UNIVERSITY OF SOUTHERN QUEENSLAND

The effects of patch and landscape factors on the resilience of poplar box (*Eucalyptus populnea* F. Muell.) woodlands, southern Queensland.

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2012

A Thesis submitted for the award of Master of Science

ABSTRACT

Eucalypt woodlands in agricultural landscapes in Queensland have significantly declined in extent and condition in recent years. One particular ecosystem, poplar box (*Eucalyptus populnea* F.Muell.) woodland, has experienced declining tree condition, function and recruitment, which threaten the ecosystem's on-going persistence. To aid the persistence of these systems, knowledge of how agricultural land uses affect their condition, biodiversity and provision of ecological function is required. Most studies of biodiversity and ecological function in agricultural landscapes focus on either the role of characteristics within a patch of vegetation, or occasionally the characteristics of the surrounding landscape, but rarely on these factors in combination. However, studies have shown that both patch and landscape factors can be important and may explain significantly more of the variation in biodiversity, condition and function than patch factors (or landscape factors) alone. This study examines trends in community (floristic composition and stand structure) and population (dominant tree condition and population structure) level processes in relation to both patch and landscape factors, and asks the question: Do both patch and landscape factors contribute to patterns in health of remnant vegetation in agricultural landscapes?

This study uses two complementary approaches; an *a priori* (natural) experiment and a correlative study. To examine the effects of agricultural land uses at the patch scale (patch grazing) and in the surrounding landscape (land use context), an *a priori* design was implemented. Patch grazing (3 levels) was defined by the current (at time of sampling) intensity of grazing at the patch, while land use context (3 levels) was defined by the proportion of cropping and grazing within 5 km of a site. The correlative study utilised various explanatory factors at both patch and landscape scales to explain patterns. These two approaches were used to examine patterns in both community and population factors.

Thirty-three sites were sampled in and around the Condamine Catchment, southern Queensland, according to the *a priori* design. Sites were sampled for floristic composition (including overall vascular plant composition, species richness,

functional group richness and richness transition ratios), stand structure (cover of strata) and disturbance factors. The diameter at breast height (DBH) of all trees, and the condition of adult trees were measured. Bulked soil samples were collected and a range of soil physical and chemical properties determined. ArcGIS was used to determine a range of spatial variables, including the proportions of cropping, grazing and remnant vegetation in the landscape surrounding the site, the distance to a river and groundwater depth.

Two-way analyses of variance were used to compare functional group richness, richness transition ratios, stand structure, tree condition and tree densities within size classes among patch grazing and land use context categories. Differences in overall floristic composition and stand structure among levels of patch grazing and land use context were examined using non-metric multidimensional scaling (nMDS) ordinations and analyses of similarity (ANOSIM) and explained using canonical correspondence analyses (CCA). Overall tree population structure was examined using the frequency distribution of multiple size (surrogate for age) classes. Potential environmental drivers of tree condition and densities within age classes were examined using generalised linear models (GLMs) in a model averaging framework.

Native species richness, C4 species richness, and the C4:C3 richness transition ratio differed among patch grazing categories, while overall floristic composition, exotic species richness and graminoid cover differed among levels of land use context. The interaction between patch grazing and land use context was important for the C4:C3 richness transition ratio and the total cover of trees. Patterns in overall floristic composition and stand structure were best explained by a mixture of environmental variables at both patch and landscape scales such as soil fertility and the proportions of cropping and grazing in the surrounding landscape.

The population age structure of *E. populnea* across the catchment suggests continuous rather than episodic recruitment of young trees. This pattern of recruitment differs to those found in other studies, suggesting changes in recruitment patterns. Mature tree density was the only measure to differ among levels of patch grazing intensity, while tree condition and tree densities within size classes did not differ among levels of land use context. The densities within size classes and tree

condition were mostly driven by both patch and landscape factors, such as soil organic carbon, patch size, the proportion of remnant vegetation in the surrounding landscape, and groundwater depth.

Overall, the study demonstrated that trends in floristic composition, stand structure within poplar box woodlands, and tree condition and population age structure of *E. populnea* may be driven by both patch and landscape factors. As the management of remnant vegetation in agricultural landscape mostly focuses on patch factors, this research highlights the need to take multi-scale factors into consideration.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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ACKNOWLEDGEMENTS

My sincere thanks go to the many people who have been part of this journey with me. First and foremost I would like to thank my supervisor, Dr Andy Le Brocque, for your guidance, support, advice and patience. Without your help and encouragement, I probably would have given up long ago. Thanks also to my associate supervisor, Dr Martine Maron, for your time and advice on statistics and chapter drafts.

I am grateful to all of the staff at the ACSC, for the help, support and making me feel welcome. I would also like to thank all the postgraduates of the ACSC, particularly Rachel Mapperson, Kate Reardon-Smith, Precila Salcedo, Justine Baillie, Peter Wagner, and Jarrod Kath for your friendship, distracting conversations and advice on statistics, mapping and more. Thank-you also to the various Faculty of Sciences administrative and technical staff who were always willing to help me with my studies.

I would like to thank all the landholders, Kim Bremner, Roy Inwood, Malcolm and Dianne Luck, John and Narelle Hoefler, Ross von Pein, Steve and Andrea Skewes, Ben Muirhead and the Wise and Wood families, who kindly gave me access to their properties. I am also thankful to Peter Wagner, Kellie Goodhew, Jarrod Kath, Michael Walker, Rachel Mapperson, Heike Eberhard, and Spencer Rigby for their company and assistance in the field. In addition, I am grateful to Kate Reardon-Smith for your assistance with plant identification and advice on chapter drafts.

This research was supported by a Land and Water Australia Postgraduate Scholarship; the financial support provided has been greatly appreciated.

Finally I would like to thank my extended family, for your support, and for encouraging me to take part in the adventure. In particular my heartfelt thanks go to Michael, for your patience and willingness to keep me company in the field, and for making life outside of university the best it could be.

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