

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

PhD thesis submitted by
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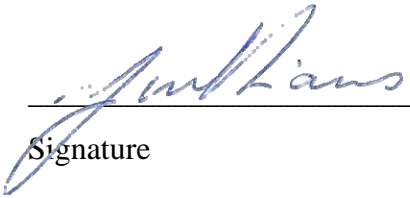
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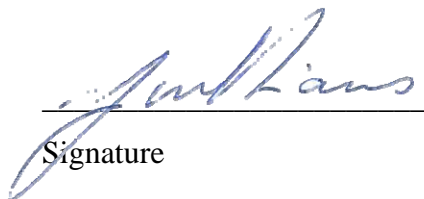
Statement of contribution of others

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.

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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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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.

Table of Contents

Statement of access	ii
Statement of sources	iii
Statement of contribution of others.....	iv
Acknowledgements.....	vi
General Abstract	x
Table of Contents	xii
List of Tables	xvi
List of Figures	xvii
Chapter 1: General Introduction	1
Which species are rare?	1
Small geographic range size	2
Abundance	2
Ubiquity	3
Ecological traits of rare species	3
Niche breadth (environmental, microhabitat and diet)	4
Dispersal ability	5
Genetic diversity	6
How do rare species persist through time?	6
Aims of this study	7
Study animals.....	7
Study region	8
Thesis organisation	8
Chapter 2: Patterns of species richness, abundance, distribution and biology in	
Microhylid frogs of the Wet Tropics, Australia.....	9
Introduction.....	9
Methods.....	10
Measurements	10
Range size estimates, distribution and species richness maps	11
Results & Discussion	12

Morphology.....	12
General ecology	12
Correlations with calling.....	13
Mate choice by females and courtship behaviour.....	15
Nests and clutch size.....	15
Longevity	16
Diet.....	17
Local spatial distribution and site fidelity in calling males	17
Phylogeny	17
Species distribution maps	20
Abundance	23
Species richness	30
Threatening processes.....	33
Amphibian declines	33
Climate change.....	34
Conclusion	34
Chapter 3: Niche breadth in rare and common species of Microhylid frogs: effects of environment and habitat selection	36
Introduction.....	36
Methods.....	38
Study organisms.....	38
Geographic area and niche breadth.....	39
Macro-habitat: environmental correlates of species occurrence.....	39
Meso-habitat: environmental correlates of species abundance within distributions	41
Micro-habitat:	44
Field sites and species.....	44
Results.....	45
Macro-habitat.....	45
Meso-habitat	51
Micro habitat.....	54
Bellenden Ker site.....	54

Atherton Tableland sites	54
Mt Lewis site.....	55
Discussion.....	59
Macro-habitat.....	59
Meso-habitat	59
Micro-habitat.....	61
Environmental niche breadths – a question of scale.....	62
Chapter 4: Niche breadth in rare and common species of Microhylid frogs: effects of diet.....	65
Introduction.....	65
Methods.....	66
Results.....	68
Discussion.....	70
Chapter 5: Comparison of population genetic structure among geographically restricted and widespread Microhylid frogs in the Wet Tropics	73
Introduction.....	73
Methods.....	75
Sample collection.....	75
DNA Extraction and Inter Simple Sequence Repeats (ISSR) amplification	75
Data analysis	78
Results.....	80
Genetic population structuring.....	83
Discussion.....	86
Chapter 6: Extinction filtering shapes patterns of commonness and rarity in Australian rainforest frogs.....	92
Introduction.....	92
A new measure of rarity.....	95
Methods.....	96
Sampling conditions.....	96
Population density.....	96
Geographic range size.....	97

Ubiquity	97
Phylogenetic analysis.....	97
Random distribution of RI values	98
Results.....	98
Discussion.....	102
Chapter 7: General Discussion	105
Summary of major findings	105
Niche breadth - habitat.....	105
Niche breadth - dietary.....	105
Dispersal ability and genetic diversity	106
Extinction filtering.....	106
Variation of ecological traits across species	106
Present threats to microhylid frog persistence	110
Future directions	110
References.....	111
Appendices.....	123
Appendix 1. QHull results for microhylid frog species	123

List of Tables

Chapter 2.

Table 1: Morphometric measurements (mm + SE) and live weight (grams + SE) of <i>Austrochaperina</i> and <i>Cophixalus</i> species occurring in the Australian Wet Tropics.....	14
Table 2: The ranges and abundances per hectare of 14 microhylid species.	23

Chapter 3.

