

# **Barking Owl Diet in the Pilliga Forests of Northern New South Wales**



*Matthew Alan Stanton*

Bachelor of Applied Science, Coastal Management,  
University of New England, Northern Rivers

A thesis submitted for the degree of  
Master of Science of the University of New England

January 2011

## Acknowledgements

Foremost, I wish to thank my supervisors for their patience and ability to respond quickly to my chapter submissions in spite of the barrier of distance. Prof. Hugh Ford's experience was valuable in helping me to set realistic goals and improving the structure of the thesis. Whenever I asked for guidance, particularly about where to find information, Hugh was able to point me in the right direction. Dr. Stephen Debus was often able to pick points where I had not fully explained my arguments or missed crucial references. His editing experience was particularly helpful on earlier drafts. Dr. Rod Kavanagh, my work manager and collaborator in the greater Pilliga Barking Owl Project is thanked for encouraging me to start a higher degree and for giving me free rein to shape the diet study. His professional guidance has been invaluable and the work would not have been completed without his support.

Dr. Todd Soderquist has been the other mainstay of the Pilliga Barking Owl Project. Todd's location of nest trees and associated roost areas has been a valuable contribution in broadening the territory base of the data set. Todd shares ownership with Rod and myself of the radio-tracking data which provided such a valuable base for Chapter 5 and improved our knowledge of Barking Owl roosting behaviour which enabled the ongoing collection of pellets so important for Chapter 3.

Our volunteer owl catchers who come to the Pilliga in the freezing depths of winter to help us band more owls are appreciated. Without banding owls, assigning roosting birds to territories would be more difficult. The volunteers include Forests NSW staff and after seven years form a long list.

Dr. Patrick Tap is thanked for his ongoing support and interest in the project. Pat willingly passed on his small mammal trapping data for use in Chapter 4. Hopefully, the completion of this thesis will help guide his management of the flora and fauna of the Pilliga State Forests.



Dr. Brad Law, Mark Chidel and Dr. Patrick Tap generously gave access to their unpublished bat data. Rod Kavanagh performed half of the Pilliga bird counts, while Graham Turner helped with the Yarindury State Forest bird counts and extralimital site spotlighting.

The staff of Baradine forestry office have been a great help with the practical support that I required for safely conducting fieldwork in the Pilliga forests. They helped with vehicle support, tree climbing equipment and countless pieces of local information that helped everything flow smoother. In particular, “Joe”, Donna, Gary, Tom and Jamie put in their own time and took a strong interest in the project.

For help collecting pellets I thank Tracey Brassil, Rod Kavanagh, Leila and Tamasin Stanton, Alison Towerton, Graham Turner and staff members at the Baradine forestry office.

Learning to identify pellet components was one of the most time consuming parts of this project. Dr. Marco Granzinoli helped start the lab work. I wouldn't have made progress on the insect components without the help of Bob Eldridge, Graham Goodyer, Dr. Debbie Kent and Kerrie Simms. In particular, Graham provided the valuable and time-consuming service of checking a range of samples to validate my own counts and identifications. Dr. Walter Boles, Collection Manager of Ornithology at the Australian Museum, helped find what I needed from their bone, wing and skin collection. Discussions about captive Barking Owl diet with Chad Staples of Featherdale Wildlife Park and raptor rehabilitation expert Lenore Wilbow were helpful. Dr. Amrit Kathuria and Dr. Trent Penman, kindly offered advice regarding statistical procedures.

I would like to thank my partner Tracey Brassil for letting me take on this project, for covering for me at home when I was out on field work and for her support, particularly in the final stages. Tracey's checking of references and other thesis corrections were invaluable.



This work was conducted under licences from the New South Wales Department of Environment Climate Change and Water and the Australian Bird and Bat Banding Scheme. Animal Care and Ethics approval was granted by the ACEC of Industry and Investment, Forests NSW. An internal research grant from UNE helped with an equipment purchase. The study was conducted with the support of my employer, NSW Industry and Investment.



## Abstract

The Barking Owl *Ninox connivens* population in the Pilliga forests of northern New South Wales is the largest known in southern Australia. Breeding pairs in this population occupy large home-ranges across less than half of the forest. In this thesis, I quantify the diet of Barking Owls in the Pilliga. I consider a number of hypotheses that could explain the species' large home ranges and restricted distribution, particularly those that are related to prey availability.

