ESAI Postgraduate Researcher of the Year 2016 – Christopher Finnegan

Christopher Finnegan is a postgraduate PhD student in the third year of his research in enviroCORE, which is the Centre of Research and Enterprise in the Institute of Technology Carlow focusing on environmental research. Work in enviroCORE encompasses bioremediation of landfill leachate, phytoremediation of soil and sediment pollution, environmental terrestrial and aquatic biomonitoring and biomarker development, constructed wetlands for waste management, biomass and bioenergy research, optimisation of biogas production, development of optochemical methods for water quality assessments, water mineralogy, biodiversity and conservation, biological control and invasive plant species studies. Christopher's project is entitled "Bioremediation of tributyltin (TBT) in Irish marine sediments: microbial screening and process optimisation", under the supervision of Dr Guiomar Garcia-Cabellos, Dr Ann-Marie Enright and Dr David Ryan and funded by the President's Fellowship Programme of IT Carlow. Christopher graduated from the Department of Science and Health in IT Carlow with a BSc (Hons) in Industrial Environmental Science in 2014.

Christopher's research focuses on tributyltin (TBT), which is a synthetic organotin compound recognised as the most toxic chemical ever knowingly introduced into the marine environment. Organotins have a wide range of applications with an estimated global production of 50,000 tons per year. This has caused contamination of marine environments largely through leaching of TBT from antifouling paints. Despite the global treaty by the International Maritime Organization that bans the application of TBT based paints since 2003, impacted organisms have not recovered and levels in water still exceed the maximum allowable environmental quality standard of 1.5 ngl^{-1}. This is due to additional pollution pathways such as dumping of dredged marine and freshwater sediment, industrial discharge, cleaning activities in shipyards and the illegal use of TBT paints.

Due to the highly detrimental environmental impact of TBT there is a pressing and urgent need to develop ways to deal with this pollution. Christopher in his project taps to nature-based solutions by searching and screening for TBT-resistant and TBT-degrading bacteria for the treatment of contaminated marine sediment and soil. The aim of his study is to assess the ability of a range of microbial species isolated from sediment and soil to degrade TBT into its less toxic species dibutyltin (DBT), monobutyltin (MBT) and nontoxic inorganic tin (Sn^{4+}). Assays used to screen isolates highlighted six candidate strains which were identified based on biochemical characteristics and 16rRNA sequence analysis and used in TBT biodegradation experiments. The samples were further analysed by gas chromatography mass spectrometry, which accurately measured and identified TBT and differentiated between degradation products (DBT and MBT). Results showed a maximum decrease of ≥70% TBT in liquid samples recovered from batch assays. Furthermore, the phytoremediation capacity of barley and oilseed rape (*Hordeum vulgare* L, and *Brassica napus*, respectively) was investigated to assess the ability of seedlings

inoculated with candidate TBT degrading strains, compared to non-inoculated seedlings, to enhance degradation of TBT in sediment and soil. This research has the potential to produce a commercial product to degrade TBT in sediment and soil and would be of great significance to the field of bioremediation and waste management.