Life History Variation and Reproductive Success in the Common Brushtail Possum, *Trichosurus vulpecula*

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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 Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given

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Preface

Publications arising from this thesis:

Chapter 3 – in review: Isaac, J.L. Life history and demographics in an island possum, *Wildlife Research*.

Chapter 4 – in re-review: Isaac, J.L., Johnson, C.N. Terminal reproductive effort in a marsupial, *Biology Letters*

Chapter 5 – Isaac, J.L., Krockenberger, A.K., Johnson, C.N. (in press) Adaptive sex allocation in relation to life-history in the common brushtail possum. *Journal of Animal Ecology*.

Chapter 6 – Isaac, J.L., Johnson, C.N. (2003) Sexual dimorphism and synchrony of breeding: variation in polygyny potential among populations in the common brushtail possum, *Trichosurus vulpecula*. *Behavioral Ecology,* **14** (6): 818-822

Chapter 7 – Isaac, J.L. (in press) Mating season mass loss in male common brushtail possums: implications for age-specific variation in mating strategy. *Journal of Zoology*.

Appendix I – in review: Isaac, J.L. Demographic responses of an arboreal marsupial, the common brushtail possum, to prescribed fire. *Oryx*.

Appendix II – Isaac, J.L., Johnson, C.N., Grabau, P.J., Krockenberger, A.K. (2004) Automated feeders: new technology for food supplementation experiments in mammals. *Wildlife Research,* **31** (4): 437-441

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Abstract

Life history theory aims to describe and explain patterns in the life cycles of organisms and relate these patterns to intrinsic and extrinsic influences. The life history of an organism is commonly defined as a set of co-evolved strategies that relate directly to an individuals genetic fitness, lifetime reproductive success (LRS) and survival. The great majority of research on life history variation in mammals has concentrated on placental mammals, while marsupials have been largely overlooked. This thesis investigates life history variation, and the influence of this variation on reproductive strategy and success, among individuals in an arboreal marsupial, the common brushtail possum (*Trichosurus vulpecula*).

A population of *T. vulpecula* was studied from 2001-2004 on Magnetic Island, north Queensland; the population was censused each month by live-trapping. Demographic changes in the population were modelled using capture-mark-recapture data. The population size remained stable over the study period and there was little temporal variation in recruitment or survival. *T. vulpecula* on Magnetic Island displayed life history traits similar to those reported for other populations of the species. The majority (>80%) of females began to reproduce at the age of two and the main birth period occurred in the autumn months of April and May. Some females went on to produce a second young in the spring, after successfully raising a first. Males became sexually mature at the age of three. Survival, body mass and body condition declined in both males and females after the age of six, although the declines were more pronounced in males.

Variation in life history was strongly related to differences in female reproductive strategy and success. In terms of somatic investment, older females invested significantly more into individual offspring than younger females; older females also gave birth earlier in the season and were more likely to produce a second offspring in the spring birth cohort. Maternal age also influenced the birth sex ratio; young, primiparous females gave birth to

significantly more male offspring than older females, regardless of their condition while older, multiparous females were more likely to give birth to a male offspring when in good condition.

The extent of male biased sexual dimorphism in *T. vulpecula* was extremely variable among 11 populations in northern Australia. Dimorphism was related to seasonality of breeding, being greatest in populations where births occurred all year round. Mean body mass of male possums also decreased with increasing population density, while there was no effect of density on female mass. There was also some evidence that population density influenced the degree of breeding synchrony within populations, particularly in locations with a more seasonal climate.

In the Magnetic Island population, mating effort also varied considerably among male possums and young males lost more mass during the mating period than did older males. There was also some indication that males demonstrated age-specific variation in mating behaviour, which may be related to their size and experience.

The results of my study show that life history traits in both male and female *T. vulpecula* are phenotypically plastic. Age-specific variation in reproductive strategy was found in both male and female possums and is likely associated with the trade-off between current and future reproduction. Increased reproductive effort in older females also appears to entail significant costs in terms of an associated decline in survival, condition and body mass. Variation in body condition also influenced offspring sex allocation in females and is most probably an adaptation to maximise LRS. Male possums displayed a more pronounced decline in survival and condition after the age of five compared to females and this may be a direct cost of increasing mating effort as a young adult.

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