MANCHESTER 1824
The University of Manchester

BBSRC Doctoral Training Partnerships

BBSRC Research Experience Placements Summer 2023

Supervisor	Project Title (further details below)
Dr Patrick Gallois	Use of DNA barcoding for identification of plant species
Dr Tucker Gilman	How does anthropogenic noise affect note use in birdsong?
Professor Holly Shiels	Micro and Nano plastic toxicity in freshwater fish
Dr Dongda Zhang	Constructing a metabolic flux based mathematical model to simulate CHO cell lines for recombinant protein production

Supervisor Details	Dr Patrick Gallois Enquiries: patrick.g.gallois@manchester.ac.uk 0161 275 3922
Project Title	Use of DNA barcoding for identification of plant species
Project outline	DNA barcoding has become an invaluable addition to our tools to understand life. Botanical collections represent an important biological resource supporting a range of subjects: from biotech to evolution and climate change. FIRS Botanical Gardens host the largest botanical collection available at The University of Manchester and require proper identification and cataloguing of collections for use in future research. Part of the collection is a diverse range of Asphodeloideae, some of which are threatened species in the wild (Grace et al., 2013). Despite the potential importance of this collection, clear identification and cataloguing of the accessions are lacking. Using molecular methods, we will identify which species are present in this collection, assess the efficacy of various markers for species identification, and leave a legacy DNA collection for future experiments. **Student development** This project will demonstrate the importance of DNA barcoding for plant studies and motivate students to enter a research career in plant sciences. Furthermore, this project is an introduction to the use of molecular methods that are important for a range of biological research fields, including PCR, DNA extraction and storage, and safe chemical handling. The student will also be shown bioinformatic analysis (sequence alignment and BLAST searches) that are of broad use. This molecular work will be supplemented with an introduction to morphological identification. From this work, we intend to publish a short paper which will develop the student in terms of scientific writing and the publishing process.

	Broader impact The student results will be published to the wider scientific community. The resulting DNA collection will fit in a larger project to collect DNA and catalogue the collection at FIRS. Demonstrating published outcomes and student development at FIRS will help to secure further funding for the facilities at FIRS from the university in the future.

Supervisor Details	Dr Tucker Gilman Enquiries: tucker.gilman@manchester.ac.uk 0161 275 1544
Project Title	How does anthropogenic noise affect note use in birdsong?
Project outline	Exposure to anthropogenic noise is changing the way birds sing. There is strong evidence that birds sing louder and at higher frequencies when the environment is noisy. Birdsong is composed of sequences of notes, and in most species the individual notes can be classified into qualitatively different types. The number and types of notes in a song convey meaning to conspecifics. For example, the number and order of note classes can signal the quality of the singer to potential mates or competitors. There is some evidence that birds may change the note types they use in the presence of anthropogenic noise, and that this might impede communication with conspecifics, but exactly how anthropogenic noise affects note usage is still poorly understood. This project will consist of two parts. First, the student will review the literature on how anthropogenic noise affects note use in birdsong, and prepare a concise report summarising existing knowledge. Second, the student will harvest the extensive body of birdsong data archived with published studies to conduct a meta-analysis on how anthropogenic noise affects the number and diversity of notes in birdsongs. The student will develop skills in bioacoustic analysis; the efficient harvesting, cleaning, and management of big data; and in mixed effects modelling for meta-analysis. The project falls firmly within the BBSRC remit to use computational and statistical models to understand the mechanisms of animal communication. The host lab has prepared a solid foundation for this study, and we anticipate that the internship will lead to a manuscript for peer review with the student as lead author.

Supervisor Details	Professor Holly Shiels Enquiries: Holly.shiels@manchester.ac.uk 0161 275 5092 https://www.research.manchester.ac.uk/portal/holly.shiels.html

Project Title	Micro and Nano plastic toxicity in freshwater fish
Project outline	The river Tame that runs through greater Manchester is the most microplastic polluted riverbed in the world but the impact on the benthic fauna are not well understood. This project would involve investigating microplastic accumulation in fishes collected at different stretches of the river where microplastic burden has already been characterised. The student would learn field work, chemical and enzymatic tissue digestion techniques, and microscopy including bright field, florescence, and IR imaging. Woodward J, Li J, Rothwell J, Hurley R. Acute riverine microplastic contamination due to avoidable releases of untreated wastewater. Nature Sustainability. 2021 May 13:1-0. Hurley R, Woodward J, Rothwell JJ. Microplastic contamination of river beds significantly reduced by catchment-wide flooding. Nature Geoscience. 2018 Apr;11(4):251-7.

Supervisor Details	Dr Dongda Zhang Enquiries: dongda.zhang@manchester.ac.uk 0161 306 5153
Project Title	Constructing a metabolic flux based mathematical model to simulate CHO cell lines for recombinant protein production
Project outline	Developing sustainable bio-manufacturing technologies for pharmaceuticals production is a top priority in growing and advancing the UK's Bioeconomy. Chinese hamster ovary (CHO) cells are the leading production platform for manufacturing protein-based therapeutics, as they possess the appropriate machinery for the synthesis and processing of proteins with large molecular structures and complex humanlike post-translational modifications. However, a significant limitation of CHO cells as a manufacturing platform is their deficient secretory phenotype which leads to protein production that compares unfavourably to cells with a dedicated secretory machinery. To improve process performance of CHO cell lines at larger manufacturing scales, it is of critical importance to investigate the biological mechanisms and overcome the intrinsic limitations of the underlying bioprocess at each level from intracellular metabolism to bioreactor operation through a whole-systems approach.

	In particular, to accelerate the continuous operation of bio-based manufacturing processes, an innovative approach is to apply cutting-edge mathematical modelling techniques to effectively analyse bioprocess data and construct high-fidelity multiscale in-silico models to explore undetermined process knowledge and guide design of efficient CHO cell lines. At present, we have collected substantial experimental data from the CHO cells recombinant protein production processes. This summer research project aims to construct a mathematical model to simulate the intracellular metabolic reaction network and macroscale cells growth kinetics. The model developed will be exploited to discover critical parameters and operation conditions that can maximise total production of the protein, providing guidance for future design of experiments and bioprocess optimisation. We will also provide a range of supervisions to support the student, including: • Assigning a senior PhD student to co-supervise the student; • Having weekly meetings with the supervisor and the PhD student to update progress; • Possibility to present research outcome at the joint research group meeting between the University of Manchester and Imperial College London.