

**Reproductive success, dimorphism and sex allocation  
in the brown falcon *Falco berigora***

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## **Declaration**

The research presented in this thesis is my original and independent work. No part of it has been submitted for any previous degree.

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Title Page: An adult male brown falcon from the focal population; note colour bands. Photo courtesy of Ian Montgomery.

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## Abstract

This project describes various aspects of the breeding ecology and behaviour of the brown falcon *Falco berigora*, a common but poorly study Australian raptor. In particular it examines (a) the main influences on reproductive success; (b) tests predictions of theories proposed to explain the evolution and maintenance of sexual size dimorphism (RSD; females the larger sex) in raptors; and (c) investigates sex allocation patterns in the light of current sex ratio and parental investment theory. The study was conducted between July 1999 and June 2002 approximately 35 km southwest of Melbourne, at the Western Treatment Plant (WTP), Werribee (38°0'S 144°34'E) and surrounds, a total area of approximately 150 km<sup>2</sup>.

- In all plumage and bare part colouration of 160 free-flying falcons was described. The majority of variation in these characters could be attributed to distinct age and/or sex differences as opposed to previously described colour 'morphs'.
- Nestling chronology and development is described and formulae based on wing length derived for determining nestling age. An accurate field-based test for determining nestling sex at banding age is also presented.
- Strong sex role differentiation was apparent during breeding; typical of falcons females performed most parental duties whilst males predominantly hunted for their brood and partner. Based on observations of marked individuals, both sexes of brown falcons aggressively defended mutual territories throughout the year, with just 10% of each sex changing territories during the entire study period. Males performed territorial displays more frequently than females, the latter rarely displaying alone.
- The diet of the population as a whole was very broad, but within pairs both sexes predominantly specialised on either lagomorphs, small ground prey (e.g. house mice *Mus musculus*), small birds, large birds or reptiles, according to availability.

- Reproductive parameters such as clutch size and the duration of parental care were constant across all years, however marked annual differences in brood size and the proportion of pairs breeding were evident.
- Age was an important influence upon reproductive success and survival, with immature birds inferior to adults in both areas. However, interannual differences were by far the most influential factor on breeding success and female survival. Heavy rain downpours were implicated as the main determinant of reproductive success and adult female mortality in a population largely devoid of predation or human interference.
- Female-female competition for territorial vacancies was intense; larger adult females were more likely to be recruited and once breeding fledged more offspring. In contrast, male recruitment and breeding success was unrelated to either body size or condition indices, although smaller immature males were more likely to survive to the next breeding season. This directional selection is consistent only with the predictions of the intrasexual competition hypothesis.
- Despite marked RSD (males c. 75% of female body mass), throughout the nestling phase female nestlings did not require greater quantities of food than their male siblings. However, female parents fed their last-hatched sons but not daughters, resulting in the complete mortality of all last-hatched female offspring in focal nests. Given last-hatched nestlings suffered markedly reduced growth rates and female, but not male, body size is important in determining recruitment patterns, the biased allocation amongst last-hatched offspring is likely to reflect differing benefits associated with investing in small members of each sex, consistent with broad-scale Trivers-Willard effects. Recruitment patterns support this, with surviving last-hatched females, in contrast to males, unable to gain recruitment into the breeding population upon their return to the study site.



Thus selection appears to act at the nestling, immature and adult stages to maintain RSD in the focal population. Larger females were favoured in the nestling phase, at recruitment and once breeding had greater reproductive success. In contrast, selection favoured a reduction or maintenance of immature male size as smaller birds had a greater chance of survival in the year following recruitment than their larger counterparts; thereafter male size was unimportant. Together, this directional selection favouring increased female competitive ability is consistent only with the predictions of the intrasexual competition hypothesis, which appears the most probable in explaining the maintenance and perhaps evolution of RSD in raptors.