The candidate will also be part of a larger research group covering diverse topics across ecology and disease specialisms, attending regular weekly meetings and gaining support from both postgraduate students and supervisors.

Desired skills: An interest in wildlife ecology and/or parasitology and disease. Proficiency in Microsoft Office (including Excel). Basic knowledge of R and/or R Studio. Good written and communication skills.

Project Title: Reeling in the risks: Assessing the non-target effects of pesticides using a freshwater fish model system

Supervisor: Stephen Cheung (PhD Student) cheungs5@cardiff.ac.uk (co-supervised by Dr Ben Ward, School of Chemistry)

Start Date: 15th July 2024 (flexible)

Project Description: Veterinary medicines are needed to prevent and manage the spread of disease in livestock and companion animals. However, while considered an emerging contaminant, the impact that pharmaceutical pollution has on wildlife and the environment is largely understudied. For ingested medicines, most of the active ingredient and the metabolites are excreted in urine and faeces, while those that are administered externally can wash off from rain and physical contact. Pharmaceuticals are not effectively removed using traditional wastewater treatment methods, increasing the likelihood of pharmaceutical pollution in the environment.

Diazinon is the active ingredient that has been banned for use in household pesticide sprays due to concerns for human health. It is not banned, however, for use in the agricultural industry and is still widely used in sheep dip products to protect livestock from fleas, ticks and other ectoparasites. While not much is known on the risk to the environment, Diazinon has been identified as a chemical of concern by government and environmental agencies.

The aquatic environment can become contaminated directly from untreated wastewater and agricultural and urban water runoff and indirectly from diffuse pollution. The health and welfare of fish is at risk when exposed to pollutants in the water sometimes resulting in reduced growth, altered behaviours and increased disease susceptibility. This is particularly worrisome for the aquaculture and fishing industries where disease and reduced yields causes great losses every year. Many growing populations rely on seafood to maintain a healthy diet and provide vital nutrients.

This project will utilise the established guppy-*Gyrodactylus* host-parasite system to assess the impact of Diazinon on a freshwater fish and ectoparasite. The student will design an experiment under Home Office regulations that explores how the welfare and disease susceptibility of fish changes when exposed to a commonly used pesticide. Here the student will learn skills in experimental design, fish husbandry, Home Office regulations, microscopy, parasitology and statistical analysis using R. This project will also look at using analytical chemistry techniques such as High-Performance Liquid Chromatography (HPLC) to detect how the parent compound breaks down into different metabolites under environmental conditions.

Desired Skills: This project would suit someone with an interest in biosciences, specifically aquatic ecology. No specific experience is needed, however the student should have a willingness to learn, be highly motivated and able to work both independently and in a team. Good time management and communication is essential for this project.

Project Title: Male reproductive health in Eurasian otters

Supervisor: Chloe Farrington (Otter Project Officer) farringtonc@cardiff.ac.uk (co-supervised by Dr Elizabeth Chadwick)

Start Date: 17th June 2024 (flexible)

Project Description: The Cardiff University Otter Project is a nationwide scheme that has been collecting otters found dead for post-mortem examination for 30 years. The otter is a European protected species, and acts as a sentinel of freshwater health. Data and samples are used in a wide range of research, while information on carcass locations is used to guide conservation.

The most recent Otter Survey of Wales noted a decline in otter signs, suggesting a decrease in the number of otters in Wales. This is the first decline recorded in Wales since the national surveys began (Kean & Chadwick 2021). To investigate potential causes of this decline we are assessing a range of health indicators using our tissue bank archive, with the long-term goal to test these metrics for associations with e.g. chemical contaminants, other health indicators, and population decline.

Specifically, this project will involve developing methods to examine male reproductive health and development in dead otters. The student will review methods to determine sperm count in the testis and epididymis and will use staining and microscopy to test whether we can detect changes in the characteristics of sperm between males at different stages of maturity, in samples that have been frozen for up to thirty years. The student will evaluate whether length of storage, and method of sample preparation (homogenised versus non-homogenised tissues) impact the robustness of these methods.

The student will be trained in statistics using R and GIS, and microscopy. They will also have the opportunity be trained in postmortems to continue adding to the Otter Project's long term sample archive, as well as fieldwork surveying for otters, and genetic techniques. The student will have scope to plan and conduct the research project from initial literature review and experimental planning to data analysis and discussion.

Desired Skills: The candidate will be studying a biology or ecology related degree. They should have an interest in pathology, reproductive health, experimental design and data analysis. They should be self-motivated, hardworking, and independent.

Project Title: eDNA quantification of fish pathogens

Supervisors: Dr Elissavet Arapi arapie@cardiff.ac.uk (co-supervised by Dr Beth Mansfield and Prof Jo Cable)

