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SHORT COMMUNICATION

A rare but successful reproductive tactic in a social wasp (Hymenoptera: Vespidae): Use of heterospecific nests

Una táctica reproductiva rara pero exitosa en una avispa social (Hymenoptera: Vespidae):
Uso de nidos de otras especies

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ABSTRACT

Successful heterospecific use of abandoned nests has been reported in birds. Although the same behavior has been observed in wasps, the success of such tactic has not been demonstrated. We described two cases in which the social wasp *Polistes versicolor* successfully reared its brood in empty nests of the social wasps *Mischocyttarus drewseni* and *Mischocyttarus cassununga* (Hymenoptera: Vespidae). We showed that this is a rare but a viable reproductive tactic for both solitary and associative foundress. Unlike birds, which use heterospecific nests very similar to their own, wasps are able to use heterospecific nests that do differ from their own.

Key words: *Mischocyttarus cassununga*, *Mischocyttarus drewseni*, *Polistes versicolor*.

RESUMEN

El uso adecuado de los nidos abandonados ha sido reportado en aves. Aunque el mismo comportamiento se ha observado en avispa, pero el éxito de tal táctica no ha sido demostrada. Se describen dos casos en los que la avispa social *Polistes versicolor* utiliza con éxito los nidos vacíos de la avispa social *Mischocyttarus drewseni* y *Mischocyttarus cassununga* (Hymenoptera: Vespidae). Hemos demostrado que esta es una rara, pero una viable táctica reproductiva. A diferencia de las aves, que utilizan nidos muy similares a las suyas, las avispas son capaces de utilizar los nidos que difieran de los suyos.

Palabras clave: *Mischocyttarus cassununga*, *Mischocyttarus drewseni*, *Polistes versicolor*.

INTRODUCTION

During the colony founding phase, *Polistes* paper wasps exhibit different reproductive tactics, including: the establishment of new nests by a sole female or a group of females, called respectively solitary and associative foundation (Pardi 1948, West-Eberhard 1969, Reeve 1991); nest usurpation, where intruders aggressively expels the original adults from its own nest (Prezoto & Nascimento 1999, Brito et al. 2010); adoption of orphan nests, in which intruders adopt a nest with immature forms, but no adults (Nonacs & Reeve 1993, Hunt 2009); and use of empty nests when nest has no host immature or adults (Starks 1998, Prezoto et al 2002).

Several studies have demonstrated the value of these tactics in different contexts. For example, the associative nest foundation in *Polistes dominulus* offers greater productivity and survival benefits when compared to solitary one (Tibbetts & Reeve 2003). Alternatively, females of *P. biglumis* who have lost their nests can practice usurpation, especially in places where the short summer does not allow nest rebuilding (Cervo & Lorenzi 1996). In addition, it is possible that in early spring, some females of *P. dominulus* don't start new nests, but instead "sit and wait" to usurpate or adopt nests initiated by conspecifics, saving nesting costs in the early season (Starks 1998).

A few cases of wasps' interaction with heterospecific nests have been reported. For

example, Hunt (2009) found a female of *P. carolina* or *P. perplexus* adopting an orphan nest of *P. metricus* and a female of *P. metricus* adopting an orphan nest of *P. exclamans*. Prezoto et al. (2002) found females of *P. fereri* occupying a nest of *M. cassununga*. Prezoto & Nascimento (1999) reported females of *P. versicolor* using a nest of *M. cassununga* and Britto et al. (2010) reported *P. versicolor* female usurping a nest of *M. cassununga*. As a result, interaction with heterospecific nests seems to be widespread at least in *Polistes* paper wasps, but the reproductive success in all these cases has not been confirmed.

The neotropical social wasp *P. versicolor* (Hymenoptera: Vespidae) is found from Costa Rica to Argentina (Richards 1978). It is known that solitary and females association are successfully reproductive tactics for this species (Gobbi 1977, Oliveira et al. 2010). Although the use of heterospecific nests by females of *P. versicolor* has been reported (Prezoto & Nascimento, 1999, Britto et al. 2010), the success of such tactic remains elusive, since colonies failed to reach the post-emergence phase. As a result, a question arises: The use of heterospecific nests for colony initiation determines colony failure or it is possible to be a successful reproductive tactic? Here, we described two cases in which *P. versicolor* wasps used empty nests of the social wasps *Mischocyttarus drewseni* and *Mischocyttarus cassununga* (Hymenoptera: Vespidae). We showed that this is a rare but a viable reproductive tactic for both solitary and associative foundress.