This is the first diet study of a Barking Owl population to incorporate data from many territories over several years and all seasons of the year. Radio-tracking of nine owls provided the opportunity to begin a substantial collection of prey remains (regurgitated pellets, food debris and faecal material). Ultimately, the collection period spanned 2003 – 2009, with prey remains from 19 territories in the Pilliga and one territory in a small forest to the south near Dubbo. In total, 1546 regurgitated pellets and 315 faecal samples were collected and examined. Foraging observations improved the understanding of the results.

Barking Owls in the Pilliga forests preyed on most species of diurnal and nocturnal birds, as well as Sugar Gliders, bats and insects, with a few items being taken from the ground. Prey size ranged from 0.3 gram insects to ~800 gram cockatoos and mammals, a similar size to the owls. Most prey were native animals in contrast to some other studies.

The proportions of consumed prey, as determined by pellet analysis, were compared with available prey, as determined by bird counts, spotlight surveys, small mammal trapping, bat surveys and insect netting. Prey items from all prey groups were available from all sampled areas of the Pilliga. Barking Owls distribution was positively associated with prey availability: significantly with the biomass of birds and with flying insect numbers. Mammal groups were not significantly different but showed the same positive trend.

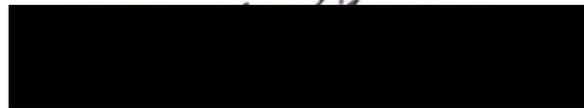
Spatial availability of total prey biomass offered a good explanation for the distribution of Barking Owls within the Pilliga forests. Crucial food resources, particularly available biomass of diurnal birds and nocturnally active prey, may limit the population density and distribution of owls in what appears to be marginal rather than prime habitat. Land cleared for agriculture, because of its higher productivity, may have previously supported higher densities of Barking Owls when wooded.



## Certification

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.



Matthew Alan Stanton



## Table of Contents

ACKNOWLEDGEMENTS	I
ABSTRACT	IV
CERTIFICATION	V
LIST OF TABLES	IX
LIST OF FIGURES	X
<b>CHAPTER 1 OWL DIET, AUSTRALIAN OWLS, HABITAT AND STATUS</b>	<b>1</b>
1.1 OWL DIET STUDIES .....	1
1.1.1 <i>The value of studying owl diets</i> .....	2
1.1.2 <i>Rare species detection</i> .....	4
1.1.3 <i>Historic/prehistoric diet</i> .....	5
1.2 BARKING OWLS AND THEIR PLACE IN THE AUSTRALIAN OWL FAUNA .....	6
1.3 BARKING OWL DIET IN AUSTRALIA .....	8
1.4 DIETS OF THE OTHER MAINLAND HAWK OWLS .....	12
1.4.1 <i>Powerful Owl diet</i> .....	12
1.4.2 <i>Rufous Owl diet</i> .....	13
1.4.3 <i>Southern Boobook diet</i> .....	15
1.5 SOURCES OF DIET INFORMATION FOR OWLS .....	17
1.6 THE PILLIGA BARKING OWL PROJECT .....	19
1.6.1 <i>Aims of the Pilliga Barking Owl diet study</i> .....	21
<b>CHAPTER 2 THE PILLIGA FORESTS</b>	<b>22</b>
2.1 <i>Landscape and context</i> .....	22
2.2 <i>Geology</i> .....	24
2.3 <i>Forest types</i> .....	26
2.4 <i>Exploration and research</i> .....	28
2.5 <i>Management and exploitation</i> .....	32
2.6 <i>Summary</i> .....	33
<b>CHAPTER 3 BARKING OWL DIET IN THE PILLIGA FORESTS</b>	<b>35</b>
3.1 INTRODUCTION .....	35
3.2 METHODS .....	38
3.2.1 <i>Study areas</i> .....	38
3.2.1.1 <i>The Pilliga forests</i> .....	38
3.2.1.2 <i>Yarindury State Forest</i> .....	39
3.2.2 <i>Method selection</i> .....	39
3.2.3 <i>Pellet collection</i> .....	42
3.2.4 <i>Regurgitated pellet examination</i> .....	44
3.2.5 <i>Faecal sample examination</i> .....	49
3.2.6 <i>Data analysis</i> .....	49



