The effect of incubation temperature on offspring phenotypes and survival of velvet gecko, *Amalosia lesueurii*

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Certificate of Original Authorship

I, M .G. T. H. Abayarathna declare that this thesis is submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy in the School of Life Sciences, Faculty of Science, at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualification at any other academic institution.

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M. G. T. H. Abayarathna

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All procedures were approved by the UTS Animal Care and Ethics Committee (protocol # 2012000256) and a NSW National Parks and Wildlife Service scientific licence (SL 101013 to JKW).

My apologies if I have missed anyone!

Preface

The main body of this thesis consists of eight chapters, including five data chapters that I have submitted to journals, or which are ready to submit. Chapter 6 has been published in the journal *Biology Open*. I have therefore formatted each chapter according to the guidelines of the individual journals. This has caused some minor formatting differences between chapters and some unavoidable repetition in the species description, experimental methods and background information in some of the chapters.

At the beginning of each chapter, I have acknowledged all authors involved, in the same order as they appear in the manuscripts under review (or soon to be submitted). In all of the chapters, I am listed as the first author and was primarily responsible for conceiving, designing and implementing the research and writing the manuscripts.

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Abstract

Heatwaves are a regular occurrence in Australia, and climate modellers predict that they will increase in intensity and duration in future. Increases in summer temperatures could produce higher incubation temperatures inside lizard nests, which could influence key traits linked to fitness, such as body size, learning ability, and locomotor performance. Developmental plasticity could also buffer hatchling lizards from higher environmental temperatures by shifting critical thermal maxima upwards, enabling lizards to withstand higher temperatures. The velvet gecko *Amalosia lesueurii* is vulnerable to summer heatwaves because females oviposit in communal nests, so that changes in nest temperatures can affect a high proportion of progeny in local populations.

To investigate how incubation temperatures influence offspring traits, I incubated eggs under cold and warm conditions that mimicked thermal profiles inside currently used shaded (cold; mean = 23.3 °C; range = 17.5–30.5 °C) and sun-exposed nests (warm; mean = 25.4 °C; range = 16.5–35.5 °C) respectively. I then measured the morphology and locomotor performance of hatchlings, and assessed their survival via mark-recapture. I found that hatchlings from the cold-incubation were larger, and hatched later, than hatchlings from the warm-incubation treatment. However, neither incubation treatment nor body size affected survival in the field. To assess how heatwaves might affect hatchlings, I incubated eggs under current (mean = 24.3 °C, range 18.4–31.1 °C) and potential future 'hot' (mean = 28.9 °C, range 19.1–38.1 °C) nest temperatures. After the eggs hatched, I measured the morphology, thermal tolerance, thermal preference and learning ability of hatchlings, before releasing them at field sites. Future incubation temperatures produced smaller hatchlings that emerged from the eggs several weeks

earlier than the current-incubated lizards. In addition, future-incubated lizards displayed reduced cold tolerance, and were slower learners, than cold-incubated lizards.

Overall, my results show how developmental plasticity can shape the phenotypic traits of hatchling geckos. While incubation under current nest temperature regimes had little effect on offspring traits or survival, incubation under future temperatures produced smaller hatchlings with reduced cognitive abilities and cold tolerance. Some of these phenotypic differences persisted for six months, and have the potential to affect offspring survival in the field. However, future studies that link offspring traits to survival are necessary to elucidate the links between incubation temperature and offspring fitness. In particular, we need a better understanding of maternal nest-site decisions, particularly if we want to forecast how lizards will cope with changing environments in future.