Spatiotemporal dynamics of surface water networks across a global biodiversity hotspot

M.G. Tulbure[a], **S. Kininmonth**[b] **and M. Broich**[c]

[a] *Australian Wetlands, Rivers and Landscapes Centre, School of Earth, Biological and Environmental Science University of New South University, New South Wales*
Email: mirela.tulbure@unsw.edu.au
[b] *Stockholm Resilience Centre, Stockholm University*
Email: stuart.kininmonth@stockholmresilience.su.se
[c] *Plant Functional Biology & Climate Change, University of Technology Sydney, New South Wales*
Email: mark.broich@gmail.com

Abstract: The concept of habitat networks represents an important tool for landscape conservation and management at regional scales. However, few studies have quantified the naturally occurring spatiotemporal dynamics of networks with the majority of studies assuming a fixed network structure through time. This can be problematic for aquatic systems which typically show high natural spatial and temporal variability. Here we derived large surface water networks using Landsat data from 1999-2011 over the Swan Coastal Plain (SCP), an area of 36,000km^2 that encompasses a global biodiversity hotspot in the Southwest of Australia and is subject to fast urban expansion, high rates of ground water extraction and a drying climate.

We generated an ensemble of 278 networks (corresponding to each remotely sensed time step during the 13 years of data) at three dispersal distances (500m, 1,000m and 2,000m) approximating the maximum dispersal distance of different water dependent organisms. We assessed the impact of climate variability on network topology metrics. We assessed the resilience of the network by quantifying the impact of removing wetland nodes on network topology according to four different strategies (removing smallest, randomly, least and most connected nodes).

Results showed high temporal variability in network topology metrics. Network connectivity with different maximum dispersal distances varied by an order of magnitude. Number of nodes, number of edges and number of clusters show a highly dynamic seasonal pattern. A decline in connectivity over time can be noted at all three dispersal distances sugegsting that the connectivity of the landscape has decresed from 1999 until 2011, with potential negative consequences for species with limited disperal capacity. Overall the trends in network topology metrics were similar between the dry and wet time steps when removing nodes according to the four different strategies.

Average precipitation in the previous two months explained approximately 70% of the variability in number of nodes. Future work will use downscaled global climate models to forecast changes in surface water network structure under various climate change scenarios and help prioritize surface water bodies in need of conservation for maintaining regional scale connectivity for different groups of organisms.

Keywords: *Surface water dynamics, complex networks, Swan Coastal Plain, remote sensing, Landsat, conservation*