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SERIAL POLYGYNY IN ROPALIDIA MARGINATA: IMPLICATIONS FOR THE EVOLUTION OF EUSOCIALITY

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Ropalidia marginata (Lep.) (Hymenoptera : Vespidae) is a primitively eusocial wasp in which the queens and workers are not morphologically differentiated (1). In peninsular India the species exhibits a perennial indeterminate colony cycle which may include multiple repeats of the typical annual colony cycle shown by temperate polistine wasps (2). Although there is some pre-imaginal caste bias, the roles of queen and worker are largely decided in the adult stage (3). Female wasps eclosing on a nest have several options available to them. These include leaving their natal nest to start their own solitary foundress nests, staying on at their natal nests and assuming the role of a worker, staying on at their natal nest and eventually taking over the role of the queen and leaving their natal nest along with a few workers to start their own multiple foundress nests (2). From several hundred hours of observation of several colonies it appears that only one individual ever lays eggs at any given time in a colony (4, this study). The impression of monogyny created by this observation is misleading because queen replacements are quite common so that workers often rear brood which are the offspring of two or more queens. Moreover, the workers are also offspring of two or more individuals. This phenomenon may thus be called serial polygyny.

In this brief report, we describe some features of serial polygyny in *R. marginata* on the basis of our study of four laboratory and three free foraging colonies. Our results show that queen turnover is quite common and that queen replacements seem to take place at all times of the year. Queen replacements are not accompanied by any significant desertion of the colony by workers. The same workers who were rearing offspring of the previous queen therefore, begin to rear offspring of the new queen. The tenure of queens is highly variable and ranges from 7 to 299 days with a mean of 124 days. The age of the queens at the time of taking over the role of egg laying is also highly variable and ranges from 7 to 78 days. The productivities of the queens can vary enormously and may be measured either as the total number of eggs laid during their tenure which ranges from 19 to 2207, the number of eggs laid per day of their tenure which ranges from 0.61 to 10.2 or the total number of adults produced which ranges from 0 to 394. The proportion of eggs laid by a queen which successfully become adults is rather low, yet highly variable, ranging from 0 to 0.49.

New queens were daughters, sisters or nieces of previous queens and workers were daughters, sisters or nieces of the queens of their colony. Queens of *R. marginata* are known to mate multiply, and use sperm simultaneously from two or more males (5). Consequently, workers rear brood which are complex mixtures of their full- sisters, half- sisters, brothers, nieces, nephews and cousins. Thus, workers sometimes reared brood to whom they had coefficients of genetic relatedness as low as 0.0625 (mother's, sisters' offspring). Our previous work has shown that workers are unlikely to be able to discriminate between different levels of genetic relatedness within the colony (6). These observations make it very unlikely that individuals stay behind on their natal nests and take on worker roles because of the possibility of being able to rear brood which are more closely related to them than their own offspring would be. Instead our observations strongly support the hypothesis that female wasps stay on their natal nests because of the hope of becoming queens in future (2). Even if the probability of becoming a queen is quite small for a given individual, the fitness gained by those that succeed can be so great as to offset the cost incurred by the remaining bearers of the hypothetical "gambling" allele which has been postulated to program its bearers to take the risk of being a part of a social group and await their chances of becoming queens (2). The mean number of adults successfully produced by a queen is 78, a number which is likely to be substantially larger than the number of offspring that a solitary wasp can produce.

TABLE 1: Serial Polygyny in *R. marginata*. Data from four laboratory colonies and three free foraging colonies.

	Min.	Max.	Mean	S.D.
Duration of study per colony (days)	199	606	387	146
Number of queens per colony	2	5	3	1.2
Tenure of queens (days)	7	299	124	89
Age of queens at the beginning of tenure (days)	7	78	38	23
Age of queens at the end of tenure (days)	19	300	139	88
Number of eggs laid	19	2207	331	500
Number of larvae produced	12	1625	258	394
Number of pupae produced	0	679	107	178
Number of adult female offspring produced	0	360	63	99
Number of adult male offspring produced	0	136	15	36
Total number of adult offspring produced	0	394	78	124
Number of eggs laid per day	0.61	10.2	2.5	2.2
Proportion of eggs laid that become adults	0	0.49	0.18	0.16

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