Table 1. The three sets of predictor variables used in the multiple regression analysis to examine the influence of broad-scale habitat characteristics on microhylid abundances.....	42
Table 2: The percentage of geographic space, percentage of environmental space occupied, and the results for calculation of 2 D, 4 D and 8 D hyper-niche volume for 13 species of microhylids.....	47
Table 3: The variance explained using linear multiple regression models on the abundance data within species ranges for 10 microhylid frog species in the wet tropics.....	53
Table 4. Summary table of the macro-, meso-, and micro-habitats of the six microhylid species for which all these scales were measured.....	62

Chapter 4.

Table 1. The number of stomach samples examined, the number of invertebrate orders observed in the diet of each species of <i>Cophixalus</i> , the total geographic range of each species in km and the % of available rainforest occupied by each species.....	67
---	----

Chapter 5.

Table 1: Sites in which samples were taken, central latitudinal and longitudinal position of sites, the number of samples from each population and the overall species estimate of density and range size.....	79
Table 2: Genetic diversity within populations H_w , total genetic diversity H_t and Wright's F_{st} (* means significantly different at 0.05 level) for all species across the 1 km transect and including extra sites (BF and LR) stated separately.....	81

Chapter 7.

Table 1. Summary of the ecological traits investigated throughout this thesis for three species of Microhylid frogs of varying geographic range size.	109
--	-----

List of Figures

Chapter 2.

- Figure 1: The rainforest area of the Wet Tropics biogeographic region spanning from Cooktown to Townsville in northern Queensland, Australia..... 11
- Figure 2: Phylogeny of *Cophixalus* and *Austrochaperina* in Australia based on mitochondrial DNA (from Hoskin, 2004). 19
- Figure 3a to 3l. The distribution of each microhylid species that occurs within the Wet Tropic region (presented with permission of Williams 2006). 30
- Figure 4. The species richness of Microhylid frogs within the Wet Tropics region. Darker colours of red denote areas of higher species richness than lighter colours (Figure from Williams 2006). 33

Chapter 3.

- Figure 1: The Wet Tropics Bioregion with rainforest shown as the shaded area..... 40
- Figure 2: The plot of annual mean temperature and annual mean precipitation for 13 species of microhylid frogs shown as points for their environmental space in which they occupy. . 51
- Figure 3: Plots of the variance explained by axis 1 and axis 2 from NMDS and presence / absence and abundance for a) *C. neglectus* from sites at BK- Bellenden Ker..... 56
- Figure 4. Plots of the variance explained by axis 1 and axis 2 from NMDS and presence / absence and abundance for a) *C. infacetus* and b) *C. ornatus* from sites at AU – Atherton Uplands. 57
- Figure 5. Plots of the variance explained by axis 1 and axis 2 of the NMDS and the presence / absence and abundance of microhylids species a) *C. aenigma*, b) *C. hosmeri* and c) *C. monticola* from sites at CU - Mt Lewis..... 58

Chapter 4.

- Figure 1: The proportions of each invertebrate taxon consumed by each species of microhylid frog 68
- Figure 2: Ordination (multidimensional scaling) using the abundance of different invertebrate taxa in stomach contents of microhylid frogs, to show patterns of similarity in diets. 69
- Figure 3: Relationship between dietary specialisation (evenness in the relative abundance of invertebrate taxa in stomach contents) and range size for the eight microhylid frog species examined. 70

Chapter 5.

Figure 1: The distribution maps for a) *C. ornatus* , b) *C. hosmeri* and c) *C. neglectus* show the sites in which DNA was obtained for the 1 km transect and sites Bartle Frere (BF) and Lamb Range (LR). 77

Figure 2. Genetic diversity within populations compared across populations along the 1km transects, at other sites, and in total for all species a) *C. neglectus*, b) *C. hosmeri* and c) *C. ornatus*. 83

Figure 3: Plots of isolation by distance for a) *C. neglectus* including the population BF from 16 km apart and b) *C. ornatus* including the population of LR from 80 km apart, line slopes and intercepts are in text. 84

Chapter 6.

Figure 1. Species A, B and C plotted in three dimensional space showing how rarity indices were generated from the point of origin to each species' position in 3D space when values were plotted for all three axis of ubiquity, abundance and range size. 95

Figure 2: Correlation of abundance (square root transformed) with ubiquity for 12 species of microhylid frogs with a fitted linear trend line. 99

Figure 3: Correlation of abundance and range size (4th root transformed) for 12 species of microhylid frogs with a linear trend line fitted. 100

Figure 4: Correlation of ubiquity and range size for 12 species of microhylid frogs with linear trend line fitted. 100

Figure 5: Rarity indices for all 12 species of *Cophixalus*..... 101

Figure 6: The distribution of 5000 randomly generated rarity index values (line) compared to those values calculated for microhylid species (solid bars). 101