3.3 RESULTS .....	51
3.3.1 Overview .....	51
3.3.2 Mammalian prey .....	52
3.3.3 Avian prey .....	53
3.3.4 Other vertebrates.....	55
3.3.5 Invertebrate prey.....	56
3.3.6 Seasonal pattern.....	57
3.3.7 Location ( <i>habitat</i> ) pattern.....	59
3.3.8 Faecal samples.....	68
3.4 DISCUSSION .....	71
3.4.1 The Pilliga Barking Owl diet compared to other regions .....	71
3.4.2 Patterns in the prey data.....	72
3.4.3 Volume of prey .....	73
3.4.4 Filling in the blanks with faecal samples .....	74
3.4.5 Effect on other endangered wildlife.....	75
3.4.6 Ideal diet for Barking Owls .....	76
<b>CHAPTER 4 BARKING OWL PREY AVAILABILITY IN THE PILLIGA FORESTS</b> .....	<b>78</b>
4.1 INTRODUCTION .....	78
4.2 METHODS .....	81
4.2.1 Prey surveys .....	81
4.2.2 Diurnal bird observation .....	84
4.2.3 Spotlighting for arboreal mammals and nocturnal/roosting diurnal birds.....	85
4.2.3 Bat detection.....	86
4.2.4 Trapping for ground mammals.....	87
4.2.5 Invertebrate trapping.....	87
4.2.6 Analysis.....	89
4.3 RESULTS.....	90
4.3.1 Available biomass in areas with and without Barking Owls .....	90
4.3.2 Within group prey selection .....	95
4.4 DISCUSSION .....	100
4.4.1 What prey groups are driving Barking Owl distribution in the Pilliga?.....	100
4.4.2 Prey selection within groups.....	103
4.4.2.1 Diurnal Birds.....	103
4.4.2.2 Nocturnal Birds.....	103
4.4.2.3 Arboreal Mammals.....	104
4.4.2.4 Small Terrestrial Mammals.....	105
4.4.2.5 Insects.....	105
4.4.3 Barking Owl Food at Extralimital Sites.....	105

