Faculty of Science and Health

Faculty Research Committee
Undergraduate Summer Research Internship Scheme 2019

Project Title: Toxicity assessment in freshwater ecosystems

Principal Investigator: Assist Prof Konstantinos Gkrintzalis

School/Research Centre: School of Biotechnology

Project description

The continuous population increase and consumption of resources has led to a significant impact to the environment as a result of human activities. Therefore, carefully monitoring and safeguarding the ecosystem is of highlighted importance. Traditional approaches for pollution monitoring were mostly based on evidence of the presence of chemicals in the environment. Such measurements are weak and quite limited to their detection but also fail to produce any diagnostic insight or predict any future impact before pollution reaches precarious levels. Therefore, using species as bioindicators enhances our acquisition of meaningful data in relation to the status of the environment.

In this context, I have been awarded a awarded a Starting Investigator Research Grant (SIRG) from Science Foundation Ireland to study the molecular responses of the water flea - *Daphnia magna*, a key species in freshwater ecoltoxicology (Figure 1), upon exposure to different pollutants. However, till this day, culturing and toxicity experiments in these organisms follow dictations of OECD without significant elucidation of the main parameters which also account for using large volumes of media, thereby, increasing time and costs for experimentation. Miniaturisation of culturing and toxicity testing would result in significant benefits considering savings in time, cost and efficiency of the experiments especially in relation to my SFI funded research.

In this project, the student will test a series of chemicals under exposure scenarios exploring the impact of different volumes and vessels to the toxicity testing. The aim is to provide publishable results for the next phase of the SIRG and significantly assist the progress this research. During this internship, the student will be trained by myself and become a member of an interactive research group and the currently 2 students and 1 Erasmus+ working in this field of my research. The project will be divided into work packages as presented in the post description and a constant supply of animals (already established) will guarantee that the student will deliver their project within the specified time schedule. The student will acquire transferrable skills which extend from culturing daphniids and algae (food source of daphniids) and gain experience in toxicity assessment of chemicals in parallel to advancing their statistical analysis and scientific writing. As part of my research group, I have established within short time from my appointment in DCU, a fully functioning *Daphnia* facility, while in light of the SIRG an allocated laboratory space has been granted.

Konstantinos Gkrintzalis Research Description

I am a Biologist with my research focus in Biochemistry and its applications in iverse fields within Biosciences. I have developed several biochemical methodologies for the quantification of biomarkers of oxidative stress [1-3] which I applied in numerous multidisciplinary research projects ranging from microbiology [4] to animal physiology, toxicology and astrobiology [5]. I have previously worked as a Research Fellow at Université catholique de Louvain, and the University of Birmingham and collaborated with prestigious institutions such the NASA Ames Research Centre.

My biochemical background allows me to work in the interphase of different research fields within Biosciences. In 2019 I was awarded a Starting Investigator Research Grant from Science Foundation Ireland, which will establish my independent trajectory in the School of Biotechnology. In doing so, I have so far supervised 4 MSc students, and currently supervise 5 undergraduate students, 1 visiting Eramsus+ student from Greece, and 2 visiting students from Coláiste Dhúlaigh College of Further Education. I take pride in delivering publishable research with undergraduate students since my postdoctoral and PhD Specifically, previous work from undergraduate projects was published in prestigious journals such as Free Radicals in Biology and Medicine, Ecotoxicology and Environmental Safety and Nature Communications. In addition, I was a tutor in the Advanced Techniques in Free Radical Biology practical course organized by the Federation of European Biochemical Societies in 2010, and I participated in the Spaceward Bound program organized by NASA. This program which brings classroom teachers in authentic planetary analogue fieldwork, side-by-side with NASA scientists was a valuable opportunity as from this interaction, teachers bring their experience back to their classrooms and assist in the development of curriculum related to human exploration of remote and extreme environments.

I was initially employed on a temporary contract as an assistant professor in the School of Biotechnology and I continue as an SFI funded researcher group leader in the School.

