# Ecological differences between rare and common species of microhylid frogs of the Wet Tropics biogeographic region

PhD thesis submitted by

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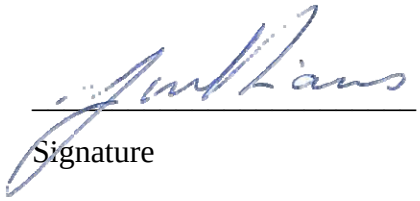

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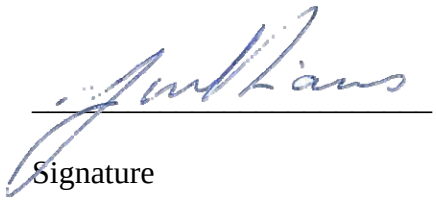

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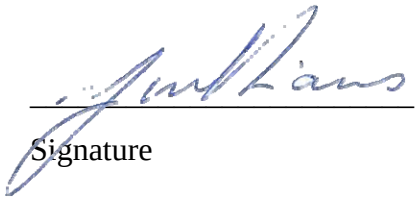

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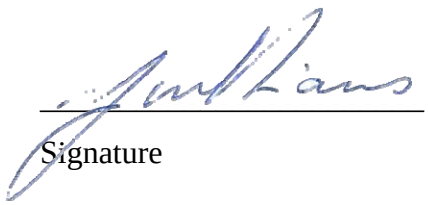
## Statement of contribution of others

Chapter Four in this thesis has been published in collaboration with my supervisors Prof. Christopher N. Johnson, Prof. Ross Alford, A/Prof Michelle Waycott and colleague A/Prof. Steve Williams. Statistic advice has been provided by my supervisors as well as A/Prof. Steve Williams, Dr Jeremy Van DerWal, Dr Rebecca Fisher and Dr Leonie Valentine. Additional data for some analysis was also provided by A/Prof Steve Williams and the Queensland museum. Species distribution maps and range sizes have been used in this thesis with permission of A/ Prof Steve Williams and microhylid species phylogeny has been presented with permission of Dr C. Hoskin. While undertaking this research, I was responsible for the project design, obtaining research funding and permits, collecting field and laboratory data, statistical analysis and interpretation, and synthesis and preparation of manuscripts for submission to peer reviewed journals.

I obtained financial support from James Cook University and the Rainforest Cooperative Research Centre. Funding to present research at conferences was obtained from James Cook University, Rainforest Cooperative Research Centre.

**Declaration on ethics**

All data collected adhered to the legal requirements of Australia, (Scientific Purposes Permit F1/000467/01/SAA) and the ethical guidelines for treatment of animals of James Cook University (Animal Ethics Approval A574_01).



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## Dedication

I would like to dedicate this thesis to the two most significant groups of people in my life:

To my gorgeous Williams family: Steve, Anna, Kyle and Zac - who are my life and give me purpose. I feel blessed every day to be part of your lives. Thank you for supporting and joining me throughout this journey.

To my wonderful Buffett clan: Mum, Dad, Glynn and Charles - no-one could have asked for a better family or childhood. Thank you for your never ending belief in me.

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Finally to my gorgeous and wonderful husband Steve and children Anna, Kyle and Zac, my world would be nothing without you. Thank you for you constant love, the kisses and cuddles, the support and simply being the best part of my life.

**Some things I have learnt along the way……**

"If a short cut truly was a short cut then it would be called "the way""
*Silent Bob*

And……..

"In life it is important to finish stuff"
*Marsha Hines*

## General Abstract

Why some species are rare while others are common remains a much asked question in ecology. As rare species are generally considered to be most extinction-prone, the importance of answering this question is becoming paramount in order to prioritise conservation efforts and resources to the most threatened species. The difficulty in gaining information on rare species which, by their very nature, are low in numbers and often difficult to detect, are just some of the reasons behind the apparent lack of answers regarding determinants of rarity. To further investigate why some closely related species are rare while others are common, this study examined the ecological differences between rare and common species of microhylid frogs in the Wet Tropics, North Queensland Australia. Eleven species of microhylid frog of the genus *Cophixalus* and three from the genus *Austochaperina* are endemic to the region. While some of these species occur across most of the Wet Tropics region, a majority are restricted to single mountain ranges. By comparing the ecological traits of niche breadth, dispersal ability and genetic diversity, in geographically restricted and widespread species, it has provided a more comprehensive understanding of what factors have shaped the patterns of distribution in these species.

The niche breadth of microhylid species was measured using climatic and microhabitat variables. Comparisons of climatic niche among species showed that geographically restricted species do have narrower niche than widespread species, i.e. climate variables explaining more variation in species abundance within their range than topography or vegetation. However when microhabitats of species were described in a smaller subset of six species no relationship of niche breadth and range size was found. Geographically restricted or widespread species were either microhabitat specialists or generalist with no clear trend shown.

The relationship between diet specialisation and geographic range was also investigated as a measure of species niche breath. Although macroecological theory predicts that species with broad niches should have the largest geographic ranges, I found the opposite: geographically

rare species were diet generalists, widespread species were diet specialists. It is argued that this pattern is a product of extinction filtering, whereby geographically rare and therefore extinction-prone species are more likely to persist if they are diet generalists.

The dispersal ability and genetic diversity were compared in a subset of three species to determine if these traits explained restricted, intermediate or widespread distributions. Similar levels of dispersal were suggested across all species however, contra to rarity theory, genetic diversity was found to be higher in the restricted and intermediate species than in widespread. It is suggested that historical habitat stability may have maintained greater genetic diversity in restricted species than in widespread species which have recolonised areas from refugia.

The population parameters of species geographic range size, local abundance and ubiquity were used to generate a Rarity Index (RI – ranging in values between 0 - 1.7). The RI allowed for the comparison of population parameters (used as three axis of rarity) of each species in three dimensional space. No species were found to be rare on all three axis, that is, if a species is geographically restricted then it compensated by being abundant and/or ubiquitous on the other two axis. In fact no species were found to have RI values below 0.8 which suggests that species with lower values may have been more extinction prone and unable to maintain viable populations over time.

It appears that no single ecological trait explains patterns of distribution seen in microhylid frogs. While rare species may be specialist in some ecological traits they compensate by being generalists in other traits, with past history of rainforest expansion and contraction in this region placing strong selection pressure on these species or these traits being left over from previously being more widespread. This may be one of many reasons that geographically restricted and rare species, while considered to be those most prone to extinction, have been able to persist through long geological time periods.

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