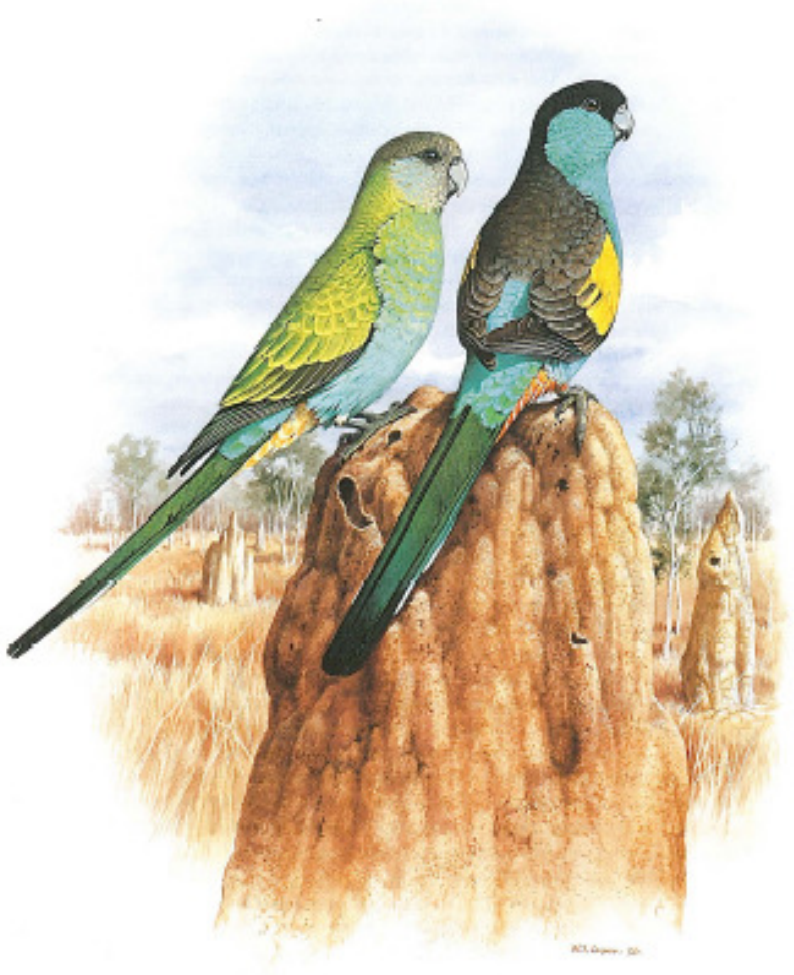
Ecological Associations

of the

Hooded Parrot (*Psephotus dissimilis*)



Stuart J. N. Cooney

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DECLARATION

The research in this thesis is entirely my own work except where due reference is given in the text. Chapter 4 is co-authored with Edward D. Edwards, Penny D. Olsen and Stephen T. Garnett. Chapter 5 is co-authored with Penny D. Olsen and Stephen T. Garnett. However, I am the principal contributor to all aspects of the work, none of which has been submitted for a previous degree.

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DEDICATION

This thesis is dedicated to my family. To Eliza who is as old as the PhD, to Georgiana who started her school life in Canberra and to my wife Sam. My champion: always encouraging, always loyal and always convinced in my ability to get here, especially when I wasn't. It seems that there really is no end to her willingness to make me happy. This final act of my PhD is dedicated to those three people who shared the journey most intimately and without whose support it could not have been done.

ACKNOWLEDGEMENTS

A PhD, for better or worse, is a collaborative process. In this case, the amount of support from the University, family and friends has been amazing, and it has been upon the shoulders of this support that I have produced this dissertation. I could not have done it without them. So, I will take a few paragraphs to single out and thank some people who have made significant contributions to this achievement.

Firstly, to Dr Penny Olsen, for her warm reception to the enquiries of a naive sales rep., the conception and genesis of this great project (it ticked my project requirement boxes of a cool bird in a cool location!), her open door policy for all my little concerns and her constant attention to detail. I hope that she is as happy with the results as I am. Prof. Andrew Cockburn similarly welcomed me to ANU, despite my humble academic beginnings and was always there right when I needed him with wisdom and insight (not before or after, but right when I needed him!). Prof. Stephen Garnett has similarly been there to help when I called for it. His calm and enthusiastic assistance early in the first field season was a defining moment in this project. My final supervisor, Dr Rob Heinsohn, has not spent hours of his time on me or my project, and may even feel a bit guilty about that, however his words of encouragement, just when I needed them (pre-field season pep-talks), were immensely important to me and I am delighted to have had him on my supervisory panel. Dr Ted Edwards has also been a keen, if unofficial, member of the project. His enthusiasm for moths, in particular the identity of Stuart's Moth *Trisyntopa neossophila*, has been a great boon to the project. Dr Terry Neeman helped me, in many meetings, with the analysis of chapter VII, which was complicated and beyond my statistical ability.