Start Date: 17th June 2024

Project Description: Over the last few years, eDNA methods have been increasingly used to detect, survey and monitor a range of organisms by capturing environmental DNA (e.g., excretion, mucus layers, abrasions of epithelia tissue, dead cells), as an alternative to traditional field survey methods (Ficetola et al., 2008; Rusch et al., 2018; Taberlet et al., 2012). So far, eDNA studies have mainly focused on free-living organisms in terrestrial habitats, where they have been used for diet analysis, biodiversity inventories and species distribution. In contrast, eDNA monitoring is limited in aquatic habitats, partly due to difficulties such as accounting for fish movement and rapidly changing environmental conditions (Amarasiri et al., 2021; Barnes et al., 2014; Bass et al., 2015; Stoeckle et al., 2017). In recent years, the problem of aquatic infectious diseases has intensified and the need to quantify abundance and diversity of parasites has become critical in order to monitor infection dynamics in aquatic ecosystems (Bass et al., 2015; Huver et al., 2015). Resources needed to monitor fish pathogens, however, are costly and often invasive, typically involving electrofishing, nets or even piscicides (Deiner and Altermatt, 2014; Evans et al., 2017; Sana et al., 2018; Yoccoz, 2012). In contrast, eDNA provides a non-invasive diagnostic tool, for detecting and quantifying infectious agents and their associated hosts in aquatic habitats, as demonstrated, for example, by Robinson et al. (2018). They successfully used eDNA to identify and quantify *Aphanomyces astaci*, responsible for crayfish plague in the UK endangered native crayfish (*Austropotamobius pallipes*) and the invasive signal crayfish (*Pacifastacus leniusculus*) (see Robinson et al., 2018).

The first study that used eDNA to monitor gyrodactylids was in 2018, where *Gyrodactylus salaris* infecting Atlantic salmon (*Salmo salar*) and rainbow trout (*Onchorhynchus mykiss*) were found in the Norwegian Drammen watercourse (Rusch et al., 2018). From these studies, it was concluded that eDNA is an efficient way of monitoring gyrodactylid parasites and suggested that it should be incorporated into future monitoring protocols.

The current study aims to use eDNA to detect and quantify *Gyrodactylus turnbulli* parasites on their associated guppy (*Poecilia reticulata*) host in laboratory conditions, in an attempt to create a reliable detection method, that could potentially be applied to study experimental co-infections. To remotely detect and quantify *G. turnbulli* parasites infecting their guppy host, this study was planned in two phases. First, development of an easy and reliable method of eDNA collection. Second, laboratory validation of the method, where qPCR quantification is applied to confirm parasite burden of the fish as well as detect possible co-infectious of the cryptic *Gyrodactylus* species.

Desired Skills: This project would suit someone with an interest in biosciences, specifically aquatic ecology. The student should have a willingness to learn, be highly motivated and able to work both independently and in a team. Good time management and communication is essential for this project. Any experience in molecular skills (such as DNA extraction and PCR) would be beneficial.

Project Title: From birds to bovines: identifying Mycobacteria in the shared farm environment

Supervisor: Joanna Pallister (PhD Student) pallisterjl@cardiff.ac.uk (co-supervised by Prof Jo Cable)

Start Date: 1st July 2024 (Flexible)

Project Description: The Mycobacterium genus encompasses over 190 described species. Among them are members of *Mycobacterium tuberculosis* complex, notable for their significance as human and animal pathogens. Additionally, there are environmental non-tuberculosis mycobacteria (NTM), increasingly recognized as significant causes of opportunistic infections. These NTM infections may also impact the sensitivity and specificity of tuberculosis (TB) diagnostic tests. TB is of One Health importance as it affects both humans and wild and domestic animals (with transmission between different animal species possible), and has significant health, social and economic impact globally.

Consequently, a One Health approach with multiple sectors working together is needed to tackle TB. Policies to eradicate TB have been initiated on both a global and national level. Bovine TB (bTB) is one of the key animal health issues facing the UK where bTB incidence is the highest in Europe, with the Southwest of England and parts of Wales particularly affected. The TB Eradication Programme in Wales aims for the country to be declared officially free of bovine TB by 2041. Whilst progress is being made across parts of the United Kingdom, deep-seated pockets of infection in parts of Wales and Southwest England may hinder eradication. Bovine TB eradication is complicated by several factors including the limited sensitivity of diagnostic tests and the presence of wildlife reservoirs, such as badgers in the UK. Exposure to environmental *Mycobacterium* species may further complicate eradication by effecting diagnostic test sensitivity and specificity. For example, it has previously been shown that *M. avium* interferes with diagnosis of *M. bovis* in calves experimentally infected with both bacteria. This masking of TB diagnosis could increase residual disease on the farm leading to subsequent herd breakdowns. Badgers are the main wildlife maintenance host of *M. bovis* in the United Kingdom, and increasing evidence suggests that transmission between badgers and cattle occurs through a contaminated shared environment rather than direct contact. Hence, biosecurity improvements including restricting access to the farm by wildlife, are recommended to reduce the risk of bTB in cattle.

This project will explore the role of the contaminated shared environment in bovine TB maintenance on farms in the United Kingdom. Cattle farms will be visited for sample collection and to carry out wildlife surveys. Samples will be collected from areas of the farm environment that pose a high risk of cattle exposure to mycobacteria, such as water and feed troughs, and bedding. Wildlife surveys will aim to gain knowledge on wildlife visitors to the farm, including birds, badgers, deer, rabbits and rodents. Environmental samples will be analysed at Cardiff University by DNA extraction and qPCR.

Desired Skills: This project would suit a student studying a degree in biological sciences (undergraduate or integrated masters), particularly in subjects related to animal health, microbiology, wildlife ecology, and environmental health. We are seeking a student who is highly motivated, reliable, and a great communicator (both written and verbal). The student should be happy to work independently and in a team and be able to seek help when needed. No prior research experience is expected – enthusiasm and a readiness to learn are required.