

**Queen Number and Sociality in Insects**

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IN A WORLD DOMINATED by struggle and selfish interests, why be cooperative and join an alliance? The chapters in *Queen Number and Sociality in Insects* point the way to understanding this problem, a problem similar to one Alice faced in Looking-Glass land: "I wouldn't mind being a Pawn, if only I might join—though of course I should like to be a Queen, best."

Social insects are well known as examples of animals that express allegiance to their fellows, even to the point where *Pawns* forsake personal reproduction in favor of teaming up with a reproductive Queen. Less well known is that sometimes several reproductives join together to form a permanent alliance of polygynous egg-layers (queens). In other cases, queens enter into a temporary alliance as part of a winner-take-all gamble at monopolizing reproduction, and the alliance is broken by a battle to the death (literally or genetically).

*Queen Number and Sociality in Insects* contains 17 chapters; an overly brief glossary; and useful author, species, and subject indices. The book reads as if it is two books. The first seven chapters, constituting nearly half of the book, are concerned with how animals should behave in a theoretical world. The 10 empirical chapters are concerned with how animals really behave. Unfortunately, the empirical chapters frequently report data bearing on questions which were not addressed in the theoretical chapters (or *vice versa*). In fact, Seger mentions this in the first chapter, noting that the remainder of the book contains a wealth of biological details that "must somehow be incorporated into the next generation of models."

Seger discusses polygyny as a specific example of the "group-size problem"—why belong to a group of size  $n$ , rather than one of any other size? The theoretical answer is that "individual fitness must be greater in groups of size  $n$ ." Seger also reviews the real-world complexities which make it difficult to answer this question in practice. Keller and Vargo point out the interesting parallels between evolutionary explanations for the origins of sociality and for secondarily-derived polygynous societies. These multiqueen societies should be rife with conflict, because each queen struggles to maximize her genetic interests (Reeve and Ratnieks). Chapters by Boomsma and by Nonacs review the consequences of polygyny for sex-ratio theory. Boomsma's chapter is especially valuable

for its critical discussion of assumptions, and for suggesting tests to falsify the theoretical models. Queller develops useful models to assess relatedness within polygynous colonies.

In the empirical half of the book, ants have six chapters, wasps have three, and bees and termites have token representation with one chapter each. Peeters, Elmes and Keller, and Rosengren et al. describe the distribution of polygyny and monogyny among ponerine, *Myrmica*, and *Formica* ants, respectively. Queen number often varies among or within populations, so each of these chapters also briefly discusses ecological correlates of queen number. These correlates (e.g., colony size, probability of successful dispersal) are reviewed more comprehensively in a chapter by Herbers. Heinze shows that queens in colonies with short-term polygyny are frequently aggressive to one another, whereas those in colonies with permanent polygyny are apparently more tolerant of one another. The ant section ends with a chapter by Carlin et al., showing that *Camponotus* ants do not display the kin discrimination abilities predicted by theory. Roisin discusses similarities and differences between polygynous termites and ants.

The numerous neotropical swarm-founding epiponine wasps are covered by Hughes et al. Broader coverage of these wasps would have been desirable, because this taxon was flagged by Hamilton as a special problem for explaining social behavior by elevated degrees of relatedness among colony members. In chapters on the Old World genus *Ropalidia*, Itô shows that polygyny is more common than previously believed, whereas Gadagkar et al. report detailed data on the consequences of serial polygyny in one Indian species.

Packer's chapter on those eminently fascinating halictine bees is the only one that attempts to take into account historical patterns (phylogeny) in understanding the evolution of polygyny. The volume would be more useful if such efforts had been more frequent, given that the causes and consequences of polygyny appear to be taxon-specific (chapters by Herbers and Roisin).

Before this volume, the origin and maintenance of polygynous associations had received much less attention than it deserves. Although coverage of topics and taxa is uneven, this volume should stimulate much interest in the problem of queen number, and will serve as a valuable reference for biologists interested in the evolution of cooperation and sociality.

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