After a shaky start in the first field season, for the second field season, I recruited some helpers. Kathryn Smith, Ona Alminas, Isobel Booksmythe, Murray Hunt (the self-appointed entertainment coordinator—who excelled by providing distraction and entertainment while I fussed over the all-consuming project and its dramas) and Richard Milner. I had no idea how I would go living with four young people (sorry Murray), up to 15 years my junior, but it was great. Their hard work, attention to detail and zeal for the project made the

second season the success it needed to be. Sure, Katy lost pens in the field and cut herself all the time. OK, so Ona got lost, either accidentally or on purpose (what was nest CAT037BUNT all about?). Yes, occasionally some of Iso's food was a touch gritty and she was incredibly rude to me. Murray may have come and gone and come and gone (he did have a job to maintain after all!). And, Richie… well, if I had a brother, hopefully he would be like him. If I had to choose another set of vollies for a project, I would be doing extraordinarily well to get another group as good as them!

Support has also come from other quarters… such as Happy House! Now long dismantled, Rachel, Leeann and Michelle, and their male sidekick Golo, welcomed me to ANU when it was all new and shiny and even let me share their coffee! Rachel and I shared a supervisor, which was a great help to me, and our discussions and her encouragement were invaluable. Similar talks with Leeann and Michelle also helped me formulate and work through ideas, focus on the important things and convinced me that I wasn't too bad a scientist. Fellow birder Golo was a constant source of encouragement, good ideas, preposterously harsh editing and valuable downtime (I will always happily recall that we ticked his 500th Australian bird together!!). I speak of these people in the past tense because they all moved on to bigger and better things and it was only then, in the final stages of my project, that I realised how truly important they have been to me. I miss them already, but know that I have made life-long friends with the members of the Happy House coffee consortium.

A range of other people provided smaller contributions to the project that were no less important in their own way. My thanks go to: Gay Crowley, Sarah Pryke and Louise Warburton for helping with the reccy way back in 2005 and being the first people to put their hands in parrot tunnels and losing skin in the process of enlarging them for me to put my hands in!; Judith Scarl and Dan Gowland for letting me handle their parrots; Jade Irwin and Jak Andrews, the managers of Manbulloo Station, where I worked (paradise on earth!) and Brian, Stephanie, Bronwyn, Bob and Zach, for their hospitality at Manbulloo Homestead, my home for 4 months a year; Mike Reed, the previous hooded parrot guru, for sharing his advice and experiences; fellow entomologists; Michael Braby for moth discussions, Dave Spratt for analysis of the blood

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Money is an important issue in any project (my project expenditure exceeded $30,000!). Therefore, I want to acknowledge the generous support of the philanthropic organisations that support this kind of science and whose small contributions make a huge difference to struggling students. I was lucky enough to receive contributions from: the Trust of the Late Violet Winifred Scott ($12 100); the Norman Wettenhall Foundation Grant ($4 400); the Cayley Memorial Scholarship ($2 000); the Birds Australia, Stuart Leslie Bird Research Award ($1 000); the Joyce Vickery Scientific Research Fund ($900); and the Ethel Mary Reid Award ($750). Throughout the project, my wage was provided by an Australian Postgraduate Award sponsored by the Commonwealth Government.

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My final thanks go to four special people that must be held accountable for me taking this course. To Dr David M. Watson, who started my research career and then told me that I could do anything that I wanted to in pursuing my PhD ambitions. His infectious enthusiasm for doing science played a huge part in my

decision to continue in higher education. To my parents; Nolene and Norm Cooney. It has taken a while, but it seems that all those happy weeks camping in the National Parks of Victoria have finally infected me, and infected me in a big way! Who'd have thunk it? And finally, to Sam. Who always believes in me, always supports me, always puts up with me, and will always be there for me.

ECOLOGY

Comprising the relation of the animal to its organic as well as its inorganic environment, particularly its friendly or hostile relations to those animals or plants with which it comes in contact.

Haeckel, E. (1870). Uber entwicklungsgang und aufgabe der zoologie. *Jenaische Zeitschrift Für Medizin Und Naturwissenschaft*. **5**, 353–370.

THESIS ABSTRACT

Interactions between nesting birds and invertebrates are a common, yet poorly understood ecological phenomenon. Many of these types of interactions are close and prolonged, and therefore potentially critical to one or both of the species involved in the interaction. However it is unusual for the nature of the interaction to be evaluated in a manner that reveals the impact of the relationship on both parties to the interaction. This study examines two relationships between nesting birds and invertebrates, both of which involve the hooded parrot (*Psephotus dissimilis*), a small grass parrot that inhabits the tropical savannas of northern Australia.

The field-work for this project was conducted over two parrot breeding seasons in 2006 and 2007 near Katherine, Northern Territory, in the Australian dry tropics. In chapter II, I present data on the breeding biology of the hooded parrot as background for the study that follows. Nest building commenced in January, with peak activity in February and the last chicks fledged in April. Fifty three active nests were located. The mean number of eggs laid per nest was 4.5 (s.d. ± 0.9), of which 3.0 (± 1.79) hatched and 2.0 (± 2.0) fledged. Clutches were laid asynchronously over a period of a week and chicks remained in eggs for 18.6 (± 1.95 days). Chicks were 29.2 (± 2.9) days old when they fledged from the nest. These data are typical for Australian parrots.

