Transitions between ecological regimes in salinising wetlands

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Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution. Chapters Three, Four and Five comprise peer-reviewed journal articles co-authored with Jenny A. Davis and Jane M. Chambers. Chapter Six is a peer-reviewed journal article co-authored with Jenny A. Davis, Jane M. Chambers and Karin Strehlow.

In the case of all chapters, my contribution to the work involved the development of the key ideas, the experimental design, the collection and analysis of the data (field data collected jointly with Karin Strehlow), the development of all new and revised conceptual models, and all chapters were written in full by me.

Lien Sim

It is agreed that in terms of the overall workload for co-authored papers (included as thesis chapters), the relative contributions of each author, in percentage terms, was:

Chapter Three	Sim, L. L.	95%
Sim *et al.* (2006)	Davis, J. A.	2.5%
	Chambers, J. M.	2.5%
Chapter Four	Sim, L. L.	95%
Sim *et al.* (submitted-a)	Chambers, J. M.	3%
	Davis, J. A.	2%
Chapter Five	Sim, L. L.	90%
Sim *et al.* (submitted-b)	Davis, J. A.	5%
	Chambers, J. M.	5%

Chapter Six	Sim, L. L.	95%
Sim *et al.* (in press)	Davis, J. A.	2.5%
	Chambers, J. M.	2.0%
	Strehlow, K.	0.5%

Lien L. Sim   Jenny A. Davis   Jane M. Chambers

Karin Strehlow

"It is now generally admitted by plant ecologists, not only that vegetation is constantly undergoing various kinds of change, but that the increasing habit of concentrating attention on these changes instead of studying plant communities as if they were static entities is leading to a far deeper insight into the nature of vegetation and the part it plays in the world."

Tansley, A. G. (1935). The use and abuse of vegetational concepts and terms. *Ecology* **16**(3):284-307

Abstract

Secondary salinisation has affected large areas of inland southwestern Australia, and in particular, low lying aquatic areas; causing the loss of freshwater submerged macrophyte communities and their replacement by salt-tolerant species. At high salinities, the salt-tolerant macrophyte-dominated ecological regime may be replaced by a regime dominated by benthic microbial communities, further reducing the structural and functional diversity of salinised wetland ecosystems. There is little prospect of restoring salinised systems to a freshwater state, meaning that saline macrophyte-dominated wetlands have a heightened structural and functional importance in this landscape. Prior to this study, little was known about the drivers for change from one ecological regime to another in salinising wetlands or about rates of ecosystem response to these drivers.

This study used experimental and observational data from seven saline wetlands in order to identify some of the potential mechanisms for the transition between the salt-tolerant submerged macrophyte-dominated regime and the benthic microbial community-dominated regime. The applicability of existing conceptual models for ecological regime shifts was then tested against these data. Some of the mechanisms responsible for the formation and maintenance of the macrophyte-dominated regime were explored by examining the effects of salinity on germination and flowering in a series of salt-tolerant submerged macrophytes. The initiation and dominance of benthic microbial communities over a range of salinity and wetting regimes was also examined.

The results suggested that macrophyte communities are unlikely to develop in

seasonally-drying wetlands at high salinities (>45 ppt), but will usually germinate and establish well at lower salinities. It was also predicted that although benthic microbial communities can survive and grow across a wide range of salinities, they are likely to be outcompeted at low salinities by macrophytes or by phytoplankton blooms if water column nutrient levels are high. However, water permanence may facilitate benthic microbial community dominance.

Existing conceptual models of ecological regime transitions, such as the alternative regimes model, did not account for the effect of water regime on the dynamics of seasonally-drying systems. Therefore, a new conceptual model incorporating the interaction between hydrology and salinity in seasonally-drying wetlands was proposed.

Acknowledgments

The last three and a half years have been a journey of discovery for me into the underwater world of saline wetlands and the ancient landscapes of Western Australia. Although focusing on secondary salinisation has been sobering at times, I am constantly amazed and awed by the beauty and resilience of the wetland biota of the southwest and feel grateful to have worked on such amazing systems.

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