5.1 OBSERVATIONS OF BARKING OWL FORAGING ..... 108

    5.1.1 Introduction ..... 108

    5.1.2 Capturing active flying prey (*sally/ strike or hawking*) ..... 109

    5.1.3 Capturing *White-throated Needletails Hirundapus caudacutus* at roost ..... 111

    5.1.4 Flushing prey (*flush/ strike*) ..... 111

    5.1.5 Prey detection by call ..... 113

    5.1.6 Ambush/pounce on ground animals ..... 113

5.2 DIURNAL PREY HOLDING BEHAVIOUR ..... 115

5.3 FOOD DEBRIS AROUND NEST TREES ..... 119

**CHAPTER 6 CONCLUSIONS AND MANAGEMENT IMPLICATIONS 121**

6.1 THE PREY OF THE PILLIGA BARKING OWLS ..... 121

    6.1.1 Consumed prey ..... 121

    6.1.2 Prey compared with other studies ..... 121

    6.1.3 Available prey ..... 122

6.2 PILLIGA – THE BEST OF THE REST ..... 123

6.3 MANAGEMENT ..... 125

    6.3.1 Increasing the density and distribution of Barking Owls ..... 125

    6.3.2 Managing Barking Owl predation of threatened species ..... 126

    6.3.3 Transferring the Pilliga example to declining populations ..... 127

**REFERENCES 128**

**APPENDIX 1 SPECIES DETECTED DURING PREY SURVEYS OR PELLET ANALYSIS 142**

## List of Tables

Table 1.1 Live weights of captured adult Barking Owls in the Pilliga.....	20
Table 3.1 The distribution of regurgitated pellet samples by date and territory.....	43
Table 3.2 The distribution of faecal samples by date and territory.....	44
Table 3.3 Bird skeleton components, their measured relationship to bird mass and benefits/issues of each item.....	47
Table 3.4 Mass (grams) for insect biomass calculations.....	48
Table 3.5a Mammal species recognised in Barking Owl regurgitated pellets from the Pilliga and Yarindury State Forests.....	53
Table 3.5b Bird species recognised in Barking Owl regurgitated pellets from the Pilliga and Yarindury State Forests.....	54
Table 3.5c Arthropod species recognised in Barking Owl regurgitated pellets from the Pilliga and Yarindury State Forests.....	57
Table 3.6 ANOSIM results for landscape and seasonal factors associated with regurgitated pellet sample measurements.....	63
Table 4.1 Sampling periods for prey availability sites in relation to Barking Owl detections.....	83
Table 4.2 Prey group biomass/density differences between areas with and without Barking Owls. Wilcoxon rank sum test results for the five available prey groups.....	92
Table 4.3 'Prey sized' and 'sub-prey sized' insects captured by scoop netting with individual and general prey masses.....	94
Table 4.4 Relative importance of woodland and non-woodland dependent birds contribution to available prey biomass for Barking Owls.....	96
Table 4.5 Predation, human detection and their relationship for three groups of mammal species and nocturnal birds in the Pilliga.....	98
Table 5.1 Prey items held at roost by Barking Owls. Published and new records by date.....	118
Table 5.2 Food debris collected from nest and roost areas of Barking Owls in the Pilliga.....	120



## List of Figures

Figure 2.1 South Eastern Australia as seen by a mosaic of SPOT satellite images compiled in Google Earth.  
 ..... 24

Figure 3.1 Barking Owl territories known from radio-tracking (coloured polygons) and known nest areas  
 (brown crosses) from which diet data were obtained during this study..... 38

Figure 3.2 Proportions of individual prey items and estimated prey biomass found in regurgitated pellets for  
 all samples by eight classes Total individuals = 3665. Total estimated prey biomass = 116 kg from  
 1546 regurgitated pellets. Data were not balanced for season or location..... 51

Figure 3.3 Three broad prey groups as represented by volume in regurgitated pellets over the period of the  
 study (except a single early sample). Sample sizes are given in Table 3.1..... 58

Figure 3.4 The percentage (volume) of mammal, bird and insect material present in regurgitated Barking Owl  
 pellets from all samples, plotted by season. Number of pellets is indicated under each season label.. 59

Figure 3.5 The percentage (volume) of mammal (◇), bird (○) and insect (x) material present in Barking Owl  
 pellets from all samples, plotted by season and split into five categories based on forest core (a/b) or  
 edge (c/d) and presence (b/d)/absence (a/c) of creeks. Yarindury is presented as the fifth category  
 (e). Numbers below the season labels give sample sizes..... 60

Figure 3.5a & b ..... 60

Figure 3.5c & d ..... 61

Figure 3.5e..... 62

Figure 3.6 (a) Seasonal and (b) forest landscape differentiation of multi-dimensional scaling of regurgitated  
 pellet volume data (Insect/Bird/Mammal)..... 64

Figure 3.7 (a) Seasonal and (b) forest edge territories differentiation of multi-dimensional scaling of  
 territory/season/year regurgitated pellet prey item count data. .... 65

Figure 3.8 Canonical Correspondence Analysis (bi-plot) of regurgitated pellet volume proportions with  
 environmental variables (territory on forest edge, territory with broad creek lines) and seasons. .... 66

Figure 3.9 Canonical Correspondence Analysis (bi-plot) of regurgitated pellet prey item numbers (a) and  
 biomass (b) (in eight classes) with environmental variables (territory on forest **edge**, territory with  
**creek** drainage lines and seasons). Data were from the Pilliga and Yarindury sites ..... 67



Figure 3.10 Mean prey biomass for regurgitated pellets with samples divided by season and three territory location categories. .... 68

Figure 3.11 Comparison of insect volume in faecal samples and in regurgitated pellets..... 69

Figure 3.12 Faecal sample prey proportions in three broad groups for Barking Owl territories/periods with low numbers of regurgitated pellets. .... 70

Figure 4.1 Location of prey sampling sites across the Pilliga forests..... 82

Figure 4.2 The flying insect scoop net, mounted on top of a utility vehicle ready to start sampling at dusk. 88

Figure 4.3 Prey biomass measures of four prey groups of Barking Owls in the Pilliga. Data is split between known territories and sites where Barking Owls have not been detected ..... 93

Figure 4.4 Number of birds/hectare and number of flying insects captured with a vehicle mounted scoop net/kilometre in known owl territories and out of known territories in the Pilliga..... 94

Figure 4.5 Nocturnal bird and arboreal mammal biomass breakdown for a range of sites with (middle four columns) and without (edge columns) Barking Owls. .... 95

Figure 5.2 Barking Owls holding prey at diurnal roosts..... 117