1. **Grintzalis K.**, Papapostolou I., Zisimopoulos D., Stamatiou I., Georgiou C.D. (2014): Multiparametric protocol for the determination of thiol redox state in living matter. Free Radical Biology and Medicine 74:85-98. **Citations: 1** PMID: 24996203 **IF: 5.784**
2. **Grintzalis K.**, Zisimopoulos D., Grune T., Weber D., Georgiou C.D. (2013): Method for the simultaneous determination of free/protein malondialdehyde and lipid/protein hydroperoxides. Free Radical Biology and Medicine 59:27-35. **Citations: 13** PMID: 23041350 **IF: 5.784**
3. Georgiou C.D., Papapostolou I., **Grintzalis K.** (2008): Superoxide radical detection in cells, tissues, organisms (animals, plants, insects, microorganisms) and soils. Nature Protocols 3:1679-1692. **Citations: 39** PMID: 18846095 **IF: 9.646**
4. **Grintzalis K.**, Vernardis S.I., Klapa M.I., Georgiou C.D. (2014): Role of oxidative stress in Sclerotial differentiation and aflatoxin B1 biosynthesis in *Aspergillus flavus*. Applied and Environmental Microbiology 80:5561-5571. **Citations: 21** PMID: 25002424 **IF: 3.668**
5. Georgiou C.D., Sun H., McKay C.P., #**Grintzalis K.,** #Papapostolou I., #Zisimopoulos D., #Panagiotidis K., Zhang G., Koutsopoulou E., Christidis G., Margiolaki I. (2015): Evidence for photochemical production of reactive oxygen species in desert soils. Nature Communications 11:7100. **Citations: 2** PMID: 25960012 **IF: 11.329**
6. #Martirosyan A., #**Grintzalis K.,** Polet M., Laloux L., Schneider Y.J. (2016): Tuning the inflammatory response to silver nanoparticles via quercetin in Caco-2 (co-)cultures as model of the human intestinal mucosa. Toxicology Letters 253:36-45. **Citations: 4** PMID: 27113704 **IF: 3.522**

Post description

Project title: Toxicity assessment in freshwater ecosystems

The continuous population increase and consumption of resources has led to a significant impact to the environment as a result of human activities. Using species as bioindicators enhances the acquisition of meaningful data in relation to the status of the environment. Among the aquatic organisms, the water flea - *Daphnia magna*, has gained significant interest in ecology and ecotoxicology due to their wide geographical distribution, central role in food webs, and adaptation to a range of habitats and sensitivity to anthropogenic chemicals. Daphniids are easily maintained under laboratory conditions, and *Daphnia magna* is with *Daphnia pulex* the most commonly species in the order of Cladocera used in ecotoxicology, with a significant amount of genomic interest acquired (Figure 1).

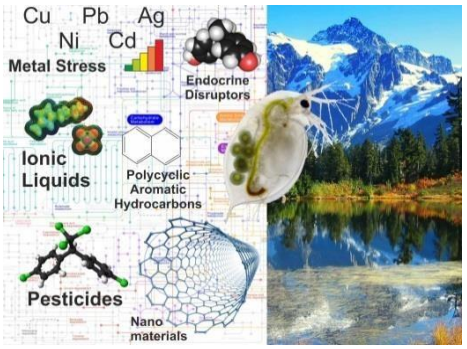

Figure 1. *Daphnia magna* is used extensively in ecotoxicology.

In this project the student will learn how to culture this model organism and how it can it is used for risk assessment in ecotoxicological studies. Considering acute toxicity tests in *Daphnia* species, neonates (newborns) are often used, however, we will be focusing on the differences in toxicity during growth of daphniids, to discover how their physiology is perturbed upon different exposure conditions such as volume and vessel type and material. Our preliminary results show that there is an impact and miniaturization of toxicity testing to allow more robust and reproducible results has never been explored or reported so far. The student will initially generate toxicity data and following spot check chemicals for their toxicity impact upon different exposure scenarios. The student will work as part of a dynamic group and assist in daily animal handling and experimentation while gaining significant research experience and transferrable skills.

The project will be divided into the following work packages.

Week	Task
1-2	Training to work under good laboratory practice. Training for the methods employed.
3-4	Development and optimisation of a culturing and test protocol based on previous results.
5-6	Determination of dose response growth inhibition curves and decision over the working concentrations.
7-9	Determination of the impact of volume, material and other vessel parameters on toxicity testing.
10	The student will generate a final report and present the results in a publishable format.