

The University of Adelaide, School of Animal and Veterinary Sciences
Submitted for the Degree of Doctor of Philosophy

*Sex Ratio Theory
Applied to a
Macropod Marsupial*

*Is reproduction by the tammar wallaby (*Macropus eugenii*) consistent
with sex ratio theory?*

ARYN W. PERRYMAN, BA, MEnvLaw
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Abstract

Marsupial species provide an important research tool in attempts to unravel the complicated mechanisms of mammalian reproduction. Comparisons between metatherian and eutherian reproductive life history patterns used to achieve the same outcomes, illuminates processes that have been difficult to investigate in eutherian species alone. Adaptive sex allocation is one such area that has provided equivocal data that is much scrutinized and debated amongst scientists. The theory that has provided the most disparity in the literature, and lead to the most debate, is the Trivers-Willard Model (TWM) (Trivers & Willard, 1973). The TWM proposes that, in polygynous mammalian species where the male has increased variability in reproductive returns, mothers in 'good condition' should bias their offspring towards sons, to maximise their fitness. There are three main assumptions associated with the theory: 1) that sons will benefit more than daughters from increased maternal resource allocation, 2) that juvenile condition predicts adult condition and 3) that maternal quality is a predictor of offspring quality. Much of the previous support for the TWM has been based on research in eutherian species (*e.g.* ungulate species), which usually tests only one assumption at a time by *a posteriori* application of the theory to observed data. Macropod species fill similar niches to ungulate species in other ecosystems and provide easy access to pouch young at a very early stage of development, which facilitates the investigation of all the TWM assumptions on a single population. The assumptions were tested by 1) field collections on wild populations of Kangaroo Island *Macropus eugenii*, to see if the pattern occurred, 2) controlled experimental breeding, to find the true adaptive nature of any bias and to see if the effect could be produced by manipulation, 3) feeding experiments, to see if compensatory growth occurred, 4) further testing on females and males to assess the presence and timing of control mechanisms. The overall sex ratio of the sampled wild population was 1:1, but larger, older females showed a 74% chance of having daughters as opposed to sons, while smaller, younger mothers showed a 60% chance of having sons. The pattern was not repeated in the breeding experiments, as females showed an 81% chance of producing a son regardless of maternal condition. Juvenile females produced an overcompensation response to reduced resource availability, while males showed partial compensation, recovering body weight but not condition. There was no evidence of a post-conception maternally-controlled mechanism, as there was no discrepancy between genetic sex and phenotypic sex. However, adult males did show a reduced %Y sperm count, averaging 44-45% Y sperm, significantly lower than the expected 50%. Therefore, although some of the results showed confirmation of the TWM, when analysed separately, there was little support for the individual assumptions and it is more likely that there is a more complicated, stress induced, adaptive sex ratio process in this species, controlled by either (or both) sex prior to or at conception, which is influenced by external stimuli other than resource allocation or in conjunction with it.

Statement of Originality

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Aryn W. Perryman and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Aryn W. Perryman

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