

ResearchOnline@JCU

This file is part of the following reference:

Maclagan, Sarah (2003) *The establishment of dominance in male jewel skinks, *Carlia jarnoldae*: the roles of displays, body size and colouration.*
Honours thesis, James Cook University.

Access to this file is available from:

<http://eprints.jcu.edu.au/22241>

The author has certified to JCU that they have made a reasonable effort to gain permission and acknowledge the owner of any third party copyright material included in this document. If you believe that this is not the case, please contact ResearchOnline@jcu.edu.au and quote <http://eprints.jcu.edu.au/22241>

**The establishment of dominance in
male jewel skinks, *Carlia jarnoldae*:
the roles of displays, body size
and colouration**

Thesis submitted by Sarah Maclagan in partial fulfilment of the requirements for the Degree of Bachelor of Science with Honours in the School of Tropical Biology at James Cook University.



Male *Carlia jarnoldae*

STATEMENT OF ACCESS

I, the undersigned, the author of this thesis, understand that James Cook University will, one year after the submission deadline, make it available for use within the University Library and, by microfilm or other photographic means, allow access to users in other approved libraries. All users consulting this thesis will have to sign the following statement:

“In consulting this thesis I agree not to copy or closely paraphrase it in whole or in part without the written consent of the author; and to make proper written acknowledgement for any assistance which I have obtained from it.”

Prior to that time, I hereby restrict the use and any form of publication of the data incorporated in this thesis.

Users of this thesis are advised that the policy for preparation and acceptance of Honours theses does not guarantee that they are entirely free of inappropriate analyses or conclusions. Users may direct enquiries regarding particular theses to the relevant school head.

19/08/2003

.....

DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

19/08/2003

.....

ACKNOWLEDGEMENTS

I would like to thank all of the people who made things easier for me this year, both academically and emotionally:

To my supervisors, Lin Schwarzkopf and Ross Alford, for all of their ideas and guidance throughout the planning, designing, and carrying out of the project(s). To Lin, for always making herself available to me, and for reassuring me that everything was okay. To Ross, for teaching me lots of great tricks in Excell, and for long-distance statistical help from the US. Thankyou both also for your prompt last-minute draft-readings and support.

To Nicola Peterson, for her invaluable help during the early stages, showing me the ropes, and making the frog-lizard transition mercilessly smooth.

To my dad, Ian Maclagan, for saving me many tedious hours of clicking the mouse and developing RSI, by writing a program to extract the raw data into a manageable form.

To Sara Townsend, for her good ideas and counselling sessions throughout the year, and for helping me with the references.

To Jason Schaefer, Haley Dingfelder, Kyoko Oshima, and Carryn Manicom, for helping me catch lizards.

To Rob Gegg, for help building the observation blinds.

To Vince Pullella and Gordon Bailey, for computer support.

To Justin Marshall from the University of Queensland, for scanning the painted chips.

To Steven Fleiss, Krisztina Szabo, Lauren Stewart, and everyone from the herpetology lab (Sara Townsend, Kay Bradfield, Mirza Kusri, Doug Woodhams, Nicole Kenyon and Jodi Rowley) for friendship and support.

To my wonderful family, for their unconditional love and support throughout all the years, but for this year in particular.

And finally, to my darling partner, Ant Backer, for being by my side through the worst of it, and for helping in more ways than I could list.

ABSTRACT

During the establishment of social relationships, many animals use displays to communicate about fighting ability or territory holding capacity. Typically, scincid lizards are cryptically coloured, and thought to have rudimentary social behaviour not involving contests or territoriality. Male jewel skinks (*Carlia jarnoldae*), however, exhibit bright colouration, use relatively complex social displays, and appear to be territorial. I examined the social and physical contexts of displays used during the establishment of dominance between pairs of males in experimental enclosures. I also determined whether body size, the colour (i.e., hue, value, chroma) of three colour patches (green-blue throat, blue dorso-lateral spots and orange flanks), or the size of the orange flank patch were associated with dominance, and tested the prediction of “sequential assessment game” theory that contests should be more escalated when opponents are most similar in body size or colour area. In my experimental enclosures, the lizards almost always (26/33) formed dominant-subordinate relationships within the first 48 hours of contact. Head bobbing and tail waving appear to be important means of opponent assessment in this species, as lizards spent more time engaging in these displays when they first interacted than a day later. Dominants displayed significantly more than subordinates on both observation days. The lizards displayed most in environmental contexts that maximised their conspicuousness, i.e., head bobs and tail waves both occurred more often on a raised platform, in the centre of the enclosure, and in the sun, whereas tail waving, which is the most conspicuous behaviour, also occurred frequently on the flat sandy substrate of the enclosures. Displaying on raised surfaces, in central locations, and in the sun probably enhances the efficiency of communication of specific displays. I found that body size was a very strong predictor of dominance in *C. jarnoldae*, but that the colours of the three patches were not. A trend for dominants to have larger orange patches relative to their body size than did subordinates approached significance, suggesting that colour patch size may also influence the outcome of dominance relationships. Orange patch size may be more important in nature, acting as a long-distance visual cue to territory ownership and fighting ability, allowing individuals to avoid escalated conflicts by assessing each other from afar. Contrary to the predictions of the sequential assessment game, escalation increased rather than decreased with the difference between opponents in body mass, and did not decrease over time, suggesting that dominant male jewel skinks will not tolerate intruders within their territory, and continue to escalate contests even with repeated intrusions by the same individual. In general, male *Carlia jarnoldae* use displays to communicate with conspecifics, and form social relationships that give the dominant individual priority of access to shelter and display sites. Body size is an important

determinant of the outcome of contests, and orange colour patch size may be a cue allowing assessment of body size in this species. Dominant individuals do not tolerate intruders, suggesting that these species are territorial in nature. Thus, *Carlia jarnoldae* do not fit the typical pattern for skinks, but are more similar to other taxa of lizards that are highly social and territorial.