METHODS

Case 1

From 22 August 2008 on, we performed a 11 week consecutive observation period during afternoon (5-6 PM) in a previously abandoned nest of *M. drewseni* used by females of *P. versicolor*, in the municipality of Simão Pereira (21°57'57" S, 43°18'43" W), Minas Gerais State, Southwestern Brazil. The nest was located in a ceramic tile, 2 m above the ground. In each observation, we registered the number of adult wasps present on the nest and the nest modification by *P. versicolor* females.

Case 2

From 14 March 2010 on, we conducted a 67 week consecutive observation period in the afternoon (5-6 PM) in a previously abandoned nest of *M. cassununga* used by a single female of *P. versicolor*, in the municipality of Juiz de Fora (21°46'3918" S, 43°22'14" W), Minas Gerais

State, Southwestern Brazil. The nest was located in a building, 2.5 m above the ground. In each observation, we registered the number of adult wasps present on the nest and the nest modification by the *P. versicolor* female. By paint marking all emerged individuals with non-toxic paint (De Souza et al. 2012), we observed the nesting sites in eight new traditional foundations from females of the maternal colony. In addition, we use the non-parametric test Mann-Whitney to compare cell diameter in *M. cassununga* and *P. versicolor* abandoned nests (40 cells from six nests of each species) located in a 1 km range of the study area.

RESULTS

Case 1

Originally, the nest had seven cells constructed by *M. drewseni*, all filled with *P. versicolor* eggs or small larvae. During colony development, original cells were increased to accommodate the immature and 15 new cells were built. For this, females used the typical building material, a mixture of plant fibers with saliva, as evidenced by the grayish color that differs from the nest built by *M. drewseni* (Fig. 1A). This colony reached the post-emergence on 5 October 2008. Colony produced seven females and two males, giving a sex ratio of 0.78. Colony was destroyed by a storm, 76 days after it was initiated.

Case 2

Originally, there were 10 cells constructed by *M. cassununga*, all of them filled with *P. versicolor* eggs. The single female used building material for both increasing original cells and to construct new cells (Fig. 1B). This colony reached the post-emergence on 7 May 2010. The colony was completely abandoned 470 days after it was initiated. Nest reached a total of 275 cells and produced 89 females and 61 males, giving a sex ratio of 0.59. Although there were 18 abandoned *M. cassununga* nests in the building at the time of new *P. versicolor* colonies foundation, all new colonies were founded directly in the building, never using a previously constructed nest. No foundation was located in the vegetation around the building. Cell diameter in traditional pre-emergent nests of *P. versicolor* (5.07 ± 0.44 [4.3-6.8] mm) differed significantly (Man-whitney: $U = 0$; $P < 0.0001$, $N = 6$ nests and 40 cells for each species) from that observed for *M. cassununga* (3.45 ± 0.28 [2.8-4.15] mm).

DISCUSSION

The use of abandoned nests is a viable reproductive tactic for both solitary and associative females. This makes sense because we showed that colonies started with a previously constructed nest produced both males and females. Additionally, adult productivity in the two studied colonies fall in the range observed for traditional solitary or associative foundations in *P. versicolor* which is 7-389 adults (Gobbi et al. 2009). As a result, adoption of empty nest seems to be at least as good as traditional tactics of colony initiation. In addition to insects, the Wood Thrushes *Hylocichla mustelina* have been documented using nests of Rose-breasted Grosbeak, *Pheucticus ludovicianus* (Richmond et al. 2007). The two bird species have very similar nest size. Birds could use such a tactic to minimize the amount of energy spent on nest construction (Cavitt et al. 1999). The same could be possible for wasps. During the initial stages of colony foundation, the wasps nest is left unattended more often than in other stages

of colony development, because foundress must forage (Gamboa et al. 1992). Using a nest that was already started could allow foundress to (i) allocate more energy in foraging for food instead of nest building materials or (ii) to stay more time in the nest protecting it. Future comparative studies with a better sample size should confirm these hypotheses.

In a previous study conducted at the same site, Oliveira et al (2010) did not record the use of heterospecific nests by *P. versicolor*. As a result, we suggest that this is rare tactic in the population. The number of *Mischocyttarus* nests does not appear to limit the adoption, because in Juiz de Fora, *Mischocyttarus* colonies are more abundant than *Polistes* in any season (Lima et al. 2000). Interestingly, females that were born in colonies founded by the use of heterospecific nests founded their new colonies in a traditional way, that is, by founding their own nest. However, all new colonies were found in human constructions, as the maternal colony. In *Polistes*, there is a "tradition" in nesting founding behavior (Wenzel 1993), i.e., females tend to use the same nesting substrate

