CHAPTER 1
INTRODUCTION

Eusocial insects are those species of insects that live together in groups that are characterised by reproductive division of labour, overlapping generations with at least two adult generations present at any one time, cooperation among adults in brood care, a morphologically differentiated egg-layer and the presence of non-reproductive or sub-reproductive worker caste (Wilson, 1971; Crozier and Pamilo, 1996). These insects aggregate in some form of permanent grouping and show a marked diversity in their behavioural patterns (Alexander, 1974).

Some Hymenopteran insects are eusocial and these include the honey bees in subfamily *Apinae*. Honey bees are considered highly eusocial. A colony consists of three castes that are distinct in origin, behaviour and morphology. The reproductive castes comprise the queen (female) and drones (males). Both the queen and drones are involved in reproduction. Female workers comprise the non-reproductive caste, (though under some circumstances they can reproduce). Workers undertake nearly all of the activities in the colony, e.g. feeding larvae and caring for the brood, foraging and protecting the colony. Females are derived from fertilised eggs (diploid) while males developed from unfertilised eggs (haploid) (Figure 1.1).

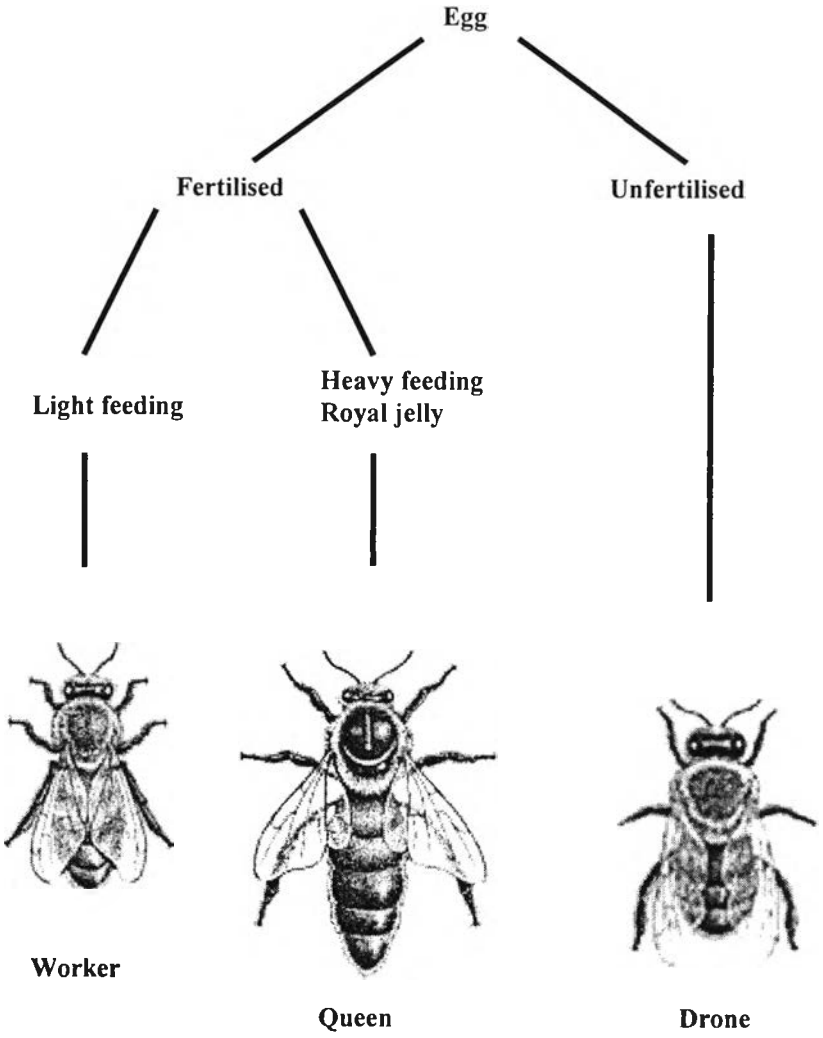

Figure 1.1 Sex and caste determination in honey bees. Reproductive and non-reproductive females are determined by sources of larvae feeding. (Modified from Winston, 1987).

Kin selection theory (Hamilton, 1964) predicts a conflict between females over male production. This conflict occurs between queen and workers and among workers. Asymmetry relatedness causes by polyandry seems to be a major factor of this conflict. Multiple mating of honey bee queens results in lower relatedness among offspring. Worker should prefer closer relatives to reproduce and rear those closer relatives in order to gain indirect fitness. To reduce the cost of rearing those who have lower relatedness, policing behaviour occurs, either via aggression towards ovary-developed workers or oophagy of other worker's eggs. Multiple mating of the queen has been reported in many species of honey bees (Palmer and Oldroyd 2000). This reproductive system has facilitated policing behaviour due to relatedness asymmetry.

This thesis aims to investigate the reproductive system and the conflict over reproduction in the giant honey bee, *Apis dorsata*. I hypothesised that worker reproduction may be more prevelant in this species relative to other species in the genus *Apis*, due to its high mating frequency and method of comb construction. In addition, multiple mating in *A.dorsata* has been observed and reported by 2 teams (Mortiz et al., 1995; Oldroyd et al., 1996). However, these studies were based on a limited sample size and used a small number of genetic markers. Thus, reassessment of mating frequency is required. I also test the hypothesis that mating frequency is dependent on the availability of mates by comparing mating frequencies in aggregated colonies (where mates should be readily available) and single colonies, where unrelated males may be less available. The evolution of these two behaviours in this species is discussed and compared to other species in the genus *Apis*.

1.1 Objectives

1. To investigate the occurrence of worker sterility of *A. dorsata* workers.
2. To investigate worker policing behaviour in this species.
3. To reassess the degree of mating frequency of the queens of *A. dorsata*.
4. To compare the level of polyandry between A. *dorsata* queens of aggregated colonies and solitary colonies.

1.2. Anticipated Benefit of This Research

Multiple mating (polyandry) has been observed in several species and has been emphasized as one of the specific characters in the genus *Apis*. Polyandry is thought to have arisen during the earliest divergence of the genus and has been observed in several species of this genus. Determination of mating frequency in *A. dorsata* will show that this evidence is common across the genus.

Worker policing behaviour is facilitated by relatedness asymmetries. This behaviour occurs in many species including *A. florea*, which thought to be the first species, arose from the divergence of this genus. Therefore, clarification of worker reproduction and polyandry of this species will fulfill the understanding in the evolution of reproductive system in this genus. In addition, finding of this research will be in part of the explanations the success of colony development of *A. dorsata* and other species in the genus *Apis*.