In chapter III, the unusual nature of the parrot's nest site is examined. Many species of bird nest in natural cavities or those they excavate. Whilst cavity nesters as a whole experience increased nesting success, the greatest success is experienced by species that can excavate their own nests. Certain arboreal cavity nesters, such as woodpeckers, require extensive morphological adaptation for this behaviour, but this has not occurred in Australia, despite competition among birds and a suite of arboreal mammals for naturally occurring cavities. Some species, however, have adapted their behaviour to make use of substrates that are not as hard as wood. Hooded parrots excavate nests in terrestrial termitaria, releasing them from competition for limited arboreal cavities. However, I show that only termitaria with a high level of termite activity, and which are more than two metres tall, are suitable, and that the parrots exhibit a strong preference for

the cathedral mounds of *Nasutitermes triodiae*. Nests placed in highly active mounds had a significantly higher success rate than those in mounds where activity was somewhat lower, suggesting that the behaviour is adaptive.

The thesis then shifts focus from the parrot to its nest symbiont, first describing the species involved in the interaction in chapter IV, and then its behaviour in the nests of hooded parrots in chapter V. *Trisyntopa neossophila* sp. n. (Lepidoptera: Oecophoridae) was reared from the nest of the hooded parrot and described using morphological characters. Aspects of its biology are reported and similarities to the biology of *Trisyntopa scatophaga* found in the nests of the golden-shouldered parrot (*Psephotus chrysopterygius*) are discussed. The possibility that a moth was associated with the extinct paradise parrot (*Psephotus pulcherrimus*) is considered in the light of the phylogenetic relationships between the parrots.

Trisyntopa neossophila is an unusual moth whose breeding cycle is shown to be closely synchronised with the hooded parrot. *T. neossophila* is one of three coprophagous, nest dwelling moths in the genus *Trisyntopa*. True coprophagy is rare in the Lepidoptera, although some species occasionally consume faeces to gain rare nutrients. *T. neossophila* lays its eggs in the nest of hooded parrots so that larvae hatch in synchrony with the hatching of the parrot's eggs. The larvae spend their larval period in the nest and exclusively consume the excrement of the nestling parrots. When the parrot chicks fledge, the larvae move to the walls of the nest cavity to pupate, emerging the following wet season to repeat the process during the next parrot breeding season.

With a description of the ecology of both species involved in the nesting symbiosis, chapter VI reviews the literature surrounding other interactions between nesting birds and invertebrates. A large number of birds are shown to nest in, or in close proximity to, structures made by invertebrates and avian nesting material provides a reliable shelter for many invertebrate species. However, the nature of such relationships has rarely been experimentally demonstrated. I propose that in order to understand the nature of these relationships they need to be explored within the theoretical framework of community ecology. Putative commensal and parasitic relationships have all been documented in the bird/invertebrate nesting literature, yet researchers, with

few exceptions, repeatedly overlook the impact that these relationships are having on the invertebrate, at best assuming the nature of its impact, but more often ignoring its impact entirely. Here I present a framework for formulating hypotheses to ensure that the nature of the relationship can be identified. Only by explicitly stating the level of organisation at which the experiment is to occur (individual or population), identifying the net cost or benefit of the interaction, the range of conditions under which such costs or benefits would apply and the spatial and temporal context in which they apply, can an investigator expect to recognise and describe the often complex nature of these relationships.

While parasitic and commensal relationships between nesting birds and invertebrates are commonly reported, mutualisms between birds and invertebrates have not been reported. Despite this, candidates for this type of relationship exist. Chapter VII uses the framework outlined in the literature review (chapter VI) to experimentally examine the relationship between the hooded parrot and *Trisyntopa neossophila*. By manipulating the populations of moth larvae in a sample of hooded parrot nests, we sought to establish the impact of the relationship on each species. The moth depends on the parrot for provision of shelter and a reliable food source. The parrot however, was neither benefited nor harmed by the interaction in terms of short term reproductive output or chick growth, although differences between the experimental and control nests were noted. The relationship between the hooded parrot and *T. neossophila*, at least during the study period, is therefore concluded to be commensal.

Collectively, the chapters of this thesis explore the complicated interactions between species. The dependence of the moth on the parrot and the parrot on the termite, demonstrate the importance of understanding interactions between species in a manner that reveals the impacts of the interactions, the range of conditions under which they would apply and the level of organisation at which they apply, as outlined in chapter VI. The dependence of the animals in this study on each other makes them more vulnerable to extinction than previously thought. Whilst this may not be immediately significant for the hooded parrot/*T. neossophila* system, which is thought to be secure, the ecologically similar system on the Cape York Peninsula, involving the golden-shouldered parrot and its nest attendant moth *Trysintopa scatophaga*, is vulnerable to extinction and

subject to intensive management to ensure its persistence. This study brings new information to the management of the golden-shouldered parrots and urgently recommends increased protection for *Trysintopa scatophaga*.

TABLE OF CONTENTS