



Thesis writing



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# Abstract - Biology example

## Example: abstract of a thesis

The yellow-bellied glider (*Petaurus australis*) is one of only a few mammal species that feed on plant and insect exudates. The studies described in this thesis were aimed at assessing the importance of the diet on the behavioural ecology of the yellow-bellied glider. Gliders were studied in detail at two sites in New South Wales in quite different forest habitats. One site was near Bombala on the southeast tablelands and the other was near Kioloa on the south coast. The following features of the behavioural ecology of the yellow-bellied glider are presented in this thesis: i) the diet and foraging behaviour, ii) a detailed examination of the influences on the sap feeding behaviour, iii) the socioecology, iv) the size of home-ranges, and v) influences on the use of vocalizations.

At both study sites, a detailed assessment was made of the contribution of various food resources to the diet. Direct observation was necessary to assess the diet because exudates are almost wholly digested and, the use of exudate indicators in the faeces allows only presence or absence to be ascertained. Exudates (eucalypt sap, insect honeydew, manna, nectar) accounted for approximately 75% of the diet of gliders at Bombala (based on the proportion of the observed feeding time) whilst arthropods accounted for the remaining 25%. Arthropods are believed to be harvested primarily to provide dietary protein which is virtually absent from exudates. In contrast, exudates accounted for 99% of the diet at Kioloa and arthropods only ca 1%. Gliders at Kioloa spent 70% of their feeding time engaged in feeding on nectar (and presumably pollen) from eucalypt blossom. Most of the protein requirement of gliders at this site may have been satisfied by pollen digestion because glider faeces contained substantial numbers of pollen grains, most of which had lost their cell contents.

Eucalypt sap was important in the diet of gliders at both sites on some occasions. Gliders obtained sap by cutting into the trunks of trees with their lower incisor teeth and licking the sap that exuded. This occurred on only a small proportion of trees within a home-range. The incidence of rainfall and the availability of alternative food resources have been suggested recently to account for this seemingly enigmatic behaviour. However, the occurrence of sap feeding was not related to rainfall at either Bombala or Kioloa. Moreover, neither hypothesis accounts for the selection of only a small number of trees for sap feeding. Gliders were also selective in the species of tree utilised, with only a few of the available species being incised.

*topic and focus of research*

*fieldwork location*

*scope of study*

*results for diet and foraging behaviour at Bombala (section i)*

*results for diet and foraging behaviour*

*previous studies of sap feeding behaviour (section ii)*

*connecting study to hypotheses*



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An index of sap flow in both sap-site and non sap-site trees was obtained periodically. Gliders fed on sap only at times of high sap flow and trees used for sap feeding tended to have a greater propensity to elevate sap flow than trees not incised by gliders. Feeding bouts during the main sap feeding periods were of a long duration (ca 65 min) but outside these periods gliders occasionally made brief (ca 6 min) 'test' incisions into both sap-site and non sap-site trees. It is suggested that this behaviour of gliders allows them to assay trees for the amount of sap flow and it is only when this is above a certain threshold that gliders engage in sap feeding. At Kioloa, high levels of sap flow were measured at times when sap feeding did not occur. This suggests that the abundance of alternative food resources, particularly of nectar, may on occasion influence the use of sap by gliders. Thus, elevated sap flow may provide a necessary precondition for sap feeding rather than ensuring its occurrence.

*methodology for sap feeding study*

An examination of the foraging behaviour of gliders at both sites revealed that gliders spend more than 80% of the time outside their dens feeding. When feeding time is coupled with time spent in other behaviours essential for foraging (ie gliding and climbing), approximately 90% of this time is accounted for. This is one of the highest values yet found for a mammal. It is suggested that this is due to the nature of the diet. Exudates are continuously renewed and can be quickly assimilated, but these food types are never sufficiently abundant to permit much time to other activities.

*discussion of results for sap feeding*

*discussion of foraging behaviour (section i)*

Gliders spent significantly longer periods in trees when feeding on exudates than when feeding on arthropods. Also, gliders tended to forage together in the same trees when feeding on exudates compared to when feeding on arthropods. Data collected at both sites suggest that the foraging behaviour of gliders is influenced, not only by the abundance of their food resources, but also by the rates of renewal. At Kioloa, when eucalypts were flowering, gliders often had a choice - of remaining in single trees for long periods of time or visiting more trees and perhaps encountering higher standing crops of nectar. Gliders were always highly selective in their choice of flowering trees in which to feed, choosing those with more than twice as many flowers as on a randomly selected sample of trees.

*discussion of foraging behaviour (section i) cont'd*

Trapping of gliders was conducted at both sites and this, coupled with extensive spotlighting, allowed the social organization of gliders to be monitored. At Bombala, gliders lived in groups consisting of an adult pair and occasionally a sub-adult. Thus, glider groups almost always contained two or three individuals which shared an exclusive home-range. In contrast, glider groups at Kioloa never contained fewer than three individuals and initially two groups contained six individuals each. Both these groups contained an adult male and at least two adult females, suggesting a polygamous mating system. Subsequently, group sizes declined to three individuals which included an adult pair with sub-adult. This decline in group size coincided with the failure of flowering in the most abundant tree species at this site, Eucalyptus Maculata, over three successive years. It is argued that the mating system of these gliders is determined by the abundance and continuity of their food resources. At Kioloa, eucalypt blossom can be available throughout the year, providing a constant supply of both energy and protein.

*methodology for socioecology study (section iii)*

*results for Bombala and Kiola*



### Example: abstract of a thesis

Gliders at the two study sites gave birth to a single young. At Bombala, young were born predominantly between July and September while at Kioloa, there was a predominance of births between February and March. This difference is suggested to be related to the timing of late lactation and weaning to coincide with the availability and predictability of certain food resources.

*discussion of reproductive habits and its significance to study*

At both sites, glider groups occupied exclusive home-ranges. At Bombala, these averaged 55 ha (using 95C\*G isopleths based on the harmonic mean distance minimum) compared to 30 ha at Kioloa. The difference in the size of the home range may reflect a greater abundance of food resources at Kioloa. Exclusive use of a home-range is often considered suggestive of territorial behaviour. The gliding capability of these possums allowed extraordinary mobility within their home-ranges which is one prerequisite for territorial behaviour. I propose that the extensive use of vocalisations by yellow-bellied gliders, which parallels the behaviour of many primates, mediates this inter-group spacing. Calling rates by gliders were higher when they foraged in the periphery of their home-range compared to when they foraged in the core of their home-range. Experimental playback of vocalisations within glider home-ranges resulted in increased calling rates by the resident gliders and in 50% of tests, led to a resident glider moving into the playback area. These results suggest that the home-ranges of glider groups are in fact, territories.

*results for study of home-ranges (section iv)*

*results for study of vocalisations (section v)*

This study shows that the extensive use of exudates by yellow-bellied gliders has a strong influence on their behavioural ecology. Exudates display a set of traits (a clumped spatial distribution, a continuous rate of renewal, can be quickly digested, have the potential to be available year-round and to be at times superabundant) which produce (i) an uncommon time-activity budget, (ii) a flexible mating system and (iii) apparent territoriality. Finally, the requirement of the yellow-bellied glider for very large home-ranges and the allocation of an enormous amount of time to foraging suggest that this species may be adversely affected by habitat alteration. Studies which examine the impact of logging on the behavioural ecology of this species are now required.

*significance of findings*

*suggestions for further research*

