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# Ecosystem function in waste stabilisation ponds: Improving water quality through a better understanding of biophysical coupling

Anas Ghadouani (1), Elke S. Reichwaldt (1), Liah X. Coggins (1), Gregory N. Ivey (1), Marco Ghisalberti (1), Wenxu Zhou (2), Isabelle Laurion (3), and Andrew Chua (4)

(1) The University of Western Australia, school of Civil, Environmental and Mining Engineering, Perth - Crawley, Australia (anas.ghadouani@uwa.edu.au, +618-(0)6488-1015), (2) Centre for Energy and ARC Centre of Excellence in Plant Energy Biology, The University of Western Australia, Australia, (3) 3 Institut national de la recherche scientifique (INRS), Centre Eau Terre Environnement, University of Quebec, Canada, (4) Water Corporation of Western Australia, Australia

Wastewater stabilisation ponds (WSPs) are highly productive systems designed to treat wastewater using only natural biological and chemical processes. Phytoplankton, microbial communities and hydraulics play important roles for ecosystem functionality of these pond systems. Although WSPs have been used for many decades, they are still considered as 'black box' systems as very little is known about the fundamental ecological processes which occur within them. However, a better understanding of how these highly productive ecosystems function is particularly important for hydrological processes, as treated wastewater is commonly discharged into streams, rivers, and oceans, and subject to strict water quality guidelines.

WSPs are known to operate at different levels of efficiency, and treatment efficiency of WSPs is dependent on physical (flow characteristics and sludge accumulation and distribution) and biological (microbial and phytoplankton communities) characteristics. Thus, it is important to gain a better understanding of the role and influence of pond hydraulics and vital microbial communities on pond performance and WSP functional stability.

The main aim of this study is to investigate the processes leading to differences in treatment performance of WSPs. This study uses a novel and innovative approach to understand these factors by combining flow cytometry and metabolomics to investigate various biochemical characteristics, including the metabolite composition and microbial community within WSPs. The results of these analyses will then be combined with results from the characterisation of pond hydrodynamics and hydraulic performance, which will be performed using advanced hydrodynamic modelling and advanced sludge profiling technology.

By understanding how hydrodynamic and biological processes influence each other and ecosystem function and stability in WSPs, we will be able to propose ways to improve the quality of the treatment using natural processes, with less reliance on chemical treatment. This will in turn contribute to the reduction in the cost of operation, but more importantly reduce the impact on the environment (i.e. discharge, GHGs), and increase water quality and the potential for water reuse worldwide.