WIDS2017 Dynamic Landscapes

Proceedings of the Wetlands in Drylands Research Network Conference
Macquarie University, Sydney, Australia, 24-26 July 2017

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ISBN 978-1-74138-454-3

Aquatic ecosystem metabolism in three distinct hydro-geomorphological zones of the Macquarie Marshes, Australia

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Wetlands are ecologically important freshwater systems that play important roles in global cycling of water, carbon and nutrients. Aquatic metabolism – the balance of gross primary productivity of phytoplankton (GPP) and planktonic respiration (PR) in an aquatic system – underpins healthy food webs and habitats in wetlands. Aquatic metabolism is affected by several factors such as water quality, availability of energy and nutrients, as well as changing biophysical conditions in wetlands. Microbial processes such as planktonic respiration and enzyme activity have received less scientific attention compared to larger wetland biota, despite the fact that wetland ecosystems are dependent on the activity and functional attributes of the microorganisms. To address this knowledge gap, this project will study aquatic ecosystem metabolism and enzyme activity related to functional groups of bacteria in three core hydro-geomorphological zones of the Macquarie Marshes, an iconic inland wetland. Representative soil samples were collected from regularly inundated wetland (Zone 1), rarely inundated wetland (Zone 2), and dryland with non-inundated alluvial soils adjacent to the wetlands (Zone 3). Soil samples were inundated under laboratory conditions in mesocosm for 120 hours and GPP and PR were determined from measurements of dissolved oxygen in biogeochemical oxygen demand bottles. Among the three zones studied, no significant difference was found for the mean GPP but the mean PR differed significantly (one-way ANOVA, $P<0.001$). Tukey HSD test showed that the mean PR in Zone 3 was significantly different (higher) from Zone 1 and Zone 2 ($P<0.05$), but there was no significant difference in mean PR between Zone 1 and Zone 2. These results suggest that inundation has an asymmetrical effect on GPP and PR, and higher net primary productivity (GPP-PR) is likely to be realised in wetland zones. Further work will determine microbial diversity and enzymatic activity in the three zones, as well as dissolved organic carbon and nutrient content, and will assess the relationships between ecosystem metabolism, microbial diversity and nutrient content to understand the functioning of the wetland ecosystem. In doing so, the project will assess how the microbial enzymatic activity can be affected by nutrient availability in the wetlands and whether this is linked to the rates of aquatic ecosystem metabolism.

Vegetation status in freshwater wetlands: an eco-hydraulic model for the Northern Macquarie Marshes

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The Macquarie Marshes is a freshwater wetland located in the terminal floodplain of the Macquarie River, in NSW, Australia. The unique mosaic-like vegetation composition of the marshes is organized