

Social Structure and the Determinants of Queen Status in the Primitively Eusocial Wasp *Ropalidia cyathiformis*

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Primitively eusocial wasps are of great interest to students of socio-biology because of the flexibility in social roles that an individual can adopt. This flexibility can be rather spectacularly illustrated using the common Indian species *Ropalidia cyathiformis* (Gadagkar and Joshi 1985). Here females eclosing on a nest have several options open to them. Some females leave the parent nest to start new, haplometric nests. Others also leave to found new nests, but pleometrotically i.e., they leave along with some workers. Yet other females stay on at the parent nest and eventually challenge the queen and take over the nest. Finally of course some females stay on at the parent nest and remain as sterile workers throughout their life. Prompted by the presence of such diverse reproductive strategies we have made a quantitative study of the behaviour of individually identified wasps. Even among the females staying back at the parent nest, multivariate statistical analysis of time activity budgets of individually identified wasps has revealed the presence of a behavioural caste differentiation into Sitters, Fighters and Foragers (Gadagkar and Joshi 1984). Here I report experiments designed to understand the biological and evolutionary significance of these behavioural castes.

MATERIALS AND METHODS

Naturally initiated post emergence colonies of *R. cyathiformis* were studied on the grounds of the Indian Institute of Science, Bangalore. Wasps were individually marked with spots of coloured paint, behavioural data were collected using unbiased sampling methods and multivariate and other kinds of data analysis were performed on a DEC 1090 Computer, all as described previously (Gadagkar and Joshi 1984). After sufficient data on a colony were collected, its queen was removed and the observations repeated.

RESULTS AND DISCUSSION

All the colonies studied showed a behavioural caste differentiation into Sitters, Fighters and Foragers both before and after the queens were removed. A typical pattern is illustrated in Fig.1. In conformity with previous results and in contrast to a related species *R. marginata* (Gadagkar and Joshi 1983), the queens of all the colonies were Fighters. In 7 out of 8 cases of removal or disappearance of a queen one of the subordinates assumed the role of a queen and began to lay eggs within about a week of queen removal. In every case the potential queen (the wasp that succeeds a removed queen) was a Fighter. As seen from Fig.1 the potential queen was remarkably different from all the other wasps in the colony and remarkably similar to the queen in her behavioural profile. In many cases the behavioural profile of that wasp who would eventually succeed the potential queen when the latter was in turn removed could be studied. Such a wasp is termed potential queen 2. The potential queen 2 was always a Sitter but not different from any other wasps in any discernable manner.

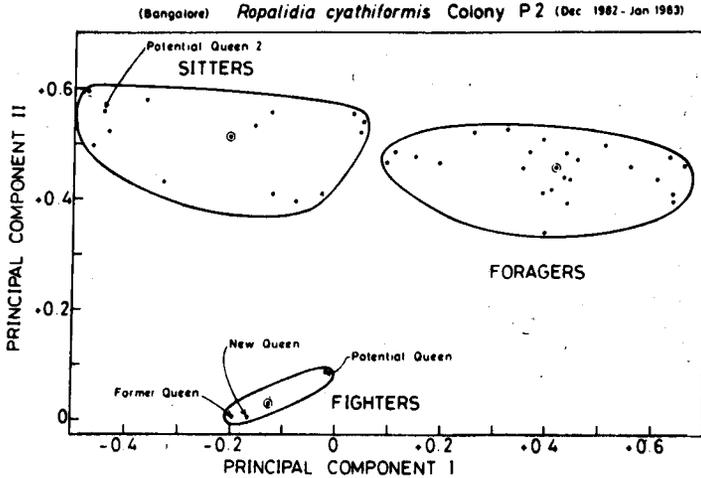


Fig.1.-Behavioural profiles of individually identified wasps in a *R.cyathiformis* colony analysed by principal components analysis. Each point represents the time-activity budget of a wasp (either before or after the queen was removed) plotted in the co-ordinate space of the first two principal components. The distinctness of the 3 clusters, Sitters, Fighters and Foragers is confirmed by the method of nearest centroid.

In 4 of the 7 cases the ages of the animals were known and in all of these the potential queen was not the oldest animal available. The four potential queens under discussion succeeded removed queens inspite of there being present 7, 10, 1 and 6 older females in their respective colonies at the time of queen removal. Among the females present at the time of queen removal the potential queens had the highest dominance rank and had shown the highest frequency of dominance behaviour in 6 out of 7 cases. The potential queens never brought food to the nest in 6 out of 7 cases and in the 7th case other females had brought food more often than the potential queen. Some of these results are in striking contrast to temperate zone wasps such as *Polistes exclamans* where high ranking but some of the oldest Foragers are known to be potential queens (Strassmann and Meyer 1983). In summary most colonies appear to have a well defined potential queen who can be predicted to become the next queen with reasonable certainty. The role of the potential queen appears to be fixed even in a healthy colony with an active queen.

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