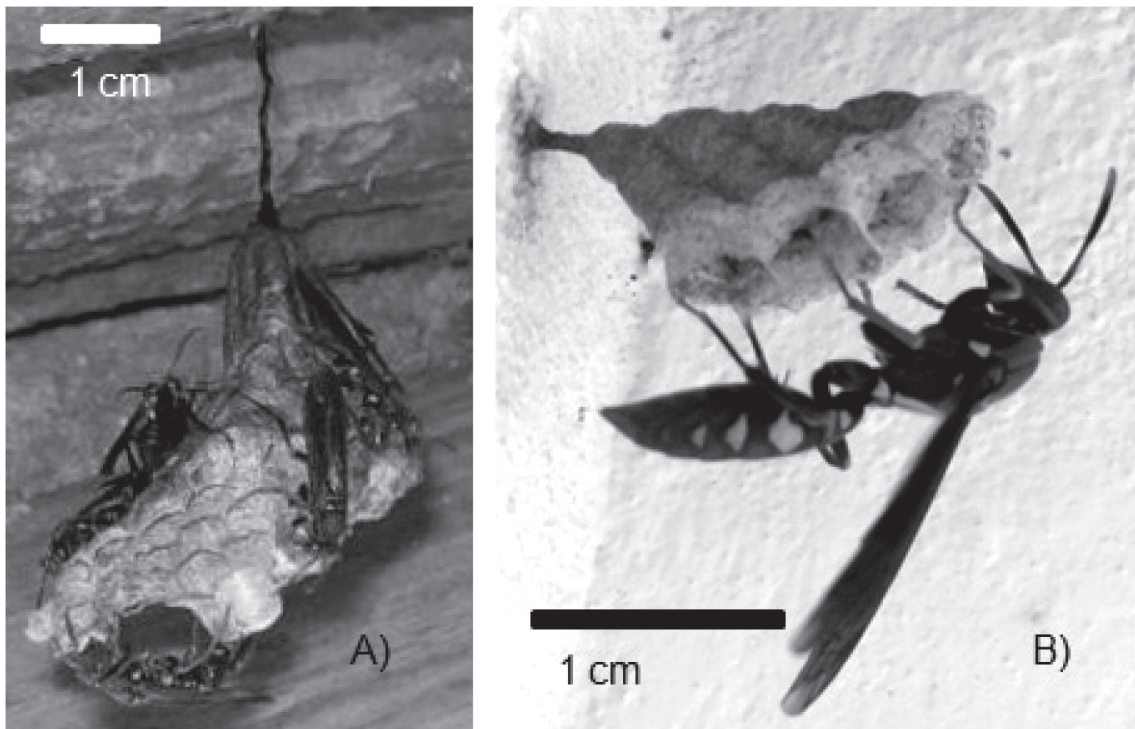


Fig. 1: Adoption of abandoned nests of *M. drewseni* (A) and *M. cassununga* (B) by *P. versicolor* females.

La adopción de nidos abandonados de *M. drewseni* (A) y *M. cassununga* (B) por hembras de *P. versicolor*.

as its mother's colony. One can ask why didn't females found new colonies by using a *M. cassununga* nests, since this was the mother's colony primary substrate for nesting? A likely hypothesis is that new founders emerge at later stages of colony development, when the nest is composed mainly by typical building material of *Polistes* and the adopted nest may be covered by the substances used to enhance nest or repel ants, which could prevent its recognition by the future founders. In this case, future foundresses could consider the building as the primary substrate for nesting, which would explain the foundations around the building. Additionally, if *Polistes* wasps acquire a template of substrate foundation based on the maternal colony (Wenzel 1993), it is unlikely that adoption of empty nests of *Mischocyttarus* can be a frequent or widespread tactic. In this case, the biology of paper wasps could limit the maintenance of interspecific nest adoption behavior.

Arévalo et al. (2004) proposed a phylogeny in which *Mischocyttarus* is more derived than *Polistes* wasps. As a result, the use of *Mischocyttarus* nests by *Polistes* wasps seems to be a more derivate reproductive tactic, compared to solitary or associative nest foundation.

The smaller cell size of adopted nest did not limit the adoption. This is possible because founders are able to modify the adopted nest, adding building material and modeling nest cells accordingly. In support, Prezoto et al. (2002) found females of *P. ferrerii*, in which cell diameter of nests vary between 5.87-7.4 mm (Andrade 2004), modifying a colony of *M. cassununga*.

The intraspecific use of abandoned nests reported for other *Polistes* species (Starks 1998) is still unknown for *P. versicolor*. However, since females are able to use abandoned nests from species of other genus, which do differ in cell diameter, it seems reasonable to suspect that the intraspecific nest adoption also occurs and it would be interesting consider such a reproductive tactic when studding the biology of *P. versicolor*.

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