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SHORT COMMUNICATION

WHY ARE WORKERS IN SOCIAL HYMENOPTERA NOT MALES?

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ABSTRACT

Several types of activities that are carried out by males of meliponids are described. Camargo (J. Kansas Ent. Soc. 55: 8-12, 1982) found that spermatozoa of *Melipona quadrifasciata* complete their migration from testis to seminal vesicles in 10 days. When 10 days old in *M. quadrifasciata* and 12 in *compressipes*, males leave the colony and collect nectar and pollen by themselves. After leaving the hive the males live another 15 days; therefore, each day after the 12th, that the male continues to work in the hive means 7% less chance to inseminate a queen, that is, 7% less in adaptive value. A similar result is expected if the male would engage in food collection for the family. Fitness for reproduction seems to be the main reason that completely worker males have not been found in social bees.

Starr (1985) reviewed the question of why workers in social Hymenoptera are not males. He concludes that male workers are unfit for work. This present note will consider the implications and correctness of his argument, in the light of the fact that, unlike the males of *Apis*, the males of meliponids are known to do some work within the colony.

In Meliponids, and in *Bombus atratus*, workers have an external morphology closer to males than to queens (Kerr, 1974; Kerr, 1987a; Kerr and Cunha, 1990). Kerr and Cunha (o.c.) suggest that the worker caste in bees evolved in two directions: one (Apinae; Halictidae) in which both queens and workers specialize but maintain female appearance, and another (Meliponinae species, and *Bombus atratus*) in which caste determination depends more and more on female gene regulation by juvenile hormone and, therefore, queen and workers specialize but workers become more and

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more male-like. Since meliponid workers in their evolution become more and more male-like, having actually reached a maximum in the meliponids, why do not the males carry out all or most of the female-workers tasks?

This potentital will be even more important in meliponids because workers can distinguish neither eggs nor larvae that will develop into males. When a colony enters into a situation of starvation, however, workers recognize the males, do not feed them and kill them while they are emerging. Workers of meliponids are super-sisters (they have 75% of genes in common) but have only 25% (sons of queen) or 37.5% (sons of workers) of genes in common with their brothers. Several biologists have found that males of meliponids carry out some jobs. Males of meliponids in the first third of their lives incubate larvae, produce wax and work with it (Kerr, 1987b), engage in trophalaxis (Engels and Engels, 1988), dehydrate nectar within the hive (Fonseca, 1973) and outside the hive (recent observations of mine for *M. scutellaris* and *M. rufiventris*), probably to diminish the weight when they fly after the queen. They leave the colony (and do not come back) and look for their own food; meliponid males were found in flowers, collecting food, by Kerr (1959), Nogueira-Neto (1959, 1964), Brenha (1987), Kerr (1987b). I found that males of *Melipona rufiventris* follow communication odor-trails of workers (observed in January, 1989). One male of *Melipona scutellaris* was seen stopped 14 cm near the hive and suddenly flew in the direction of a spider (Salticidae) that was 5 cm from the nest entrance trying to hunt a worker; this spider jumped away and was not seen in the next 30 minutes, at the end of the observations; this means they can act as guards of the nest. Kukuk and Schwarz (1988) found that in the Australian Halictinae bee *Lasioglossum erythrurum*, males are dimorphic: typical and macrocephalic. These macrocephalic males are flightless, and act as guards against predatory ants and other heterospecific intruders; about 5% of their time is spent in tunnel repair; and they mate within the nest. Males of *Bombus griseocollis* and *B. pennsylvanicus* share in the brood care of nestmates by incubating pupae (Cameron, 1985).

Kerr and Cunha (1989) suggest that since female workers of meliponids are very similar to males, mutations that would affect them would also affect the males activities, affecting colony performance for the tasks they carry out.

According to Garofalo (1972), in *Apis* the spermatozoa complete their migration from the testis to the seminal vesicles when the male is 9 to 10 days old. From the data collected from caged drones of *Melipona quadrifasciata* by Camargo (1984), one can estimate that migration ends around the 9th day and that males live on average 25 days (Camargo, 1982): 10 inside the hive and 15 outside. Each day that he delays leaving the hive corresponds to a 7% decrease in average of his probability to inseminate a virgin queen and to have offspring. The same would happen if the male were to engage in food collection for the colony. Therefore, fitness for reproduction is the main reason that completely worker males have not been found in social bees.

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RESUMO

Vários tipos de atividades desempenhadas pelos machos de meliponíneos são descritas. Camargo (J. Kansas Ent. Soc. 55: 8-12, 1982) determinou que espermatozóides de *Melipona* quadrifasciata completam sua migração do testículo para as vesículas seminais em 10 dias. Quando os machos estão com 10 dias, em *M. quadrifasciata*, e 12 dias, em *M. compressipes*, os machos saem da colméia para coletar néctar e pólen. Depois de deixar a colméia os machos vivem mais 15 dias; portanto, cada dia após o 12º, que o macho continua a trabalhar, significa 7% a menos de chance para inseminar a rainha, quer dizer, 7% menos em termos de valor adaptativo. Um resultado similar seria esperado se o macho participasse na coleta de alimento para a família. A aptidão para reprodução parece ser a principal razão pela qual não são encontrados machos operários em abelhas sociais.

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