TABLE OF CONTENTS

	Page
Statement of Access	iii
Declaration	iv
Acknowledgements	v
Abstract	vi
Table of Contents	viii
List of Tables	ix
List of Figures	x
Glossary	xii
Literature Review: Hedging One's Parental Bets	1
Introduction	18
Chapter One: Display behaviours and the establishment of dominance in male jewel skinks, <i>Carlia jarnoldae</i> .	
Summary	22
Introduction	22
Methods	24
Results	30
Discussion	40
Chapter Two: The roles of body size and colour during the establishment of dominance in male jewel skinks, <i>Carlia jarnoldae</i> .	
Abstract	50
Introduction	50
Methods	52
Results	56
Discussion	59
Chapter Three: Final Report	
Introduction	66
General Methods	67
Analysis, Results & Discussion	72
Summary and Conclusion	79
Literature Cited	
Literature Review	I
Introduction	VI
Chapter One	VIII
Chapter Two	XI
Final Report	XIV

LIST OF TABLES

	Page
CHAPTER 1:	
Table 1: Comparisons of behaviour and contest escalation between days 1 and 2, using non-parametric multivariate paired difference tests and Wilcoxon's Signed Ranks tests.	33
Table 2: Comparisons of behaviour of dominant and subordinate individuals, using non-parametric multivariate paired difference tests and Wilcoxon's Signed Ranks tests.	35
Table 3: Hierarchical non-parametric multivariate paired difference tests comparing observed and expected rates and durations of behaviours on different substrates.	41
Table 4: Hierarchical non-parametric multivariate paired difference tests comparing observed and expected rates and durations of behaviours under different light levels.	41
Table 5: Hierarchical non-parametric multivariate paired difference tests comparing observed and expected rates and durations of behaviours in different enclosure sections.	41

LIST OF FIGURES

	Page
CHAPTER 1:	
Fig. 1: Mean duration (\pm 95% CI) spent (a) head bobbing and (b) tail waving on each day.	34
Fig. 2: Standardised difference between dominants and subordinates in rates of various displays and general behaviours.	36
Fig. 3: Standardised difference between dominants and subordinates in duration spent doing various displays and postures.	36
Fig. 4: Standardised difference between dominants and subordinates in duration spent doing various movement behaviours.	38
Fig. 5: Standardised difference between dominants and subordinates in duration spent on each substrate.	38
Fig. 6: Standardised difference between dominants and subordinates in duration spent in each section of the enclosure.	39
Fig. 7: Mean (\pm 95% CI) proportion of time dominants and subordinates spent in each section of the enclosure.	39
Fig. 8: Mean difference (\pm 95% CI) between observed and expected values of durations spent (a) head bobbing and (b) tail waving on different substrates.	42
Fig. 9: Mean difference (\pm 95% CI) between observed and expected values of durations spent (a) head bobbing and (b) tail waving under different light levels.	43
Fig. 10: Mean difference (\pm 95% CI) between observed and expected values of durations spent (a) head bobbing and (b) tail waving in different enclosure sections by dominant and subordinate individuals.	44

CHAPTER 2:

- Fig. 1:** Mean (\pm 95% CI) (a) mass, (b) snout-vent-length, and (c) orange patch size for dominant and subordinate lizards. 57
- Fig. 2:** Relationship between mass and size of orange patch in male *C. jarnoldae*. 58
- Fig. 3:** Relationship between the standardized difference between opponents in mass (calculated as the absolute value of the difference between opponents in mass, divided by the average mass of the two individuals) and the maximum level of escalation observed on day 1. 60
- Fig. 4:** Relationship between the standardised difference between opponents in mass (calculated as the absolute value of the difference between opponents in mass, divided by the average mass of the two individuals) and the total number of bite marks sustained by members of a pair over the course of the trial. 60

GLOSSARY

Chroma: saturation, of or pertaining to a colour.

Diurnal: primarily active during the day.

Fossorial: associated with the ground or subsurface.

Hue: colour as determined by position of wavelengths within the visual spectrum (i.e., “green” or “blue”).

SVL: snout-to-vent length

Value: greyness, of or pertaining to a colour.

Behaviours of *Carlia jarnoldae*:

Head Bob: rapid up and down movement of the head.

Tail Wave: side-to-side movement of the entire tail.

Distal Third: subdued tail wave in which only the distal third portion of the tail is waved.

Gape: wide opening of the mouth.

Throat Flash: sideways tilt of the head at a 90° angle.

Head Tilt: sideways tilt of the head at a less-than-90° angle.

Bask Flat: dorsoventral flattening of the body against the substrate.

Bask Normal: head raised but forebody resting on substrate.

Bask High: head and forebody raised off substrate by full extension of the forelimbs.

Body Lift: head and entire body raised off substrate by full extension of the forelimbs and hindlimbs.

Lateral Tilt: posture such that body is tilted to one side.