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SHORT NOTE

# Age Polyethism in the Swarm-founding Wasp *Metapolybia miltoni* (Andena & Carpenter) (Hymenoptera: Vespidae; Polistinae, Epiponini)

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**Abstract**
In Epiponini division of labor is associated with age polyethism and individual task specialization. We observed worker activities in three colonies of *Metapoybia miltoni* in Brazil. We analyzed differences of task allocation among age groups. Old workers tend to forage more than young, but age polyethism was less evident in other tasks. Age composition of population could be a determinant factor in task allocation. Workers are probably allocating to perform tasks according to colony needs, and not to individual's age. Considering age population in studies of division of labor could help to understand how colonies respond to different situations.

## Introduction

Division of labor characterizes insect societies. Workers allocate tasks responding to internal and external conditions, and to individual workers decisions (Sendova-Franks & Franks, 1999). There are two general patterns: worker age polyethism (task allocation correlated with age) and morphological polymorphisms (changes in size or shape related to task performance) (Beshers & Fewell, 2001). Organization of labor in wasps of the tribe Epiponini seems not to be related with morphological polymorphism because there is no morphological specialization or subcastes. Division of labor could be associated with worker's age, or with individual task specialization (Jeanne, 1996; Karsai & Wenzel, 2000).

According to Jeanne (1991) epiponines have the most evident worker age polyethism of social Vespidae. Previous studies in *Polybia* (Lepeletier), *Protopolybia* (Ducke) and *Agelaia* (Ducke) (Simões, 1977; Forsyth, 1978; Jeanne et al., 1988; Jeanne et al., 1992) found that young and middle aged workers perform nest tasks (building, brood care, nest maintenance, defense), while old workers forage. Nevertheless, the presence of workers specialized in a particular task is rare in most of social Hymenoptera (Robinson, 1992; Sendova-Franks & Franks, 1999; O' Donnell, 1998; Karsai & Wenzel, 2000; Beshers & Fewell, 2001; Johnson, 2003). Within Epiponini, Karsai and Wenzel (2000) did not find specialization in colonies of *Metapolybia aztecoides* (Richards) and *M. mesoamericana* (Smethurst & Carpenter).

Because organization and regulation of work is complex, conventional patterns are insufficient to explain the division of labor of several insect societies (Beshers & Fewell, 2001). For these reasons, we studied task allocation according to age in three colonies of *Metapolybia miltoni* (Andena & Carpenter) in Maranhão, Brazil.

We observed colonies for three days in 2008: colonies N-1 and N-2 on February, in Reserva Merck (S 02° 39' 7.8" and W 44° 09' 04.0"); and colony N-3 on March, in Reserva das Paineiras (S 03° 14' 35.4" W 43° 25' 28.7"). Nest envelope was removed in order to perform video recordings (Sony Handycam DCR-SR42). We took a random sample of work-

ers to perform individual observations (N=15 for N-1, N=11 for N-2 and N=18 for N-3). All individuals were marked with quick-drying paint. Video recordings included 197, 194 and 370 minutes for N-1, N-2 and N-3, respectively. We observed allocation of work in three tasks: cell inspection, construction (envelope and cells) and forage. In these cases, forager's activities were directly observed due to difficulties to follow them in video.

Females were classified according to age, based on three categories for the coloration of the transverse apodeme (Richards, 1971): light for younger, brown for middle age, and black for older females. To verify if the amount of workers that performs a determinate task varied according to age, and within colonies N-1 and N-3 (all observed workers of N-2 were young) a Chi-square test was applied.

Our results indicate that colony cycle stage did not affect workers frequency performing tasks among colonies (cell inspection $x^2$=0,854 df= 2 p>0.5; construction $x^2$=0,381 df= 2 p>0.5; foraging $x^2$=3,641 df= 2 p>0.5). Colony N-1 was in a mature stage of colony cycle (eggs, larvae, pupae and low queen proportion), and most of workers were young (old= 1% middle= 8% young= 90%). Colony N-2 was also in a mature stage, but in male production and most of the workers were young (young= 90% middle= 10%). Colony N-3 was in a pre-emergence phase (only eggs and higher queen proportion), and most of workers were old (middle= 17% old= 83%).

