

Anuran richness and occurrence relative to urbanisation on the Swan Coastal Plain, Western Australia

Thesis submitted for the Honours Degree in Environmental Science,
Murdoch University

Student: Jai Thomas BSc Biology

Supervisor: Dr Joe Fontaine

Submitted 28 October 2013



Litoria adelaidensis, Lake Joondalup. Photo: Jai Thomas

Declaration

I declare this thesis is my own account of my research, and contains as its main content work that has not been previously submitted for a degree at any tertiary educational institution.

.....

Jai Thomas

Word Count

Introduction	3,960
Methods	4,065
Results	1,087
Discussion	2,907
Total (including Abstract)	12,327

Abstract

Anurans are an important component of ecosystems, as they contribute to the transfer of energy between aquatic and terrestrial habitat and act as predators, prey, and herbivores. However, even though urbanisation is acknowledged as a threat to 50% of Australia's endangered anurans, there is little published research on anurans in urban patches in Australia compared to those in undisturbed habitat. This type of research may prove vital to the management of biodiversity within the Perth region, which is currently the fastest growing capital city in Australia, and existing urban remnants may become increasingly important to conservation. The aim of this thesis is to investigate the influence of a modified landscape on anuran occupancy and species richness, incorporating analyses to account for variations in detection probability amongst species within wetlands on the Swan Coastal Plain in Western Australia. Temperature was found to exert a consistent effect on the detection of all species. The observed influence of survey-dependent variables on species detection can aid the design of future surveys of the study species. Occupancy amongst species was best predicted by combinations of road cover and residential area. Interestingly, residential area showed a positive relationship with occurrence, which is most likely due to the changes in hydroperiod that occur within urban wetlands. Species richness was best predicted by both residential and wetland area. Several species were encountered very infrequently during the survey period, which may indicate that these species are limited in their distribution along the Swan Coastal Plain. Projected climate change predicts the loss of surface water groundwater expressions in some areas, which may pose a threat to the local existence of these species. Overall, the findings of this study may inform the future management of anurans within the Swan coastal Plain, and highlights the potential for wetlands to contribute to the protection of biodiversity in an increasingly degraded environment.

Acknowledgements

There are several people who I would like to thank who have contributed to the making of this thesis.

Firstly, I would like to thank Mark Cowan and Ric How, for giving me the time, advice and encouragement that helped considerably in the preparation of this thesis. I would also like to thank Niels Brouwers, for his tutelage in the ways of ArcGIS. Most of all, I would like to thank my supervisor Joe Fontaine. Thanks firstly for taking me on as a student, and secondly for your encouragement and perseverance which enabled me to learn so much throughout this year.

I would like to thank my partner Elysia, for putting up with me, supporting me, and pushing me through the final stages of my thesis; I will forever be grateful. I would also like to thank my parents for supporting me through my undergraduate degree, and also my sister Nic, for her constant support throughout my life.

Lastly, I would really like to thank people who have contributed to my development as a biologist over the last 10 years. Particularly, the many students, post docs and research assistants who came through the Shine lab while I was fortunate enough to work for the great man. Thanks especially to Melanie Elphick, who took me under her wing and taught me a great deal. Last but not least I would like to thank Professor Shine, for giving me the opportunities which enabled me to pursue a career in science. It's very rare that somebody gets to firstly meet somebody they look up to, secondly to work with them and lastly for that person to call you their friend. I will forever be grateful.

Cheers

Jai

Contents

1	Introduction	1
1.1	Urbanisation	1
1.2	Amphibian declines.....	1
1.3	Landscape scale impacts of urbanisation	2
1.3.1	Loss and degradation of vegetation.....	2
1.3.2	Hydroperiod	4
1.3.3	Fragmentation and isolation	6
1.4	Extent and Distribution of Anuran Research in Urban Australia.....	7
1.4.1	The Swan Coastal Plain.....	8
1.5	Why study anurans of the Perth region?	9
1.6	Research aims.....	10
2	Methods.....	11
2.1	Study Area.....	11
2.2	Study species.....	14
2.3	Site selection protocol	15
2.4	Survey protocol	15
2.4.1	Detection covariates	16
2.5	Site covariates	17
2.6	Data analysis	18
2.6.1	Single-Season Site Occupancy Model	18
2.6.2	Species richness.....	21
3	Results.....	23
3.1	Goodness of Fit testing.....	23
3.2	Detection	23
3.3	Occupancy.....	25
3.4	Species Richness	29
4	Discussion	32
4.1	Detection	32
4.2	Species occupancy and richness.....	34
4.2.1	Road length	34
4.2.2	Residential area	35
4.2.3	Wetland area.....	37
4.2.4	Infrequently encountered species	37
4.3	Conclusion.....	38

References	40
Appendix	55

List of Tables

Table 3.1	Detection frequencies for the nine species identified during this study.	24
Table 3.2	Top models for the effect of urban- related landscape variables on the occupancy of the five anurans species which were analysed and species richness using Akaike’s Information Criterion for small sample size.	26
Table 3.3	Model coefficient (β), standards error (SE), and upper and lower confidence intervals (CI) for the top model identified for each species.	27

List of Figures

Figure 2.1	International Bioregions of Australia (IBRA), showing the Swan Coastal Plain.	13
Figure 2.2	Wetland sites sampled in this study.	17
Figure 3.1	Predicted relationships and 95% confidence intervals between the predicted probability of detection by (a) <i>Crinia insignifera</i> and (b) <i>Litoria adelaidensis</i> and temperature, and (c) <i>L. adelaidensis</i> and barometric pressure.	24
Figure 3.2	Predicted relationships and 95% confidence intervals between the predicted probability of occupancy by (a) <i>Crinia insignifera</i> and residential area, (b) <i>Crinia insignifera</i> and road, (c) <i>Litoria adelaidensis</i> and residential area, and (d) <i>Litoria adelaidensis</i> and road.	28
Figure 3.3	Species richness at each of the 30 wetland sites sampled, overlaid with residential area (red).	30
Figure 3.4	Partial regression plots for the two explanatory variables included in the model for anuran species richness. (a) residential area within 750m; (b) wetland area within 500m.	31

Appendices

Appendix 1	The biology and life-history traits of anuran species of the Swan Coastal Plain (data from Main 1965; Bamford and Huang 2009; Tyler and Doughty 2009).	55
Appendix 2	Site characteristics of each of the 30 wetlands sites surveyed in this study.	57
Appendix 3	Box plots used to assess the scale at which each landscape variables exerted the strongest influence on anuran occupancy.	58
Appendix 4	Plates 1 and 2: Frogs of the Swan Coastal Plain	64