WIDS2017 Dynamic Landscapes

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Timothy J. Ralph  Editor
that aquatic biota can impart regarding the health status of a wetland, it is critical that a basic understanding of their dynamics in different wetland types, under various periodicities and hydroperiods is established and developed. From recent field data, we now know that there are significant differences between some wetland types in terms of aquatic flora and faunal composition. This knowledge is important when characterizing successional changes in aquatic biota, in order to relate these shifts to natural abiotic changes and/or anthropogenic perturbations. Clearly our understanding of wetlands in drylands and their ecological role in the landscape is still developing with a number of unanswered questions. For example, how much do we know about the community successional patterns of wetlands in drylands around the world? Is our knowledge regionally, locally or project based? And if so, how can we extrapolate regional or local knowledge into generalisations that can help in regions where there is little or no data to make informed decisions regarding the management of wetlands elsewhere? In this session, we will share our understanding from a South African perspective with regard to the dynamics of ephemeral wetland ecosystems.

Rapid analysis of soil carbon in wetlands, using Laser Induced Breakdown Spectroscopy (LIBS)

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Measuring soil carbon stores and fluxes is important for our ability to understand ecosystem health and carbon sequestration. Soil carbon can be measured in a range of ways, most usually and simply by loss on ignition (LOI) at temperatures from 375 to 850 °C and durations from 0.5 to 16 h, with the application of a conversion factor to convert LOI to organic carbon. The lack of a standard method is not the only complexity; the loss on ignition metric is prone to error as waters of formation are lost from hydrated minerals including salts, clays and other minerals. In field measurements of soil carbon are now possible using Laser Induced Breakdown Spectroscopy (LIBS). Measurements are fast, inexpensive and have reasonable accuracies. Here, we present a measurement program for soil carbon from a wetland in semi-arid central NSW, and we will highlight some of the advantages and pitfalls of using LIBS for measurement of soil carbon.

Contemporary fluvial charcoal supply to floodplain wetlands of the Macquarie Marshes, NSW, Australia

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Fire plays a pivotal role in modifying and shaping the Australian landscape, including floodplain wetlands, which respond dynamically to flooding, fire and geomorphological changes. Buckinghuy Swamp, a key ecological asset in the Macquarie Marshes, has experienced numerous fires in the past. For example, a total of 32 fires occurred in the period 2004-2014 within a ~10 km² zone in and around the wetland, as shown on contemporary satellite imagery (Geoscience Australia Sentinel Hotspot data). However, the volumes of charcoal produced in situ by local fires and that supplied to the wetland from the upstream catchment (i.e. not representative of local fires) are unknown. This
study assesses the fluvial input of macroscopic charcoal (>125 \mu m) associated with sediment from upstream to disentangle these two major sources of charcoal. Sediment was collected from synthetic grass mats that were deployed in the wetland for 7 months to establish the contemporary charcoal flux to Bucklinguy Swamp. Preliminary results show that charcoal counts were highest at site B4 and consistently lower at the three other sites. Sites B1, B2 and B3 appear to yield a consistent fluvial charcoal signal. Charcoal found at B4, near the outlet of the reed bed and with the lowest volume of deposited sediment, may have been remobilised and redeposited from nearby in the wetland, rather than being supplied from upstream. The results showed that B2 and B3 near the terminus of Bucklinguy Creek had the highest volume of deposited sediment (0.74 to 0.98 kg m\(^{-2}\)). The amount of charcoal and sediment deposited near the channel and on the adjacent floodplain was highly variable, probably due to flow attenuation by vegetation (e.g. *Phragmites australis* and *Paspalum distichum*) and differential patterns of sedimentation. The findings from this study will help to provide a baseline charcoal flux (i.e. a background fluvial deposition rate) for Bucklinguy Swamp, which will be used to separate the in situ and fluvial charcoal signal from sediment cores and to determine the historical charcoal signal related to local fires preserved in the wetlands.

Eco-morphodynamics in non-perennial rivers: challenges and opportunities

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Geomorphological analyses are often applied in river management to provide a frame of reference for the state of the physical fluvial habitat template. Recognising that this reference state is neither singular, nor static in its characteristics, processes and behaviour, it is common to evaluate the historical range of variability (HRV) of a river or reach of interest. Common approaches to documenting the HRV involve combinations of i) time-series historical image analysis, ii) reconstruction of past environments using field morphological and stratigraphic surveys, supplemented by chronologies of geomorphic change, and iii) type i and ii analyses of geomorphologically-equivalent systems in ‘better’ condition, to apply space-for-time substitution. These approaches, although well-grounded in observation, may be subject to underdetermination, and can lead to a wide range of incompatible hypotheses. However, they may be valuably supplemented by morphodynamic modelling of the potential range of variability (PRV) in habitat characteristics, given specified historical, prevailing, or likely future flow/sediment feeds. This poster presents an example of such an approach applied to a large non-perennial river system in South Africa, and illustrates some of the challenges that must be addressed for the successful application of eco-morphodynamics in non-perennial rivers. These challenges include i) selecting or developing a modelling framework that is sympathetic to environments with highly variable flow/sediment feeds (at times approaching hyper-concentration), complex and poorly-sorted particle mixtures, patchy and dynamic roughness and bed sediment thickness characteristics (‘rivers’ that are for the most part networks of ‘wetlands in drylands’), and large differences in the inlet and outlet fluxes of water due to transmission losses, ii) accessing field flow and sediment transport data for model calibration and confirmation in rivers that may experience no flow for several concurrent years, and iii) defining, in consultation with ecologists, and extracting from model output, geomorphological metrics of physical habitat quality and diversity, such that changes in geomorphology may be translated into the ecological terms that typically form the basis of river management practice. Examples of such metrics are provided.