Developing effective habitat restoration strategies for the green and golden bell frog (*Litoria aurea*) through adaptive management.

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Declarations

Originality

I hereby certify that to the best of my knowledge and belief this thesis is my own work and contains no material previously published or written by another person except where due references and acknowledgements are made. It contains no material which has been previously submitted by me for the award of any other degree or diploma in any university or other tertiary institution.

Thesis by Publication

I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written statement from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers.

Signed: Carla J. Pollard Date: 11/08/2017

This thesis consists of an introduction to adaptive management and project overview, followed by five papers, of which three are published and two are unpublished manuscripts, and finally a conclusion summarising the findings of all the papers. Graphs and tables are embedded within the published papers and unpublished manuscripts. References are presented at the end of the introduction/overview and each of the five papers, rather than at the end of the thesis.

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List of publications included as part of the thesis

Chapter 1: Pollard, C. J., Stockwell, M. P., Bower, D. S., Garnham, J. I., Pickett, E. J., Darcovich, K., O'Meara, J., Clulow, J. & Mahony, M. J. (2017). Removal of an exotic fish influences amphibian breeding site selection. *The Journal of Wildlife Management*, 81(4), 720-727.

Chapter 2: Stockwell, M. P., Storrie, L. J., Pollard, C. J., Clulow, J., & Mahony, M. J. (2015). Effects of pond salinization on survival rate of amphibian hosts infected with the chytrid fungus. *Conservation Biology*, 29(2), 391-399.

Chapter 3: Pollard, C. J., Stockwell, M. P., Pickett, E. J., Garnham, J. I., Bower, D. S., O'Meara, J., Darcovich, K., John Clulow, J. & Mahony, M. J. Using adaptive management to evaluate the effectiveness of a disturbance regime in the conservation of a threatened amphibian. (*unpublished*)

Chapter 4: Pollard, C. J., Stockwell, M. P., Bower, D. S., Clulow, J., & Mahony, M. J. (2017). Combining ex situ and in situ methods to improve water quality testing for the conservation of aquatic species. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 27(2), 559-568.

Chapter 5: Pollard, C. J., Bower, D. S., Stockwell, M. P., Pickett, E., Garnham, J. I., Fardell, L., Clulow, J. & Mahony, M. J. Trialling captive breeding and release methods for reversing declines in a wild frog population. (*unpublished*)

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Abstract

Traditional management of species and ecosystems is reliant on the ability to accurately predict the outcomes of management actions. Due to the high level of uncertainty in natural systems, this level of predictability is unlikely to be possible in the vast majority of management situations. Adaptive management is an alternative approach that can be effective regardless of how much is known about the species or system and the way in which it will respond to management, as actions are used as a series of experiments to test hypotheses and build knowledge about the way it functions. I used this approach to investigate the effectiveness of a range of management actions aimed at conserving the threatened green and golden bell frog (*Litoria aurea*), a species which was once common but has experienced large-scale declines since the 1970s. I found that the removal of the exotic predatory fish *Gambusia holbrooki* via pond draining was effective in greatly increasing the reproductive success of this species, and the addition of sodium chloride to increase the salinity of ponds was effective in reducing the prevalence of the pathogenic amphibian chytrid fungus, and in turn increasing *L. aurea* survival. Actions aimed at creating early-successional habitat (the removal of overgrown aquatic vegetation and shade trees) do not appear to be necessary to maintain habitat quality at sites that are dominated by urban or industrial land uses which provide incidental disturbance (though they may still be required to maintain pond function). Population supplementation via the release of captive bred tadpoles had temporary benefits for naïve occupancy and abundance, but it is likely that this strategy can only be effective in the long term if the cause of declines can be