ESAI Postgraduate Research of the Year 2021: Irene O'Callaghan, UCC

Irene O'Callaghan is a PhD candidate at University College Cork, funded by a joint Irish Research Council and EPA Government of Ireland Postgraduate Scholarship, and supervised by Dr Timothy Sullivan. She graduated with a BSc (Hons) in Chemistry, and a subsequent MSc in Analytical Chemistry. Her current research aims to elucidate mechanisms underpinning the bioaccumulation of environmental contaminants, and thereby develop a novel biomonitor to improve the analysis of emerging contaminants in freshwater systems.

Irene's research has identified and demonstrated the existence of a relationship between the accumulation of contaminants within organisms and an intrinsic chemical property known as thiophilicity. Thiophilicity is a relatively new concept describing an element's preferential affinity to a sulfur atom over an oxygen atom. This finding offers insight into the reason contaminants have differing ecological fates and risk of trophic transfer; it also provides support for the hypothesis that thiol-containing proteins, called metallothioneins, are responsible for detoxification and bioaccumulation in living organisms. Irene's research has also produced a model describing contaminant bioaccumulation in a moulting crustacean. The inclusion of the moulting process in the model results in periodic depletion of contaminants when the exoskeleton is shed. This can both reduce the effective toxicity to the creature and introduce error into measurements of whole-body concentrations, and an accompanying sampling methodology was developed to overcome these limitations. Ultimately, her research has produced and validated a biomonitoring approach to improve measurement sensitivity and reduce cost of analysis. This approach employs the natural process of bioaccumulation to amplify the concentrations of target contaminants, allowing the instruments to "see" more of the contaminant than through direct measurement of water samples.

Irene has published papers in journals such as Chemosphere, Environmental Pollution and the Journal of Crustacean Biology, as well as widely disseminating her research at national and international conferences, symposia and colloquia. She has carried out policy research for An Fóram Uisce on the topic of legacy sediment contamination in freshwaters. She has served on the Scientific Committee of the SETAC Europe Annual Meeting, and currently serves on the Board of Directors of the Irish Naturalists' Journal and the committee of the Royal Society of Chemistry's Environmental Chemistry Group, where she is also a member of the editorial board of the group's Bulletin. Beyond academic dissemination, Irene shares her research with the wider community as part of various outreach activities.