We observed a similar number of old and young workers perfoming nest tasks (cell inspection and construction) and foraging (young $x^2$= 4.588 df= 2 p>0.05; middle $x^2$= 1.333 df= 2 p>0.5; old $x^2$= 0.839 df= 2 p>0.5). Nevertheless, it is clear that young workers tended to forage less than olders (Fig 1 colonies N-1, N-3), even in colony N-2 young workers tended to forage less. Also, the amount of workers that perform tasks across different ages inside colonies N-1 and N-3 was similar (N-1 $x^2$= 2,798 df= 2 p>0.1; N-3 $x^2$= 0,802 df= 2 p>0.5).

As mencioned before, previous studies of division of labor in the Epiponini found that as workers get old they switch to perform tasks less related with brood care (Jeanne, 1991). Similarly, we observed that old workers tend to forage more than young individuals (Fig 1). We did not find significant differences probably because of the small sample of foragers (N=24). Nevertheless, even when old workers tend to forage more, young workers can also forage (Fig 1).

Age polyethism was less evident in the other tasks: old workers as young ones can build and inspect cells (Fig 1). Age composition of worker population within colonies may be a determinant factor in task allocation. The observed colonies did not include individuals of different ages; workers of colonies N-1 and N-2 were mostly young, and workers of colony N-3 were mostly old. Because colonies population has little variation in terms of age, workers must be allocated to perform tasks according to colony needs and not to individual's age. On the other hand, in colonies with differently aged workers, polyethism could be more important to delimit tasks, as demonstrated in previous studies (Jeanne et al., 1988; Jeanne et al., 1992).

As observed by Karsai and Wenzel (2000), we also found flexibility in activities performed by workers; young, middle and old individuals perform different tasks. Workers of all insect societies retain some behavioral flexibility that helps to respond to changing conditions (Robinson, 1992). Caste flexibility is decisive for colony survival in swarm wasps because it allows colonies to respond efficiently to different situations that may arise.

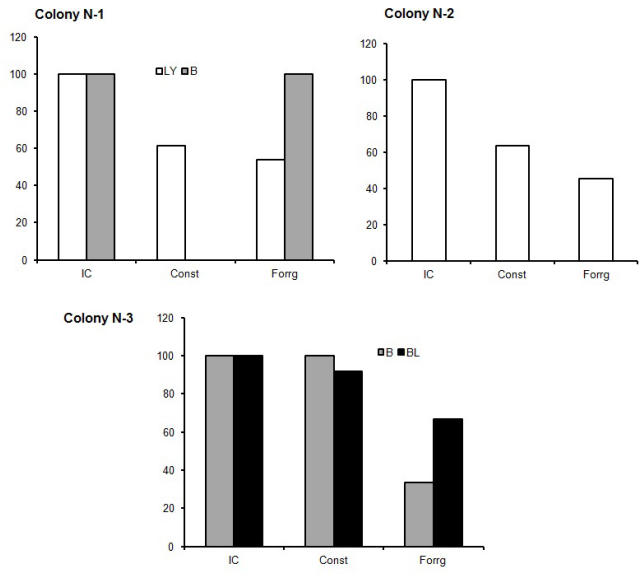


Fig 1. Percentage of workers of different age (LY= light yellow for younger, B= brown for middle age, BL= black for older females) that perform a task (IC= cell inspection, Const= construction, Forrg= foraging) throught the studied colonies of *Metapolybia miltoni*.

Workers decisions are dependent of colony context, and workers would be allocated to perform certain tasks when necessary (Karsai & Wenzel, 2000).

In conclusion, considering age composition of population and studying colonies exposed to different situations would help to understand how colonies allocate tasks. The division of labor of swarm wasps is more complex than previously thought; colonies do not organize labor in the same manner. In fact, as evidenced by Noll & Wenzel (2008), caste dimorphism may have evolved at least eight times and social organization probably derived directly from an ancestor with incipient caste dimorphism in most taxa. For this reason general patterns are not enough to understand different strategies across the tribe.

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