Socioecology and Phylogeography of the Yellow-bellied Glider (*Petaurus australis*)

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Abstract

Marsupials have complex and interesting socioecology and life history strategies that differ quite markedly to much-studied eutherian mammals. However, the socioecology and life history strategies of a number of Australian marsupials are most often observed only within the context of a much larger study on their ecology. My aim was to study, using a combination of behavioural observations and molecular DNA techniques, aspects of the socioecology of a population of yellow-bellied gliders (*Petaurus australis*) in Rennick State Forest, south-western Victoria. Petaurid gliders feed on plant and insect exudates, pollen/nectar and arthropods. Yellow-bellied gliders are arboreal, rare, nocturnal and cryptic, have persistent pair bonds, are territorial and exist in low population densities. In particular, I sought to confirm that the Rennick population of yellow-bellied gliders maintained a predominantly monogamous mating system. I also sought to confirm that the timing of reproduction in this population of yellow-bellied gliders would be seasonal, and timed to coincide with peaks in the abundances of two indices of protein food resources (i.e. flowering and bark shed). In a more broadscale study, I sought to examine the geographic distribution of mitochondrial haplotyes and morphological variation of the yellow-bellied glider throughout its range.

Polymorphic microsatellite loci are the choice of genetic marker for fine-scale studies, such as relatedness and paternity. Microsatellite loci had previously only been characterised and optimised for *Petaurus norfolcensis* (squirrel gliders). However, close inspection of the GenBank sequences revealed the presence of replicates differing only by sequencing errors. A panel of seven polymorphic tetranucleotide loci in *Petaurus breviceps* (sugar gliders) and three polymorphic trinucleotide loci in *P. australis* were isolated and optimised. Five *P. breviceps* loci were polymorphic in *P. norfolcensis* and two were polymorphic in *P. australis*. Only one *P. australis* locus was variable in *P. breviceps* and *P. norfolcensis*. No locus showed a deficit in heterozygotes according to Hardy-Weinberg expectations, and the large number of alleles for some of the loci confirmed their usefulness for studies in relatedness and paternity.

A number of Australian arboreal marsupials have been reported to show monogamous and polygynous mating systems in different populations, but previous studies have not included genetic analyses to confirm the observations. My aim was to test the hypothesis that monogamy was the predominant mating system in a population of yellow-bellied gliders (*Petaurus australis*) in south-western Victoria. Home range overlap, cohesiveness of pairs, rates of den site co-occupancy and location of den trees within the home ranges of 13 gliders were determined via radio-tracking. A monogamous social system predominated, demonstrated by extensive home range overlap between cohabiting adult males and females (40-100%) and little home range overlap between adjacent territories (< 7%). Males spent approximately 55% of their active time within 25m of their female partners and 55-85% of their sleeping time in dens with their female partner. The paternity of all juveniles within the population was analysed using five microsatellite DNA markers. Of 37 individuals genotyped, 12 of 13 juveniles could be attributed to the resident adult male. My results suggest that social monogamy equates with genetic monogamy in this population of yellow-bellied gliders.

Mammalian taxa living in seasonal environments usually coincide energy-demanding reproductive activities with the seasonal availability of food resources. However, few studies on arboreal marsupial taxa in Australia have focussed upon the interplay of forest phenology and the timing of breeding. This study examined forest phenology in a temperate environment, and the timing of reproduction the yellow-bellied glider. I captured adult females once per month between August 2001 and August 2003 to determine reproductive condition, and monitored indicators for two key food resources over the same period. Flowering phenology (as an index of pollen availability) was assessed in 170 manna gum (*Eucalyptus viminalis*) and brown stringybark (*E. baxteri*) trees, while bark shed (as an index of arthropod availability) was assessed in 45 manna gum, the only eucalypt species at this site that sheds it bark. Aseasonal reproduction was indicated within this population of gliders, as distributions of births were not statistically different from random. However, yellow-bellied gliders did exhibit distinct birth peaks in spring, summer and winter, when data were combined for both years. The temporal distributions of flowering for both eucalypt species were statistically different from random, indicating seasonal availability of nectar and pollen. Peak flowering occurred in summer for brown

stringybark, and autumn for manna gum in both years, although for manna gum peak abundance of flowers was one month earlier in the second year. While the temporal distribution of bark shed on the trunks of trees did not differ from random, it did show seasonality on the main and outer branches, peaking in summer and declining thereafter. Thus, it appears that yellow-bellied gliders breed aseasonally in a predictable, seasonal environment. However, yellow-bellied gliders have a reliance on the complex temporal interplay of different seasonal food resources.

Subspecific status has often been used as a surrogate for conservation unit, but does not always reflect intra-specific lineages with different evolutionary histories. One contentious case of subspecific classification occurs in the yellow-bellied glider, a marsupial species showing considerable decline in population size and requiring conservation management. Our aim was to assess the current subspecific status of populations and define units of conservation using a combination of phylogeographical analyses of mitochondrial DNA and morphological analyses. Analyses of the mitochondrial ND4 gene provided evidence for significant phylogeographic structure within yellow-bellied gliders. Isolated populations in north Queensland (NQ) and Victoria/ South Australia were genetically distinct from populations in New South Wales and southern Queensland. Morphological analyses provided little evidence for discrimination of populations, although NQ specimens were generally smaller in size compared to southern forms. My analyses do not support the classification of subspecies, *P. a. reginae*, for the original type specimen from southern Queensland. Taking into account other behavioural and ecological data, and the disjunct distribution of NQ populations from southern populations, I propose that the NQ population represents a distinct Evolutionarily Significant Unit, a lineage showing highly restricted gene flow with the rest of the species.

Declaration

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

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Meredeth Brown

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